RESEARCH ARTICLE OPEN ACCESS

Design of Eco Car

T.Ravi teja*, B.Lakshman Kumar*, G.Suresh*, M.Prudhvi Raj*, T.Rathna babu*, B.Rajasekhar**, S.Kiran Kumar***
**(Student of Department of Mechanical Engineering, SVIST, Tiruvuru,AP*
*** (Assistant Professor of Department of Mechanical Engineering, SVIST, Tiruvuru,AP,*
*** *(Professor of Department of Mechanical Engineering, SVIST, Tiruvuru, AP,*

ABSTRACT
This paper proposes a Solar Electric Powered system which solves the major problems of fuel and pollution. An electric vehicle usually uses a battery which has been charged by external electrical power supply. All recent electric vehicles present a drive on AC power supplied motor. An inverter set is required to be connected with the battery through which AC power is converted to DC power. During this conversion many losses take place and also the maintenance cost of the AC System is very high. The proposed topology has the most feasible solar/electric power generation system mounted on the vehicle to charge the battery during all durations. With a view of providing ignited us to develop this "Solar/Electric Powered Vehicle". This multi charging vehicle can charge itself from both solar and electric power. Two solar panels each with a rating of 200watts are attached to the top of the Vehicle to grab the solar energy and is controlled with a help of charge controller. The ECOCAR can be driven by 48V BLDC motor consisting of four 50 watts PV panel in the voltage rating of 48 V. The power which is absorbed by the PV panel is stored into the four 150 AH 12 V batteries. When there is no presence of sun, electric power supply act as an auxiliary energy source. For controlling speed of the motor, switches designed with four tapping, provided with different values of resistance at each tapping. It acts as a speed control switch for Solar/Electric Powered Vehicle. This type of technique is to reduce the running cost and increasing the running efficiency of the vehicle. The performance of the ECO CAR was found to be satisfactory for the load of four people with the average speed of 45km/hr. The integrated system consisting of Solar module, Charge Controller, Batteries, Boost Converter, Step-down Transformer, Diode Rectifier and BLDC motor which are required for the vehicle. Experimental results are presented to confirm the theoretical analysis.

Keywords - About five key words in alphabetical order, separated by comma

---

Date of Submission: 07-06-2020 Date of Acceptance: 23-06-2020

I. INTRODUCTION

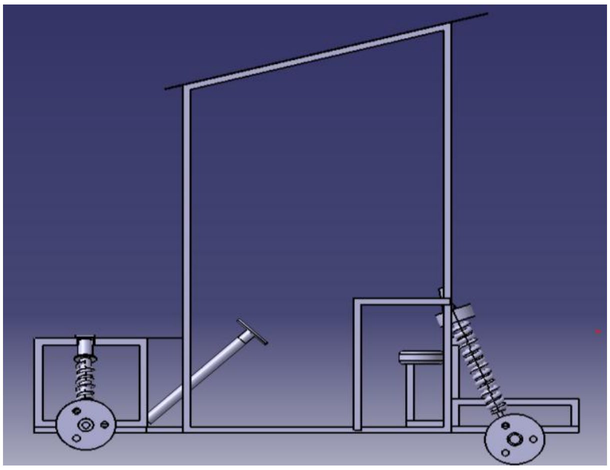
Eco –friendly car is solar and electric car. It is a competition to design and fabricate a single seated vehicle which is operated by a DC Motor and power source will be battery as well as solar panel. The purpose of the event is to build up interest towards mechatronics projects, and enhance theoretical as well as practical knowledge along with management and team work of students. Our aim is to reduce the usage of organic fuel powered vehicle and design environment friendly electric power vehicle. A solar vehicle is primarily powered by direct solar energy. Photovoltaic cells (PVC) are installed on the Vehicle to collect and convert solar energy into electric energy. Made of silicon and alloys of indium, gallium and nitrogen, the semiconductors absorb light and then release it, producing a flow of electrons that generate electricity which charges the 48V battery connected to it, which runs the 750 Watt Brushless DC Motor to transmit power to drive the vehicle, using some arrangements the motor can run directly by the power generated through solar cells. As the vehicle is to run for racing on the racing track, so weight of the vehicle should be given proper attention. We are using Seamless Aluminum Pipes and the design is made such that vehicle has proper Power to Weight ratio and is of less weight and has high strength which is the foremost requirement of any solar vehicle

II. LITERATURE SURVEY

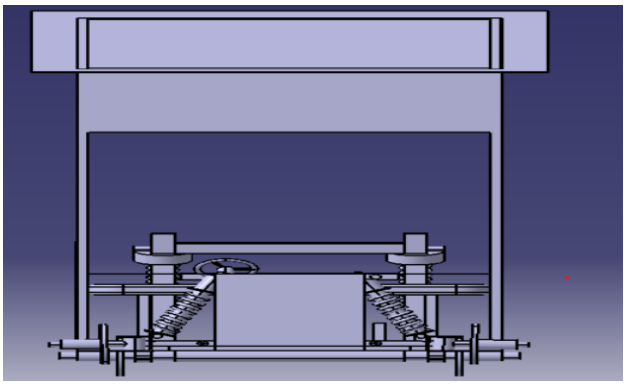
It is necessary to understand solar energy collection and its conversion into electricity, evaluation of electrical performance, and the current efforts being made to improve conversion efficiency. It was also important to examine the actual effect of the colour filters on the light input into the panel. The primary material used in the modern collection of solar energy is silicon. Even though it takes 100 times more surface area of silicon than that of other solid-state materials to collect the same amount of energy, silicon was already developed and in mass production when solar energy collection technology was developed, and so it was the practical choice. However, any semiconductor is acceptable. The semiconductor is part of a panel called a photovoltaic, or solar cell. This cell absorbs sunlight and transfers it into electricity, typically with 15-20% efficiency. The true principle of this study (the factor observed) canters not on the inner processes involved in the energy transfer, but rather on the efficiency of the solar cell. The purpose of solar panels and solar energy collection is for the output of power, measured in Watts (P=V x I, V=voltage, I=current). However, in order to study how factors affect this output, it is crucial to understand how this performance is evaluated. A study was conducted by the Florida Solar Energy Canter (1999) observing the performance of two separate solar setups for homes in Kissimmee, Florida. Analyses were done on the long-term performance and efficiency of the two systems, measuring power over time in Watt-hours. This study examines similar parameters on a smaller scale, but does not look at many of the extra angles examined by this study. For example, the standard requirements of Electrical Codes had to be considered, which does not apply in this study. In essence, the Florida study was designed to incorporate all the elements necessary to practically supply a fully functional family home with all its electrical needs, whereas this study is more concerned with the general principles of solar energy collection. However, the most basic analyses are the same. The Florida study determined photovoltaic to be an adequate and acceptable alternative to standard electrical power. It examined thermal efficiency of solar panels, a factor not being considered in this study, but still presents sound examples of useful graphics, aptly demonstrated analysis equations, and a good explanation of what it all means. A scatter plot with a linear regression was displayed and used to determine the thermal efficiency coefficient, which was then compared to calculated values of the same. These are sound statistical techniques that can be applied to a variety of situations

Design rules and parameters:

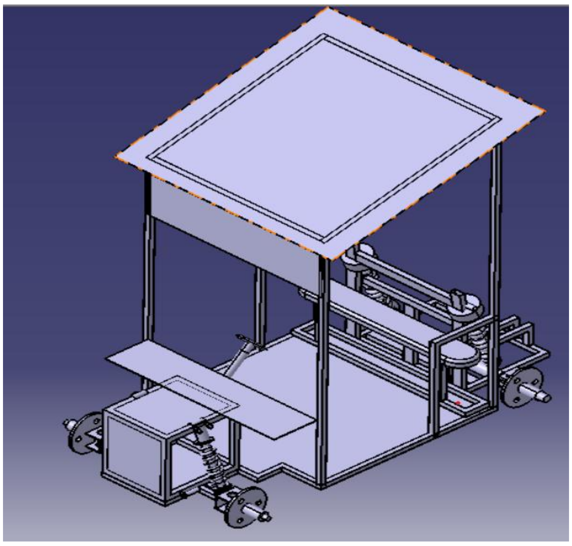
- The solar vehicle must be manufactured within INR 1, 50000
- The vehicle must have a wheelbase of at least 1168.4 mm (46 inches).
- The smaller track of the vehicle (front or rear) must be no less than 75% of the larger track.
- 2-inch suspension travel (1-inch Jounce & 1 Inch Bounce).
- Tyres and wheels: using four wheels then there should be two wheels on the front and back.
- Material: use only galvanised pipe.
- The ground clearance with the driver aboard must be minimum of 50.8 mm (2 inch) of static ground clearance under the vehicle at all times of the competition.
- Jack Points: must be two jack points on the vehicle
- Ergonomics: Driver must be able to exit to the side of the vehicle in no more than 5 seconds.
- Driver Visibility: must have a minimum field of vision of two hundred degrees (200°) (a minimum one hundred degrees (100°) to either side of the driver).
- Push rod: Detachable push rod is mandatory for all the team. Push rod should have the capability push as well as pull the vehicle.
- Steering system: The steering wheel must be mechanically connected to the wheels.
- The break circuit: It must have hydraulic circuits such that in the case of a leak or failure at any point in the system.
- Motor: Teams have to use motor of power 1 kW maximum and operating voltage is restricted to maximum 48 Volts at any point of the circuit.
- Batteries: Batteries should have maximum of 48V and 50ah all the time of event.



Eco car side view



Eco car back side view



Eco car

III. EXPERMENTAL SETUP:

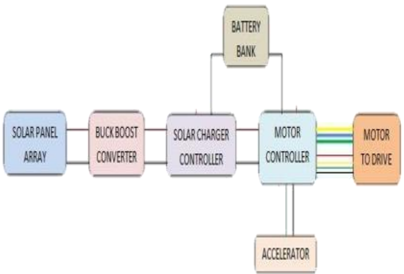


Fig: 4.1 Block diagram

Battery with capacity of 12V, 75Ah is connected with 12V, 65amps (at full load capacity) DC series motor through MCB (Mini circuit breaker) using 16 square mm single core copper wire, so as to withstand the load. This motor setup is connected to the crank shaft by the help of 26mm v-belt and pulley drive. Other end of this shaft is coupled with dynamo which generates 12V, 65amps. Initially the DC series motor draws power from the battery for starting at idle speed. Once motor reaches the particular speed, the gearbox will activated based on the centrifugal force and transfer the power to the rear wheel, so as to enable the vehicle to move. Also the dynamo starts to produce current due to the rotation and it is directly coupled to the battery for charging purpose simultaneously. In addition to that, the horizontal windmill setup is placed in the front of the vehicle. When the vehicle starts to move, based on the wind direction and pressure, the wind blade starts to rotate, which in turn starts to produce current. This is also connected with battery for charging purpose in the running condition itself

1. Strength: Light weight and durable chassis. We have manufactured our roll cage chassis with aluminum alloy composites for light weight and high strength and durability. We have also done high grade aluminum welding for joining the chassis parts to make a robust and stable chassis for better dynamic stability of the vehicle. We have also used alloy wheels for more light weight material. Also, we have tried to reduce as much extra materials from the vehicle as possible. Our vehicle body is also made of Fiber sheets. Which is ultra-light weight? But this doesn't reflect on the strength of the vehicle nor on its dynamic stability and vehicle is durable at any extreme conditions. Run directly on Solar Energy We have specially concentrated on the fact to run the vehicle directly on solar power on full load with best performance and speed of the vehicle. We have been successful in designing and manufacturing such vehicle which is capable of running directly on solar power. We have 6 solar panels which is sufficient to drive a powerful electric hub motor to take an average load on 50-80 kg mass. This is a great achievement from the future point of prospective.

2. Weakness: Not ideal for long rides .One of the demerits of this vehicle is that it is not manufactured for very long-distance rides since its design is neither that comfortable for long rides nor it is suitable keeping in mind the weather and constant need of solar power. We can easily switch to battery mode which is being charged on the go with those solar panels and is stored for use when the intensity of the solar power is not enough for driving the vehicle. Thus, we get a limit to the power stored in the batteries which limits from not suitable for very long rides. Performance varies with weather conditions as discussed earlier our vehicle runs directly through solar power effectively. We have another limitation in terms of the climatic conditions. As we know that sun ray's intensity is not uniform throughout the day time and is absent in the night time. So that limits our vehicle's performance at different time of the day. Also, the vehicle is not effective at times of cloudy environment or raining season.

IV. CALCULATIONS FOR ELECTRIC SOLAR VEHICLE

Let us consider the following assumption in Electric Solar Vehicle:

- Mass of the Vehicle = 150 kg
- Speed = 40 kmh-1
- Slope % = 0.1
- Wheel Diameter = 0.58 m
- Battery Weight = 30 kg
- Average Speed = 35 kmh-1
- Range = 50 km

Final result:
Angular velocity 38.3 rad.s
Frequency 365.59rpm
Peak torque 45.47 N-m
Power required (peak) 1741.5 watts
Air Resistance 278.68 watts
Rolling resistance 418.6 watts
Power required (continuous) 697.28 watts
Continuous speed 320 rpm Torque required (continuous) 20.8 N-M

BRAKING CALCULATION ASSUMPTIONS FOR BRAKE CALCULATIONS

Coefficient of friction between brake pad and disc 0.4
Effective radius of disc (re) 0.1m
External load (m) 160 kg.
Speed of vehicle (v) 11.11 Ms
Radius at which the load acts (r) 0.29 m
Maximum disc speed (m) 365.7rpm
Force applied by the driver on the paddle 40 kgf
Pressure generated in master cylinder 490*104 Nm
Area of calliper (Acal) 1.6*10 m Leverage 3
Acceleration due to gravity (g) 9.81 Ms

V. ADVANTAGES:

- Unlike regular cars, solar energy powered cars are able to utilize their full
- Power at any speed. Solar powered cars do not require any expense for running.
- Solar cars are quiet.
- Solar cars require very low maintenance.
- A solar car produces no harmful emissions

VI. DISADVANTAGES

.•More number of moving parts.
- Need skilled operators to repair and replace this car.
- Maintenance is needed.
- Only low loads are bearable when the car is in battery operated mode

VII. APPLICATIONS:

- Solar car which completely uses renewable sources of energy
- It uses the dynamo which is used to regenerate electric energy.
- This technique using renewable resources which runs completely free of cost can
- Be used for private use.

VIII. CONCLUSION

As a conclusion, this project was completed whereby meeting the objectives stated before. Firstly, to construct a 3D design of under structure platform based on the conceptual vehicle design. The new design of the platform was minimized to a smaller size to reduce the weight of the platform without affecting the safety, which is the strength of the structure. The analysis using Solid Works was to analyse stress distribution using Finite Element Analysis on the under structure platform, where stress concentration area was focused and minimize during the fabrication process in the future. The analysis done is to determine the weak location of the structure, and thus design improvement can be made before the fabrication process starts. This method can avoid problems from happening and can reduce the total waste cost of the structural repair process. According to the result, the selection of the material is essential to increase the efficiency of the electric vehicle.

REFERENCE

[1]. Solar cells: past, present, future. Adolf Goetz Berger*, Joachim Luther, Gerhard Willeke,
[2]. A high-efficiency triple cycle for solar power generation (2002). Kribus A.
[3]. A high-efficiency triple cycle for solar power generation (2002). Kribus A.
[4]. Kivalov, Salikhov, Tadzhiev, and Avezov's study (2001).
[5]. Hazel O'Leary(2002) greets contestants of the Solar Car Challenge Competition in 1995.
[6]. Hamakawa Y (2002) Solar PV energy conversión and the 21st century´s civilization, Solar Energy Materials & Solar Energy 74, 13-23.
[7]. Callahan, Parker, Sherwin, and Anello's study (1999) examined.
[8]. Effects of color filter on the performance of solar photovoltaic module. Hecht (2002).