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Optimal design and static simulation of a hybrid solar vehicle

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Abstract

This paper deals with the design and simulation analysis of the hybrid solar vehicle under static conditions. The solar hybrid vehicle is effective in our everyday lives because many people have petrol cars and the emissions and fuel cost is now a serious problem. In addition to controlling vehicles pollution in the city, reduced fuel consumption and hybrid solar car use is used in vehicles to effectively reduce global warming and the environmental challenge in large-scale applications. In the last ten years, research has taken place on a large quantity of solar, hybrid solar and electrically operated cars, which is originating from several independent developments that all resulted in the idea of hybrid solar car and electric operated car. A hybrid solar vehicle was successfully designed, analyzed and fabricated at the end of this research.

Key words: Hybrid Vehicle, Solar vehicle, Fuel Efficiency, Static analysis

1. INTRODUCTION

Development of a Three-wheeled Motor car Micro-Hybrid System as mentioned below.[1,2] The future of cars seems to be the hybridization of various energy sources in the current state of technical development. The Configuration of transmission line shown in Fig.1. This type of vehicle development aims to take advantage of the best quality of each energy resource and is particularly useful in urban driving. Auto rickshaws, which produce huge variability of air pollution as well as greenhouse gases such as co2, is one of the major transport modes in cities of India. 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 which is available in plenty in country like India, adopted solar energy as the additional sources in addition to the conventional IC engines. You can convert light energy as electricity, which is fed into the DC motor for a mechanical motion using the solar panel, control unit and DC motor set-up. In the propeller shaft, the mechanical motion was transferred to the rolls via a chain speed drive which results in low cost and efficient transmission. [3,4] Finally, with the help of the modified transmission system a rickshaw concept was developed.

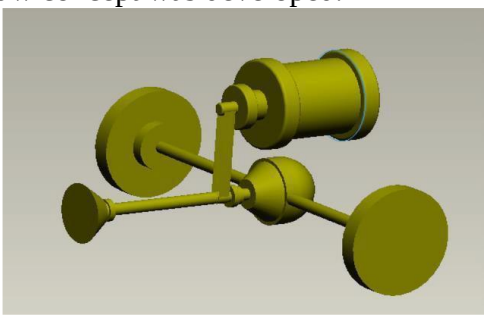

Fig.1. Configuration of transmission line

Design Methodology of Energy Storage Systems for a Small Electric Vehicle' this paper has brief study of how this hybrid solar car is efficient in our daily life because now day's pollution and fuel rate is very big problem many people having petrol cars. Use of solar energy is being used for vehicles, besides the control of vehicular pollution in the city, less consumption of fuel,[5,6] hybrid solar car are effective educing global warming and environment problem in big frame. Over the last 10 year, a larger amount of solar car, hybrid solar car and electric operated car research has been carried out, which is originating from several independent developments that all resulted in the idea of hybrid solar car and electric operated car. These are three main innovations.

2. COMPONENTS OF THE VEHICLE

2.1. Solar panel

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

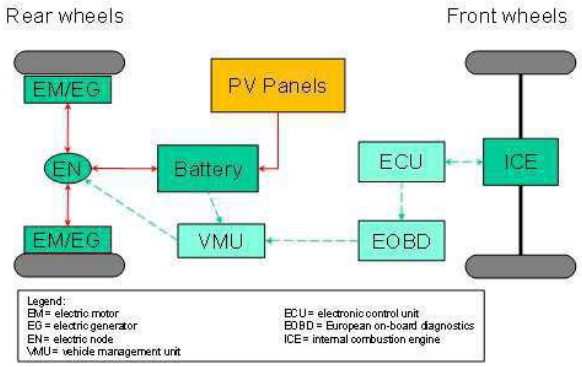

Fig.2. Block diagram of circuit design

A photovoltaic module (in short PV) is the packaged connected assembly of 6×10 solar cells. Solar photovoltaic panels comprise solar panels for the manufacture and supply of solar energy for photovoltaic systems for both commercial and residential applications. Block diagram of circuit diagram shown in Fig.2.Each module has its DC power rating, which typically ranges from 100 to 365 watts, with standard test conditions. The efficiency of a module determines the area of a module with the same rated output–an 8% efficient 230 watt module with a 16% efficient 230 Watt module is double the area. A few solar panels have an efficiency of over 19 percent. Only a limited amount of power can be produced by one solar module, most systems contain a number of modules. Usually, a solar panel or board, a solar inverter, or sometimes a battery and/or solar monitor, or connecting cable is included in a photovoltaic system. Solar panel efficiencies can be determined by the solar panel MPP price. Solar inverters convert the DC power to AC power by performing MPPT process: solar inverter samples the output Power (I-V curve) from the solar cell and applies the proper resistance (load) to solar cells to obtain maximum power. MPP (Maximum power point) of the solar panel consists of MPP voltage (V mpp) and MPP current (I mpp): It is a solar panel capability that can make higher MPPs with the higher value.

2.2 Battery (lithium-ion polymer battery)

A battery that can be charged, unloaded and reloaded many times, when a non-recharitable or primary batteries is supplied fully charged and discharged, can be used for rehabilitation, battery storage, or accumulator. It consists of one or more electrical cells. The term ' accumulator' is used as a reversible electro-chemical reaction to accumulate and storage energy.

2.3 Electronic control unit

In automotive electronics, Electronic Control Unit (ECU) is a generic term for any embedded system that controls one or more of the electrical system or subsystems in a motor vehicle. The design of an ECU requires both software and hardware to carry out the intended functions of this particular unit.

2.4 BLDC hub motor

Most electric-powered vehicles (electric cars, electric bicycles, and wheelchairs) use onboard batteries and a single, fairly ordinary electric motor to power either two or four wheels. Nonetheless, some of the new electric cars and electric bike operate in another way. They put a motor directly into the hub of each wheel, so that motors and wheels are one and the same thing, rather than having an engine driving all the wheels using gears or chains. The Specification of motor is used as mention below.

- Motor type: BLDC hub motor
- Power: 360 watts
- Voltage:48 volts
- Speed :600 rpm
- Torque :5.5 N-m
- Weight:8 kg

3. INFLUENCE OF MOTOR CAPACITY AND RATING

Key criteria for selecting a DC motor includes first finding out voltage is readily available for the application and physical size of the motor needs to be. Speed and torque can then be considered parameters are determined. The input Current=7.5amps and Voltage=48v.

***a)INPUT POWER*, (IP)**

IP = voltage x current (1)
= 48*7.5
= 360watt

b) TORQUE, (T)

T = Input Power / Angular Velocity (2)
= (360 x 60)/ (2 x 3.14 x 600)
= 5.729Nm

a) RUNNING SPEED, (V)

V = 2 x π x Radius of wheel x max speed x (60/1000) (3)
= 2 x π x 0.2 x 600 x (60/1000)
V = 45.216 km/hr

c) OUTPUT POWER, (OP)

OP = (2 x 3.14 x N x T)/60 (4)
= (2 x 3.14 x 5.729 x 600)/60
=359.78watts

4. TESTING AND VALIDATION

Comprehensive FMEAs and other failure analysis by suppliers are performed in the development cycle, which can lead to volatile conditions or drivers discomfort. Extensive testing and validation activities are carried out as part of the Production part to gain confidence of the hardware and software. On-board diagnostics or OBD help provide specific data related to which system or component failed or caused a failure during run time and help perform repairs. Fabrication model shown in Fig.3. Fig.4,Fig5 and Fig 6 shows the 3D model, Stress analysis and messing model.

Fig.3. Fabrication model

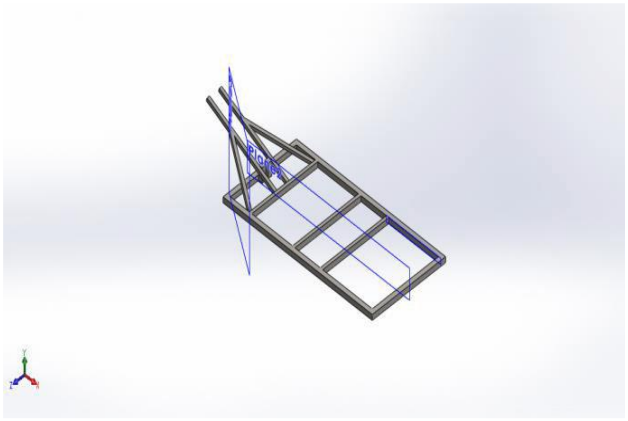

Fig.4. 3D model of frame

Name	Type	Min	Max
Stress1	VON: von Mises Stress	5.53431e-006 N/m^2 Node: 33507	23852.6 N/m^2 Node: 1945

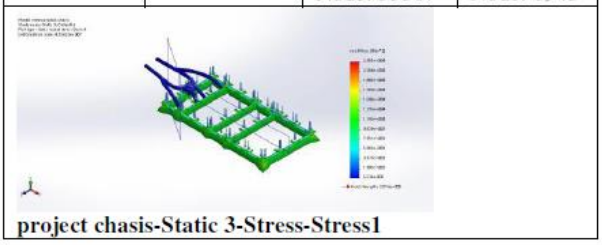

Fig.5. Stress analysis

Table 1 total no.of nodes & elements

Total Nodes	87518
Total Elements	50666
Maximum Aspect Ratio	16.501
% of elements with Aspect Ratio < 3	99.4
% of elements with Aspect Ratio > 10	0.0217
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:09
Computer name:	Frame

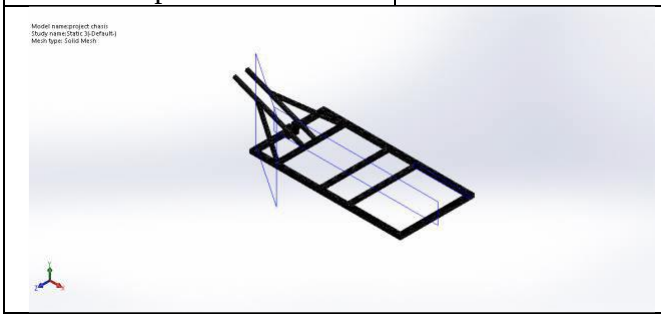

Fig.6. Details of meshing

Conclusion

Solar energy is going to be our alternate source of energy, thus we selected solar energy as another source. Electric solar vehicles has more advantages such as renewable source which is of free of cost, economic advantage like saving fuel, and preventing tree from deforestation. The experimental work was carried out using mathematical relations and designed based on the results of Input power, (ip) = 360 watts, Torque, (t) = 5.729Nm, Running speed, (v) = 45.216 km/hr, Output power (op) = 359.78 watts. This work results highly optimized the performance in terms of vehicle weight, load distributing to each members due to both electrical systems and IC engine. The static simulation is analyzed by solid works and those results are considered while model fabrications.

References

[1]. Hofman, T., van der Tas, S. G., Ooms, W., van Meijl, E. W. P., & Laugeman, B. M. (2009). Development of a micro-hybrid system for a three-wheeled motor taxi. *World Electric Vehicle Journal*. https://doi.org/10.3390/wevj3030572

[2]. Trovao, Joao Pedro & Pereirinha, P.G. & Jorge, Humberto. (2009). Design Methodology of Energy Storage Systems for a Small Electric Vehicle. World Electric Vehicle Journal. 10.3390/wevj3040670.

[3]. Kim, C. H., & Lee, K. M. (2009). Analytical study on the performance analysis of power train system of an electric vehicle. *World Electric Vehicle Journal*. https://doi.org/10.3390/wevj3040830

[4]. Dyke, K., Schofield, N., & Barnes, M. (2009). Analysis of electric vehicles on utility networks. *World Electric Vehicle Journal*.https://doi.org/10.3390/wevj3040747

[5]. Lan, H., Wen, S., Hong, Y. Y., Yu, D. C., & Zhang, L. (2015). Optimal sizing of hybrid PV/diesel/battery in ship power system. *Applied Energy*. https://doi.org/10.1016/j.apenergy.2015.08.031

[6]. Vezzini, A., Sharan, H., & Umanand, L. (2005). Low-pollution three-wheeler autorickshaw with power-assist series hybrid and novel variable DC-link voltage system. *Journal of the Indian Institute of Science*.