International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

Solar Powered Plug-in Electric Vehicle

Harin M Mohan[1], Akash M Nair[2], Akhil B Chandran[3], Anuraj P[4], Aromal B Chandran[5]
[1] Assistant Professor, Dept. of EEE, VKCET, Thiruvananthapuram.
[2,3,4,5] Student, Dept. of EEE, VKCET, Thiruvananthapuram.

***Abstract*— The Solar powered plug-in electric vehicle is an economic vehicle with minimum maintenance. The main drawback of electric vehicles is the limitation of driving distance. By adding a solar PV module the vehicle battery can be charged while on drive. Here the mechanical parts like gearbox and differential are avoided. Direct drive to wheels allow efficient drive.**

Keywords- BLDC, Solar PV

I. INTRODUCTION

The whole world is moving with automobiles. Huge amount of fossil fuels are burned for automobiles. Nothing on earth is free of cost, but what if we could find a way to implement free rides? Indeed it would be wonderful if our cars could continue to run without us having to spend billions o3n fossil fuels every year and to deal with natural hazards that their combustion leave behind. Considering the availability and pollution of fossil fuels we need a substitute. The best substitute is electric vehicles which will not create any pollution to environment. The main impediment is the storage capacity of electric power, the ride is restricted up to battery capacity. This storage issue can be beaten by adding solar power to automobiles. By adding PV modules the vehicles can be charged while driving by this the driving distance can be increased. If we could drive a solar-powered car, that auto dream would come true. Solar cars would harness energy from the sun via solar panels. A solar panel is a packaged, connected assembly of solar cells, also called photovoltaic cells which are solid state devices that can convert solar energy directly into electrical energy through quantum mechanical transitions. They are noiseless and pollution-free with no rotating parts and need minimum maintenance. The electricity thus generated would then fuel the battery that would run the car's motors.

Unlike a single motor operation our vehicle is driven with two motors which are placed at the wheel hubs. By this mechanical parts like gearbox clutch drive axles can be eliminated, so the regular mechanical maintenances are not required.

II. LITERATURE SURVEY

With the increasingly severe environmental problems around the world, exploitation of clean and renewable energy has been a crucial topic. As indispensable transportation in modern society, vehicles are ubiquitous but also one of the main sources of pollutants. Because of their status, it is almost impossible to decrease the volume of vehicles. One solution to lowering emissions is the electric vehicle. Overall, the electric vehicle is more energy efficient, environmentally friendly, and cleaner than the vehicle that relies on fossil fuels. [1]

An electrically powered vehicle has essentially three major electrical components. These include energy source (usually are chargeable battery bank), an inverter or, motor controller and an electric motor. In the case of a solar car, the energy source is typically a bank of batteries, which may be recharged by photovoltaic solar panels. The motor controller is typically a power electronics device which when supplied with the driver's input commands, controls the torque and speed of the electric motor [2]

The solution is SPEV is supported with a charging cable that plugs in to the vehicle and into a 230v wall socket. The electric vehicle have a built in features like security system, Seatbelt Detection system, Collision detection.[3]

Hence, by incorporation of the solar photovoltaic panels, the range of the Battery powered cars can be increased. Electric vehicles are currently emerging in the present market and the automobile industry is investing a lot of their R & 0 resources for the development of electric solar vehicles. These are the future of zero carbon emissive car transportation. The present work aims to develop a model of plug-in electric solar vehicle and discusses the design parameters of these vehicles to come in the market.[4]

III. PROPOSED SYSTEM

The proposed vehicle is not a complex one. It is very simple in construction compared to Fuelled vehicles. Electric vehicle's layout is shown in fig 1. System mainly consist of two motors with controllers, reversing circuit, battery pack, solar PV module with charge controller and an accelerator.

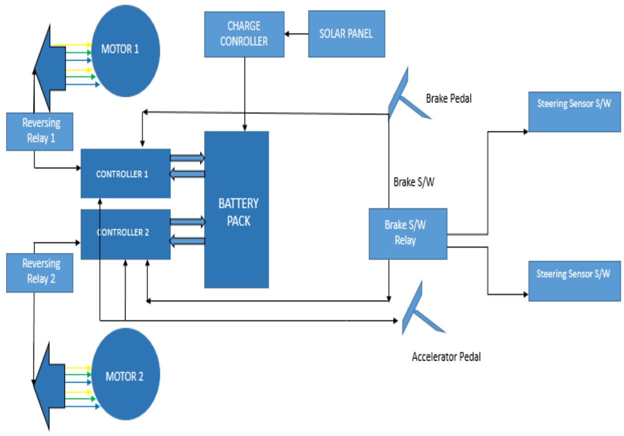

Fig 1. Basic Block diagram

A common accelerator is used for triggering both of the controllers. Brake switches will turn off motors while brake is applied. One of the motor will turn off while turning the vehicle to opposite to the motor position. The vehicle need to be reversed while driving here the two phases and two control

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

wires are interchanged for reversing. Reversing switch is mounted on steering column.

VI HARDWARE COMPONENTS

A. ACCELERATOR

Accelerator is used to trigger the motor controllers. Here we use a cable to attach accelerator pedal to accelerator circuit mechanically. Accelerator consists of a Hall Effect sensor and a magnet. An accelerator is shown in fig 1.

Fig 2. Accelerator.

The two wires are for working voltage and other one is the switch wire through which Hall Effect sensor output is carried to motor controller. It has a linear type Hall Effect sensor on the fixed part and a permanent magnet on the rotating part.

B. MOTOR CONTROLLER

The motor controller is the heart of the vehicle. All the electric parts of the vehicle are controlled by this. A BLDC motor controller is shown in Fig 2. It controls the speed of motor, breaking, battery voltage calculation, speedometer control and electrical accessories control. It has two wires from battery pack, 3 phase wires, 5 rotor position sensor wires, wire to accelerator, brake sensor wires from brake pedal, speed.

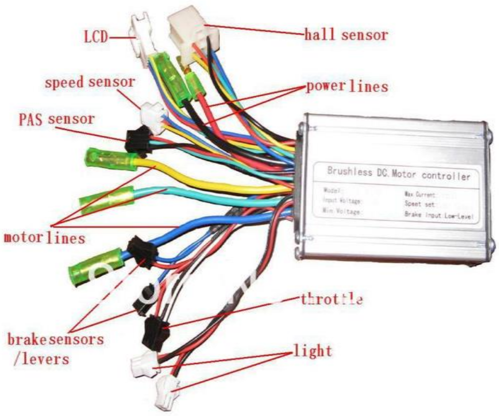

Fig 3. BLCD motor controller.

Regulator wire, speedometer wires, electrical accessory wire for lights, and wire to DC-DC converter. Motor controller consists of IGBT Switching transistors for controlling motor rotation.

C. POWER DRIVERS

80NF70 N-Channel Power MOSFET

The STP80NF70 is a N-channel Power MOSFET realized with STMicroelectronics unique STripFET™ process. It has specifically been designed to minimize input capacitance and gate charge. The device is therefore suitable in advanced high-efficiency switching applications.

Specifications:

Parameter	Value
Drain-source voltage	68 V
Gate-source voltage	± 20V
Drain current (continuous) at TC = 25 °C	98 A
Drain current (continuous) at TC=100 °C	68 A
Drain current (pulsed)	392 A

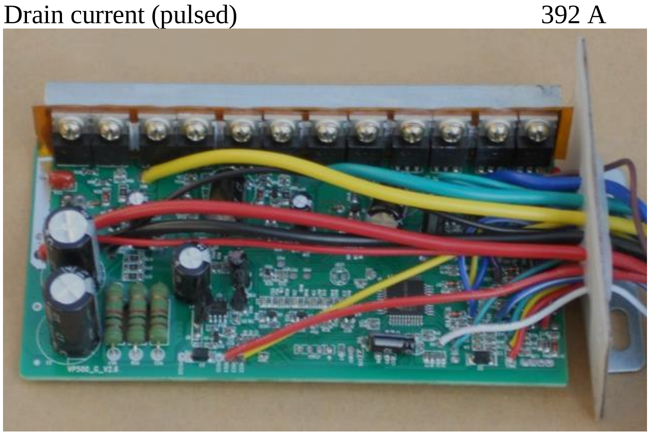

Fig 4. Motor controller board

D BLDC Motor

A brushless DC motor (BLDC motor) is an electronically commuted DC motor which does not have brushes. BLDC motor is shown in Fig 4.3.

Fig 5. BLDC motor.

E BATTERY PACK

The batteries are the essential part of an electric vehicle. In our vehicle we use four Li-ion batteries in series to get a working voltage of 48V.Comparing with Lead acid batteries Li-ion is of lesser weight and has 3 times life. Fig 6 shows a single Li-ion battery.

Fig 6. Li-Ion Battery

F SOLAR PV MODULE

Here the PV module is used for charging the vehicle on running mode from sunlight. Here we use Polycrystalline solar cells. Polycrystalline solar panels generally have lower efficiencies than mono crystalline options. In addition, polycrystalline solar panels tend to have a blue hue instead of the black hue of mono crystalline panels.

Polycrystalline solar panels are also made from silicon. However, instead of using a single crystal of silicon, manufacturers melt many fragments of silicon together to form the wafers for the panel. Polycrystalline solar panels are also referred to as "multi-crystalline" or many-crystal silicon. Because there are many crystals in each cell, there is to less freedom for the electrons to move. As a result, polycrystalline solar panels have lower efficiency ratings than mono crystalline panels, but their advantage is a lower price point. Solar PV module is shown in figure 7. Polycrystalline solar panels tend to have slightly lower heat tolerance than mono crystalline solar panels.

Fig 7. Solar PV Module.

Polycrystalline solar panels will tend to have a higher temperature co-efficient than solar modules made with mono cells. This means that as heat increased output for this type of cell will fall less. However, in practice these differences are very minor.

Solar PV Module Specifications

Capacity	250 W
Output Voltage	0-35V

G CHARGE CONTROLLER

An MPPT, or maximum power point tracker is an electronic DC to DC converter that optimizes the match between the solar array (PV panels), and the battery bank or utility grid. Fig 4.8 shows MPPT solar charge controller.

Fig 8 MPPT Solar Charge Controller.

To put it simply, they convert a higher voltage DC output from solar panels (and a few wind generators) down to the lower voltage needed to charge batteries. The charge controller looks at the output of the panels and compares it to the battery voltage. It then figures out what is the best power that the panel can put out to charge the battery. It takes this and converts it to best voltage to get maximum AMPS into the battery. (Remember, it is Amps into the battery that counts). Most modern MPPT's are around 93-97% efficient in the conversion. You typically get a 20 to 45% power gain in winter and 10-15% in summer. Actual gain can vary widely depending weather, temperature, battery state of charge, and other factors.

Fig 9 Prototype of Solar Powered Plug-In Electric Vehicle

V WORKING

The BLDC motor is driven by an electronic drive which switches the supply voltage between the stator windings as the rotor turns. The rotor position is monitored by the Hall Effect sensor which supplies information to the electronic controller and based on this position, the stator windings to be energized

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

is determined. These electronic drive consist of IGBTs (2 on each phase) which operate motor drive.

For obtaining the rotor position a Hall Sensor is embedded on the stator. As motor rotates, the hall sensor senses the position and develops a high or low signal, depending on the poles of magnet. Control voltage is implemented by microelectronic device has several high-tech choices. This may be implemented using a microcontroller.

Speed control of BLDC motor is essential for making the motor work at desired rate. Speed of BLDC motor can be controlled by controlling the input DC voltage. The higher the voltage, more is the speed. When motor works in normal mode or run below rated speed, input voltage of armature is changed through PWM model. When motor is operated above rated speed, the flux is weakened by means of advancing the exciting current.

In this scheme, current is controlled through motor terminals one pair at a time, with the third motor terminal always electrically disconnected from the source power.

THREE Hall devices embedded in the motor are usually used to provide digital signals which measures rotor position with 60 degree sectors and provide this information to the motor controller. Because at any time, the currents in two of the windings are equal in magnitude and the third is zero, this method can only produce current space vector having one of six different directions. As the motor turn to the motor terminals is electrically switched every 60 degree of rotation so that the current space vector is always within the nearest 30 degree of the quadrature direction.

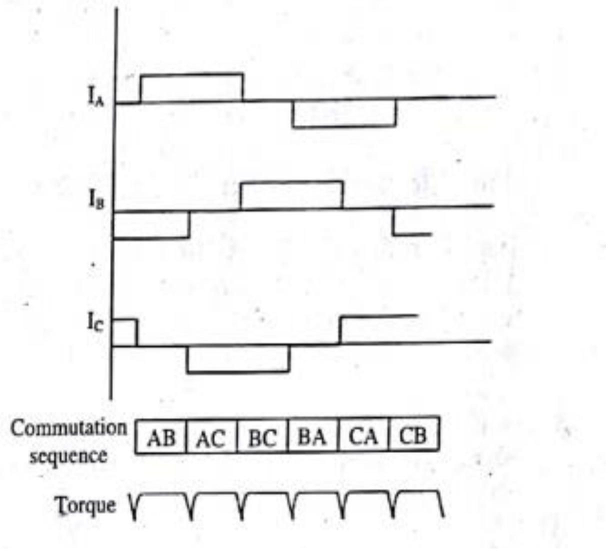

Fig 9. Current waveforms

The current waveform is shown in fig 4.3.2.each winding therefore a staircase from zero, to positive current, to zero, and then to negative current. This produces a current space vector that approximates smooth rotation as it steps among six distinct directions as the rotor turns.

The controller provides pulses of current to the motor windings which control the speed and torque of the synchronous motor. These types of motors are highly efficient in producing a large amount of torque over a vast speed range. In brushless motors, permanent magnets rotate around a fixed armature and overcome the problem of connecting current to the armature. Commutation with electronics has a large scope of capabilities and flexibility. They are known for smooth operation and holding torque when stationary.

VI CONCLUSION

In order to cope with the increasing demands for fuel and the disastrous environment pollution due to driving carbon-based vehicles, it is quite necessary to switch to a new source of energy, i.e. the solar power which would be a cheap, efficient, limitless and of course an eco-friendly alternative. Solar-powered electric vehicles are safe with no volatile fuel or hot exhaust systems. They are zero emission vehicles, odorless, smokeless and noiseless. They require minimal maintenance, are more reliable with little or no moving parts and can be efficiently charged nearly anywhere. Needless to say it is very much cost efficient The Solar Powered EV would benefited by the end users like Industries, university campus, amusement parks.. The technology used in SPEV contribute its supports to Green transportation

REFERENCES

[1] Literature Review of Electric Vehicle Technology and its Applications, Fan Zhang, Hubei Electric Engineering Corporation, Wuhan, P.R. China, 430040, Xu Zhang, Department of Mechanical Engineering and Materials Science, Duke University, Durham, USA, NC 27708-0287

[2] Economically Designed Solar Car for Developing Countries (Pakistan), Farooq1, Adil Salman2, Sohaib Ahmad Siddiqui1, M. Ibrahim Khalil3, and Wasim Mukhtar41Brandenburg University of Technology (BTU), Cottbus-Senftenberg, Germany

[3] SOLAR POWERED ELECTRIC VEHICLE, SOLAR POWERED ELECTRIC VEHICLE Manivannan S, Embedded Team, Telecom Centre Of Excellence, Chennai, India, 978-1-5090-3498-7/16/$31.00 2016 IEEE

[4] 2016 Biennial lnternational Conference on Power and Energy Systems: Towards Sustainable Energy (PESTSE) " Plug in Electric Solar Vehicle" 978-1-4673-6658-8/16/$31.00 ©2016 [EEE