



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 8, August 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.118

 9940 572 462

 6381 907 438

 [ijirset@gmail.com](mailto:ijirset@gmail.com)

 [www.ijirset.com](http://www.ijirset.com)

# Smart Battery Management System of Electric Vehicles

Mast. Ruthvik Shetker

Student (PG), Goa College of Engineering, Farmagudi Ponda Goa, India

**ABSTRACT:** there has been severe exponential increase of electric vehicle users in recent couple of years, the people are switching to ev from petrol/diesel engine cars. There could be various reasons behind it like, increase in fuel price rates, awareness about pollution creation by the vehicles etc. As running of ev is way cheaper and because of low maintenance, number of ev is increasing day by day.

But also as the time passes, these ev users faces a serious problem which could challenge their decision of shifting from old engine vehicles to ev. And that problem is arising due to degradation in the quality of the battery used in ev as it ages. Thus to limit this degradation, a battery management system should be used in ev. And in thus paper we will be seeing about the upgraded battery management system which we designed to insure better condition of the batter so to increase its life and also efficiency.

The bms which we designed basically performs various functions like analysing the data, real time inputs, cell balancing, matching with threshold limits and finally giving the output on lcd. Basically, bms ia heart of a device which will be monitoring or observing the real time conditions and provide time to time notification for better efficiency and healthy conditioning of the battery.

**KEYWORDS:** Electric Vehicle (EV), Petrol/diesel engine vehicle, battery, Battery management system (BMS).

## I. INTRODUCTION

As we know, most of the EV uses rechargeable LI-ion batteries because of its various benefits, one of which requires a module system which will keep eye over it for its functioning. that module we used is call as BMS module. Which continuously examines the various conditions like Temperature, current, voltage, even charging, state of charge, etc.

Its basic function or work is to observe the input provided, and control the charging and keep ye on discharging process. Which will than ensure the healthy functioning of the Li-ion battery which will lead to long life and low risk of degradation of battery over longer period of time.

The BMS is designed in such a way that it should prevent the mismatch problems which occurs in Li-ion batteries due to manufacturing defects. This leads to asymmetrical charging and discharging with aging of the battery. Thus charge equalisation is very much needed and is provided by BMS. There are various methods for cell balancing like shunt resistive method, dissipative method, active-passive cell balancing etc. but these methods have very high losses.



Fig No. 1 State of Charge of EV



II. LITERATURE REVIEW

We have studied almost eleven papers and a short survey of those papers is being discussed in this chapter. To begin with, the first topic is “ what is the **overview** of the BMS?” Well it is a system which observes the data provided by the series or parallel connected cells to form a battery. The observation could be any kind of data like current, voltage, temperature etc. Some systems will also revert back the data to the original central system. In some research papers, the cell is balanced using the technique called as fly back dc-dc converter method. Our system does not revert back the data back to the BMS. But it will give whether the failure has occurred or not by a buzzer which will produce sound when certain condition is mismatched.

**The need for BMS** is very high these days as it raises various issues which affect the battery life and its working. Thus BMS helps to maintain the symmetrical charging, indicates whether there has been any fault, and when the indication is frequent, that will be the time to decide whether to change the battery. That will be very much costly thus to not reach such conditions, BMS is very much needed.

**Types of BMS:** there are two types of BMS that is Active and passive. In a passive system, it works only while charging of the battery also the efficiency is less due to wastage of energy due to conversion of energy due to shunt elements. Flyback converter and bi-directional dc link bus is an example for an active type of system

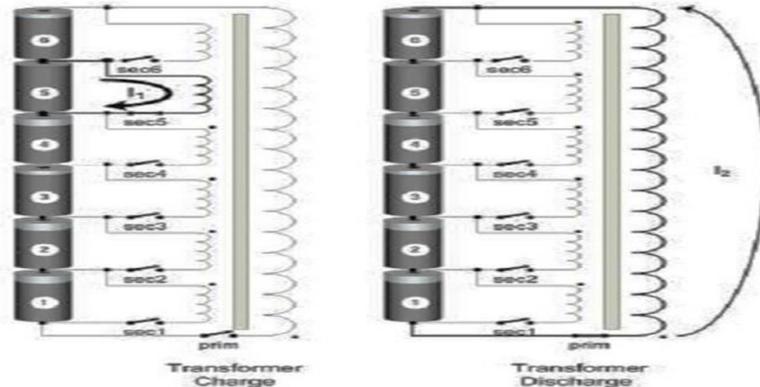


Fig. No. 2 Flyback converter and dc-dc bi-directional transformer

**Operation of BMS**

It initially takes real time inputs such as state of charge, current, voltage, temperature. Then analysis of the data takes place that is which cell is least charged, is the output voltage is dropped or not, is temperature is high etc. then if the cell is charged less, it is either provided charge through higher charged cell or if the charge is not equalising then the faulty cell is notified on the LCD display. Similarly if temperature is high, the supply will be cut off from the battery and same will be notified on the LCD.

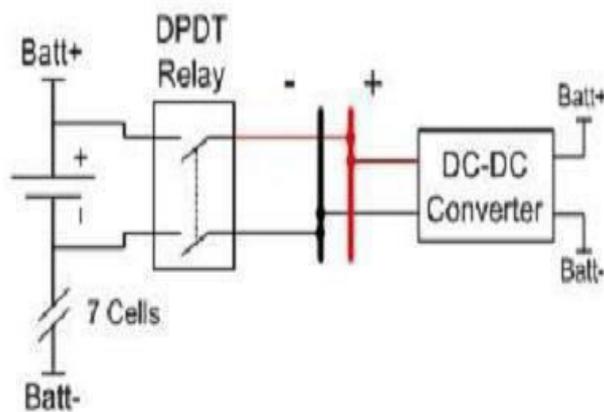


Fig No. 3 Operation circuit diagram of BMS



III. CONSTRUCTION AND WORKING OF BMS

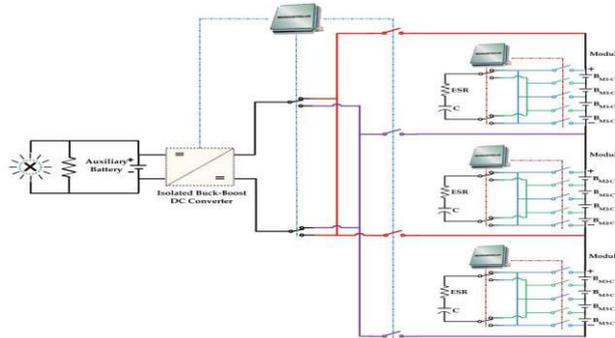
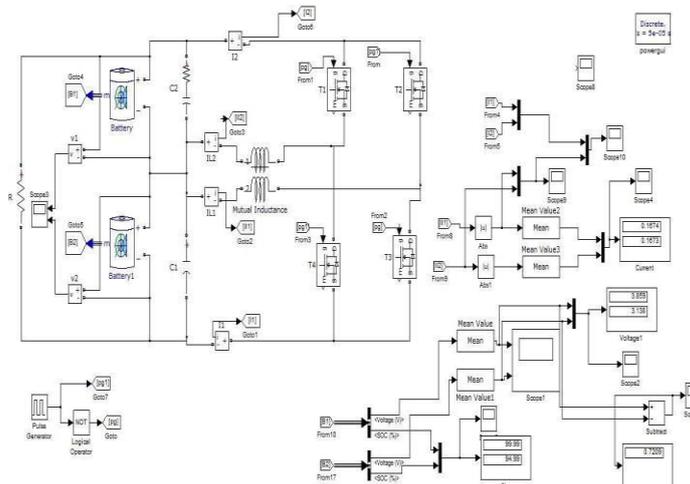


Fig No. 4 Modularised BMS

We divided the battery into different groups to reduce the cell balancing complexity which leads to increase in efficiency and decrease the total losses during cell to cell equalisation. Then using different cell balancing topologies, cells are equalised. If the process isn't successful than a message will be displayed on the LCD screen, than the user will have to decide either to change the battery or to continue with the same one. It will then monitor the current flow and voltage of the battery if above case satisfies, it will monitor the current flow as the time passes and will eventually notify when the charge decreases but will not allow to drain the battery completely as a relay is in circuit to prevent both overcurrent and undercurrent. A current will be set so when the charge of the battery reaches 10% it will automatically disconnect the battery from the circuit. Also temperature sensor will detect the temperature and if the temperature exceeds 45 degree C it will notify and a buzzer will start to make sound.

IV. SIMULATIONS



A simulation was created to show the cell balancing process, we took 2 different batteries and connected them in parallel to each other with a H- balancing bridge with two mutual inductances coils. Four MOSFETs were used as switches, which were given supply from a pulse generator that is both inverse and output wave of the generator. The values from the inductance coils were taken in real time and their average was found out which was the current and current percentage of the battery. Directly battery tapings shows the real time voltage of the battery and by doing further calculations it shows the battery charge percentage and at such discharging rate how much time it will take to drain out.

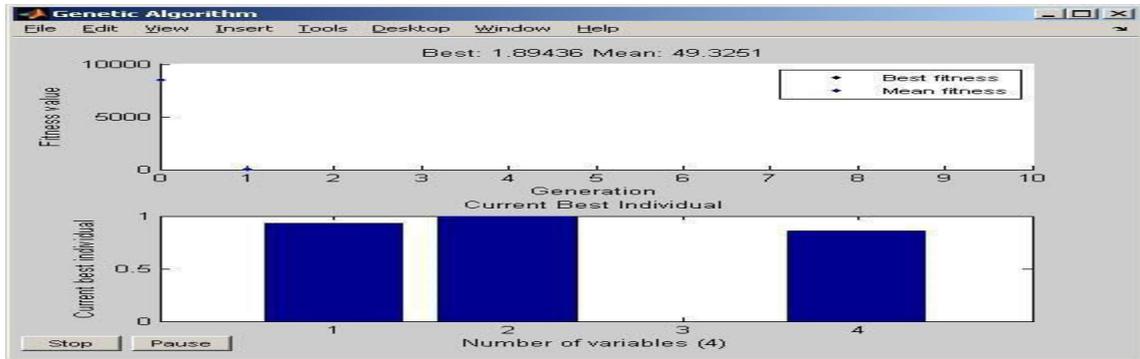


Fig No. 5 Fitness Value of the cell

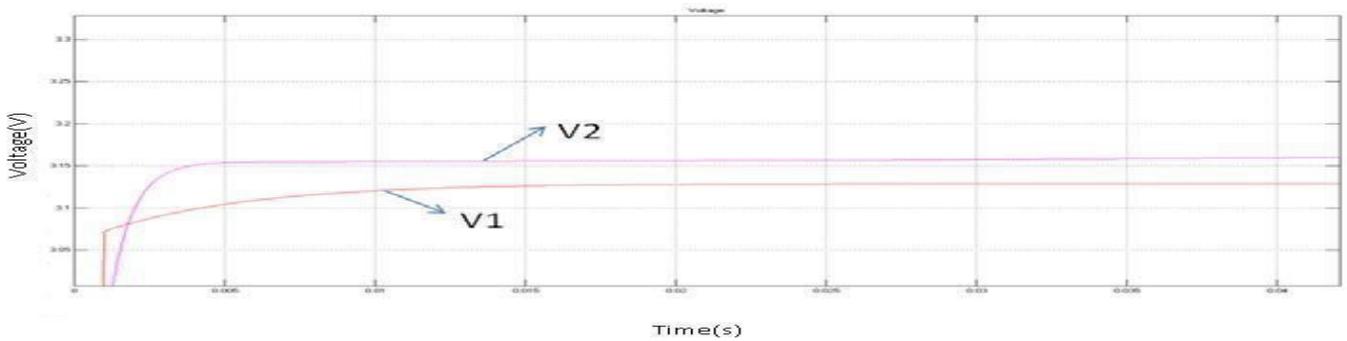


Fig No. 6 Voltages of the two Batteries used.

From the graph it can be seen that the initially the voltage of V1 was way higher than that of V2 than due to cell balancing , their gap decreases as time passes.

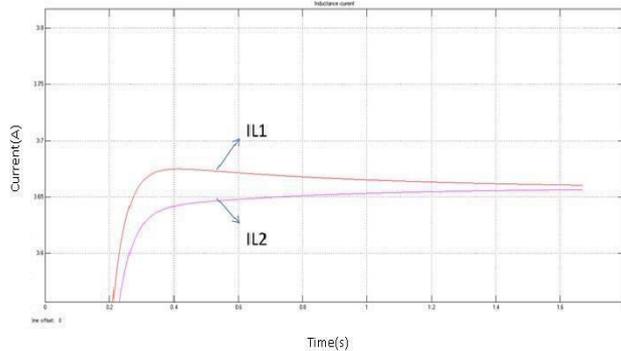


Fig No. 7 current at inductor coil tapings.

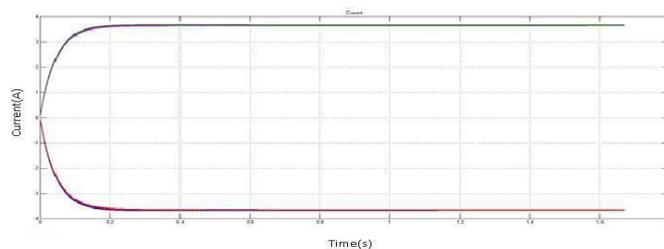


Fig No. 8 Cell unbalanced current

It can be seen that the cell balanced currents after compensation, the cell with lower voltage has the lower current which is transferred from higher voltage cells.

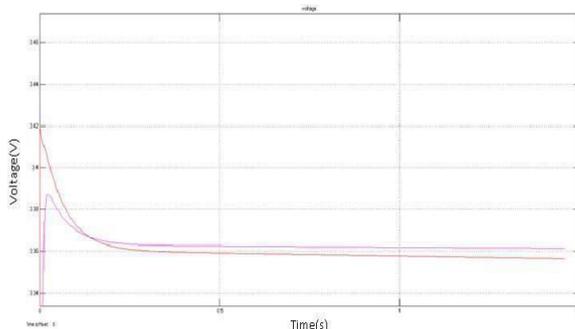


Fig No.9 reduction in voltage ismatch

These are the graphs produced after simulations, which shows the mismatch has been reduced below 50mV

### V. WORKING MODEL

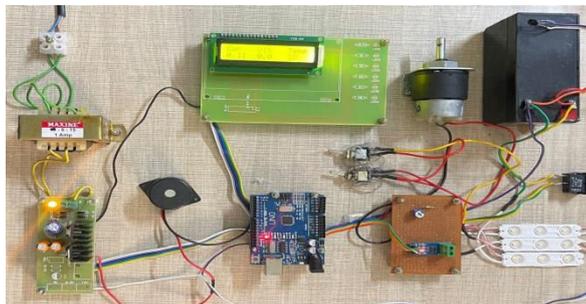


Fig No. 10 Working prototype model of Smart BMS

In our working model, we have taken a 12 v li-ion battery and connected it with a microcontroller which is powered by ac AC-AC step down transformer. Load is connected to the battery. If the battery voltage falls below 12v, the buzzer will start to sound. If temperature increases, it will be displayed on the screen.



Fig No. 11 LCD display under no load condition



Fig No. 12 LCD display under load condition

### VI. ADVANTAGES OF SMART BMS

- No need for extra space
- Reduces the risk of changing the entire battery
- Environmental and eco friendly
- Awareness of the battery condition
- Quick analysis of real time changes
- Reliable and guarantees safety



## VII. RESULTS AND CONCLUSION

By using smart battery management system we increases the battery efficiency, its life is made healthier, more long lasting also the performance of the battery increases which will help the user as it will save a heavy cost in case the degradation of battery takes plce without BMS. Smart BMS system intern is very crucial and very critical component which could be used in the EVs and a reliable solution for problems like heating, sudden power outages and guarantees safety and efficiency.

## REFERENCES

- 1) Simona Onori, Lorenzo Serrao, Giorgio Rizzoni, “Hybrid Electric Vehicles Energy Management Strategies”,springer
- 2) Chris Mi, M.Abdul Masrur and David Wenzhong Gao, “HYBRID ELECTRIC VEHICLES PRINCIPLES AND APPLICATIONS WITH PRACTICAL PERSPECTIVES”,wiley
- 3) <https://www.smev.in/ev-industry>
- 4) [https://en.wikipedia.org/wiki/Lithium-ion\\_battery](https://en.wikipedia.org/wiki/Lithium-ion_battery)
- 5) <https://www.tesla.com/blog/bit-about-batteries>
- 6) M. Daowd, N. Omar, P. Van den Bossche, and J. Van Mierlo, “Passive andactive battery balancing comparison based on MATLAB simulation,” inProc. IEEE VPPC, Sep. 6–9, 2011, pp. 1–7.
- 7) H.-S. Park, C.-E. Kim, C.-H. Kim, G.-W. Moon, and J.-H. Lee, “A modularized charge equalizer for an HEV lithium-ion battery string,”IEEE Trans. Ind. Electron., vol. 56, no. 5, pp. 1464–1476, May 2009.
- 8) M. Einhorn, W. Guertlschmid, T. Blochberger, R. Kumpusch, R. Permann, F. V. Conte, C. Kral, and J. Fleig, “A current equalization method for serially connected battery cells using a single power converter for each cell,”IEEE Trans. Veh. Technol., vol. 60, no. 9, pp. 4227–4237, Nov. 2011.
- 9) M.-Y. Kim, C.-H. Kim, S.-Y. Cho, and G.-W. Moon, “A cell selective charge equalizer using multi-output converter with auxiliary transformer,” inProc. 8th Int. Conf. Power Electron. ECCE Asia, Jun. 2011, pp. 310–317.
- 10) C.-H. Kim, M.-Y. Kim, H.-S. Park, and G.-W. Moon, “A modularized twostage charge equalizer with cell selection switches for series-connected lithium-ion battery string in an HEV,” IEEE Trans. Power Electron.,vol. 27, no. 8, pp. 3764–3774, Aug. 2012.



**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.118**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
**INDIA**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details