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Case Study: Implementing Solar Range Extender to an EV Developed from Maruti 800

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ABSTRACT: Introduction of electric vehicles was a solution to the ever increasing fuel prices and global warming. But limited driving range of the EV is the main hindrance for its non-popularity among the public. Range extenders can be a solution for this problem up to a certain extent. Solar range extenders are eco-friendly and can extend the range of EV using the renewable source of energy from the sun. An MPPT charge controller using P & O algorithm is used along with the solar panel to extract maximum possible power.

KEYWORDS: Range extender, Solar panel, MPPT charge controller.

I.INTRODUCTION

Electric Vehicles are becoming more and more popular day by day because of its advancements in technology. EVs are no less than conventional petrol or diesel vehicles in terms of top speed, power, performance, etc. The only limitation EVs possess is its limited driving range.

Kerala SRTC has once implemented electric buses open for public, but it didn’t gain expected popularity because the maiden trip itself stopped midway as the batteries ran dry.

It happened due to unexpected traffic delay in between, which caused increased use of air conditioner that led to more battery discharge. Thus, the range of an EV is not a static quantity. It is a dynamically varying parameter which depends on the social and environmental factors. Here arises the need of a range extender to cope up with uncertainities.A solar range extender is a good option for the same as it adds the value of using a renewable source of energy. In this paper, it uses a MPPT solar charge controller which helps us to get maximum possible extractable power.

II.DESIGN OF COMPONENTS

The solar range extender consists of a solar panel, a MPPT charge controller which also provides the over voltage protection and the battery of the vehicle. The block diagram of the same is as shown in fig.1.

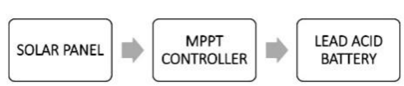

Fig.1. Block diagram of a solar range extender.

Maruti 800 model was taken as the host vehicle and it was converted to EV. Considering the available roof top area, the rating of the solar panel was selected as 200W.

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Four numbers of lead acid battery rated at 12V, 100Ah was used as the battery. A boost converter was used to boost up the solar panel voltage to match up with the battery voltage. The switching frequency of the MOSFET was set at 10kHz. Inductor used had an inductance of 1.1mH and the capacitance of the capacitor was 225.6μF. These values were selected considering the solar panel voltage as 35.6V and the battery voltage as 48V.

III.MATLAB SIMULATION

The solar panel voltage and current was measured and MPPT algorithm was implemented. Perterb and Observe algorithm was used due to its simplicity. Duty ratio is determined after performing this algorithm and is given as the gate pulse to the mosfet. Fig. 2 shows the simulation of battery charging.

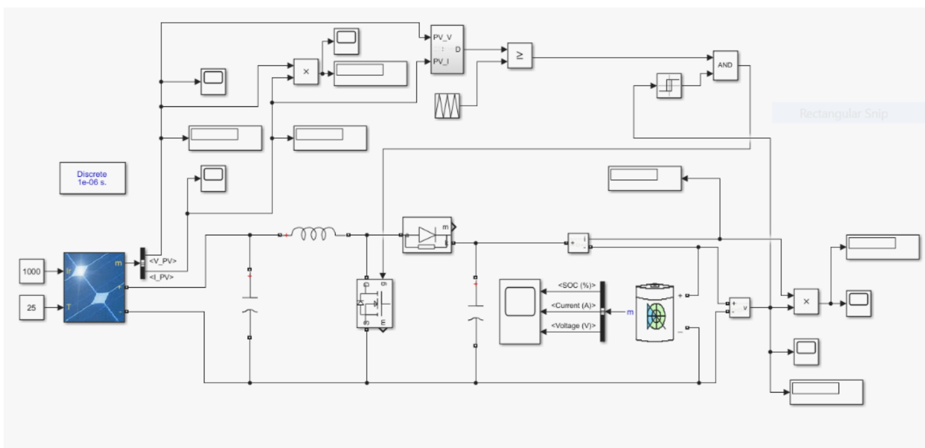
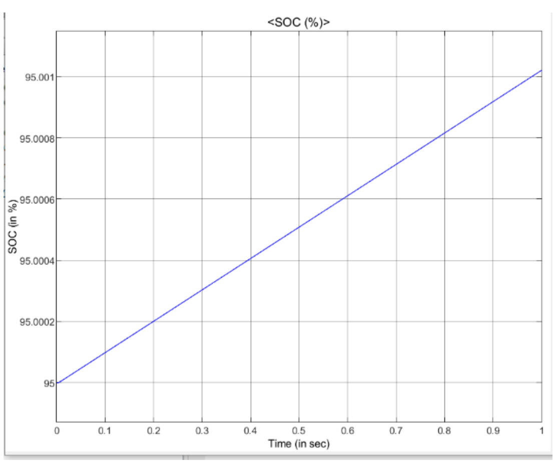


Fig. 2. MATLAB Simulation of battery charging.

The solar irradiance is taken as 1000W/m^2 and temperature as 25°C. The scope waveform of state of charge of battery is as shown in Fig. 3 and Fig. 4 respectively. The state of charge of battery increases from 95% to 95.001% in one second and battery voltage is kept at 52V which is the nominal voltage of the battery.



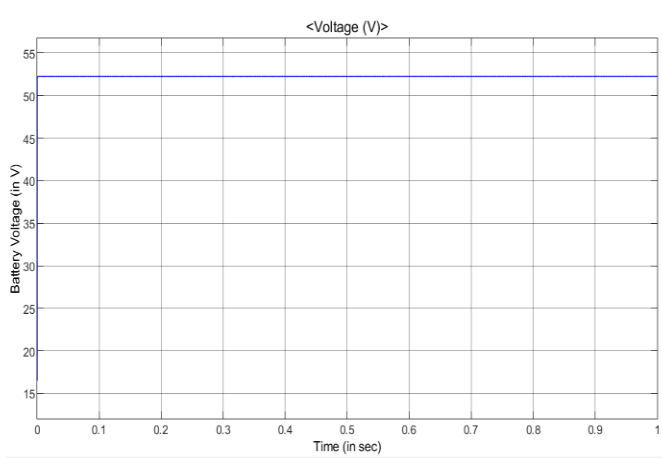


Fig. 3. Scope waveform of state of charge of battery.

Fig. 4. Scope waveform of battery voltage.

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IV.MEASUREMENT OF RANGE EXTENSION

The mass of the vehicle was assumed to be 1000kg and after considering various friction and resistance coefficients it was calculated that the vehicle required 4.5kW BLDC motor. From the simulation we came to know that 25% of the battery will be charged in 7 hours of sunlight.
Battery needs to power 4.5kW load at 48V.

Current drawn by the load = $\frac{4.5\times10^3}{48} = 93.75A$
No. of hours the battery can supply the load = $\frac{100}{93.75}\times\frac{25}{100}$ =0.2667 hrs.
Assume the speed at 50km/hr.
Range extended = 50x0.2667 = 13.335km.

Thus, from the simulation results the range of the EV could be extended further by 13.335km. For vehicles such as an electric rickshaw which requires less power, the range extension could be further more. The efficiency of solar panel may increase in the practical case mainly because of two reasons. The vehicle is moving which provides a cooling effect to the solar panel leading to increased efficiency. Also, the moving vehicle helps in reduced dust accumulation which might increase the efficiency further.

V. CONCLUSION

A petrol vehicle was converted to an EV and a solar range extender was implemented on it. The circuit was simulated in MATLAB and found that 25% of the battery could be charged in one day assuming 7 hours of sunlight per day. The range of the vehicle was found to be extended by more than 13km per day. The implementation of solar panel on an EV could lead to improved efficiency due to cooling effect and reduced dust accumulation. This setup could solve the limited driving range of an EV to a certain extent.

REFERENCES

[1] Y. Raghunandhan and ShivatejaManala, *"*Modelling of DC-DC Converter for Solar based Electric Vehicle*",* International Journal of Applied Engineering Reasearch, *Vol. 13, 2018.*
[2] Debashish Mohapatra, SubhransuPadhee, Jhansirani Jena, "Design of Solar Powered Battery Charger: An Experimental Verification", in IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS), 2018.
[3] Chaitanya Kanumilli, Amit Singh, Akshatha Ganesh, Madhurya Srinivas, "Plug in Electric Solar Vehicle", in *Biennial lnternational Conference on Power and Energy Systems: Towards Sustainable Energy (PESTSE)*, 2016.
[4] Zhancheng Wang, Weimin Li,Yangsheng Xu, "A novel power control strategy of series hybrid electric vehicle," in *Intelligent Robots and Systems, IEEE/RSJ International Conference* on, pp.96-102, 2007.
[5] Jarushi A., Schofield N., "*Modelling and Analysis of Energy Source Combinations for Electric Vehicles*", EVS24, Stavanger, Norway, May 2009.
[6] Md. Rokonuzzaman, Mahmuda Khatun Mishu, Md Hossam-E-Haider and Md. Shamimul Islam, "Design of a MPPT Solar Charge Controller," in *International Conference on Mechanical Engineering and Applied Science*, MIST, Dhaka, 2017.