

Improving Performance of Electric Vehicle with a Combination of Renewable Sources and Supercapacitor

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Abstract

The fossil fuels on earth are depleting day by day, and the pollution like air, soil, water, noise etc are increasing by these. The increasing cost of the fuels is also a point of concern. So, the universe is on the way to use mostly the renewable energy for all the purposes of daily need rather than the use of fossil fuels for electricity generation, kitchen, industry and also, for the energy used for transportation. The electric vehicle is thus proposed to overcome the fuel problem. The main challenge of electric vehicle is to charge the storage battery to continue the drive as long as need. At present, charging of the battery bank is done by manual plug-in the vehicle with the electrical power source or by using the solar photovoltaic (PV) cells [2]. The PV charging serves an important role but the unavailability of solar light for whole day (24 hours) is a big issue. So, this work is a forward step to make the charging more efficient with the combination of wind generator and solar PV cells. Wind generator will give the energy to the storage system when the vehicle is on running state while PV cells do charging when the sun is available.

Keywords: *Electrical vehicles, solar energy, wind energy, supercapacitor*

1. Introduction

Traditional cars are driven by fossil fuel. Although, burning of these fossil fuels causes emissions of harmful gasses like CO, SO. Therefore, the vehicles such as car, bus, train, etc are the basic need of human for its daily need, same for the industrial and corporate world. For the modern society car is an essential component which is facing a very serious challenge of environmental pollution, by which the research of green cars are taking a huge appreciation. As we know the electric vehicle is taking highly initiative in recent years but the short continuous run and long-time of charging, type drawbacks are sending it a step back to taking place of the cars running of fossil fuels. So the renewable energy is great option to take care of this problem [4]. As today the solar cars are on the road and working well by charging the batteries via solar PV cells [2]. But the solar is not available at all the time so this can work only at the time when the sun light is available.

In this paper the improvement in charging of storage is done by the wind generator along with the solar PV cells. This energy is used to generate the electricity and stored in batteries with less cost and no carbon emissions. To improve the characteristics of charging - discharging of batteries, a supercapacitor is used [5]. The solar light is available at day time to charge the battery and the wind generator works when the vehicle is on running state [4]. In this regard, a supercapacitor is used to make battery [1] more effective thereby increasing battery life and has less effect of load fluctuation of motor. It makes the pure electric vehicle to run for a long duration efficiently.

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with the help of battery as storage, which is done in traditional vehicles by the diesel, petrol and gas engine by burning of fossil fuels [1].

In this system the charging of the battery and storage of energy in huge quantity, to make the vehicle working for a long term, is a big issue. So in this paper, combination of the wind generator and solar PV cells has been used to solve this problem. The solar PV cells are working to produce electricity when the sun light is available. But when the sun is unavailable to the solar PV cells then the charging is stopped and due to this the battery will supply the power till storage. So we have added the wind generator to this system which works when the vehicle is moving than by the force of air the fans of wind turbine rotates and generator start working to produce electricity and the charging of the battery continues [3]. To increase the life of battery and make the charging better and reduce the fluctuation of the load and charging, which affect the battery storage and life, here we use supercapacitor [1,5].

2. Solar-Wind Generating System with Supercapacitor in Pure Electric Vehicle

Solar and wind power is the most available and free to generate the electricity without any pollution. These days whole universe is trying to catch this energy in a huge quantity for generation of electricity. In the pure electric vehicle the most important thing is that it do not need any internal combustion of fossil fuel for the energy so it can called green vehicle because of zero pollution [2]. The combination of solar and wind for generation of electrical energy is used in all over the word. Now we are trying it with the vehicles to charge the battery (storage) to continue the charging and nonstop performance.

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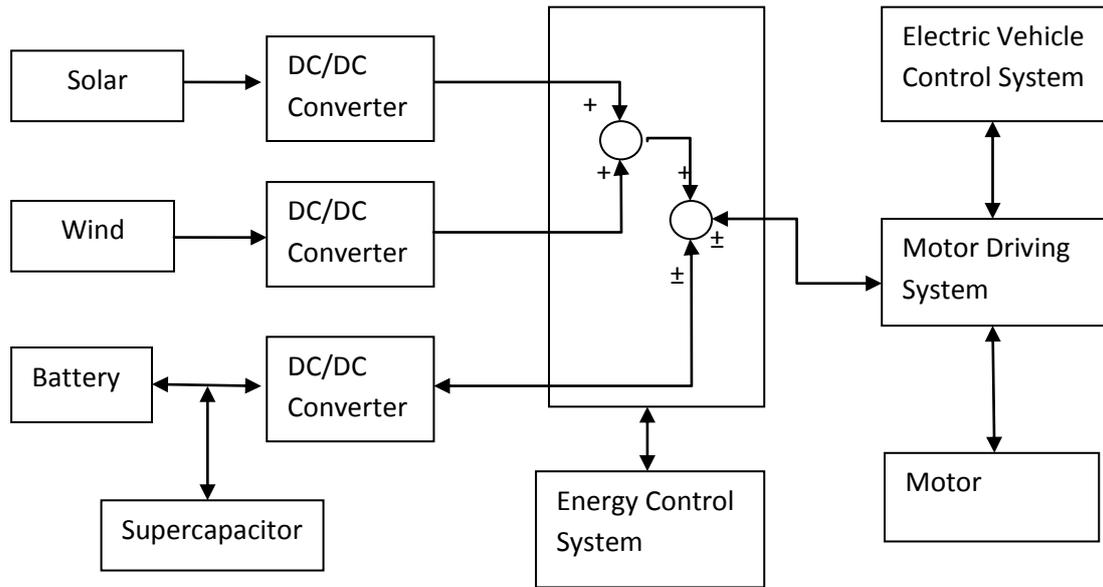


Figure 1. Block Diagram of the Electrical Vehicle with Combination of Wind Generator and Solar PV Cell Using Supercapacitor

3. Results and Discussion

To meet the requirement of power from the non-conventional or renewable sources the design of system is done as per Figure 1 above and hence selection of PV system and wind system is done to meet the supply requirement.

3.1. Photovoltaic (PV) System

The system we used in this model has specifications:

Area used	6.25 m ²
Number of Panels	4 (shunt connected)
Cells each panel	60

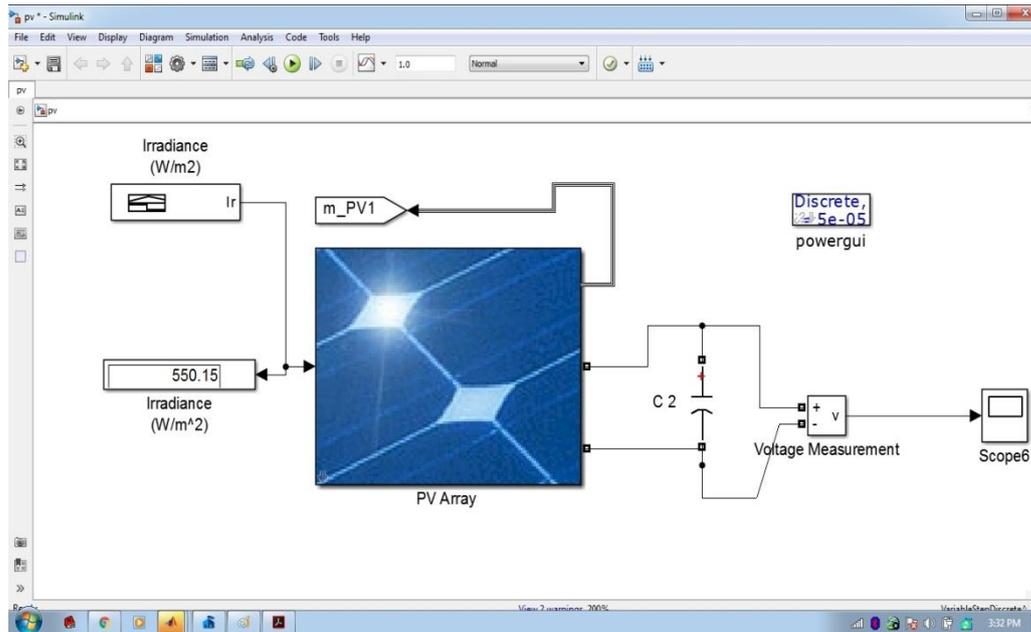


Figure 2. Solar Power System

The designed solar system as shown in Figure 2 gives the performance which remains same for constant solar condition. Solar system is a combination of PV module to generate the dc power from solar radiation [6]. The characteristic shown in Figure 3 represents the performance of solar system in term of current and power.

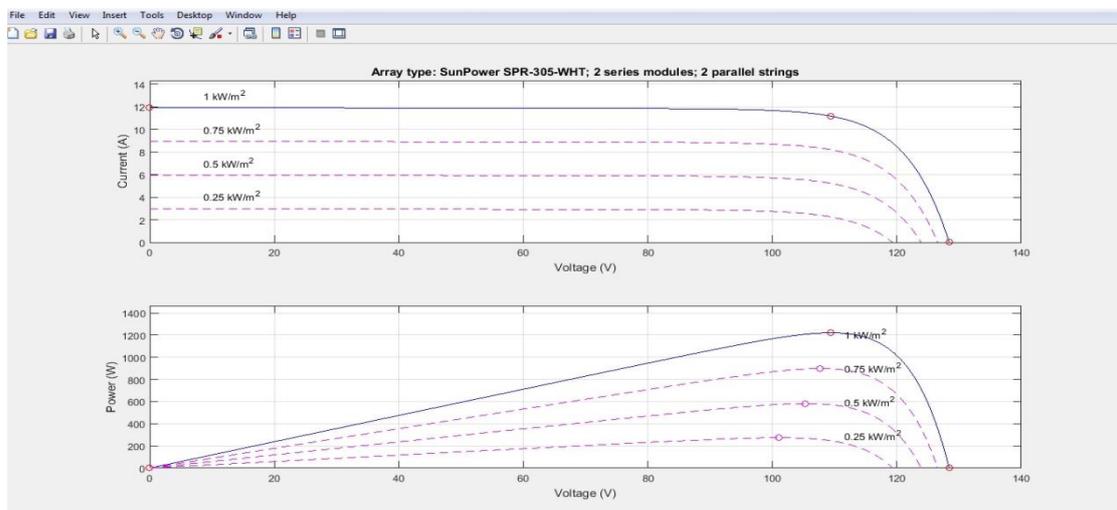


Figure 3. Current and Power Characteristic of Solar System

Characteristic shows that the current value remains constant up voltage 110 Volt and decreases to zero if further increase in voltage but power value inverses to 110 volt and again decreases to zero for further increase in voltage.

Output Characteristic: Solar output characteristic is represented in term of power. Power depends on factor like solar condition.

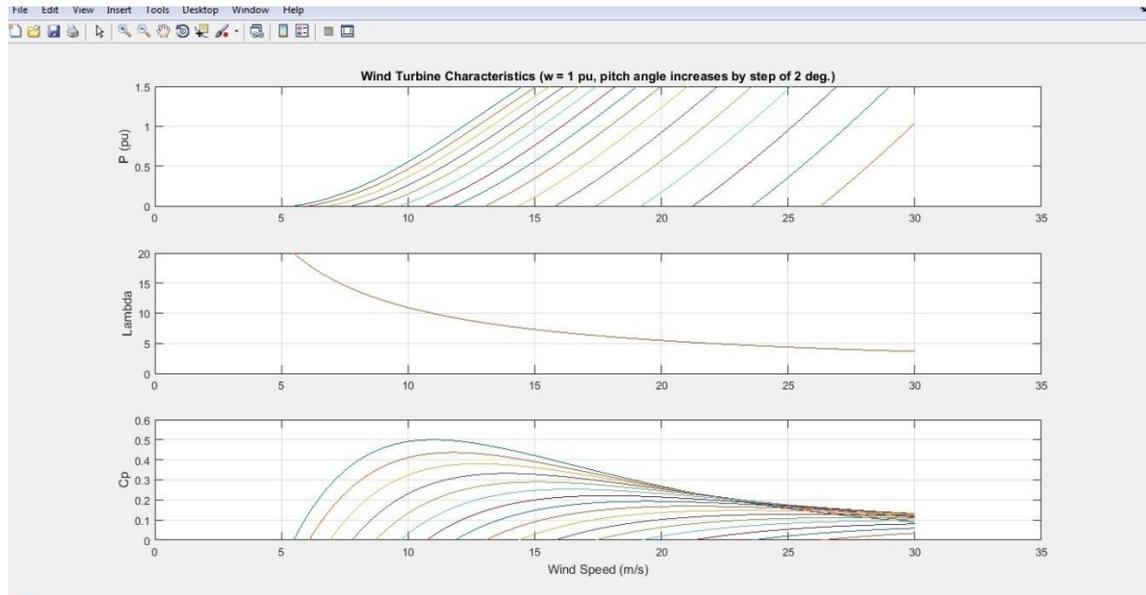


Figure 6. Wind Power Output in Relation with the Wind Speed

Figure 6 shows that as wind speed increase, the power output also increases. It is also shown that below the minimum speed the power output is zero. Output power of wind system is a function of wind and varies as per the condition of operation.

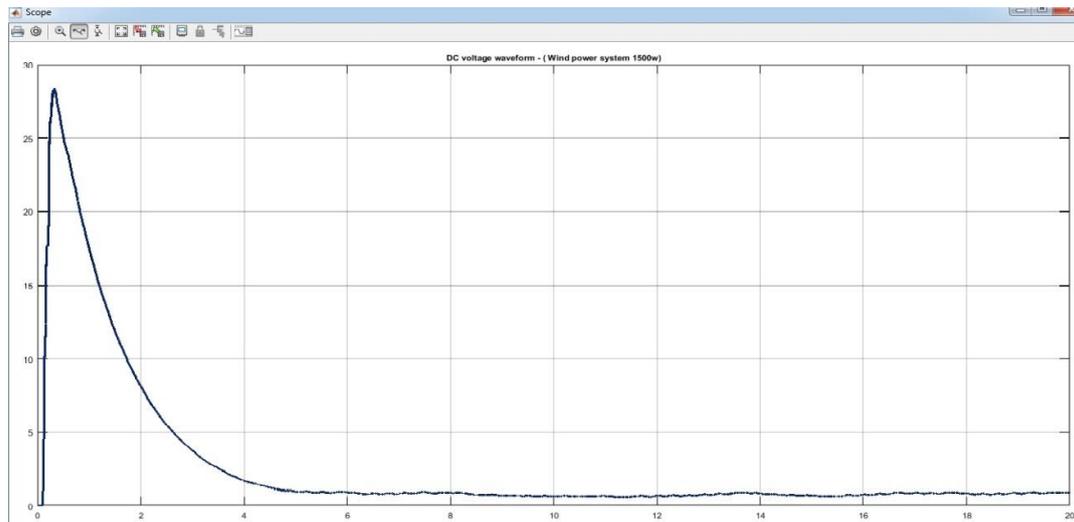


Figure 7. DC Voltage Waveform

Characteristic as shown in Figure 7 presents that the power generation is rapid if the wind is optimum and turbine is able to meet the load in small time.

Total Output (solar and wind): The combined effect of solar and wind systems are used to drive load and is a renewable solution of power demand. Under the normal condition both solar and wind, the power output obtained is constant which provide good operating condition to drive the circuit.

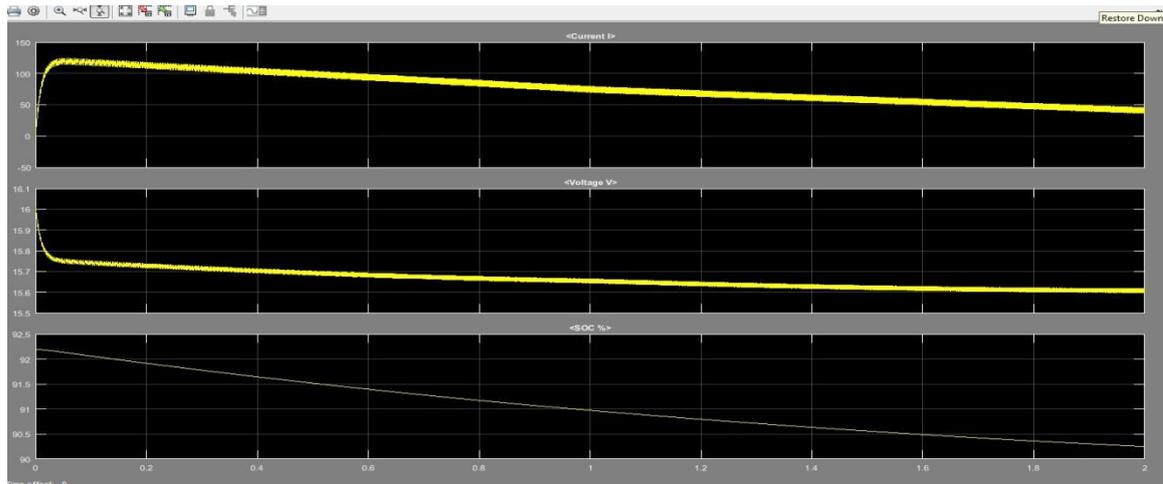


Figure 10. Operating Characteristic of Supercapacitor

Current value of super capacitor is increases rapidly as shown if characteristic when connected to source and its discharging is also good enough to drive the load circuit. Voltage of the system reduces at the instant of which its charging and reduces slowly as the discharging is taking place as shown in Figure 10.

3.4. Comparison of Total Power Output and Required Power

Supercapacitor is use as its charging is quick as compared to normal capacitor and normal battery system and its operation is also satisfies the requirement of drive circuit.

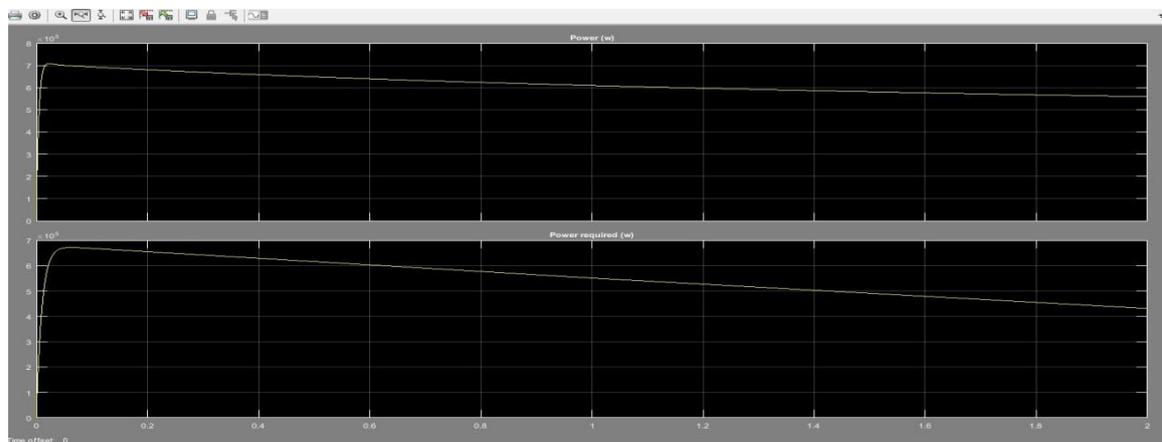


Figure 11. Total Output With Respect to Demand

Figure shows the demand of a drive circuit and the output of the supercapacitor. It can be seen from characteristic that Supercapacitor output is more than the requirement every point of operation.

The waveform shows the output power of the combined system of battery and the Supercapacitor and the total power required to the electrical vehicle. The output power of the combined system of battery and the Supercapacitor fulfill the required power.

4. Conclusion

Electric vehicles fill a perfect specialty in the urban commute car market, it is the best where the extent is short and the requirement for non-polluting cars. It demonstrated that Electric Vehicle can be effortlessly fabricated in anyplace. General this anticipates is a delineation that Electric Vehicle can be marketed in any transportation as a solitary person carrier and it can be further stretched out for carrying 3 to 4 persons like a basic car which will be clamor less, free of any upkeep and running expense and environment cordial

In this work, we have modelled the electric vehicle more solid and proficient with the assistance of blend of wind and solar power system, to offer supply to storage on static condition or sun accessibility as well as on running condition through the wind generator, and the mix of battery and supercapacitor, to expand yield power, productivity, storage life, influence of variance and sudden high current on storage system.

At long last, through this work, we are exceptionally certain that in the event that this car can produce monetarily and advanced then it would beat the reliance on normal fuel for transportation which would be extremely gainful for transportation as well as for mankind.

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