Dual battery management system with wireless and solar charging

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Problem Statement

Due to the limited charge holding capability of a Lithium ion-battery the conventional plug-type charging methods prove to be less efficient and tiresome also there is always case of the charge of the battery running out and there in no charging stations nearby when the vehicle is on the road

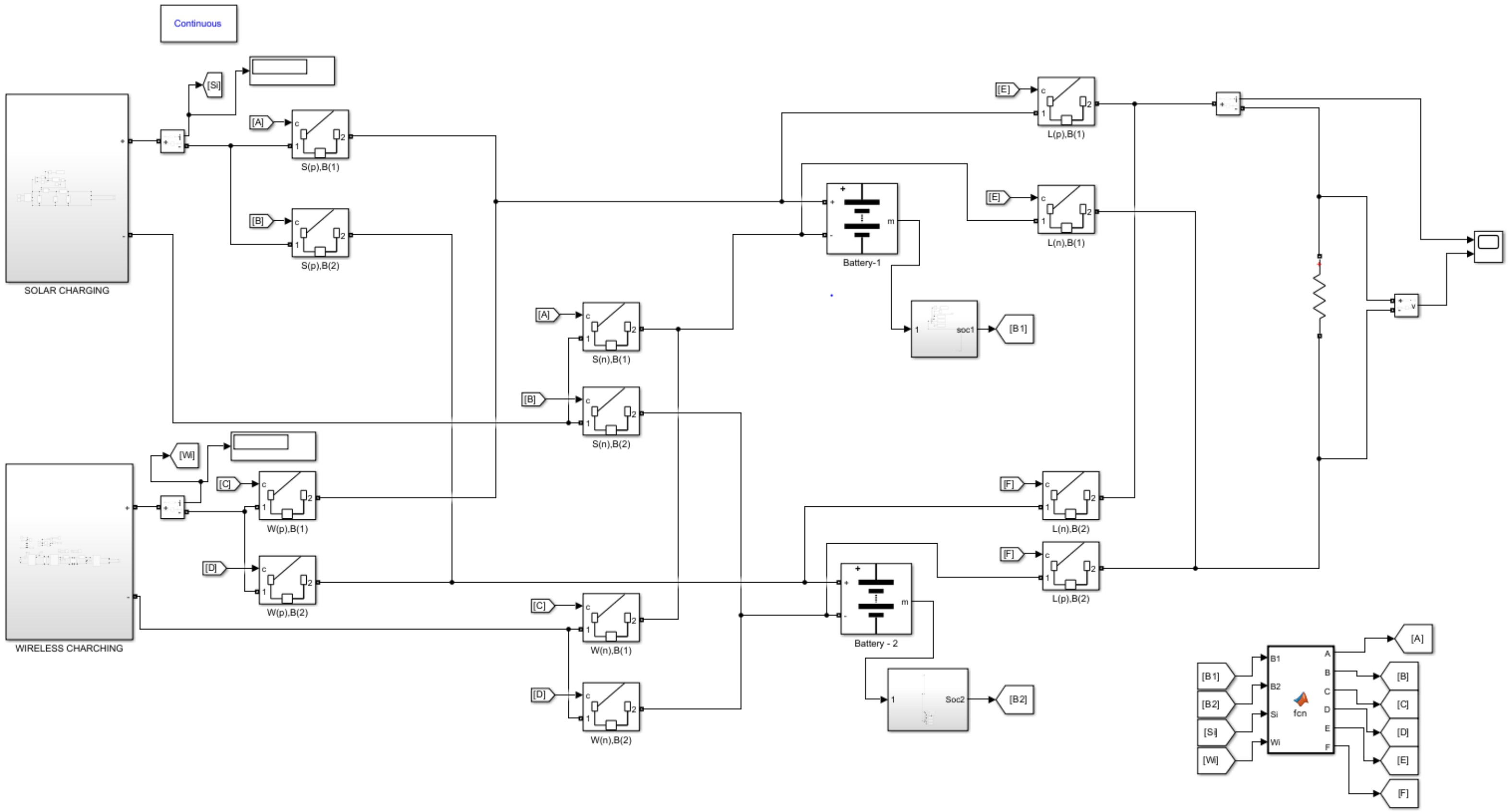
The problem addressed in this project gives us the need for an efficient and reliable battery charging system for electric vehicles. With the increasing popularity of electric vehicles, there is a growing demand for effective charging solutions that are environmentally friendly and cost-effective.

The proposed system aims to achieve efficient solar energy and wireless energy utilization from to operate the grid in a feasible manner such that all the rated output voltage and currents are fed into the vehicle system for convenient working.

Abstract

Electric vehicles have now hit the road worldwide and are slowly growing in numbers. Apart from environmental benefits electric vehicles have also proven helpful in reducing cost of travel by replacing fuel by electricity which is way cheaper. Well here we develop an EV charging system that solves with a unique solution. This EV charging of vehicles without any wires, No need of stop for charging, vehicle charges while moving, Solar power along with wireless charging through underground coils for keeping the charging system going. The system makes use of a solar panel, battery, transformer, regulator circuitry, copper coils, AC to DC converter, mutual inductance coils to develop the system. The system demonstrates how electric vehicles can be charged while moving on the road, eliminating the need to stop for charging. Thus the system demonstrates a solar co-powered wireless charging system for electric vehicles that can be integrated in the road.

Block diagram



Design Specification

Solar panel:

Irradiations-1000 Wb/m2

Temperature-25C

Maximum power-416W

Cells per module-61

Vmp=32V

Imp=613A

Efficiency=95%

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Simulation Studies

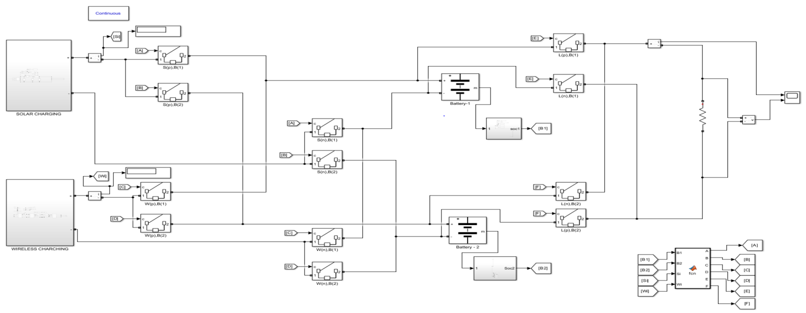

Figure 1 Circuit diagram of the dual battery management system

First there are two subsystems that contains two energy sources that is solar and wireless with two output ports where each of the ports is connected to both Lithium ion battery blocks and the selection of the power source among the two would be decided with respect to the situation if the vehicle is parked in a crowded place that embodies a wireless charging system it would be given the priority or else if it is in motion then the solar charging system would come into play. After the power source has been decided the next phase would be charging and discharging of the batteries. Henceforth the SOC level of the first battery is calculated and the control algorithm coded in MATLAB will decide whether it should be discharged or charged and if the result is determined then the power source would be charging the battery with a lower SOC simultaneously with the other one that is being discharged.

Simulation Studies

```
MATLAB Function
function [A,B,C,D,E,F]= fcn(B1,B2,Si,Wi)

%initializing the breaker conditions
A=0;
B=0;
C=0;
D=0;
E=0;
F=0;

if B1>=5 || B2<=1
    E=1;
    F=0;
    if Si>=Wi
        A=0;
        B=1;
        C=0;
        D=0;
    else
        A=0;
        B=0;
        C=0;
        D=1;
    end
else
    E=0;
    F=1;
    if Si>=Wi
        A=1;
        B=0;
        C=0;
        D=0;
    else
        A=0;
        B=0;
        C=1;
        D=0;
    end
end
```

Figure 2 Code snippet of 1st C-function block controlling the two sources and both the batteries

This the code present in the 1st C-function block checks the SOC levels of both the batteries and if the level of the 1st battery is greater than 5 percent and that of 2nd battery is greater than 1 then the prior would be ready to discharge into the load and the successor would enter charging mode and while taking charging in as the condition another subclass of code comes into picture after we find the one to discharge it smoothly compares the current outputs of both the sources and figures the one with the higher output that will be charging the other battery. Now in the vice-versa condition where the SOC of the 1st battery is less than 5 or the 2nd battery is greater than 1 then the 2nd battery would enter into discharging mode while the 1st one is getting charged

Simulation Studies

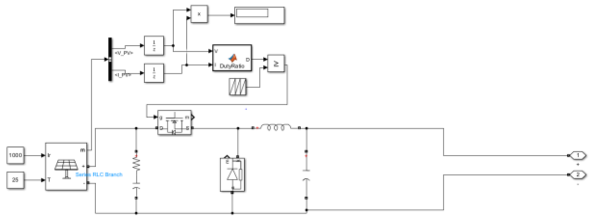

Figure 3 Circuit diagram of the solar power charger

This solar power charger has two input ports which receive the irradiations from the sun and its maximum operating voltage is 32v,rated power is 416W and rated current is 13A and apart from this there is also a MPPT system included which considers the highest power generated at that instance of time and using a PWM generator it sends the required power as the reference to the IGBT which in turn does the switching to allow the current to pass through the circuit so as to ultimately bucking the voltage to 24V.The output power seen is around 380W and efficiency mounting up to 96%

Simulation Studies

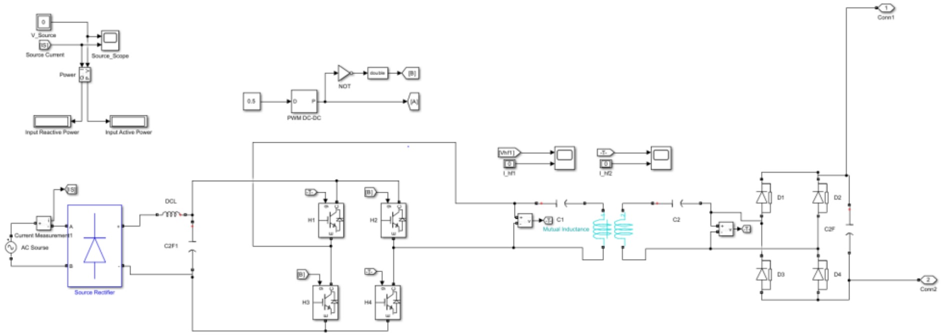

Figure 4. Circuit diagram of the wireless charging system using induction coils

This is the complete circuit of a wireless charging model using the induction coils where first the AC power is pushed through a source which is then passed through a source rectifier which rectifies the AC input to DC and also makes the power factor correction after that the rectified voltage is sent to the inverter such that the DC voltage is converted into a AC voltage of frequency range 80-120 kHz as it is a necessary measure to pass them through the induction coil then again the AC voltage is rectified to DC through a Load rectifier and after which it is ready for deployment

Simulation Studies

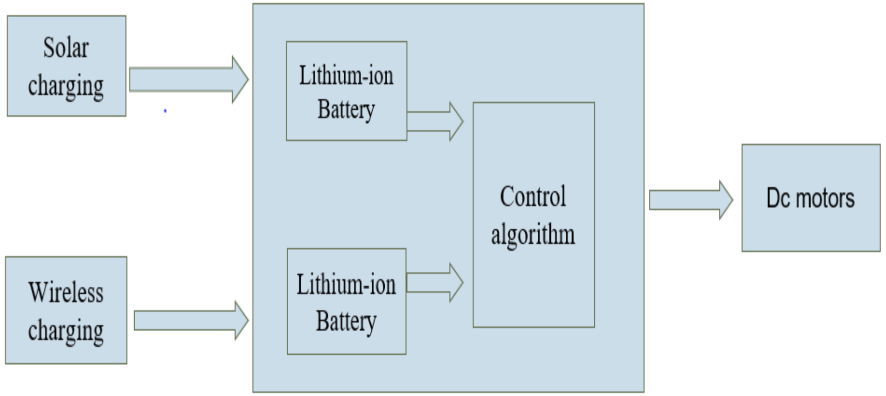

Figure 5.Block diagram of the dual battery management system

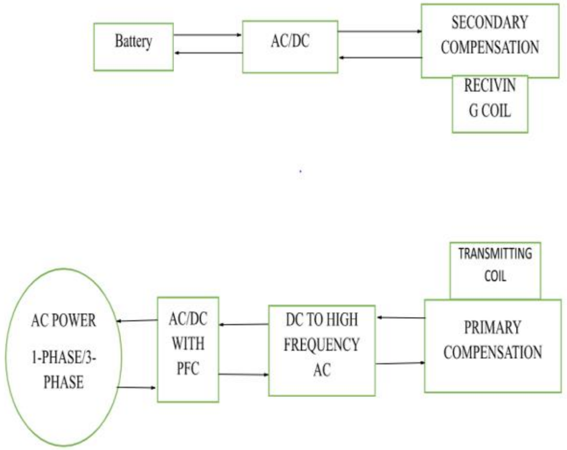

Figure 6.Block diagram of the wireless charging system using induction coils

Experimental Verification :

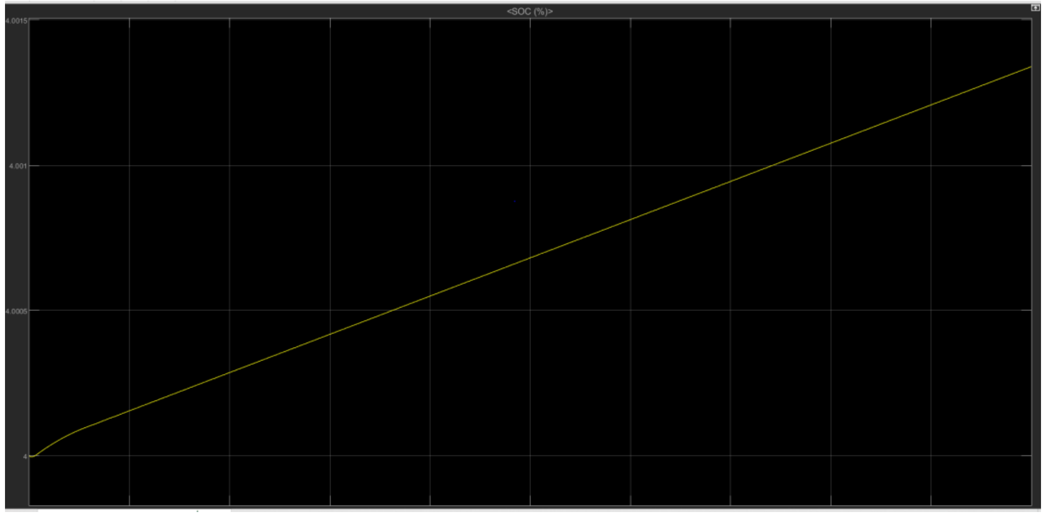

Figure 7.Battery under charging condition

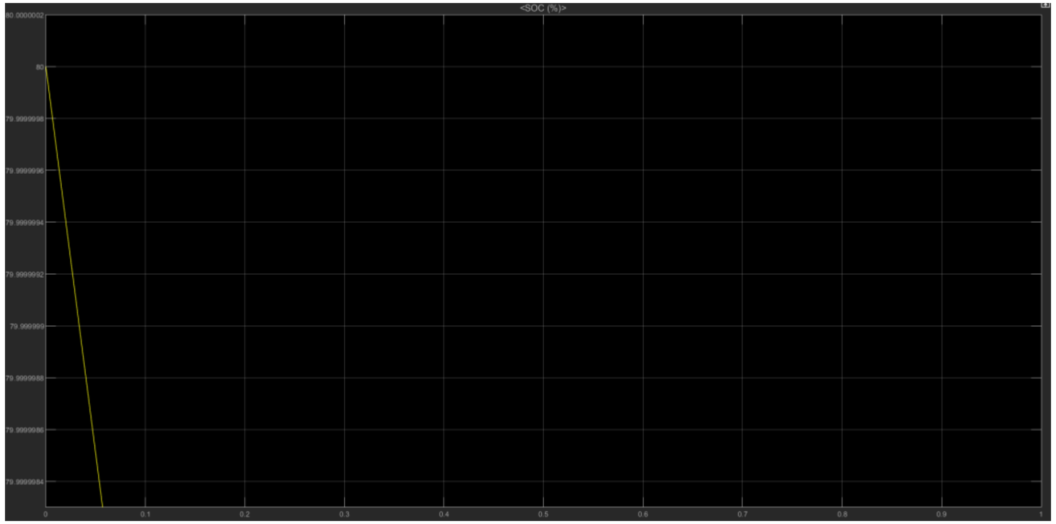

Figure 8.Battery under discharging condition

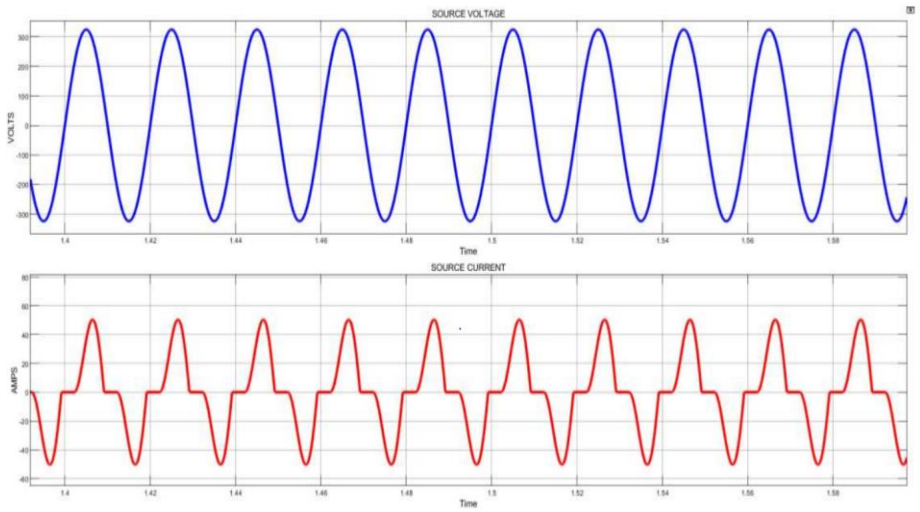

Figure 9.Source voltage and current graph of the wireless charging system

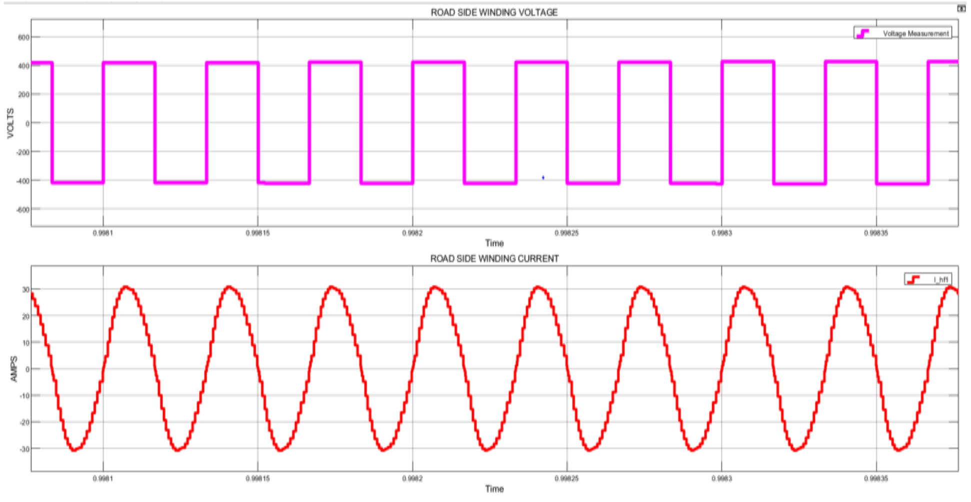

Figure 10.Graphs of road side voltage and current

Conclusion

In conclusion, the design of electric vehicle charging with an intertwined PV and a on-road wireless system has been successfully designed and enforced. The design aimed to give a sustainable and effective result for EV charging by using exercising renewable energy sources and wireless charging methods.

It is obvious that environmental and energy-related challenges make vehicle electrification necessary. Compared to wired charging, wireless charging offers a number of advantages. The basis for EV mass market acceptance, regardless of battery type, will be laid when highways are electrified with wireless charging capabilities and the car getting a in-motion solar power converter replacing the conventional charging stations. The wireless charging of EVs is a possibility as technology advances.

The charging time is reduced, and the cost of charging is minimized and the energy consumption is optimized. In summary, this design demonstrates the eventuality of wireless charging system with renewable energy integration in EV charging systems, leading to a more sustainable and effective future for the transportation assiduity.

References

1) **Overview of batteries and battery management for electric vehicles.**by WeiLiua,TobiasPlackeb,K.T.Chaua

2) **Super-Capacitor based Electric Vehicle Electric Vehicle Charging by** International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 http://www.ijert.orgvol. 10 Issue 05, May-2021.

3) **MUTUAL INDUCTANCE IN WIRELESS CHARGING FOR E-MOBILITY** by International Research Journal of Modernization in Engineering Technology and Science Volume:03/Issue:06/June-2021 Impact Factor- 5.354 www.irjmets.com.

4) **Solar Charger for Electric Vehicles by** 2018 International Conference on Emerging Trends and Innovations In Engineering And Technological Research (ICETIETR) ,11-13 July 2018,**INSPEC Accession Number:** 18249634,**DOI:** 10.1109/ICETIETR.2018.8529129\

5) **Dual Battery Control System of Lead Acid and Lithium Ferro Phosphate with Switching Technique** by *World Electr. Veh. J.* 2021, *12*(1), 4; https://doi.org/10.3390/wevj12010004