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Design and Development of Solar Electric Vehicles at Delhi Technological University

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Abstract

The face of the automotive industry is being reshaped by concerns over oil supplies, international policy and fuel costs. A wide variety of new technologies are now available including discussion of nuclear possibilities. The solar powered Vehicles, one of the oldest alternative energy vehicles, has many applications to the emerging electric vehicle market. The development of a telemetry system and using MPPT for a solar powered vehicles aids in a better understanding of the energy usage of a vehicle and the aspects applicable to electric vehicles a s a whole. This paper gives an idea about the future vehicle multipurpose compact vehicle which can be used for transportation, surveillance ,special vehicles and to give a new idea and open a new path which would further help us to replace conventional appliances and electric appliances by solar appliances

1. Introduction

Automotive consumers are growing increasingly more interested in highly fuel efficient vehicles, environmentalists are concerned over vehicle emissions, and politicians are fighting to ease foreign relations and maintain international oil trade.

The effects of the combustion engine automobile are diverse and widespread. Research in ethanol, hydrogen, biodiesel and electric vehicles aims to improve energy efficiencies while decreasing pollution and dependency on foreign oil. In the early 1900's, the majority of pleasure vehicles sold in the United States were electrically powered. Since the acceptance of the internal combustion engine, electric vehicles became an insignificant portion of the automobile market, but have been gaining market share in recent years. In the 1990's, California passed the Zero Emissions Vehicle Mandate and forced automotive companies to produce electric vehicles. The law was later changed and automakers gained increased flexibility in the requirement to produce electric cars [1]. As a result, the electric vehicles in today's market are primarily produced by smaller companies but are slowly becoming more common in the market. The development of electric vehicles as practical, marketable automobiles has been a continual, though slow process. Numerous technologies have developed that continue to increase range and performance while decreasing expense to consumers. For three decades, considerable academic efforts have been applied to the development of solar powered cars. This research has produced many advances, though the technologies have not yet been applied to the more general electric vehicle. Many of the improvements could benefit electric cars and further their efficiencies in a demanding market. This paper is covers two topics: a history and overview of solar vehicles ,the vehicles made by SOLARIS DTU(applications of solar vehicles built). system and a discussion of the solar car technologies that are applicable to the broader electric vehicle market.

Fig 1: Solaris Avenir

2. History

The first combination of photovoltaic devices and electric vehicles happened in the late 1970's. Pressured by the oil crisis, engineers and environmentalists began looking for alternative energy sources and eventually turned to solar. To generate more publicity and research interest in solar powered transportation, Hans Tholstrup organized a 1,865

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mi (3,000 km) race across the Australian outback in 1987. Called the
World Solar Challenge (WSC), competitors were invited from industry research groups and top universities around the globe. General Motors (GM) won the event by a large margin, achieving speeds over 40 mph with their Sunraycer vehicle[2]. In response to their victory, GM teamed with the US Department of Energy (DOE) to hold the GM Sunraycein 1990 [3]. Approximately the same length as the WSC, Sunrayce is considered to be a more difficult race due to more diverse terrain and climates as well as more challenging road surfaces and traffic congestion. Further WSC events have been held every three years along the original route from Darwin to Adelaide, Australia. The Sunrayce, recently renamed the American Solar Challenge in 2001, then the North American Solar Challenge in 2005, is held every two years across
different routes. In 2005, the race set a new record for the longest solar vehicle race, covering 2460 mi (3960 km) from Austin, Texas, USA to Calgary, Alberta, Canada. Despite initially being dominated and funded by General Motors, the design and construction of solar vehicles has produced its own unique development process. Originally motivated by research, the building of solar vehicles is now
referred to as ”brain sport,” developing dozens of new vehicles each year for the sole purpose of competition, not production. In contrast to research developing new technologies, solar vehicle competition is an environment in which technology
has been built for research. Manufacturers actively produce power trackers, motors and even tires specifically for use with solar vehicles. The various competitions were designed to promote exposure and interest in the vehicles and demonstrate a proof of concept for electric and solar vehicles. Today, the vehicles remain as a collegiate sport but continue to develop and improve valuable technologies. Due to the unique nature of the solar community and events, these technologies remain an untapped resource. Significant improvements and understanding of electric vehicles has been developed that can be applied to a broader range of automobiles to provide more efficient and cleaner alternatives over combustion engine vehicles.
B. Solar Vehicle Design Because solar cars are not built in production quantities, each vehicle is unique, though many common characteristics are shared as some components have few variations. All solar vehicles must be light and efficient in order to be practical given the low power output of a solar array. For the most part, each vehicle is composed of the same basic elements. Most modern solar vehicles use either a tubular space frame chassis or a composite monocoque shell . Space frame designs tend to be easier and less expensive to build than a monocoque chassis. The monocoque structure is lighter and simpler than a space frame, and allows for vehicles to easibe split into compartments to separate different mechanical
and electrical subsystems. The composite designs are more difficult to analyze and integrate with suspension and steering components without compromising the structural integrity of the shell.

3.SOLARIS DTU-
A new world of exploration of solar energy

Solaris DTU team of 16 members of Delhi Technological University started in 2006 when the first Solar car of India SAPPHIRE was launched in India which was first of its kind in India and after that Solaris never looked back and made world to look a new world of exploration in which vehicles ran using solar energy and till now Solaris has made 5 cars and presently working on 6th car. Following are the different cars made:

2.1 Sapphire'06

This was the first Solar Electric Vehicle of India and was presented at Auto Expo and also at the Akshay Urja Divas ’08 organised by The Ministry of New and Renewable Energy (MNRE), Govt of India. The vehicle had a maximum speed of 90 kilometers per hour and ran successfully on the roads of India. This car had conventional solar panels with a comparatively low efficiency as compared to the latest monocrystalline panels available now a days.

Fig 2: Sapphire'06

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2.2 Solaris'08

This was a golf kart type solar model and can be used as a caddy in golf fields or as a rickshaw for travelling and transportation. This had a lesser surface area and a comparatively lesser panels. It had a maximum speed of 60 kilometers per hour but had a good stability and could easily move on difficult terrains. It was for the first time the concept of solar electric rickshaw came into existence in India.

2.3 Avenir'11(fig 1)

India's first racing solar electric vehicle. Flagged off by Chief minister of Delhi, Smt. Sheila Dixit at the CM's residence.Participated in the World Solar Challenge '11. It had a maximum speed of 100 kilometres per hour. It had great straight line stability so was easily able to cruise through the straight highways .

2.4 Solarik'12

India's First Solar good's carrier vehicle. Prototype made for Sahara Q shop. It was used by Sahara for the transportation. It gave a new idea to the world of electric vehicles and it worked successfully however had a low average speed of 30 kilometers per hour and used conventional solar panels.

2.5 Arka'12

First passenger solar electric vehicle. Flagged off by Sh. Pranab Mukherjee, President of India at the Rashtrapati Bhawan. Participated successfully at the South African Solar Challenge '12.

This was for the first time when mono crystalline solar panels were used. The main properties of these panels were that these were extremely light weight and were also very flexible. Moreover these panels had a higher efficiency of 22.5 percent . Due to these properties these panels gave a huge success to this car. This car had a maximum speed of 120 kilometers per hour and had powerful two BLDC motors which made this car very fast.

This car was also used for designing a commercial solar car. This was a great achievement for this car.

Fig 3: Arka'12

4. Conclusions

A vehicle with a footprint of 8m2 can generate 1600-2400 watts or 2-3 horsepower given current photovoltaic efficiencies. Assuming 100% efficient cells, the vehicle would still produce only 11 hp at midday. For this reason, it is unlikely to see solar vehicles produced in large quantities. Even so, in 2006, when Solaris DTU started making the first solar car. The drawbacks of a production vehicle are evident in the projected range of 68 miles. Though the majority of the population will never own or drive a solar vehicle, photovoltaic technologies are beginning to be applied to combustion engine vehicles. Work has been done to use solar power to offset the electrical need of conventional vehicles and reduce the engine load. One application involves the use of solar power to active cool the passenger compartment while the vehicle is parked [4]. The use of air conditioning to cool the vehicle introduces additional load to the engine and results in increased emissions. Additional technologies from solar vehicles can benefit the electric cars being developed today. The use of electric vehicles is becoming increasingly more common and will continue to do so over the next few decades. The environmental, economic, and political concerns over combustion vehicles
will contribute to an increase in the use of electric vehicles and drive further advances in battery technologies vehicle

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efficiencies.

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References

[1] S. Shaheen, “California’s zero-emission vehicle mandate,” Institute of Transportation Studies, vol. UCD-ITS-RP-04-14, 2004 [2] R. J. King, “Photovoltaic applications for electric vehicles,” Conference Record of the Twenty First IEEE Photovoltaic Specialists Conference,
vol. 2, pp. 21–25, 1990.
[3] ——, “Recent solar car technology developments including australian
world solar challenge results,” Conference Record of the Twenty Second
IEEE Photovoltaic Specialists Conference, vol. 1, pp. 629–634, 1991.
[4] K. D. Huang, S.-C. Tzeng, W.-P. Ma, and M.-F. Wu, “Intelligent solar powered automobile-ventilation system,” Applied Energy, vol. 80, pp.
141–154, 2005.

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