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Design of Electrical Vehicle based on Solar Panel and Fuel Cell

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ABSTRACT

In the present world the petroleum fuel prices are playing an important role in the development of a nation. The price of petroleum fuels are increasing drastically and it is estimated that if consumption of petroleum fuels consumed keeps on increasing with the same rate it will come to an end in next twenty five years. One of major part of fuel is used in transportation and thus one of the major consumers of petroleum fuels is transportation Medias. In this paper we have made an approach to develop an alternate vehicle which runs on solar energy. This the paper aims to develop a prototype for a car run by solar energy. Here we are using a special type of motor Brushless Permanent Magnet D.C. Motor (BLDC) and a microprocessor based controller to run the car. A solar powered car is an electric vehicle powered by solar energy obtained from sun and converted into usable form by solar panels on the roof of the vehicle. Photovoltaic (PV) cells in the solar pane convert the solar energy directly into electrical energy. Solar vehicles are not practically used in day to day life but they are in the experimental stage.

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I. INTRODUCTION

In the present world the petroleum fuel prices are playing an important role in the development of a nation. The price of petroleum fuels are increasing drastically and it is estimated that if consumption of petroleum fuels consumed keeps on increasing with the same rate it will come to an end in next twenty five years. One of major part of fuel is used in transportation and thus one of the major consumers of petroleum fuels is transportation media. In this paper we have made an approach to develop an alternate vehicle which runs on solar energy. This the paper aims to develop a prototype for a car run by solar energy. Here we are using a special type of motor Brushless Permanent Magnet D.C. Motor (BLDC) and a microprocessor based controller to run the car. A solar powered car is an electric vehicle powered by solar energy obtained from sun and converted into usable form by solar panels on the roof of the vehicle. Photovoltaic (PV) cells in the solar pane convert the solar energy directly into electrical energy. Solar vehicles are not practically used in day to day life but they are in the experimental stage keeping in mind the facts about the future of petroleum we had to think in using the nonconventional energy available in the most effective manner. Taking into account the climatic conditions in the major part of our country solar energy is the most easily available and in most efficient form of renewable energy in our country. In this paper we have made an approach to develop an alternate vehicle which runs on solar energy. The basic of this vehicle comes from the earlier developed model as an academic project.

Charging of electric vehicles (EV) from solar energy provides a sustainable method for recharging the car batteries [1]. Workplace like office buildings, factories and industrial area are ideal places to facilitate solar EV charging where the building rooftops and car-parks can be installed with photovoltaic (PV) panels. The generated PV power is directly utilized for EV charging in an EV- PV charger, without the need for storage. A grid connection is necessary to ensure reliable power supply for EV charging due to the variable nature of PV generation. The employee's cars are parked for 6-9h at the workplace and the long charging duration results in low EV charging power requirements and possibility for grid support through Vehicle-to-grid (V2G) technology. In this paper, different possible system architectures for a solar EV charger are proposed and compared. A review of EV-PV power converters from literature is made and is compared based on the system architecture, converter topology, isolation and capability for V2G operation. The power converter design are correlated with the requirements from global EV charging standards. From this literature survey, two power converter layouts for a 10kW EV-PV charger are proposed – one based on a high frequency three-winding transformer and the second based on a central DC-link. In the last part of the paper, different methods to make the power converter design modular and enable the connection of multiple EV to a single charger are investigated.

II. LITERATURE REVIEW

Heng bing Zhaoa et. & all [1] have proposed the fuel cell powered vehicle is one of the most attractive candidates for the future due to its high efficiency and capability to use hydrogen as the fuel. However, its relatively poor dynamic response, high cost, and limited life time have impeded its widespread adoption. With the emergence of large super capacitors (also know as ultra-capacitors, UCs) with high power density and the shift to hybridization in the vehicle technology, fuel cell/supe rcapacitor hybrid fuel cell vehicles are gaining more attention. Fuel cells in conjunction with super capacitors can create high power with fast dynamic response, which makes it well suitable for automotive applications. Hybrid fuel cell vehicles with different power train configurations have been evaluated based on simulations performed at the Institute of Transportation Studies, University of California-Davis. The following power train configurations have been considered.

Monzer Al Sakka1et.& all [2] have proposed the large number of automobiles in use around the world has caused and continues to cause serious problems of environment and human life. Air pollution, global warming, and the rapid depletion of the earth's petroleum resources are now serious problems. Electric Vehicles (EVs), Hybrid Electric Vehicles (HEVs) and Fuel Cell Electric Vehicles (FCEVs) have been typically proposed to replace conventional vehicles in the near future. Most electric and hybrid electric configurations use two energy storage devices, one with high energy storage capability, called the "main energy system" (MES), and the other with high power capability and reversibility, called the "rechargeable energy storage system" (RESS). MES provides extended driving range, and RESS provides good acceleration and regenerative braking. Energy storage or supply devices vary their output voltage with load or state of charge and the high voltage of the DC-link create major challenges for vehicle designers when integrating energy storage / supply devices with a traction drive. DC-DC converters can be used to interface the elements in the electric power train by boosting or chopping the voltage levels. Due to the automotive constraints, the power converter structure has to be reliable, lightweight, small volume, with high efficiency, low electromagnetic interference and low current/voltage ripple. Thus, in this chapter, a comparative study on three DC/DC converters topologies (Conventional step-up dc-dc converter, interleaved 4-channels step-up dc-dc converter with independent inductors and Full-Bridge step-up dc-dc converter) is carried out. The modeling and the control of each topology are presented. Simulations of 30KW DC/DC converter are carried out for each topology. This study takes into account the weight, volume, current and voltage ripples, Electromagnetic Interference (EMI) and the efficiency of each converter topology

Ying Wu, et.& all [3] have suggested an optimal design to minimize the cost of the fuel cell and super capacitor in a fuel-cell electric vehicle is presented. It is assumed that the cost of the fuel cell and super capacitor is a function of the number of units of each, respectively. The constraints on the number of fuel-cell units and super capacitor units are derived

According to the system requirement of maintaining stable dc-link voltage for all possible vehicle operations. These constraints are combined with the derived cost function to obtain the optimal number of fuel-cell units and super capacitor units and the minimum cost. The cost, volume, and weight of the optimized fuel cell and super capacitor of the power train and the fuel economy of the vehicle are evaluated. Simulation results are presented to verify the design.

Kavita Pawar et.& all [4] have proposed the objective of this paper is to demonstrate a low-cost, efficient, and reliable inverter for traction drives of fuel cell vehicles (FCVs). Because of the wide voltage range of the fuel cell, the inverter and the motor need to be oversized to accommodate the great constant power speed ratio. The Z-source inverter could be a cheap and reliable solution for this application. Currently, two types of inverters are used in FCV and hybrid electric vehicle (HEV) traction drives: • The traditional pulse width modulation (PWM) inverter The dc/dc boosted PWM inverter. For FCVs, the fuel cell voltage to the inverter decreases with an increase in power drawn from the fuel cell. Therefore, the obtainable output voltage of the traditional PWM inverter is low at high power for this application, so an oversized inverter and motor must be used to meet there requirement of high-speed, high-power operation. The dc/dc–boosted PWM inverter does not have this problem; however, the extra dc/dc stage increases the complexity of the circuit and the cost and reduces the system efficiency. To demonstrate the superiority of the Z-source inverter for FCVs, a comprehensive comparison between the three inverters has been made for the efficiency, price and switching device power comparisons (sdpc).

III. BLOCK DIAGRAM

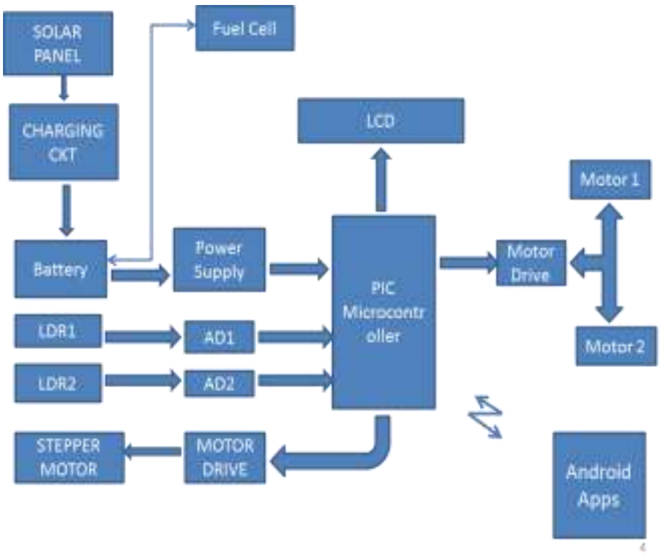

Fig 1. Block Diagram

At present, solar vehicle is used as one of the cardinal energy saving vehicle where the application of renewable energy meets sustainable energy demand with reduction of fuel cost plus purification of atmosphere. In this vehicle, solar energy powers all or part of a vehicle's propulsion. For running a model car or toy car which is a miniature representation of an automobile, electric power is needed to run the car. As there lies shortage of electric power in Southeast Asian country, it has become a vital issue to initiate the use of renewable energy in developing countries like Bangladesh for reducing the demand of electricity. This paper deals with an attempt to investigate the energy recovery possibilities from the solar energy by using a solar panel which converts light energy from the sun into electrical power. That power is transmitted to the storage battery. The stored power of battery is used to run the car. Speed to weight ratio of toy car illustrates comparatively more flexible and simple than any other design when load is varying.

Component:

Layout:

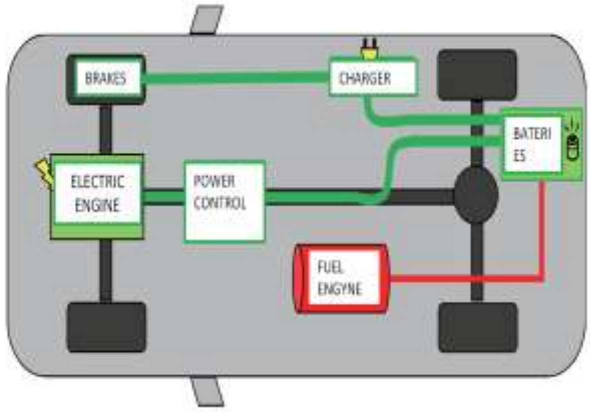

Fig 2. System layout

SOLAR CAR & FUEL CELL:

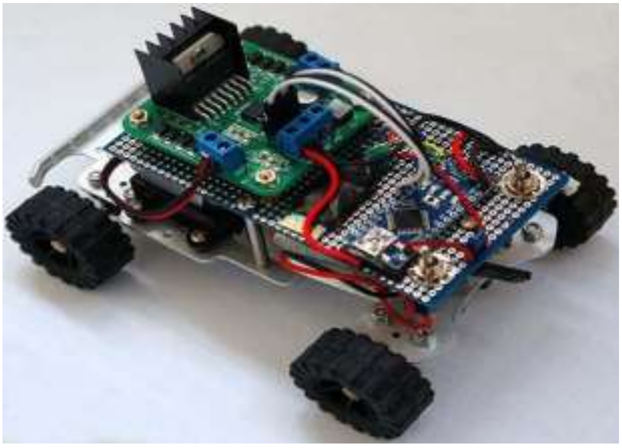

Fig 3.Car layout

BATTERY AND CHARGING CIRCUIT:

Battery is an electrical device which is a combination of several electrochemical cells, used to convert stored chemical energy into electrical energy or vice versa. As most of you may have seen, there are some writings such as 12V, 60Ah, 255A in addition to its trademark. 12V: Battery voltage. (this value gives information on how many cells the battery contains. Since, a cell is 2 Volt, 12Volt means it contains 6 cells) 60Ah: Signifies battery capacity which means the amount of current the battery can give in stated voltage for an hour constantly. 255A: It defines maximum current amount which could be safely taken from the battery.

Battery Charging Circuit:

Charging current for batteries must be chosen between one over ten (1/10) and one over twenty (1/20) of the battery capacity, but closer to one over ten. In introduction part, some information about batteries is given. The aim is to make you understand why we choose 12 Volt sealed lead-acid batteries and to give a brief information on the current and voltage values we will use in circuits.

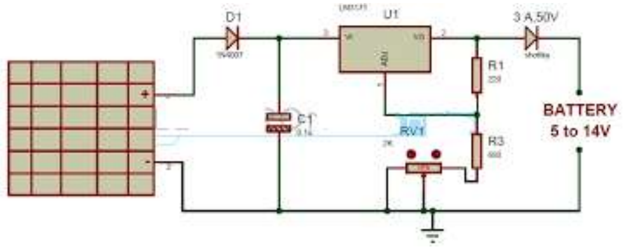

Fig. 4 Battery Charging

DC motor drives

In a DC motor, the static field flux is established using either permanent magnets or a stator field winding. The armature winding, on the rotor of a dc machine, carries the main motor current. The armature winding is a series of coils, each connected to segments of a commutator. In order that the motor develops constant torque as the rotor moves, successive armature coils must be connected to the external dc circuit. This is achieved using a pair of stationary brushes held in contact with the commutator. The motor torque is produced by the interaction of the field flux and the armature current.

IV. CONCLUSION

After this study it can be concluded that the electric vehicle is cost-effective in most of the cases analyzed, but it varies greatly depending on many factors such as type of vehicle, the distance traveled daily, the initial investment, the electric vehicle consumption and its fuel-vehicle equivalent. In any case it can be seen that when a higher mileage driven the EV takes greater advantage over the combustion-vehicle equivalent.
The main benefits and advantages of using EV are:

- Null noise
- Pollution and CO_2 emissions. In any type of electric van, vehicle, motorbike or motorcycle CO_2 emissions is less than a third compared to its combustion equivalent
- An improved efficiency of the electrical system, it can be seen the demand curve is stabilized, the large differences that occur between periods of higher and lower power consumption are reduced.
- It facilitates integration of renewable energy into the system safely.
- Electric cars are new consumers and it is expected that in the next decade they will represent approximately a 2% of the demand.
- The electric car can be, in long-term, a reversible electric storage system.

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