International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 1151-1155 www.ijaem.net ISSN: 2395-5252

Design and Fabrication of Hybrid Vehicle

M. Vijayakumaran[1], N. Hariprakash[1], S. Rajarajan[1]
Mr. B.Balaji[2]

B.Tech, Students[1], Assistant Professor[2]
Department of Electrical and Electronics Engineering,
Periyar Maniammai Institute of Science and Technology, Thanjavur, Tamil Nadu, India

Date of Submission: 12-04-2023 Date of Acceptance: 22-04-2023

ABSTRACT: This project describes two type of energy management first one is the solar to generate the power for charging the battery packs of electric vehicles (EVs) next one home based charging stations supply electricity to charge the battery of electric vehicle. Vehicle Electric Multiple Charging An excellent and cutting-edge way to charge an electric vehicle's batteries is by using solar energy. Battery efficiency, mileage, charging stations, heavy, bulky battery chargers, and wall sockets are common issues when charging EVs.Now this all problem can solve by using new innovative method of charging system. The conversion of solar energy here acts as a charger, as the vehicle is in motion. Since this power is generated from a solar pv. And the power develops from 48 volt without considering losses. A Charge controller is installed between solar and battery which control the voltage and allow the suitable voltage pass to the respective load. Here load is Brushless Direct Current Motor (BLDC).

Keywords: BLDC MOTOR, CONTROLLER, SOLAR PANEL, BATTRY.

I. INTRODUCTION

Electric vehicles, which use 100% electric power, use electric motors instead of an internal combustion engine to provide motive force.Photovoltaic (PV) cells are used in solar-powered vehicles (SPVs) to turn sunlight into electricity. Either a special storage battery or an electric motor that powers the vehicle directly receive the electricity. PV cells can only generate electricity when the sun is out. A solar-powered vehicle relies on the electricity stored in its batteries when there is no sunlight. Solar-powered automobiles, boats, bicycles, and even aeroplanes have been developed since the 1970s with the assistance of innovators, the government, and business. Robert and Roland Boucher, two brothers, piloted a remote-controlled, pilotless aircraft to a height of 300 feet in 1974.It was powered by a PV array on the wings. (The U.S. Air Force funded the development of these aircraft with the hope of using them as spy planes.) The first totally solar-powered car was built in 1977. It was small, lightweight, and cost relatively little. Major automakers like General Motors, Ford, and Honda have supported the development of experimental SPVs that are outfitted with cutting-edge technology.

There will be a big area at the aggie campus wardha when it is fully built and operates. Thus, in order to get from one side to the other, students need a vehicle. Students will choose to use tricycles as their mode of transportation over more expensive options like cars or motorcycles.There several types of tricycle that can be chosen such as paddle tricycle, motorized tricycle and electric tricycle. But that particular type of tricycle has some drawbacks.To overcome the weakness this project will develop a better tricycle.This project will use the energy of the sun, which is rarely used in India due to its location in the area of Capricorn, to generatetheelectrical vehicle. In this we are discussing about the various component which we will use. As we know that there are different types of components are available in market.

Brushless DC motor, solar panel, battery, charge controller, and throttle are the parts we're using.Hand-powered tricycles are presently being used to provide mobility for disabled persons. With this project we designed and manufactured a system to convert the hand powered tricycle to an electric motor powered version. Solar-powered vehicles (SPVs) use photovoltaic (PV) cells to convert sunlight into electricity. The electricity goes either directly to an electric motor powering the vehicle, or to a special storage battery. PV cells produce electricity only when the sun is shining. Without sunlight, a solar powered car depends on electricity stored in its batteries.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 1151-1155 www.ijaem.net ISSN: 2395-5252

The main parts of a solar-powered multi-charging electric vehicle are solar PV cells, charge controllers, BLDC motors, and batteries with controllers.As a vehicle moves the solar charge the electric car battery by using the same. A charge controller is installed to supply the sufficient voltage to the load also to avoid the chances of shot circuit. Here, lead acid batteries are used lithium ion and lithium phosphate ion can also be. A 900w 48v BLDC motor with its controller are used which provide a torque of 18 Nm and the speed up to 30 to 40km/hr. The big issue of charging the batteries and its efficiency can be solved here as the electric vehicle are future scope for us since the fossil fuels are continuously are in used to generate electricity for charging EVs and for other used too. It may largely impact on the rate of fossil fuels which can also be a big problem for our environment just like Electric Solar Vehicle (ESV) which uses unconventional energy for developing power for a particular; similarly WVCS can also be a very useful innovation of power generation for electric vehicle.

It can increase the efficiency of vehicle up to 25 % and the charging rate from plug in system / valve socket system can be reduced and gradually it will affect in the rate of fossil fuels and helps to increase it. We developed a kit which will be very useful for E- rickshaws and can be selling after market.Electric vehicles have been used since the 1990s, but their adoption into the automotive market has not been as successful as it could have been because they are less economical and require recharging every 60 to 70 kilometres.The hybrid vehicles play a major role in the present market .However, in order to alleviate the utilization of gasoline, the plug-in electric vehicles (PHEVs) entered into the market and it takes the energy from the grid for driving. To increase the life of storage system, cost reduction, and the flexible grid connectivity, the PHEVs are still under research. Nowadays, the park stations, roadside units, and the standard home outlets are used to charge the battery packs of EVs.The amount of time required by the EV's storage system to recharge the battery packs varies depending on their capacity.

II. PROPOSED SYSTEM

- In this project, proposes a Hybrid Electric Vehicle (HEV).
- The use of Four 12v lead acid batteries which provide a longer lifetime. 10 W solar panel is used to charge the battery.
- The BLDC motors is powered by 900 w
- The BLDC motors are replaced by a permanent magnet DC motor.
- The use of BLDC motors has its own significance.
- The absence of field windings in the BLDC motors eliminates the field circuit copper losses.
- This in turn increases their efficiency.
- Solar Panel is used to recharge the batteries.
- The output of the proposed system of the solar powered vehicle is as follows:
- The maximum speed attained at the end of the accelerating period is 30 kmph.
- The starting acceleration is 10kmphps.
- Distance covered is above 3 km depending on the speed and acceleration.
- Total time of the run is above 600 s.
- Average speed is 45 km.

III. METHODOLOGY

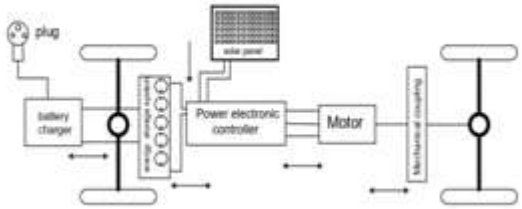

FIG. 1 Block diagram of the project

At the point when the electrically operated throttle pedal is throttled, the controller controls and transmits required current and voltage to the engine. The required measure of current is from batteries which are charged from sunlight by solar panels. The solar panels get sun's radiation and charges the batteries. The solar panel comprises of photovoltaic cells which observes heat from daylight i.e. sunlight and changes over it as current. The engine shaft rotates and make the drive shaft rotates. The drive shaft rotates the wheel and vehicle moves. There is no emission and it is an Ecofriendly vehicle. When the brake pedal is depressed, the master cylinder and calliper are connected as part of an arrangement that causes the vehicle to stop.The calliper impels the brake pad and it will stop the disc to rotate which is connected with the wheels of the vehicle. Forward and reverse switch is utilized to run the vehicle in forward and reverse movement. The kill switches are making use of to stop the vehicle ordinarily or if there should be arise and an occurrence of any crisis. It stops the general supply of current to the motor.

IV. DESIGN CALCULATION

Load calculation for BLDC Motor

To design an electric vehicle of 750kg and to run at maximum speed of 30 km/hr

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 1151-1155 www.ijaem.net ISSN: 2395-5252

F_{total}= $F_{rolling}$ + $F_{gradient}$ + $F_{Aerodynamic}$.

a. $F_{rolling}$ = C_r.m.a

C_r = Co-efficient of rolling resistance
m = mass of the vehicle
a = acceleration due to gravity (m/s^2)
C=0.01, m = 750kg, 9=9.81 m/s^2
$F_{rolling}$ = (0.01) (750) (9.81).
= 73.5 N
Power required = $F_{rolling}$ x [velocity of Vehicle in m/S^2
=73.5 N X 30 [1000/3600]
=612.2 watts

b. **$F_{gradient}$= m.a.sinθ**
Consider θ = o^o when the vehicle travels at flat surface.
$F_{gradient}$ = 0N

c. **$F_{Aerodynamic}$ drag = 0.5 ρv^2. CA. Af**
ρ = Density of air medium
V = velocity of vehicle (m/s^2)
CA = co-efficient of air resistance
Af = frontal area calculation
ρ = 1.23 kg/m^3 / V = 8.33 m/s^2 / CA = 0.5
Af = 1.96m^2
F_{Aero} = (0.5) (1-23) (8-3). (0.5) (196),
= (0.5) (1.23) (68.8). (0.5) (1.96)
F_{Aero}= 41.4 N
Power Required = F_{Aero}X velocity of vehicle.
= 41.4N x 8.3 m/s^2
= 344 watts.
Power needed for motor = 612 watts + D + 344 watt
Total power required for DLDC motor = 956 watts.

V. COMPONENTS USED

a. BLDC Motor

FIG. 2BLDC Motor

The popularity of brushless direct current (BLDC) motors is one of the motor types that is growing quickly.BLDC Motors are used in industries such as Appliances, Automotive. Aerospace, Consumer, Medical, Industrial, Automation, Equipment's communication; instead they are electronically commutated. BLDC motors have many advantagesover Brushed DC motor and induction motors. A few of them are;

- Better speed versus torque characteristic
- High dynamic response
- High efficiency
- Long operating life
- Noiseless operation
- Higher speed ranges

In addition, the ratio of the torque delivered to the size of the motor is higher, making it useful in applications where space and weight are critical factor.

b. Controller

FIG.3 Controller

The HY3408AP is a heavy duty brushless DC controller. It is specially designed to run the motor which is used in our project. This controller can run with 48 or 60 volts depending upon the given input. Its operating current is 90 ampere. Unlike other controller it has also protection classes. This has IP 33 protection class. This controller has operating temperature between -20 to 80 degree centigrade.

Unlike its predecessors it does not feature separate drive circuit's supply and ground pins, brake input, or fault output signal. Include in the MC33033 are protective feature consisting of under voltage lockout, cycle-by-cycle current limiting with a selectable time delayed latched shutdown mode, and internal thermal shutdown. Typical motor control features include run enable, forward or reverse direction, and open loop speed.The over and under operating temperature is 68 and 42 volts respectively. The HY3408AP is designed to operate brushless motors with electrical sensor phasing of 120°/240°, and can also efficiently control dc motors.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 1151-1155 www.ijaem.net ISSN: 2395-5252

c. Solar Panel

FIG.4 Solar Panel

Here the PV module is used for charging the vehicle on running mode from sunlight. Here we use Polycrystalline solar cells. In general, polycrystalline solar panels are less efficient than monocrystalline ones. In addition, polycrystalline solar panels tend to have a blue hue instead of the black hue of mono crystalline panels. Polycrystalline solar panels are also made from silicon. However, instead of using a single crystal of silicon, manufacturers melt many fragments of silicon together to form the wafers for the panel. Polycrystalline solar panels are also referred to as "multi-crystalline" or many-crystal silicon. Because there are many crystals in each cell, there is to less freedom for the electrons to move. As a result of polycrystalline, solar panels have lower efficiency ratings than mono crystalline panels, but their advantage is a lower price point. Polycrystalline solar panels tend to have slightly lower heat tolerance than mono crystalline solar panels. Polycrystalline solar panels will tend to have a higher temperature co-efficient than solar modules made with mono cells. As a result, this type of cell's output will decrease less as the temperature rises.However, in practice these differences are very minor.

d. Differential Assembly

FIG.5 Differential Assembly

When the vehicle is travelling straight, the drive pinion will screen the rear axle's wheels through the differential case's ring gear, wheel-wheel gear pinion shaft, and wheelpinion gears while the side gear teeth continue to be drawn into the ring gear's rotation even though they are not spinning. As a result, the wheel spins both left and right. At the time of vehicle turning left prisoners left wheel is bigger than the right wheel. If the differential case with the ring gear rotates, the pinion will also rotate on its axis and the movement around the left side gear will also increase. This causes the movement around the right side gear, which has two times as many revolutions as the ring gear, to increase. It can be said that the rotary ring gear and the typical second round gear are comparable.

e. Battery pack

FIG.6 Battery pack

The lead acid batteries will store the electrical energy that the solar panels will use to transform solar energy into usable electrical energy, which will then be delivered to the motor as needed.

f. Charging system

Charging system of the battery basically consists of a two way charging process. One is charging by solar panel using a solar retrofit (it converts the solar heat energy to electrical energy) and the second is direct charging. Our charging system consist of a step down transformer that converts the power to three voltages using voltage regulator the three output voltages are 48v, 50v,and 52v. The output voltage is dc but the input is ac so a rectifier is used to convert the AC current to DC current.

VI. PERFORMANCE STUDY

Once all of the drive motor's connections have been made, both the input (power supply) and Output (transmission system) ends, routine checks of the lubrication and braking systems were carried out. The car was then tested after being properly modified and restored.Initially, it was detected that the vehicle could run only in first and reverse gears. The motor circuit tripped due to unusual heating of the connecting wires. Subsequently, the 10mm2 connecting wires were replaced with 16mm2 wires to rectify the problem.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 1151-1155 www.ijaem.net ISSN: 2395-5252

- The use of adapter plate preferred over the chain drive enhanced the transmission efficiency of the car and it was found able to carry 5 persons including the driver.
- In first gear the recorded speed is 15kmph while moving uphill and speed increased to 20kmph while moving downhill.
- In the second gear the vehicle speed reached up to 30kmph.
- In third gear it achieved 40kmph.
- In fourth gear it reached up to 50kmph.
- In the fifth (final) gear average speed recorded was 55 kmph.

With fully charged batteries, the car can travel at a top speed of 60 kmph. The mileage of the vehicle is around 45-50 Km. per charge 4 numbers of batteries each of 12V and 100 Amp are connected in series so that the voltage of the system increased instead of current. The custom made charger used can give output voltages of 48, 50 and 52 Volts but current of 50 Amp. Hence, time required to charge the 1st battery (100 Ah) of the pack will be 1 hour. So, all the 4 batteries of the pack can be charged fully in 4 to 5 hours approximately through regular power supply. This implies that the vehicle can be charged overnight and kept ready for the next day. In addition, solar panels have been used to replenish charge of the battery pack while the car is running or parked during daytime. 4 numbers of 75W and 12V solar panels have been provided for back up. Time taken to charge all the batteries of the pack through solar panels alone is estimated to be today

VII. CONCLUSION

In order to deal with the increasing demands for fuel and therefore the disastrous environment pollution thanks to driving carbon-based vehicles, it's quite necessary to modify to a replacement source of energy, i.e. the solar energy which might be an inexpensive , efficient, limitless and in fact an eco-friendly alternative. Without hot exhaust systems or volatile fuel, solar vehicles are safe. They are eco-friendly vehicles, odorless, smokeless and noiseless. They require less maintenance, and more reliable with little or no moving parts and may be efficiently charged nearly anywhere. Needless to mention it's considerably cost efficient.

REFERENCES

[1]. M.V.Ramesh , G.Vijay Kumar , G.Diwakar all proposed “Design And Fabrication Of Solar Electrical Vehicle System” - International Journal of Scientific & Engineering Research - June-2017.

[2]. Sasikumar C, Aswath C, Surendrakumar K, Suryaprakash A all proposed “Design and Fabrication of a Solar Car” - IJRTE - Nove 2018

[3]. V.Naveen Prabhu, N.Manigandan allproposed “Design and Fabrication of Solar Transport Vehicle” - IOSR Journal of Mechanical and Civil Engineering -

[4]. Rishabh.S.Khobragade, Swapnil.K.Mandawkar, Kalpak.A.Mahajan, Jay.S.Takalkhede all proposed “Design And Fabrication Of Electric Solar Vehicle” – IRJET - Sep 2018

[5]. Mr. V. Prabakaran Assistant professor, Sreenithi.R.M, Suresh.G, Tamilmani.R, Tamil Selvan.V all proposed “Design And Fabrication Of Solar Tricycle For Physically Challenged Persons” - International Journal For Research In Mechanical & Civil Engineering - April 2017

[6]. Harin M Moha , Akash M Nair , Akhil B Chandran , Anuraj P , Aromal B Chandran all propose “Solar Powered Plug-in Electric Vehicle” - IJERT - May 2019