

Design and Fabrication of Student Solar Car

Mobin M Mathew¹, Dilshad E², Mohammed Fakrudheen Bava³,

Anver Sadeth. Kp⁴, Bipin Chandran Mv⁵, Rajneesh P S⁶, Sinzal. H⁷, Jishnu. Np⁸, Sanjid Siddique⁹.

Kt, Mohammed Sharafath. K¹⁰, Mohamed Favas. M¹¹, Mohammed Fayis. B¹², Rinshad. E¹³, Mohammed Sharfan. T¹⁴,

^{1,2} Faculty of Mechanical Engineering, Eranad Knowledge City Technical Campus, Manjeri, Malappuram, Kerala, India.

^{3,4,5,6,7,8,9,10,11,12,13,14} Students of Mechanical Engineering (2015-2019 batch), Eranad Knowledge City Technical Campus, Manjeri, Malappuram, Kerala, India

Abstract: Electric solar energy alters the environment and energy economy system. Solar energy is one of the best renewable energy resources. Solar energy one of the parallel solutions to overcome energy shortage and to decrease greenhouse gaseous emission. Using electric cars in cities we can positively improve the air quality. The empirical evidences from National Centers for Environment Prediction shows us that the amount of solar energy is higher than the world's total energy demand, considering the possible technology being used. To use uninterrupted solar by PV cells generating electricity we need to store the surplus solar energy and then releasing it on demand. We need to know the availability of solar energy in advance to manage its storage. Solar energy stands on weather conditions and we have weather forecasting system. Through this innovation we considering renewable energy. Coming year, we facing one of the major problems in lack of fossil fuel and increase in environmental pollution.

Keywords:- Solar Cars, Controls, Photo Voltaic Cell, Batteries.

I. INTRODUCTION

We are living in modern nationalized era where every country in this world tend to focus more on industrialized nation while the left out was being forcefully added to it more in a peripheral outlook. As like as the simple economic concept, the resources are limited and the demand is unlimited. The energy is behind the hallmark of all developments and its demand is enormously increasing day by day due to environmental pollution and abnormal usage. The time has come for a paradigm shift in the source of energy that will lead the future world. A world with sustainable developments as its tone and progressive growth in nature.

The upturn in population, urbanization and demand left us no choice but to swing to alternative energy sources rather than clinging on the fossil fuels. The renewable energy sources are the best substitutes to this ill juncture. Solar energy, wind power, Hydroelectric energy, Wave energy... etc, are among these alternatives. One of the most important is the solar energy which can uses in different ways. Solar electric car produces no pollution and eco-friendly in nature. Its time for us to act wisely by cope up with our excellence in technology to make a better usage of maximum renewable energy sources and storing the surplus to release when it needs.

In 1962, the first solar car was introduced in which a person can drive it. In 1958, the International Rectifier Company altered a vintage model in to an electric car which run on solar energy, but they didn't show it until 4 years later. Around 10,640 individual solar cells were mounted on the rooftop of the altered vehicle to run it.

II. OBJECTIVES

Solar vehicle which can run in Electric power, which help to reduce the environmental pollution caused by emission of vehicle. Unlike the internal combustion engines source of energy is the sun which is a renewable source of energy. It's a contribution and a big step for the coming future.

III. LITERATURE REVIEW

In 1970's photovoltaic devices and electric vehicles were implemented. Solar came to a boom when oil crisis was high. Engineers and environmentalists started looking for additional energy sources and finally turned to solar. To get high publicity and research interest in solar powered transportation, Hans Tholstrup conducted 1,865-mile (3,000km) race across the Australian outback in 1987, called the World Solar Challenge (WSC), participants who participated in this program were invited from various industry research groups and top universities around the globe. General Motors (GM) won the event by a large margin, achieving speeds over 40 mph with their Sunraycer vehicle. Improvements in battery technology made greatest advancements in solar vehicles over the past few decades. First invented vehicles used lead-acid batteries. This type of battery is cheap and easy to manage, lead-acid battery has high weight to size ratio. Developments in technology led to the use of nickel-metal hydride (NiMH) and nickel-cadmium (NiCad) batteries which have better power to weight ratios than lead-acid batteries.

A solar cell is an electronic device which uses photovoltaic (PV) effect directly to convert sunlight into electricity. When the light incident on the solar cell which will produce both a voltage and a current to create electric power. PV energy conversion in solar cells involves two essential steps. First one, a material in which the absorption of light generates an electron-hole pair is required. The electron and hole are then separated by the structure of the device and electrons will travel to the negative electrode and holes to the positive electrode, hence generating electrical power.

IV. FORMATION PROCEDURE

- Step 1- Literature Survey: To study about solar car and impact of solar energy, causes for fossil fuels environment.
- Step 2- Design various part of the solar car.
- Step3- Manufacturing of prototype
Before manufacturing same copy of the vehicle is build as prototype
- Step 4- Cost estimation
It is carried out by as per design conditions different elements of solar car.
- Step5- purchasing of materials and parts.
- Step6- selection of work place
Need for some typical works such as welding and bending.
- Step7-manufacturing of solar vehicle
Manufacturing is done at mecon cfc with proper guide lines.
- Step8- Assembling and testing
Testing carried out by different level such as acceleration, solar endurance test brake test etc.

V. MANUFACTURING METHODS



Fig. 1:- showing final manufactured solar vehicle.

A. FRAME

Frame is the major part in automobile. It is also called backbone of an automobile. The major components like motor, controller, battery, gear drive, steering systems and seats are mounted on the frame. For the manufacturing of this solar car we are using tubular frame, due to following

- Light weight.
- High strength.

➤ Tubular Chassis

Here we have used tubular frame of chromoly steel it is also called AISI 4130.

Components	Wt.%
C	0.28-0.33
Cr	0.8-1.1
Fe	97.3-98.22
Mn	0.4-0.6
Mo	0.15-0.25
P	Max 0.035
S	Max 0.04
Si	0.15-0.35

Table 1:- Composition of Chromoly

B. PROTOTYPE MAKING

The material chromoly is an expensive material comparing to normal steel. So, the errors in the chromoly frame may lead to rebuild or alterations. Alteration of the existing frame will lead to reduce the strength of some major parts of frame like front hop main hoop. So, we prototyped the actual design in a scale of 1:1 to minimize errors in actual manufacturing process by using pvc pipes.



Fig. 2:- Prototype

C. CHASSIS

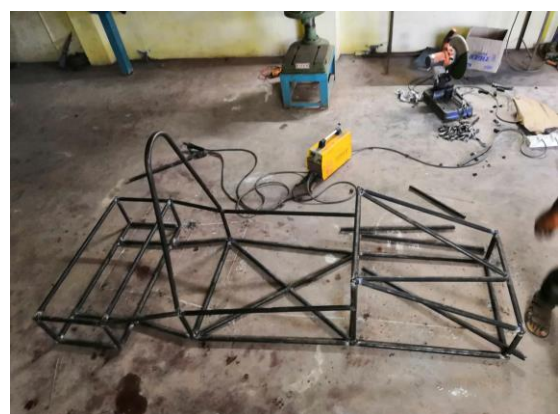


Fig. 3:- Final Chassis

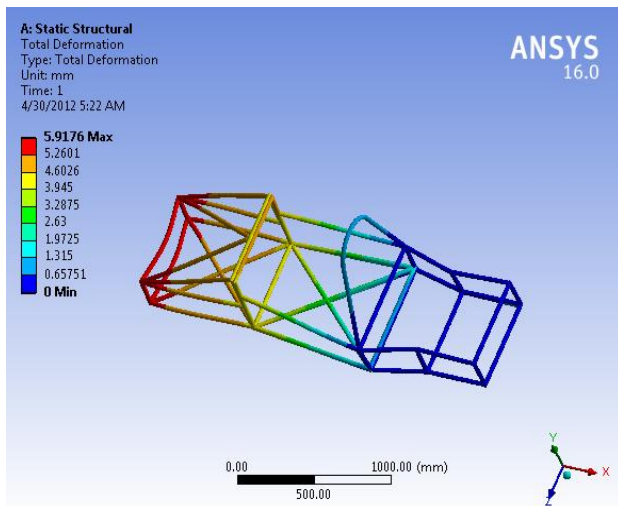


Fig. 4:- CAE Output of front impact of chassis

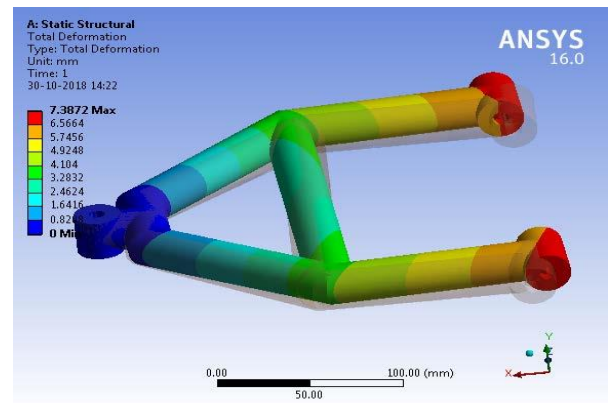


Fig. 7:- CAE output of A- Arm

D. SUSPENSION SYSTEM

Suspension is used to absorb shock of the vehicle. Which connects between tyre and chassis of the vehicle with using proper linkage mechanism.



Fig. 5:- A-Arm suspension system

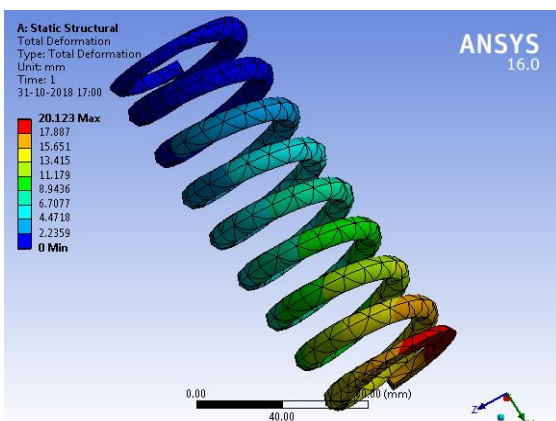


Fig. 6:- CAE output of suspension spring

❖ Double A- arm suspension system

A Double A-arm suspension is an independent suspension design using two (occasionally parallel) wishbone-shaped arms to locate the wheel. Each wishbone or A-arm has two mounting points to the chassis and one joint at the knuckle.

➤ Components

• A- Arm

A-Arm is a tubular structure fabricated by Arc welding. And the material used is same as the material for the chassis. In A-arm there are total three connecting points. The two points are connected with chassis and other one is connected with the hub. It has only one direction movement (up and down).

• Coil spring shock absorber

Coil spring shock absorber is a commonly used shock absorber

• POS bearing

It is a type of bearing or a joint used in the end of the rods. Here we used this bearing at the three connecting ends of the A arms which are connected with chassis and the hub.

E. STEERING SYSTEM

Steering system is used for controlling the direction of vehicle. It is a collection of components linked together to work as a single system.



Fig. 8:- Steering rack

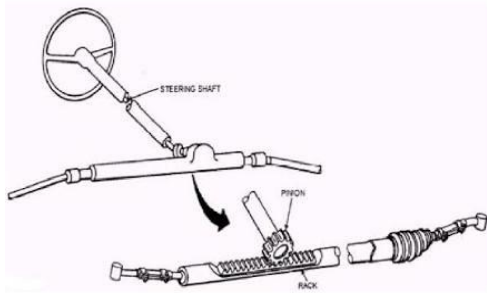


Fig. 9:- Steering assembly

F. BRAKING SYSTEM

The braking system is an important part in a vehicle. It is used for stopping and speed reduction using friction. Here we are using hydraulic breaking with disc brake.

➤ **COMPONENTS**

- i. Brake pedal
- ii. Brake line
- iii. Calipers
- iv. Master cylinder



Fig. 10:- Brake caliper



Fig. 11:- Master cylinder

G. POWER TRAIN

Power train is the heart of any vehicle. The term power train defines the main components that make power and deliver it to the wheels. Solar car consists of BLDC Motor as the power train of this car which the motor is coupled to gear by using the gear train the rotation of wheel is made possible.

➤ **BLDC (BRUSHLESS DC MOTOR)**



Fig. 12:- Brushless dc motor

Parameter	Value
Type	Brushless Hub motor
Output Power	2000 W
Rated Voltage	48 V
Rated current	42
Rated Torque(NM)	6.3
RPM	3000

Table 2:- Motor Specification

Brushless motor has a permanent magnet rotor surrounded by a wound stator. The winding in the stator get commutated electronically, instead of brushes. So, it doesn't have the friction and voltage drop that brushes create by dragging against the spinning commutator.

- Faster reaction and higher operating speeds
- Simpler to control in regard to speed control and reversing

H. KELLY CONTROLLER

BLDC motor is most popular among electric vehicles. BLDC motors don't utilize brushes, motor movement is controlled by means of carefully designed drive signals which helps to improved reliability, longer life, and higher performance. All the controls are happening inside the component called motor controller. It can't run without this controller.



Fig. 13:- Kelly controller

I. CHAIN DRIVE



Fig. 14:- Chain and sprocket

Chain drive is used to transmit the power from Motor to wheels. Most commonly the power is conveyed by a roller chain, known as drive chain, passing over a sprocket gear, with the teeth of the gear is meshing with the holes in the links of the chain. We can easily adjust the length of chain easily than belt drive, also we can reduce frictional loss and slip by using chain drive. Although chains can be stronger than belt their greater mass increases drive train inertia.



Fig. 15:- Chain drive

J. BATTERY

Two battery's having 48 V, 40 Ah are connected in series connection to give the output of 48 V and 80 Ah for the working of motor. Battery can be charged from outside manually or can charge from vehicle itself by the solar panels. Lithium-ion battery is most suitable for electric vehicles because it has high discharging current and fast charging capacity. Also, the efficiency is above 80% and the weight is three times lesser than flooded battery. But the cost of lithium-ion batteries is very high and it's highly explosive.

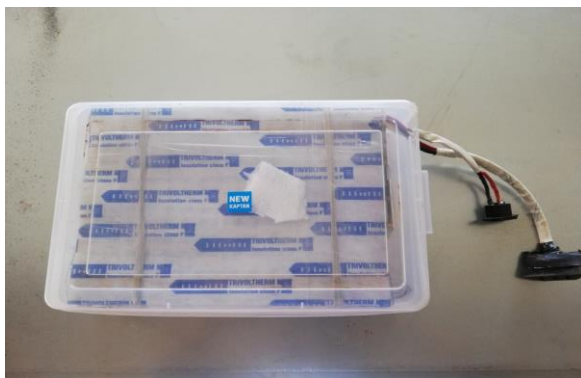


Fig. 16:- Lithium-ion battery

K. SOLAR PANNEL



Fig. 17:- Solar Panel

We used two solar panels which are flexible Poly crystalline solar panel having 125 watts connected in series to power the vehicle. The efficiency of Poly crystalline solar panels is less than that of monocrystalline panels, but polycrystalline have lower price. In addition, polycrystalline solar panels tend to have a blue hue instead of the black hue of monocrystalline panels.

The raw material of Polycrystalline solar panel is silicon. Silicon is melted in to many fragments and combined to form the wafers for the panel. These solar panels are also called as “multi-crystalline or many-crystal silicon. Because, number of crystals present in each cell. Polycrystalline solar panels have lower efficiency ratings than monocrystalline panels due to less freedom for the electron's movement.

Parameter	Front	Back
Type	Flexible-Poly Crystalline	Flexible-Poly Crystalline
Panel Length	1640mm	1640mm
Panel Breadth	990mm	990mm
Cell Size	156mmx156mm	156mmx156mm
Max Power Output	125 W	125 W
V _{mpp}	31 V	31 V
I _{mpp}	4 A	4 A

Table 3:- Solar Panel Specification

L. WORKING

When the accelerator pedal is engaged the motor, controller draws the required current from the battery and transfers to the motor via phase wires. The motor shaft is connected to the drive mechanism via chain drive and thus transfer of mechanical power from motor shaft to drive axel occurs and vehicle starts to move.

A Mini solar car gets the required energy from sunlight. In a mini solar car, its surface is almost covered with PV cells, this will help to absorb the sunlight. PV cell comes with black in color which can absorb most of the light incident on it due to its black color. Usually, black objects just get hot in the sun. But in the case of mini solar car, most of the light incident on it is converted in to

electricity due to photovoltaic effect of solar cell. Each solar panel contains many such solar cells. The electric motor uses the electricity which produced by solar cells.

M. Summary of Electrical System

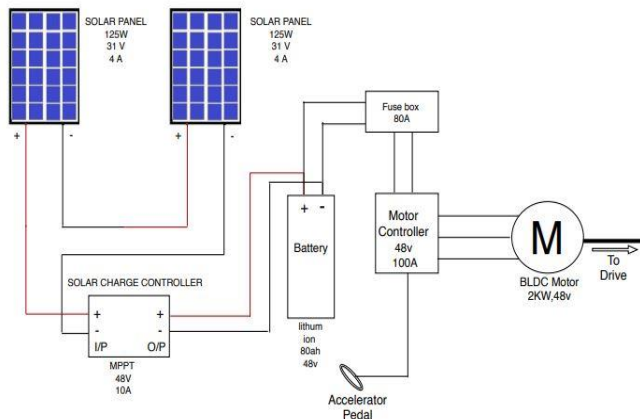


Fig. 18:- Overall energy conversion in a solar car

The solar energy from the sun is converted into electrical energy by using solar panel. The solar panel is connected in series in order to meet the required voltage input to the battery. A charge controller (MPPT) is used to prevent overcharging of battery and to maintain constant voltage output from the solar panel. The current flow to the motor is controlled by motor controller and a fuse box which is placed between motor controller and battery for over current protection (ie, limiting the current discharge from the battery to 80A).

VI. CONCLUSION

The world is today is more industrialized and gonna be escalating its ramification to each square and centimeters of tomorrow’s lifestyle. Thus, there would be an enormous increase in the demand of fuel energy. The lion share might come with the abnormal usage of carbon-based vehicles. The disastrous hike in the environment pollution is the worst consequences of all this trajectory. So, it’s time to switch to a new source of energy.

Solar-powered electric vehicles are safe and eco-friendly. They are zero emission vehicles, odorless, smokeless and noiseless. Solar vehicles require minimum maintenance due to its fewer moving parts. Though these vehicles are more reliable and can be efficiently charged nearly anywhere. These vehicles are highly cost efficient.

Thus, solar cars can easily trigger the future technology, we hope that the growth of this technology would not belong as well as the majority of the worlds people would shift to driving this contemporary vehicle. This will make a positive change in their life style as well as the environment. This is just the beginning of a new era and without any doubt we can say that the future developments will make solar cars the predominant mode of transportation over vehicles with internal combustion engines.

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