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Solar Powered Hybrid Vehicle

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***Abstract*--- The fossil fuel such as petrol and diesel are very expensive way to be extracted and used. The use of fossil fuel based vehicles is one of the major reasons that has accelerated the extraction of these non-renewable resources in an unsustainable way. Further, transportation of these fuel to rural areas itself has become a problem. The major problem is greenhouse effect caused due to this burning of fossil fuel where large amount of CO2 will be emitted which causes lots of problem. Solar vehicles depend on PV cells to convert sunlight into electricity to drive the PMDC motors. Unlike solar thermal energy which converts solar energy to heat, PV cells directly convert sunlight into electricity. According to recent surveys the fossil fuels are depleting at a fast rate where in and around 50 years the whole fossil fuel in the world must be completely depleted. Therefore it is the need of the time to make a new exploration of natural resources of energy and power among the natural resources available sunlight is the most promising one. Sunlight is considered to be a source of energy which is implemented in various day to day applications.**

***Index Terms*— Hybrid Vehicles, Electrical Vehicle, PV Cells**

I. INTRODUCTION

At present, the utilization and extraction of non-renewable energy sources like fossil fuels are very high. This increased usage of fossil fuels has lead to environmental pollution and global warming. With the increasing civilization and mechanization, a huge amount of fossil fuels are used that has lead to drastic problems. These fossil fuels used in Internal combustion vehicle releases gases like CO2, CO, etc. which leads to global warming and can even cause serious diseases in humans. Subudhi et al. reviewed different MPPT techniques and its classification based on various characteristics such as control systems, type of variables, etc. Hybrid MPPT techniques are also explained which is useful to use in various Photovoltaic Systems [1].Schultz et al. presented the architecture, power management system of Fuel Cell Hybrid Electric Vehicle System and analysis design of energy storage device i.e., the battery and ultra-capacitor of FCHEV. It proposed double energy management strategies of the storage device. It was found that the overrating of either of the storage device i.e battery or ultra-capacitor affect various parameters of the system which include the volume of the system, battery lifetime, the mass of the system. It was concluded that not only the power and energy management should be taken into account but it is also necessary to consider the lifetime of battery [2]. Onar et.al proposed an energy storage system comprised of battery and super capacitors with the help of an integrated magnetic bidirectional dc-dc converter. With the Help of super capacitors, the stress on battery is significantly reduced which increases the lifetime of battery [3]. Shukla et.al designed a solar electric-powered vehicle. It was found that the battery Can run the solar-powered electric vehicle for about 12 km and its speed was found to be 20km/hr [4]. Solar-powered Electric vehicle was constructed using various components like PV array, charge controller, battery, and motor controller, motor. Calculations were made for all the components and its hardware implementation was carried out and various results obtained were studied [5]. Jang et.al designed a novel interleaved boost converter that has voltage double characteristics which makes it suitable for power factor correction applications [6]. Nirmala et.al explained the working of solar PV powered Electric Vehicle and it also explained that the key drawback of fuel and contamination. This paper discussesed electric vehicle that utilizes a battery that is charged from an outside power supply, yet solar PV modules are utilized to charge a battery by methods for retaining radiation from the sun and changing over it into electrical power (Photovoltaic Effect) [7]. Girish Allampallewar et al analyzed performance solar cells with SiO_2 coating. The Sol-Gel method is implemented to prepare coating. It is proposed to compare the performance of Solar powered Hybrid vehicle with or without coating.

II. MAIN COMPONENTS

a. Motor

Motor and its Controller are the two most critical components for HSV. As the selected motor must be able to produce enough torque and power to pull the load.. According to calculations and references we concluded by choosing, 24 V BLDC motor.

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b. Motor controller

A motor controller is a component which is used to start and stop the motor also which is used control and varying the speed of the motor drive. The direction of motor rotation also possible to change using this controller.

c. Braking system

Braking system is a key feature in any vehicle. Two types of braking system namely disc brake and drum brake. In this work disc brake is mounted on the chassis for considering the safety precautions.

d. Battery

Three types of battery namely lead acid battery, Nickel metal hydride battery and Li-ion battery were examined. Li-ion battery is widely used in the application of hybrid vehicle.

e. Solar panel

According to the design calculation and torque requirements, 75 watts solar panel has been selected in this work. All the materials were effectively utilized to avoid energy losses.

f. Solar charge controller

Solar charge controller controls the voltage received from the panel to the battery. It is generally used to convert non-linear energy form into linear energy form. It is used to prevent the short circuiting of the components.

III. CALCULATIONS FOR SELECTION OF MOTOR

To calculate Power

Consider

1 .Weight of the system = 20 Kg

2. Weight of the person = 65 Kg

Total weight = 85 Kg

i. Rolling force (F_r)

$$F_r = c*w$$

Where w = ma

m = mass of body

a = acceleration of gravity

c = rolling resistance = 0.004 for asphalt roads

F_r = 0.004*85*9.81

= 3 N

ii. Drag Force (Fd)

$$F_d = ½(c_d*p\ (v*v)*A$$

Where

F_d = drag force

c_d = drag coefficient

ρ = density of fluid (1.2 kg/m)

A= frontal Area Of the body (0.6m2)

F_d = 0.45*0.5*1.2*11*11*0.6

= 19 N

A. Power

$$P = F_t*v/\ \eta$$

Assume efficiency = 80%

P = ((3+19) *11)/0.80

= 300 watt

B. RPM

Consider

D = 0.5 m

C = 2πr

= 2 *3.14*0.25

= 1.57 m

Therefore for one revolution of wheel it will cover the distance of 1.75 m and for

11 km/Hr. = 11000/60

= 183 m/min

Wheel RPM = v/C

183/1.57 =117 RPM

Motor RPM = gear ratio * wheel RPM

= (driven/drive) *wheel RPM

= 21/9 *117

Motor RPM = 273 RPM

C. Acceleration

According to the 1st equation of motion

$$V= u + at$$

Assume t = 20sec

10 = 0 + a (20)

a = 0.5 m/s^2

D. Force

F = m a

= 85*0.5

= 42.5 N

E. Torque

Torque Max = F*r

= 42.5*0.25

= 11 Nm

So according to these calculations we are selecting 450 watts Motor which can produce the torque of 11 Nm

IV. SERIES AND PARALLEL CONNECTION OF BATTERIES

a. The cells in a battery can also be connected in mixture of both series and parallel. These combinations are sometime referred as series parallel battery.

b. Cells or batteries connected in series have the positive terminal of one cell or battery connected to the negative terminal of another cell or battery. This has

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the effect of increasing the overall voltage but the overall capacity remains the same.

c. A set of batteries are said to be connected in series when the positive terminal of one cell is connected to the negative terminal of the succeeding cell.

So according to this principle,

We are selecting the two batteries of 12 v and 20 amp. These two set of batteries and we will connect them in series to increase the voltage of battery.

That's how we will get the voltage of **12 +12=24 volt**

V. METHODOLOGY OF WORKING PROCESS

Composite materials are considered as the wonder material, as all the industries are obsessed to reduce weight and increase the specific stiffness. Fiber reinforced composites fit the billrein perfectly, and reduce weight significantly. However, there are still some associated obstacles to realize their true potential in the industrial manufacturing landscape. Polymer matrix composites are increasingly used in aerospace, automotive, marine, transport, sports and many other applications, as compared to conventional metals this is due to the lower weight, specific stiffness, corrosion resistance and high fatigue life, as compared to metals.

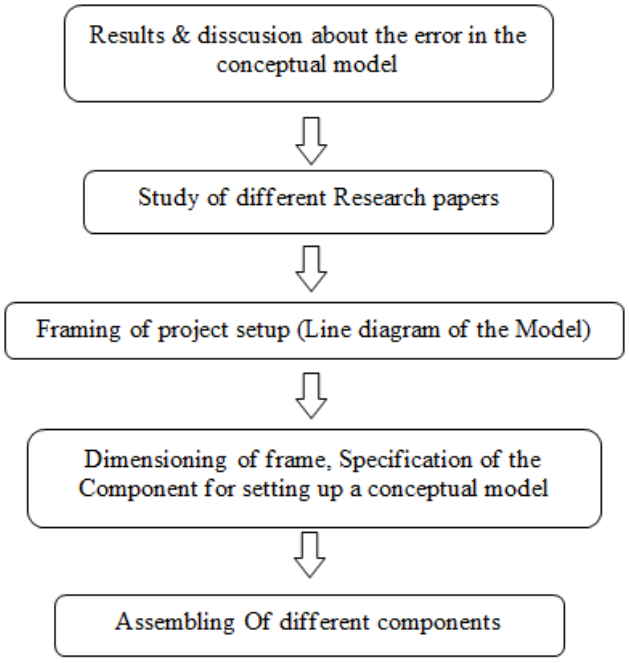

Fig. 1 Flow Chart for Working Process

VI. CONCEPTUAL CATIA 3D MODEL

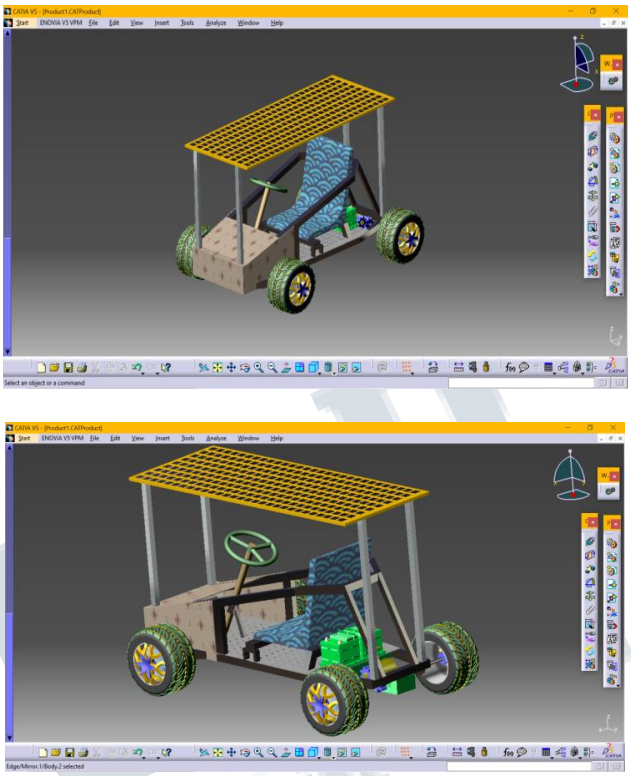

Fig. 2 Solar Powered Hybrid Vehicle

VII. ADVANTAGES

1) Environment-Friendly –

The biggest and the best reason to use an electric vehicle is that it is environment-friendly. They do not release vicious gases that lead to air pollution against the fossil fuel powered cars.

2) No Fuel or Gas Cost –

Since electric vehicles need no fuel or gas to power them, a user can escape the steep rise in prices of these commodities. All it needs is to be plugged in and ready to go another 100 miles.

3) Wide range of speed –

An electric car can easily run at 100 miles to 200 miles per charge. The new Tesla electric car model is estimated to run at a speed of more than 300 miles per charge.

4) Cheaper to operate –

Electric cars are much cheaper to operate especially in parts of the world where electricity prices are falling. It is estimated that the cost to fuel an EV per mile is almost 25%-30% lower than the cost of gasoline.

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5) More Efficient –

An electric car is around three times as efficient as cars with an internal combustion engine, according to Wikipedia.

VIII. DISADVANTAGES

1) Lack of Charging Stations –

One of the major advantages of using an EV is the fact that it does not need any petrol or diesel to run. Instead, it just needs a charging station. However, one of the major challenges that are hindering its adoption is the lack of a sufficient number of charging stations

2) Expensive –

Buying an electric vehicle is still expensive. There are many fossil fuel cars available in the market at different price points. However, electric vehicles offer lesser options to choose from, and the better ones are highly priced.

3) Lack of Power and Reduced Range –

Fossil fuel based cars offer better acceleration when Compared to electric vehicles. Though Tesla and Volkswagen are making EVs with better range, an average electric car can easily run at 100 miles to 200 miles per charge. Hence people are still skeptical is using electric vehicles for long journeys/ highway drives

4) Minimal Amount of Pollution –

Electric vehicles is not 100% emission free. Even they cause a little amount of pollution indirectly. The batteries and electricity used for charging are not necessarily generated from renewable energy sources.

IX. CONCLUSION

The solar powered hybrid vehicle solves problems related to environment and pollution. The continues running of vehicle can be obtained by the application of dynamo in the vehicle. The efficiency of solar electric hybrid vehicle obtained 100 percentage efficiency as compared to existing electric vehicle. The house hold electric supply of 230 V reduced with step-down transformer to 48v. And it is converted to D.C with a charge controller unit. The solar electric hybrid vehicle we designed is to rectify the problem occurring that the limited distance running of electric vehicles. The efficiency and running of solar electric hybrid vehicle was verified by theoretical results.

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