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Solar Powered Vehicle

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Abstract

In the current state of technological development, the future of vehicles seems to be with the hybridization of various energy sources. This sort of development in vehicles seeks to take the benefits from the best quality of each energy source and it is especially useful in urban driving vehicles. In cities of India one of the major medium of transportation is auto rickshaws, which is producing a huge amount of air pollution as well as greenhouse gases like CO2. Fuel, which is used is a non-renewable source and also which costs high as a result of that transportation charges increases. It would also affect the economy as well as the users of the auto rickshaw. Thus they should go for a reliable source as know that current trend of using the reliable source like solar energy which is available in plenty in country like India. Adopted SOLAR ENERGY as the additional sources in addition to the conventional IC ENGINES. They using the solar panel, controller and DC motor setup to convert the light energy as an electrical energy which is fed to the DC motor to obtain mechanical motion. The mechanical motion was transferred to wheels through chain drive in the propeller shaft which leads to cheap and effective transmission. Finally, fabricated a concept auto rickshaw with the help of modified transmission system and energized with solar energy to run it.

Keywords- solar energy; photovoltaic (pv); transmission

Nomenclature

HSC	Hybrid solar car
ECU	Electronic Controlling Unit
ESVC	Electric Solar Vehicle Championship
BLDC	Brushless DC motor

I. Introduction

If we talk about solar technology, it deals with the variability and the cyclic nature of the Sun i.e. to store excess collected energy until it is needed. This is more effective for fulfilling the lack of sunshine at night. For example, a 0.1-m thick slab of concrete in the floor of a home will store the solar energy absorbed during the day and release it to the room at night. When observations are made for a longer period of time such as one year, or over a large geographical area such as a continent, solar energy offers greater service. The use of both these concepts of time and space, together with energy storage, has enabled designers to produce more effective and advanced solar systems. The property of solar energy of inherent variability is the most useful when it is integrated with other energy source which are being used in the place of solar energy when it is not available. But there is great potential for integrating direct solar energy with other RE technologies. Nowadays automotive engineers and consumers are more concerned and looking towards the most fuel efficient vehicles. 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 .In the early 1900's, the majority of vehicles sold in the United States were electrically operated. Since the acceptance of the internal combustion engine, electric vehicles became an important portion of the automobile market, but have been gaining market share in recent years. In the 1990's, California passed the Zero Emissions Vehicle authorization and forced automotive companies to produce electric vehicles. The commandment was later changed and the engineers gained increased flexibility in the need to produce electric cars [4]. As a result, the electric vehicles in today's market are becoming more demandable. The progress of electric powered automobiles has been a continual and challenging process. A number of technologies have been developed aiming to increase the efficiency of solar vehicles with decrease in prices. 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.

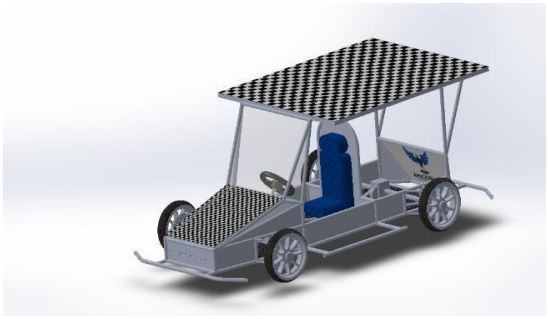

Fig. 1. Designed solar car of vairocana team of ESVC

II. SOLAR VEHICLES

A. History of Solar Vehicles

In the late 1970's photovoltaic devices and electric vehicles were combined for the first time. Facing the pressure of the oil crisis, engineers and environmentalists started looking for an alternative source of energy and finally found solar as the best alternative. In order to create more coverage and examine interest in solar powered transportation, Hans Tholstrup organized a 1,865 mi (3,000 km) race across the Australian outback in 1987 ,better known as the World Solar Challenge (WSC), in which competitors were invited from industry research groups and top universities around the globe. General Motors (GM) with their Sunraycer vehicle won the event by a large margin, achieving speeds over 40mh [2]. In response to their success, GM came up with the US Department of Energy (DOE) to hold the GM Sunrayce in 1990 [3]. Approximately the same length as the WSC, Sunrayce is considered to be a more difficult race due to more varied terrain and climates as well as more challenging road surfaces and traffic blocking. USA conducted American Solar Challenge in 2001, then the North American Solar Challenge in 2005, which are now held every two years across different routes. A new record for the longest solar vehicle race, covering 2460 mi (3960 km) from Austin, Texas, USA to Calgary, Alberta, Canada was setup in the year 2005. Initially 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. Solar vehicle competition enables engineers to research and develop new technologies. With the unique nature of the solar community and events, these technologies remain an available resource. Considerable improvements and attentive technologies of electric vehicles has been developed that can be applied to a broader range of automobiles to provide more efficient, effective and reasonable alternatives over combustion engine vehicle.

III. Related Theory

Hybrid solar car Components -Electric vehicle was first designed and developed by the Baker Motor Company since 1990s. A main advantage of EV over the internal combustion engine can thus be exploited in terms of no carbon emissions occurred due to only use of the electric motor to drive the engine [5]. Generally, the electric car and hybrid solar car is consisted of six main parts: PV panel, electric motor, electric Generator, battery bank, IC engine and electronic controlling unit (ECU) respectively.

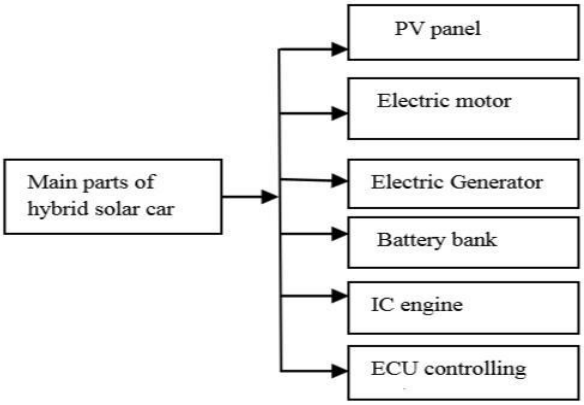

Fig. 2. Main components of hybrid solar car

1. PV panel convert sunlight into electricity, which is stored in batteries. Then its energy will be utilized for hybrid car propulsion.

2. Electric motor has, generally, been employed for driving the hybrid solar car (HSC). However, we can observe that the brushless DC motor (BLDC) is often operated in the (HSC)over the classical DC motor due to long lifetime operation, high speed and also high torque.

3. Electric Generator is self-energy generated in a car during a regeneration brake or slop on a road.

4. Battery bank is an important component for the HSC. It has been generated 24V DC for supplying to the electric motor and also electronic devices in the HSC.

5. IC engine has been employed for driving of hybrid solar car which can be used during a night or minimum electric energy of HSC.

6. Electronic controlling unit (ECU) is an electronics circuit that is used for controlling the energy in the electric motor which can be provides a speed variation.

IV. Types of transmission system

A. Front drive system

The IC engine is placed on the front of the car. With the help of chain drive mechanism, the power stored in crank shaft is driven to the axle of front wheels.

B. Rear drive system

The electric motor is placed near the rear axle of hybrid solar car which can be operated by charged batteries then electric motor rotate the rear axle of rear wheels Both systems are placed in hybrid solar car, at a onetime one system can be used in transmission of power to wheels as either rear or front wheels of a hybrid solar car. If one system gets fail then we have an option to choose from alternative driving mechanism.

Hybrid solar car is the location of solar panel across on roof, bonnet and boot section of a car, at almost horizontal and vertical potion of a car. In a general model, it could be consider of at least two additional options as

(i) Horizontal panel
(ii) Vertical panel

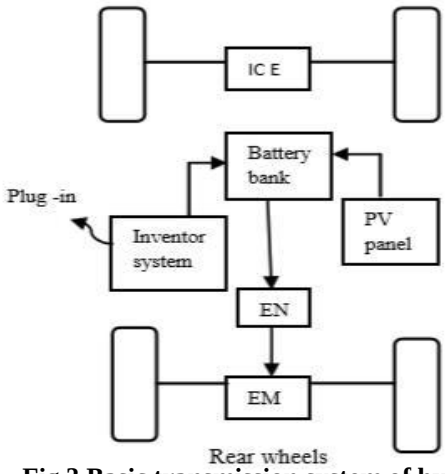

Fig.3.Basic transmission system of hybrid solar car

IV. Solar panel specifications

Solar cells are solid state semiconductor devices which convert light energy directly into electrical energy. A solar cell contains a low voltage typically about 0.45 volts per cell; cells are connected in series to increase voltage [3]. The model of solar cell can be categorized as P-N semiconductor junction, when exposed to light, the DC current is generated. The generated current depends on the solar irradiance, temperature and load current. The energy produced by solar panel obtained from two types of energy contribution as mentioned in below equation

A. Energy during driving time $(\boldsymbol{Edt})$

The energy produced during a running period of a vehicle is calculated by the following expression.

$$Edt = \eta pv * Apv * esun * [(SEsun - SEPT)/\ SEsun] * [(\ BAct - BAdt\ )/BAct]$$

B. Energy during Parking Time $(\boldsymbol{Ept})$

The energy produced is captured during the parking period of vehicle is calculated by the following expression.

$$Ept = ELDT + \eta pv * Apv * esun * [(SEsun - SEPT)/\ SEsun] * [(\ BAct - BAdt\ )/BAct]$$

$Where, \eta pv - PV\ Panel\ efficiency$
$Apv - PV\ Surface\ Area$
$e\ sun - Average\ energy\ enough\ by\ solar\ panel\ captured.$
$SEsun - Solar\ energy\ captured\ during\ a\ sun\ at\ (7\ AM\ to\ 6\ PM)$
$SEPT - Solar\ energy\ during\ a\ parking\ time.$
$BAct - Battery\ Charging\ time.$
$BAdt - Battery\ Discharging\ time.$
$ELDT - Energy\ loss\ during\ driving\ time.$

V. WORKING

After giving an overview of the cars which are already in use, here is a detailed description of our solar powered vehicle. It is a four wheeler, two seater vehicle. In this vehicle we have used a belt pulley mechanism. The solar energy is harnessed using solar panels which are used for charging the batteries. The batteries run the motor which drives the wheel of the vehicle. The vehicle which we have made as our project uses a belt pulley mechanism in which the shaft of the motor is connected through the belt pulley system. The power supplied to the batteries is from the solar panels which are giving a total output of 4ooW and this output is used for charging the batteries. The batteries which we are using are lead acid batteries which are of 48V rating each of 12V. The motor's rating is of 48V which gets charged through the three 12V batteries. The belt used in our project is a timing belt which has teeth that fit into a matching toothed pulley. When correctly tensioned, they have no slippage, run at constant speed, and are often used to transfer direct motion for indexing or timing purposes. They are often used in lieu of chains or gears, so there is less noise and a lubrication bath is not necessary. Timing belts need the least tension of all belts, and are among the most efficient. We have laid emphasis on the economical part so that it can be used to cover short distances without consuming energy from external sources and at the same time it keep the environment pollution free.

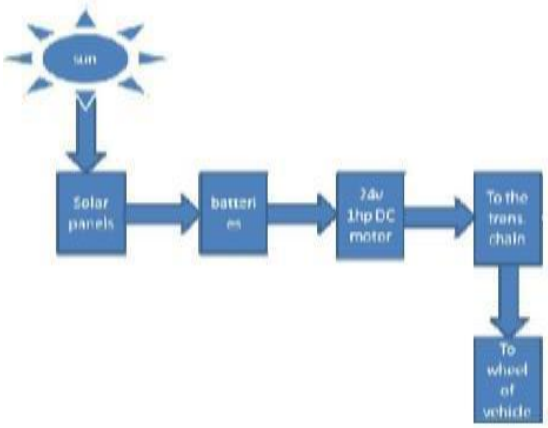

Fig.4.Basic block diagram representation of solar vehicle

VI. Application

Electric vehicles can become more practical and usable by applying many of the technologies refined within the solar vehicle community. To maximize performance and range, designers must maximize the efficiency of the electrical components while minimizing the power requirements for motion. The power needed to maintain a constant velocity V must overcome the aerodynamic drag, road grade and rolling resistance of the vehicle and is written as

$$P\ (V\ ) = Paero + Pgrade + Proll\ where\ Paero = 0.5\rho airCdAf\ V\ 3$$
$$Pgrade = mgzV$$
$$Proll = mgV\ Cr$$

for ρair, the density of the air, Cd, the coefficient of aero-dynamic drag of the vehicle, Af, the frontal area of the vehicle, V, the velocity, m, the mass of the vehicle, g, the acceleration due to gravity, z, the road grade and Cr, the vehicle's coefficient of rolling resistance. In any given environment, ρair, g and z are constants not within the control of the vehicle.

VII. Conclusion

The solar vehicle solves many problems related to the environment and is the best pollution free method. We need to make use of them so that we can reduce our dependence on fossil fuels. Solar vehicles do have some disadvantages like small speed range, initial cost is high. Also, the rate of conversion of energy is not satisfactory (only 17%). But these disadvantages can be easily overcome by conducting further research in this area; like the problem of solar cells can be solved by using the ultra-efficient. solar cells that give about 30-35% efficiency. As this field of automobiles will be explored the problems will get solved. The solar automobiles have a huge prospective market and we should start using them in our day to day life.

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Author Biography

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