

Solar Electric Powered Car with Manual Five Speed Gearbox

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ABSTRACT

Fossil fuels are fuels formed by natural processes such as anaerobic decomposition of buried dead organisms, containing energy origin in ancient photosynthesis. The age of the organisms and their resulting fossil fuels is typically millions of years. This fossil fuel consists of a high percentage of carbon and includes petroleum, coal, and natural gas. These fossil fuels are used to fulfill human requirements, which creates many environmental effects due to which the life of living organisms decreases and releases other pollutants. To overcome these problems, the electricity sector is unique and utilizes electricity with solar arrays to run the vehicle. Electric vehicles with solar arrays have more advantages: no noise and pollution, energy saving, and reduced carbon emissions. Solar electric vehicles are a research & application "hot spot" in automobile industries and a trend for the future due to their vast advantages. About 35% efficiency increase is seen in solar electric vehicles in good sunny conditions. Solar electric vehicles are made of photovoltaic cells (mono-crystalline), batteries, charge controllers, motors, power controllers, etc. Use of monocrystalline panels increases efficiency, has lower cost, and is easily available in the market. They can generate energy even in low sunny conditions. The energy produced from the solar array is stored in the battery by passing through the controller and then utilized by the motor through a power controller. Solar vehicles can achieve low carbon, energy saving, environmental protection, and zero-emission for the future of human life.

Keywords: Motor, Batteries, Charge Controller, Solar Panels, Power Controller

I. INTRODUCTION

The aim of manufacturing a solar car is mainly on developing a vehicle which is pollution-free to the environment and to reduce traveling expenses. The ELECTRICAL system plays a crucial role in the manufacturing of the solar car. Now in the modern world, photovoltaic cells are replacing fossil fuels in automotive industries. A solar panel refers to a panel designed to absorb sun rays as a source of energy for generating electricity. Solar modules use light energy (photons) from the sun to generate electricity through the photovoltaic effect. The photovoltaic cell we utilize is monocrystalline; this type of cell has good efficiency in sunny conditions as well as in low sunny conditions. It is easily available in the market as per required quantity; these PV cells have a longer life span compared to other PV cells.

An electric motor can be considered as the workhorse of the present-day industrialized society. The crucial part of our design includes the research on motors. Based on the mode of commutation, motors are briefly classified into two types: mechanical commutation (brushed DC motors) and electronic commutation (brushless DC motors). A brushless motor is electronic commutation, has no spark, high efficiency, is maintenance-free, produces less noise, and has low motor inertia compared to a brushed DC motor. So, by considering the advantages of brushless DC motors, which are more suitable for our vehicle than other motors we have used.

An electric battery is a device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy. Four 12V lead acid batteries are used in this electric solar vehicle. In this electric solar vehicle, energy comes from the

pvcell is pass through the charge controller and energy stored in the battery and that energy is used by motor which is connected to the internal combustion engine transmission system, through which we can maintain the speed ratio per the requirement. the motor does not have any sudden shocks after applying breaks of the vehicle. whereas without any transmission sudden break application causes heavy shock on motor.

II. PHOTOVOLTAIC CELL

The term "photovoltaic" comes from the Greek: photo meaning "light", and "voltaic", from the name of the Italian physicist Volta. A typical photovoltaic system employs solar panels, which is made up of no of cells, which generate electrical power. In our vehicle, solar panels are mounted on right side, left side back and front side. The mount may be fixed and the conversion of electricity from sunlight directly by photovoltaic effect without moving any parts of vehicle and stored in the battery. The schematic diagram of solar cell and electricity storage in battery have shown in fig below

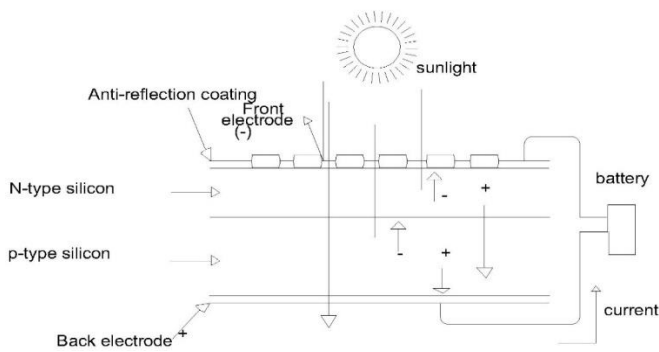


Figure 1.Schematic diagram of solar cell and electricity storage.

In our vehicle, solar panels are arranged in series connection in following position have shown in figure below.

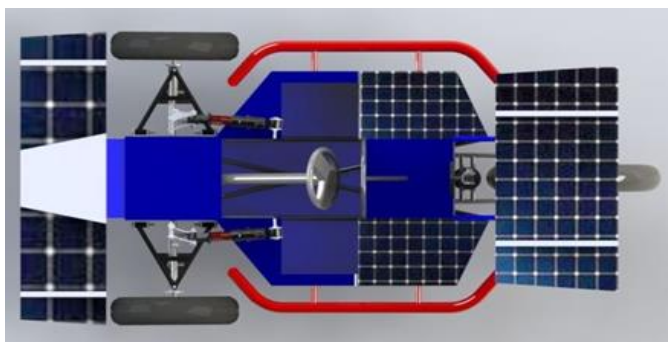


Figure 3.top view of the vehicle

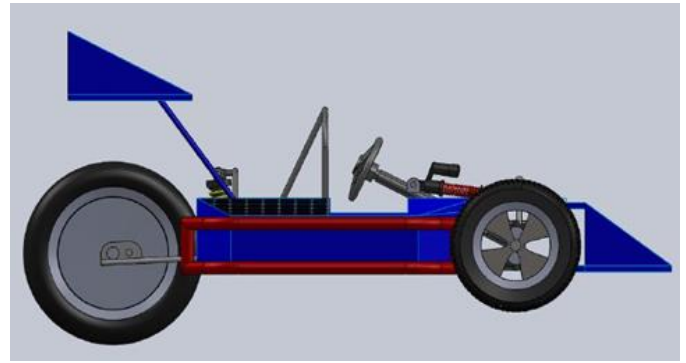


Figure 3.Side view of the vehicle

Specification:

Solar power generation	=540watts
Solar panel voltage	=12 volts,42 amp
Solar connections	=series

efficiency of solar panels:

$$= \frac{\text{power o/p}}{\text{incident radiation} \times \text{area of panel}}$$

$$= \frac{100}{1000 \times (0.88 \times 0.59)}$$

$$\eta = 0.1926 \times 100$$

$$\eta = 19.26 \% (\text{for } 100\text{w})$$

Solar charge controller

Solar charge controller is a device which holds the power distribution between (pv panel) & batteries. It manages power distribution & also prevent reverse flow of current the solar charge controller which we have used in our connection is of 1000 Watt capacity have shown in figure below.



Figure 4. Solar charge controller

Below setup shows the arrangement of solar charge controller, batteries, solar panel, motor.

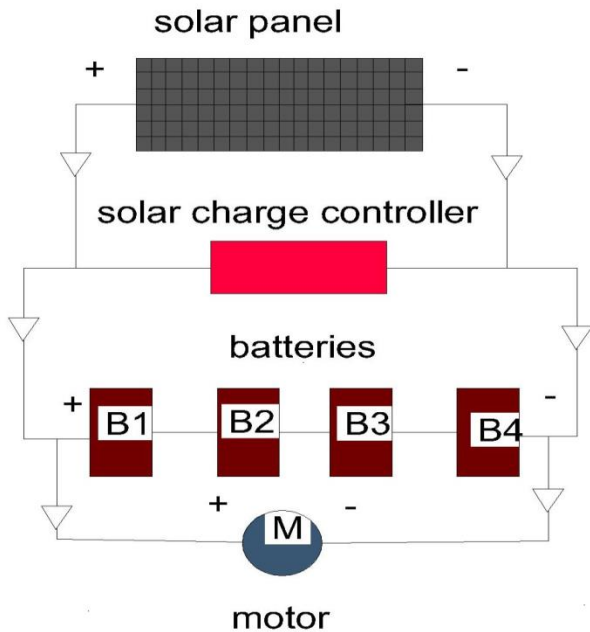


Figure 5. Connection Chain Setup

From the connection chain setup, the solar charge controller is placed in between the solar panels and batteries to regulate batteries from overcharging and reverse current to the solar panels. It regulates voltage and current coming from the solar panels to the batteries.

III. ELECTRIC MOTOR

This can be considered as *Workhorse* of the present-day industrialized society. The crucial part of our design includes the research on Motors. Based on the mode of commutation, Motors are briefly classified into two types:

- a) Mechanical commutation. (Brushed DC motors)
- b) Electronic commutation. (Brushless DC motors)

Note: We have considered only based on commutation PMDC or BLDC motors only, which are electronic commutated machines.

Table-1. Difference between brushed and brushless motor

Brushed motors	Brushless motors
Mechanical commutation	Electronic commutation
Sparks near brushes	No sparks
Low efficiency	High efficiency
Periodic maintenance	Maintenance free
More weighted	Low weight
More noise	Less noise
More rotor inertia	Low motor inertia

Due to the more advantages of brushless DC motor than the brushed motor we have selected to use brushless motor as name implies, BLDC motor do not use brushes for commutation instead they are electronically commutated.

BLDC motor do not experience the slip that is normally seen in induction motor. brushless DC motor which we have used in our vehicle is shown in figure below.

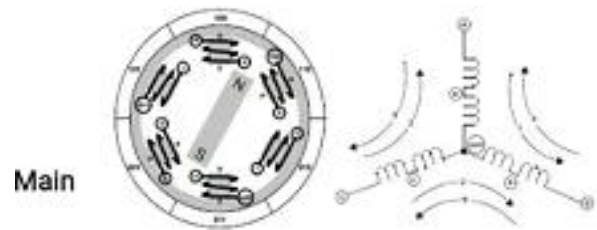


Figure 6. BLDC Motor



Figure 7. BLDC Motor

Motor Configuration

Type	BLDC
Voltage	48V
Power	2000W or 3 HP
Rated torque	3.2 N-m
Rated speed	3700 RPM
Max current	35 amp
Manufacturer	Imperial Techno corp.

Motor calculations:

Torque during starting = $T_r + T_i$

T_r = torque to overcome rolling friction

T_i = torque to overcome inertial force

$T_r = \mu \times m \times g \times r$

Where μ = coefficient of rolling friction, which is usually 0.08 for tar road.

Torque due to inertia is usually 0.5 times of load torque i.e., rolling friction torque.

$$T=1.5Tr$$

$$=1.5 \times 0.08 \times 130 \times 9.8 \times 0.16$$

$$=24.73 \text{ N-m}$$

This torque is developed near wheel, as we are speed reduction of 3.3:1, we get

$$\text{Required torque at motor} = 24.73 / 3.3 = 7.412 \text{ N-m}$$

DC motors usually provide 300% of rated torque (Except for series tars).

Our rated torque is 3.2 N-m

$$\text{Starting torque that can be produced} = 3 \times 3.2 = 9.6 \text{ N-m}$$

IV. BATTERIES

Batteries are the device which convert chemical energy to electrical energy. the type of batteries which we are using in our vehicle are of LEAD ACID.

Specifications of batteries

Table 3. Specification of battery.

Type of battery	E-Solar type
Ampere hour	42 amps
Dimension (L×B×H) in Inch	8×4×7 inches
Approx. weight in kgs	4 kgs
Number of unit	4

Charging time of battery can be determined as

Specification

Volts=12v

Amps=42

battery storage=504watts

charging time= $\frac{\text{battery Ah}}{\text{charging current}}$

charging current

$$= \frac{42}{5}$$

$$= 8.2 \text{ hrs}$$

Charging time = 8hrs

V. INNOVATION

- ✓ Solar array generates power from sun radiation which is stored in the battery and this stored power is used to rotate the BLDC motor of our vehicle. where motor shaft is connected to the Gearbox via

chain derive system so that when the motor shaft rotates the Gearbox main shaft is also rotates this main shaft is allowed to run the rear wheel of our vehicle.

- ✓ HMI stand for Human Machine Interface this is one Innovation which is a type of application performed on tablets. this application is used to indicate the turning signals, Battery charging, parking, Antitheft, Seat belt, Warning alarm, Smart sensor, heat intensity, ultrasonic distance, Temperature etc. All the above sensors are friendly with the driver of vehicle. this all sensors are installed in vehicle which operates through HMI Application.
- ✓ Actuators converts electrical energy to mechanical motion or action and it has large weight lifting capacity which we have used to lift the back solar panel case according to the direction of sun rays to provide high solar efficiency.
- ✓ Except electrical innovation and concept we have also installed unique suspension system which is horizontal suspension system weighted by the push rod connected with the front wheel of vehicle. the design is aerodynamicated design which itself is a unique and speak all about the Innovation. As shown in figure below is original picture of our vehicle with electrical system arrangement.



Figure 8. Original picture of Vehicle in Front View

I. CONCLUSIONS

- ✓ This work main aim is to manufacture a vehicle with solar power which would allow us to travel in less amount or free of cost by comparing to other vehicles and nearly unlimited accessibility.
- ✓ If the hurdles can be passed then for sure this solar vehicle will be the wave of the future.
- ✓ solar power is a cleaner way to conserve energy and is not as polluting to the earth as fossil fuels if every human on this earth uses solar power, the world would be a more non-polluted, Energy efficient world.
- ✓ d) We have obtained a Maximum speed of 60 kmph speed by using 2kw motor and developed a car which can run on solar and electric power which is sustainable and pollution free.

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