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Electric Vehicle with Multiple Sources

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ABSTRACT: Electric vehicles (EV) are mushrooming globally to reduce the consumption of petroleum products and to avoid toxic gases. Anyhow existence of some drawbacks in EV, people are hesitating to buy and use EV, like Unavailability of battery charging stations in the high way, heating of battery during long travel and inadequate starting torque particularly in up-hilling or acceleration after a break is applied when riding in up-hills. The Efficacy of Electric vehicle can be enhanced by using more than one renewable source. This will enhance the vehicle run time (Range) also. The multiple sources will also enhance the starting torque which is a common problem in the electric vehicle. It Reduce the need of number of refuelling stations in the highways. Therefore the biggest problem in the problem in the Electric vehicle is less reliability among the people about long run and need refuelling stations in the high ways. It needs more initial amount which is not possible by the under developing countries and developing countries. Now this problem is eliminated in the proposed system. The proposed system used Battery and Solar Photo voltaic sources as input to the electric vehicle. Now the energy produce by the solar panel in the day time can be stored in the battery and it can be utilised at any time for long run of the vehicle. Fuel cell can be the other possible source which is not included in the proposed system. The output voltage and power of proposed Battery – Solar PV hybrid system is analysed using MATLAB simulink.

I. INTRODUCTION

Currently, one of the greatest engineering issues to tackle is the need for clean energy sources. Much of the world is highly dependent on natural gases and coal to produce electricity. Although this power source is abundant, it is shown to assist in global warming. Furthermore, extraction methods such as fracking are shown to have detrimental effect on the environment, namely earthquakes. One source of energy being heavily studied is solar energy. Until recently, the efficiency of the solar panels, used in collection of solar energy, was too low for it to be a viable option for replacing energy obtained from fossil fuels.

Advances in materials has paved the way for using solar energy as a renewable resource that is slowly meeting the energy demands that society has become accustomed to. According to the EPA, transportation accounted for 26% of the total Greenhouse Gas emissions in the year 2014 [01 - 05]. For this project, the concept of a solar vehicle will be designed and fabricated. Vehicles have already been modified to run on alternative sources for fuel, so for this project, an urban application solar car will be designed under specifications for the Shell Ecomarathon Urban Concept Battery Electric competition. The project is focused on the design of an electric driven vehicle that can regenerate power using solar energy technology. If this type of vehicle became a standard commercial vehicle, the demand for fuel would decrease substantially. Designing this vehicle for practicality is the primary difficulty. The vehicle must be lightweight to minimize the size of the motor required to withstand urban transport needs. The vehicle is being designed to house one driver; practically, there would be need for additional space for other passengers and materials [06-08].

Another consideration in the use of solar energy to power a vehicle is that the solar panel must be efficient enough to generate enough power for propulsion in a reasonable amount of time. This leads to a variety of decisions that must be considered during the design process. Both mechanical and electrical engineering considerations must be taken into account for the project. Components must be suitable for the application of the urban concept division of the Shell Eco-marathon. Components will be purchased and manufactured from raw materials to suit the application. Some components will need to be machined to specifications due to the abnormal size of the vehicle. Decisions will be made based on monetary constraints and fabrication feasibility [09-12].

All-electric vehicles (EVs) run on electricity only. They are propelled by one or more electric motors powered by rechargeable battery packs. EVs have several advantages over conventional vehicles:

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1.1 Various Benefits of EV

Energy efficient. EVs convert over 77% of electrical energy from the grid to power at the wheels. Conventional gasoline vehicles only convert about 12% to 30% of the energy stored in gasoline to power at the wheels.
Environmentally friendly. EVs emit no tailpipe pollutants, although the power plant producing the electricity may emit them. Electricity from nuclear-, hydro-, solar-, or wind-powered plants causes no air pollutants.
Performance benefits. Electric motors provide quiet, smooth operation and stronger acceleration and require less maintenance than internal combustion engines (ICEs).
Reduced energy dependence. Electricity is a domestic energy source.
Driving range. EVs have a shorter driving range than most conventional vehicles—although EV driving ranges are improving. Most EVs can travel more than 100 miles on a charge, and some can travel in excess of 200 or 300 miles depending on the model.
Recharge time. Fully recharging the battery pack can take 3 to 12 hours. Even a "fast charge" to 80% capacity can take 30 min [13 – 15].

1.2 Battery Performance

The battery serves to store electrical energy from solar panels when generated during the day and is used at night or when solar panels do not generate electrical energy. The battery will charge or discharge depending on the sun that will be produced solar module. Within international standards each accumulator cell has a voltage of 2 volts. So the battery is 12 volts, has 6 cells while the 24 volt battery has 12 cells. The battery storage system is made of several low voltage or power batteries connected in series or parallel according to the characteristics of the power to be achieved. The battery undergoes a charging process when the electrical condition of the chemical reaction is below the specified terminal level and delivers electrical energy (discharging) when the energy is fully charged. The required battery capacity can be determined by the following equation : Battery capacity = Daily Energy Battery Voltage (3) Battery capacity is calculated by considering the losses and depth of discharge of the battery according to the type of battery used [16-18].

II. PROPOSED SYSTEM

The MATLAB/SIMULINK is used to develop a self-driven simulation model for solar PV based vehicle, to endorse the faces of diverse components along with the competency of estimating its inclusive performance in a responsive simulation environment. The main objective of this project is to simulate the performance of solar PV based electric vehicle using MATLAB/SIMULINK. The important components are PV panel, Battery and PMBLDC motor. The important components of the vehicle are modeled and its performance is analyzed. In this model, a Buck-Boost converter using IGBT have been designed such that the output voltage increases to the specified voltage in order to charge the battery. Additionally, a Voltage source inverter designed to supply power the BLDC motor, under a closed loop operation with the help of Hall sensors. Thus, simulation results of this model are analyzed.
A solar PV cell is a device that directly transforms solar energy to electrical energy by the photovoltaic effect, it defines an electrical characteristics such as current and voltage fluctuate when it exposed to light. The solar cell equivalent circuit is shown in fig.1 and describes the current drawn from the solar cell.

1.2 BLOCK DIAGRAM

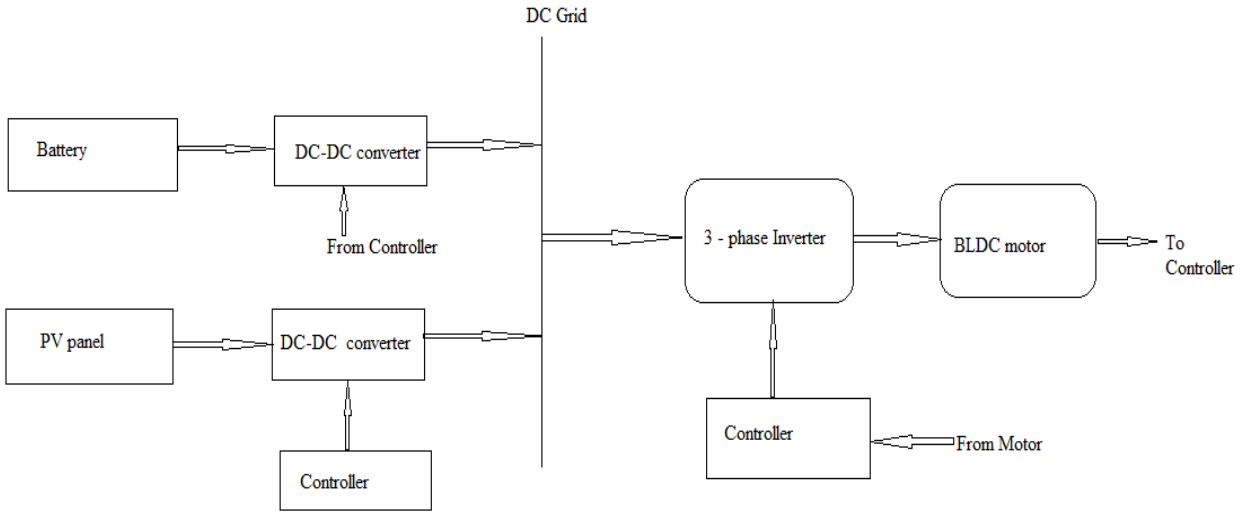

Fig 2 Block Diagram

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The proposed hybrid electric consist of two renewable sources; 1. Battery, 2. Solar panel. Both sources are connected to the dc grid or bus to maintain constant dc voltage and then it is given to a 3 – phase voltage source inverter. The VSI will convert the given dc in to ac and it operates BLDC motor. The PI controller used to tune the 3 phase VSI by giving the gate signal at right time. The block diagram of the proposed system is illustrated in figure 2.
Generally hybrid system is used to increase the run time of the electric vehicle and avoids the need of I.C engine requirement. By this way the pollution occurring due to the fossil fuel such as petrol and Diesel can be reduced. It also reduces the requirement of refueling station which is very tough task to erect in the high ways. It increases the reliability of the electric vehicle among the public.

2.2 CIRCUIT DIAGRAM

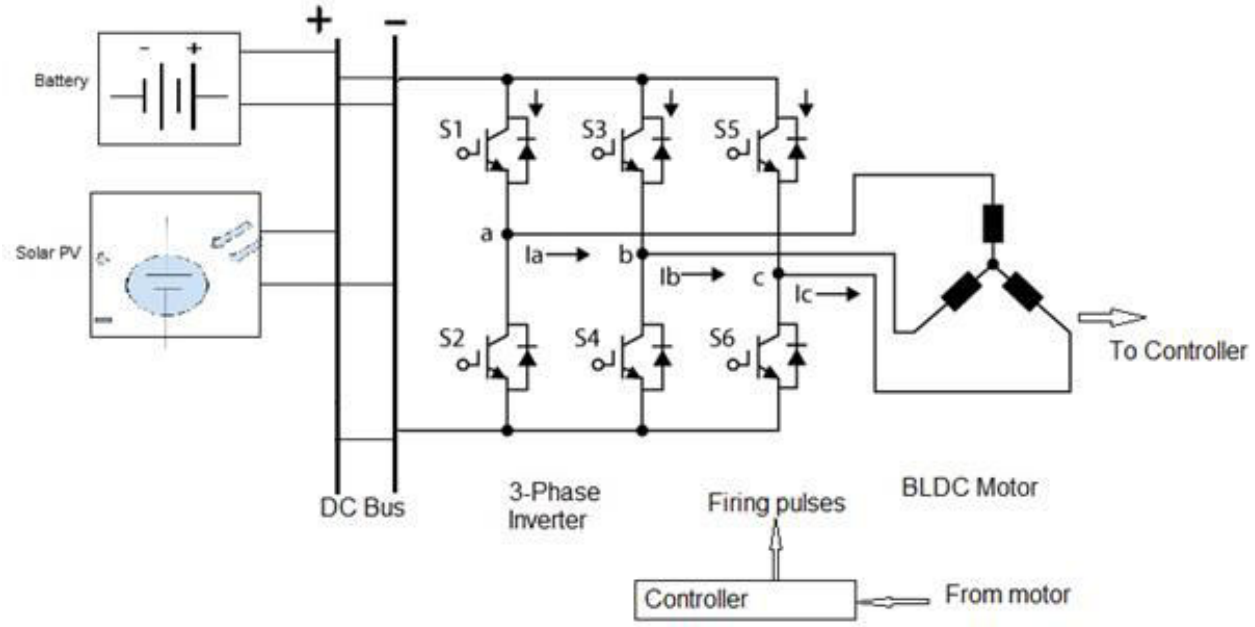

Fig 3 Circuit Diagram

Two renewable sources Batter and Solar PV are energise the dc bus and from the dc bus the 3 phase ac voltage is given to the BLDC motor through 3 phase inverter. The output voltage and current are taken and given to the controller as feedback. The inverter can be maintained constant output voltage across the motor due to the feedback signal. PI controller is used to give the firing pulse to the inverter. The PI controllers are very effective controller to tune the inverter as the output requirement. Solar power is used to energise the dc bus as well as the battery. The three phase voltage source inverter is used to supply the BLDC motor. Hence the inverter is connected in the dc bus, the source voltage is always constant. Therefore need not to connect capacitor to maintain constant input voltage. The constant dc voltage from the dc bus can operate the 3 phase inverter effective to run the BLDC motor. The variation in the voltage is sensed by the voltage sensor send it to controller to vary the firing pulse and to maintain constant output voltage across the motor. The circuit diagram of the proposed system is shown in figure 3.

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III. SIMULATION DIAGRAM

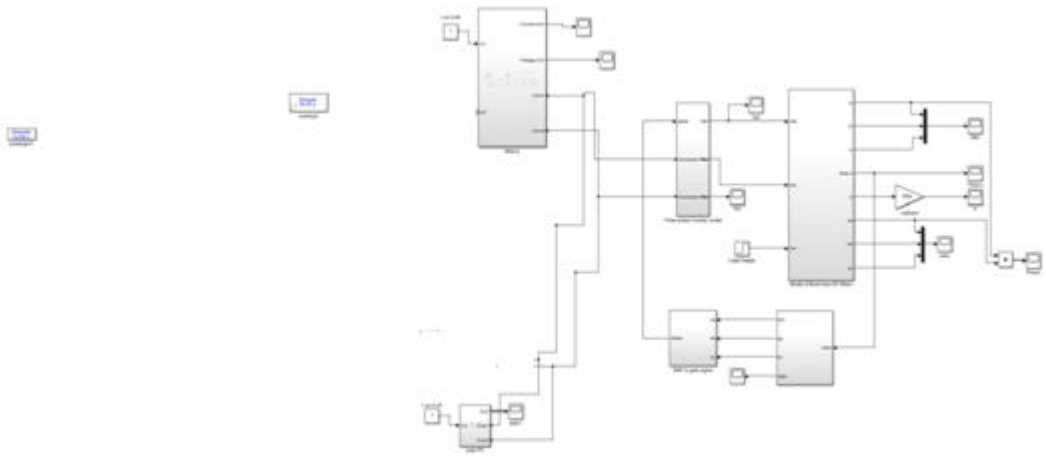

Fig 4 Simu-link diagram

The simulink diagram is shown in fig 4.

1.3 OUTPUT VOLTAGE WAVEFORM WITH BATTERY

The output voltage wave form with battery source alone is shown in figure 5.

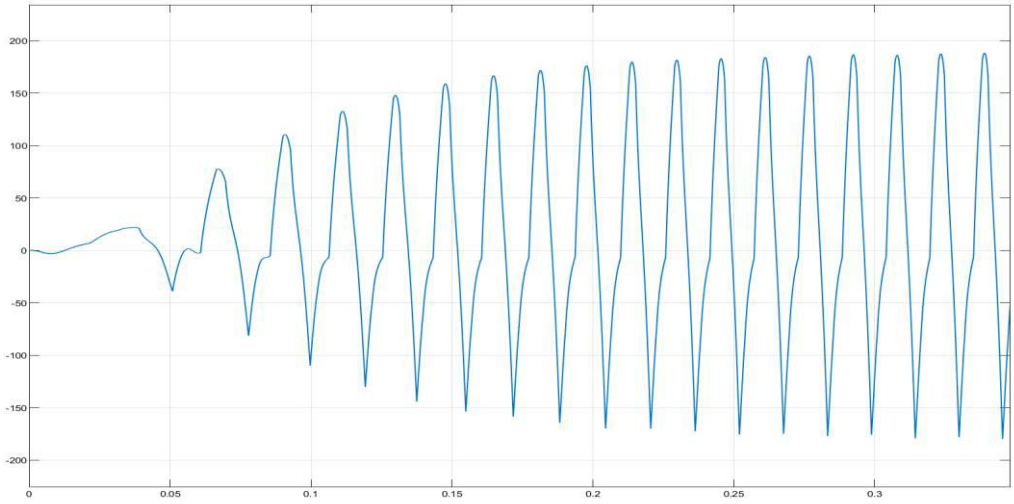

Fig 5 Output voltage waveform with battery

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OUTPUT VOLTAGE WAVEFORM WITH BATTERY& SPV

The output voltage wave form with battery source and Solar PV is shown in figure 6.

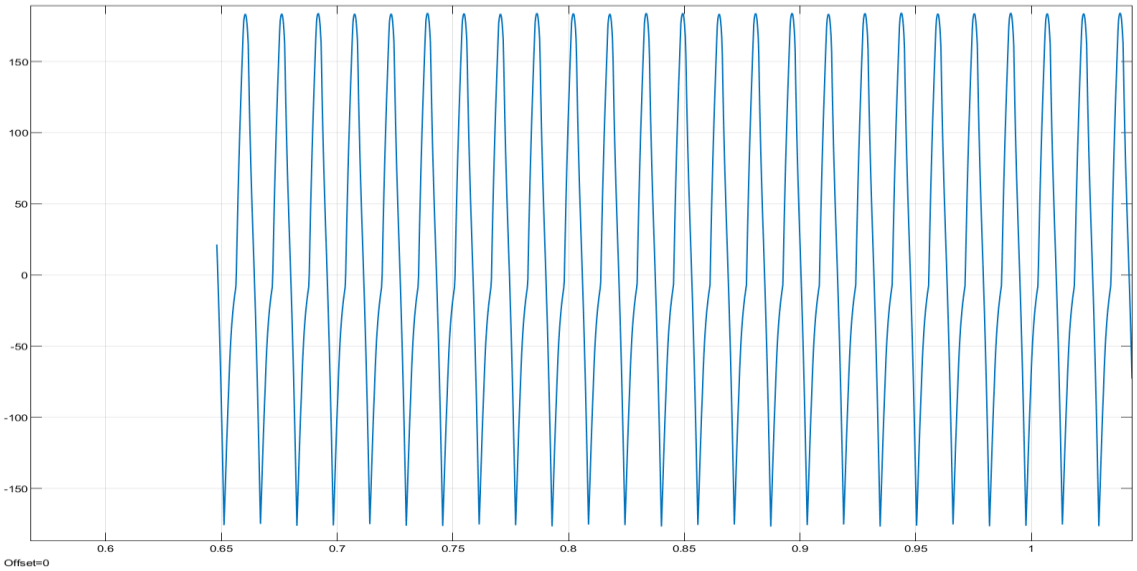

Fig 6 Output voltage waveform with battery& spv

OUTPUT POWER WAVEFORM WITH BATTERY

The output power wave form of the proposed system with battery source alone is shown in figure 7.

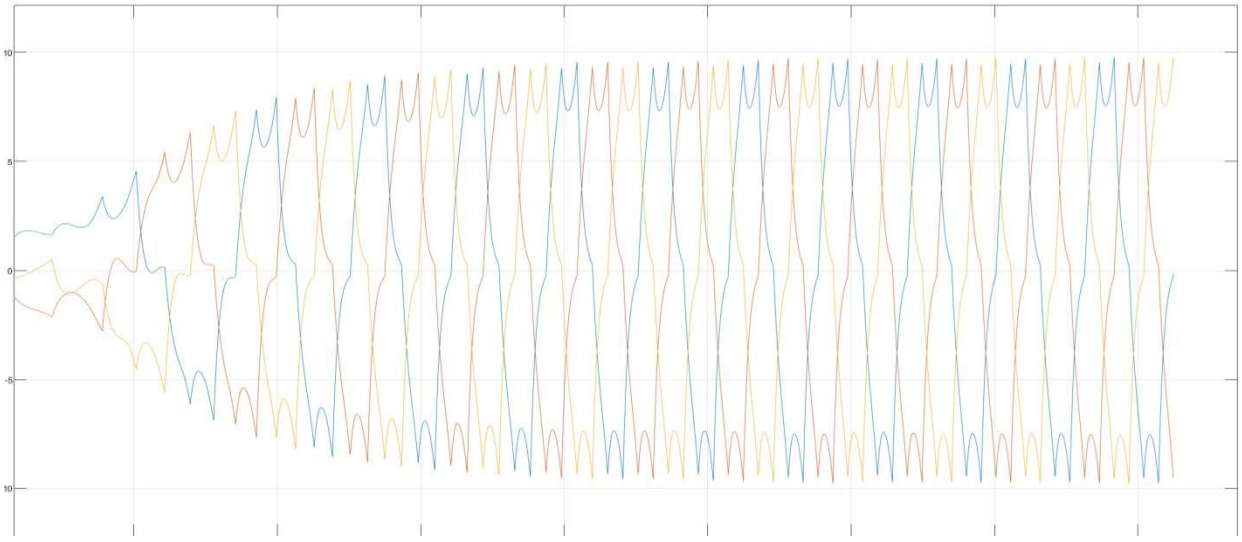

Fig 7 Output power waveform with battery

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4.5 OUTPUT POWER WAVEFORM WITH BATTERY & SPV

The output power wave form for the proposed system with battery source and solar PV is shown in figure 8.

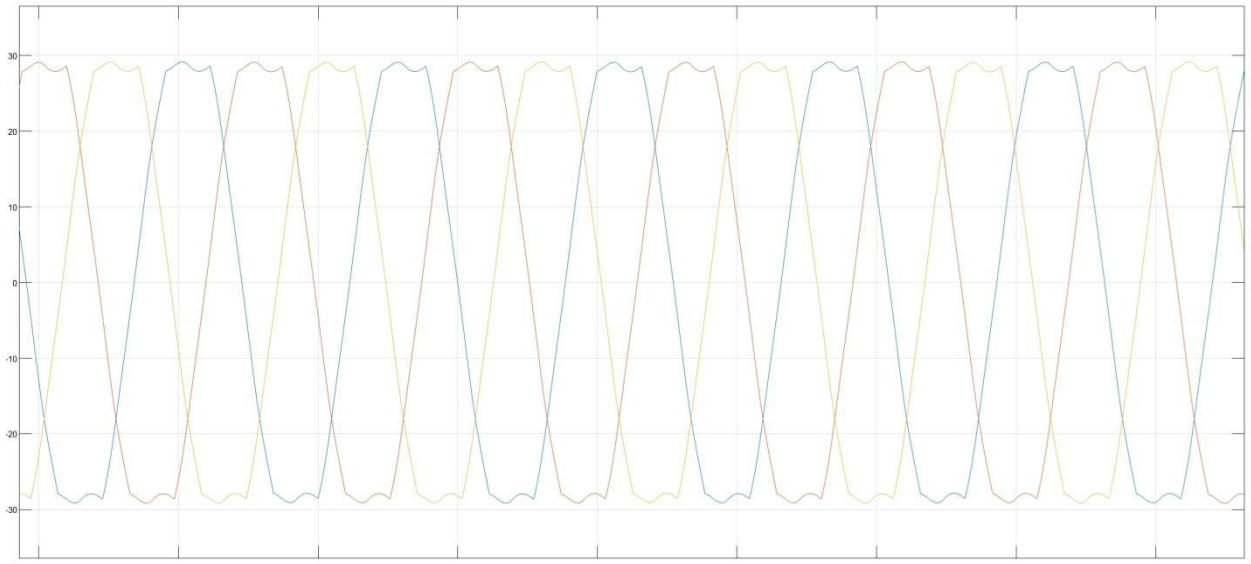

Fig 8 Output power waveform with battery & spv

V. CONCLUSION

The performance of the Electric Vehicle with more number of sources will enhance manifold. In the proposed system, it has a Battery and a SPV (Solar Photo Voltaic) source. The two source given the inverter to get 3 phase output and to drive the BLDC motor. The PI controller is used to maintain constant output across the motor even when load is changed. The feedback system provided with the help of PPI controller used to maintain the output voltage at constant. The Efficacy of Electric vehicle can be enhanced by using more than one renewable source. This will enhance the vehicle run time (Range) also. The multiple sources will also enhance the starting torque which is a common problem in the electric vehicle. It Reduce the need of number of refuelling stations in the highways. Therefore the biggest problem in the problem in the Electric vehicle is less reliability among the people about long run and need refuelling stations in the high ways. It needs more initial amount which is not possible by the under developing countries and developing countries. Now this problem is eliminated in the proposed system.

5.1SCOPE FOR FUTURE WORK

The proposed system can be extended with multiple sources to drive the BLDC motor. Therefore the performance of the EV will increase and reliability of vehicle also increases. Any how this will take more initial amount to implement in the electric vehicle. Anyhow when it is manufacture in massive quantity the price of the vehicle will come down to affordable value even common man can buy.

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