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Electro-Mechanical Car

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***Abstract*: The face of the automotive industry is being re-shaped by concerns over oil supplies, international policy and fuel costs. A wide variety of hybrid technologies. E-M car is a hybrid and eco-friendly car which is run by the help of two sources, first is solar energy and second is mechanical energy. In solar energy we use photo voltaic panel to charge my battery for motor drive. In mechanical energy we use pedal system to drive my car during low battery condition for this we apply dynamo to charge my battery by converting men drive into electrical power.**

***Keywords*: Photo voltaic panel, PV panel, solar panel pedal, BLDC Motor, dynamo, pedal system, driven gear, driving gear, E-M car.**

1. Introduction

In recent times geologist are highly concerned about reducing the use of fossil fuels as the demand is very high than the total deposit of natural gases. Researcher are working relentlessly to solve this problem and trying to find out the best alternative to fossil fuel. Using solar energy is one of the very few solutions they have found so far. As the solar energy is renewable and less harmful to the environment, it is gradually taking the place of fuels. Solar have some critics and demerits which is generally occur in cloudy days, which causes solar panel only 10-25% produce of their typical output.

The best way to charge the battery by the help of dynamo which are drive by any source. So by applying pedal system to run the solar vehicle could help in transmit power to alternator for charging the battery.

To make the optimum use of solar power and pedal system(dynamo) we took the initiative to work on our project E-M car. Our solar and mechanical power hybrid car uses pv panel, batteries and dynamo instead of using fossil fuels and electricity. So it can be considered as a fully eco-friendly vehicle is the crying need of present situation of the world. By considering these things, we have made our E-M car which is more effective and efficient for commercial uses. Hopefully EM car will be able to replace the fuel vehicle and E-car, it will play a major role in creating a safe and soul environment.

2. Project aim and objective

Our objective is to design an efficient, cheaper an d most of all an environment friendly car. The design consists of a dynamo as an additional power source which will be used only when power from solar cells is unavailable. Thus we aim at reducing the fuel consumption thus decreasing carbon emission for daily personal automobile uses. Less noise pollution is also expected as no internal combustion engine is used.

A. *Design and methodology*

Power transmission system of our hybrid vehicle shows in fig. 1.

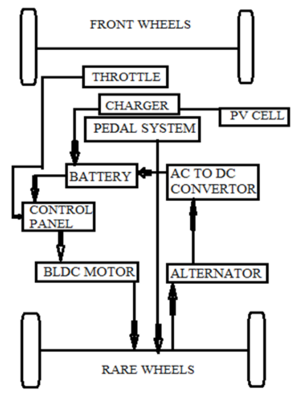

Fig. 1. Transmission system of the vehicle

B. *Mechanical design*

1) *Drafting*

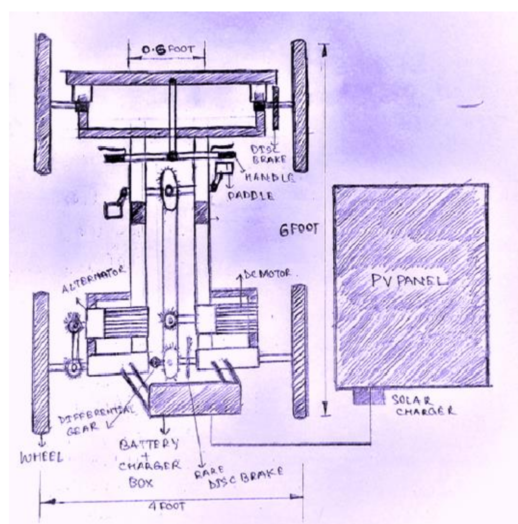

Fig. 2. Top view

Length and width of the car is 1829mm and 1220mm respectively. Mild steel was used to build the chassis. There are about 18-20 welding joints in the chassis. Length of chassis is 1825mm and width is 1120mm. Ground clearance is about 610mm. Four wheel of 550mm diameter were used. Disc brake was used in the system. For steering system, we used rake and pinion method in steering. The Fig. 3. shows the construction of our proposed car. The top view is given in the fig. 2.

Fig. 3. Isometric view of the proposed model

C. *Mechanical parts details*

1) *Pedal system*

Pedal system is the main part of our car that rider pushes with their foot to propel the car during our battery were discharge. It helps in drive the alternator to charge the battery. A pedal consist of a spindle that threads into the end of the crank and a body on which the foot rest is attached, that is free to rotate on bearing with respect to the spindle.

Fig. 4. Pedal system

2) *Brake*

We have used only one pair of rear brakes. It is a pair of Disc brakes which controlled by brake lever.

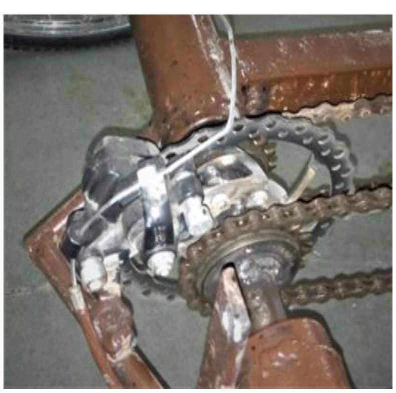

Fig. 5. Disc brake

3) *Steering system*

Steering type is rack and pinion and minimum turning radius 4.4 m.

Fig. 6. Steering System

4) *Load and torque*

The car chassis is made of 6-foot mild steel. MS contains a maximum of 0.29% carbon and is used in almost any project. It has high toughness and also high strength so that it can carry a good amount of load. We also used differential gear instead of a chain-drive mechanism for better work of rear wheels.

3. Electrical design

A. *Solar panel*

The amount of solar energy is impressive, the 89 pet watts of sunlight reaching the Earth's surface is almost 6,000 times more than the 15 terawatts of average electrical power consumed by humans. Most of the current PV panels, with multi-crystalline silicon technology, have efficiencies between 11% and 18%, while the use of mono-crystalline silicon allows increasing the conversion efficiency of about 4%. The amount of radiation theoretically incident on Earth surface is about 1360 W/mP2P (Quaschning, 2003) and only a fraction of this energy can be converted as electrical energy to be used for propulsion. Considering that the space available for PV panels on a normal car is limited.

In order to maximize the energy captured during parking mode, we can use horizontal panels (on roof).

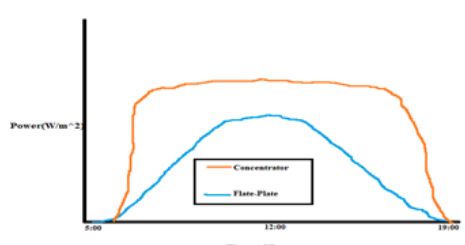

Fig. 7. Power curve with respect time of day

The energy from PV panels can be obtained summing up the contribution from parking (p) and driving (d) periods. While in the former case it is reasonable to assume that the PV array has an unobstructed view of the sky.

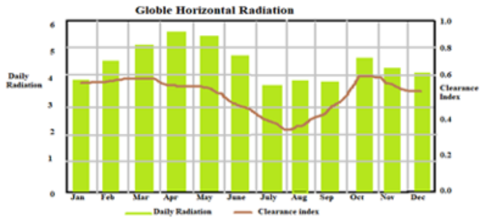

Fig. 8. Power curve with respect time of day

This hypothesis could fail in most driving conditions. Therefore, the energy captured during driving can be reduced by a factor 1. In order to estimate the fraction of daily solar energy captured during driving hours (Hc), it is assumed that the daily solar energy is distributed over sun hours (Hs). A factor 1 is then introduced to account for further degradation due to charge and discharge processes in the battery for energy taken during parking. The net solar energy available for propulsion, stored during both parking and driving modes, can therefore be expressed as:

$$Es{,}p = \eta Ae\frac{(Hs-Hc)}{Hs}\alpha \quad (1)$$

$$Es{,}d = \eta Ae\frac{(Hs-Hc)}{Hs}\beta \quad (2)$$

Where e is the average daily energy captured by solar panels in horizontal position. It has been assumed e is equal to 4.6 KWH/day. Daily radiation and clearance index in HOMER analysis is given in Fig. 7.

The energy required to drive the vehicle during the day Ed (kWh) can be computed as function of the average positive power Pav(kW) and driving hours HD:

$$\text{Ed} = \int_{HD}^{\infty} P(t).dt \quad (3)$$

The instantaneous power is estimated starting from a given driving cycle, for assigned vehicle data, integrating a vehicle longitudinal dynamic model. Thus, required driving energy Ed depends on vehicle weight and vehicle cross section, which in turn depend on the sizing of the propulsion system components and on vehicle dimensions, related to solar panel area. The contribution of solar energy to the propulsion can be therefore determined as:

$$\lambda = \frac{Esun}{Ed} \quad (4)$$

$$= \frac{Es{,}p + Es{,}d}{Ed} \quad (5)$$

Here we have used 150 watt four solar panels. So we can gain 54.54% (approx.) power from the solar panel.

B. BLDC Motor

Brushless DC motors typically have an efficiency of 85-90%, while brushed motors are usually only 75-80% efficient. Brushes eventually wear out, sometimes causing dangerous sparking, limiting the lifespan of a brushed motor. Brushless DC motors are quiet, lighter and have much longer lifespans. Because computers control the electrical current, brushless DC motors can achieve much more precise motion control.

In our project we have used 850W, 48V BLDC Motor. Maximum rated current is 50A. Its RPM is 3600. By using 3:1 gear ratio we decrease it in 1200 RPM. Motor torque calculation.

Generated Torque:

$$Tg = \frac{Pw*9.55}{n} \quad (6)$$

Where, Tg is the total torque, Pw is power of motor in Watt, n is rotation of motor in rpm.

For our car

$$Tg = \frac{1100*9.55}{1200}$$
$$= 8.75\text{N-m} \quad (7)$$

Required Torque:

$$Tr = F*r \quad (8)$$

Here, Tr is required torque, F is required force and r is the radius of the wheel.

C. Battery

We have used 12V lead-acid battery. Four cell of this kind of battery are connected in series to make 48V. The whole battery pack is 65 AH. It takes 8-9 hour to recharge. According to our calculation the depth of discharge of battery is 80%. At low and extremely high temperature the efficiency of battery decreases. The battery Pack capacity in AH is-

$$Brc = \frac{Ecah*Ds}{DOD*\eta} \quad (9)$$

Where, DOD is battery depth of discharge, Ds is battery autonomy is Temperature Correction factor which is 0:9 and Each is energy or load given in Ampere hour.

D. Dynamo

In our design we use dynamo of 48V 90Ah helps to generate electrical energy when our battery got discharge.

4. Control system

A. Solar charger

Fig. 9. Solar charger

To charge the battery pack efficiency we have used the solar charger.

B. Voltage controller

To control the Speed of the motor we have used a voltage controller which will be connected with throttle. In the basis rotation in anticlockwise and clockwise it will generate a pulse in the controller which will control the provided voltage of the motor. Fig. 10. shows the control module.

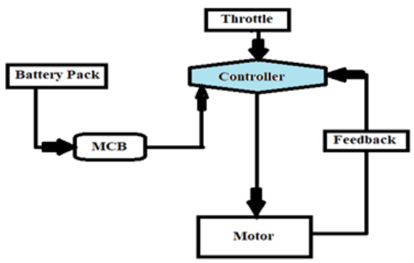

Fig. 10. Controller module of proposed model

5. Solar charging system

A. Solar charging system

This idea can be help in the case of long driving. The solar charging station can be built by using solar panels along with the CNG stations. The solar panels will store the energy in a battery during the day.

Fig. 11. Monocrystalline PV panels

6. Dynamo charging system

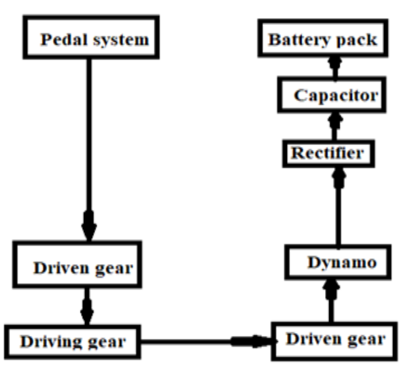

Fig. 12. Dynamo system of proposed model

The most common problem for solar powered vehicle is that cannot provide required efficiency due to lack of solar radiation and sky clearance during rainy season and winter render it unable to function properly, in this problem we used dynamo which is driven by the pedal system and convert mechanical energy into electrical energy and this alternating energy could converted into pulsating direct current by using bridge rectifier after that we connect it to capacitor to covert pulsating DC into linear flow.

7. Features and advantages of proposed E-M Car

In the recent years, comprehensive research work is going on for the development of solar powered electric vehicles. The most common problem for solar powered vehicle is that none of the solar panels are available that can provide required efficiency. Also, Lack of solar radiation and sky clearance during rainy season and winter renders it unable to function properly. Keeping this in mind, our project was designed to mitigate these problem as much as possible. The new techniques adopted are dynamo system

A. Maximizing the panel area tray system

As the E-M car is prevalently a solar hybrid, the area of solar panel used is an important criterion to consider the sustainability of the vehicle. Four 800mm x 200mm panels is used on roof of the vehicle to generate power from the solar radiation. It is possible to generate double power by increasing the panel size twice.

The E-M car provides some facilities that benefit the mankind and pollution free environment. Since this is an eco-friendly car it hardly affects the environment hence pollution is reduced. The weight is significantly lower than the traditional vehicle. Also it provides comfortable driving experience with less noise and vibration. The car offers simple design and low manufacturing cost. Besides Being cost-efficient the three seated E-M car can be popular to every walk of life. Dynamo can be used for back-up power generation. It can be useful in both rainy and winter season.

8. Conclusion

This solar powered hybrid vehicle, designed by integrating battery powered motor and backup dynamo with photovoltaic panels, can represent a valuable solution for both energy saving and ecological problems, especially for urban usage. We have forced on the technological issues and challenges faced by grid-plugged hybrid electric vehicles in relation to components which can be used for design consideration and selection of electric motor and battery bank, controller circuits. Significant reduction of greenhouse gas emissions can be achieved through a simultaneous use of various technological aspects, such as method we present such as photovoltaic cell, using dynamo in vehicles. This type of car does not create much pollution so it is beneficial for environment. The cost of production is low and maintenance cost is minimal. Hence this car is very economical and Environmental friendly than the conventional fuel driven cars.

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