



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 6, June 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

Battery Management System and Regenerative Braking in Electric Vehicles

Anjali J Nair¹, Melbin Abraham Babu², Neenu Johnson³, Sanu K S⁴, Mr. Prasobh P⁵

U.G. Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India¹

U.G. Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India²

U.G. Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India³

U.G. Student, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India⁴

Assistant Professor, Department of Electrical Engineering, College of Engineering Chengannur, Alappuzha, Kerala, India⁵

ABSTRACT: The use of green energy is very crucial in today's world. Therefore, electric vehicles are best choice for environment in terms of public and personal transportation. Compared to traditional rechargeable batteries, lithium-ion batteries have high efficiency for electric mobility. Advanced BMS could significantly improve the performance of EV's. Cell balancing and fault analysis model were proposed for increasing the life span of battery. The monitoring circuits would provide triggers to protection device, which would cut-off battery from load or charger. The combination of regenerative braking and adaptive BMS improves battery functioning.

KEYWORDS: Equalization charging, Fast charging, Overcurrent fault.

I. INTRODUCTION

Battery is an integral part of electric vehicles. Compared to traditional rechargeable batteries, Li-ion battery requires less maintenance, no scheduled cycling, less self-discharge rate and high-power density. To improve the quality of battery and ensure safe operation, battery management system was established and it plays a vital role in the application of electric mobility. Our proposed design includes monitoring each cell voltage, temperature control, fast charging, equalization charging, short circuit and overload protection. Regenerative braking is also equipped for recharging the battery during braking action.

II. RELATED WORK

The paper [1] presents the performance analysis of Lithium batteries and management techniques. The paper [2] presents a discussion about regenerative braking and techniques adopted to utilize the recaptured energy. This paper [3] describes batteries and battery management system for electric vehicles. It discussed the demanding requirement and standards that apply to IC's and system for battery management. The main approach towards cell modelling and state of charge estimation was discussed. In paper [4], the design and implementation of battery management system for on-grid system was presented. The author created a prototype that will supervise the battery charging via solar panel. This BMS has three modes – charging, discharging and on-grid mode. A comprehensive review on cell voltage sampling, battery temperature sampling and battery current sampling were discussed in paper [5].

III. METHODOLOGY

In BMS Arduino Mega 2560 controls all operations. The current flowing into the Li-ion battery pack was measured by the ACS712 current sensor module. The output of the current sensor module is an analog value which is being continuously monitored by the Arduino MEGA. Whenever the current increases above the threshold (3A), the charging of Li-ion battery is cut out and it gets isolated from the system. In this way, the battery could be protected from over

charging. ACS712 also checks whether the current falls below a particular threshold value to protect it from over discharging. The overcharging and over-discharging were protected by a single channel relay.

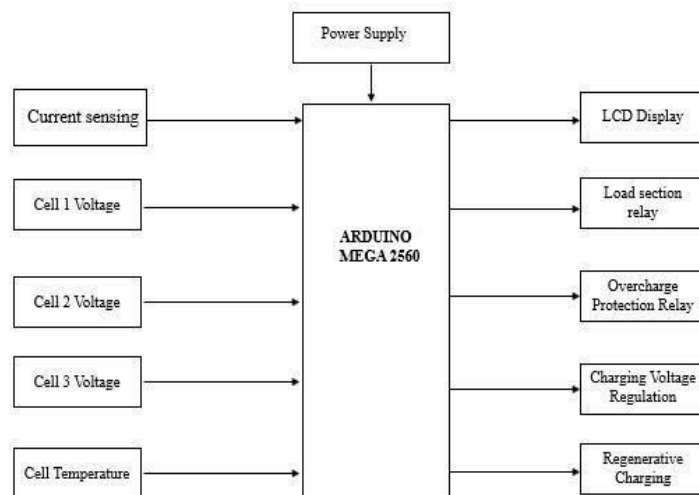


Figure 1. Block diagram

The three cell voltages of Li-ion cells were measured by the voltage divider circuit and cell temperature was measured by LM35 temperature sensor. When the battery pack temperature became greater than 40°C the charging process of Li-ion cells were cut-off by the relays and protects the battery from over temperature. The load section relay and overcharge protection relays were used to perform the over temperature protection, overvoltage protection, overcharge and overdischarge protection.

The cell balancing was performed by balanced charging. The charging voltage was regulated and each Li-ion cell was charged up to 4.2V. When the total cell voltage goes above 13V, the equalizing or balancing of cell happens. The excess charges were distributed among the cells to get an uniform charge in each cell. When the voltage was less than 12V fast charging was activated. All the cell voltage reading and intermediate results were displayed in 16*2 LCD. The power supply was used to power the Arduino Mega. For the power supply, 230V/50Hz AC was converted into 14V DC by 14V 2A step down transformer and it was then given back to Buck converter to further step down the voltage and to provide a regulated DC for all components.

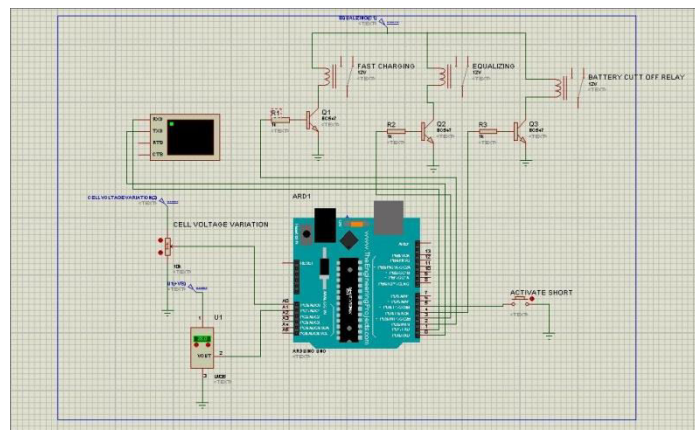


Figure 2. Simulation model for proposed system.

Simulation was done in Proteus design suite. Charging of battery take place in two modes:(i) Boost mode (ii) Equalization mode. Threshold voltage was set in order to switch between the modes, taken as 5V. Battery voltage was continuously monitored and if it is less than threshold, charging take place on fast mode. When it exceeds the threshold, charging switches to equalization by relays. Protection of battery from high temperature was monitored by LM35 temperature sensor. Whenever temperature exceeds a predetermined threshold limit, battery was isolated from load using battery cut off relay. 40°C was taken as threshold limit for simulation. Overload protection relay get activated in the case of short circuits. An active short button was introduced for this purpose. Regenerative power generation relay gets activated when battery voltage is greater than 12.5 V during braking action.

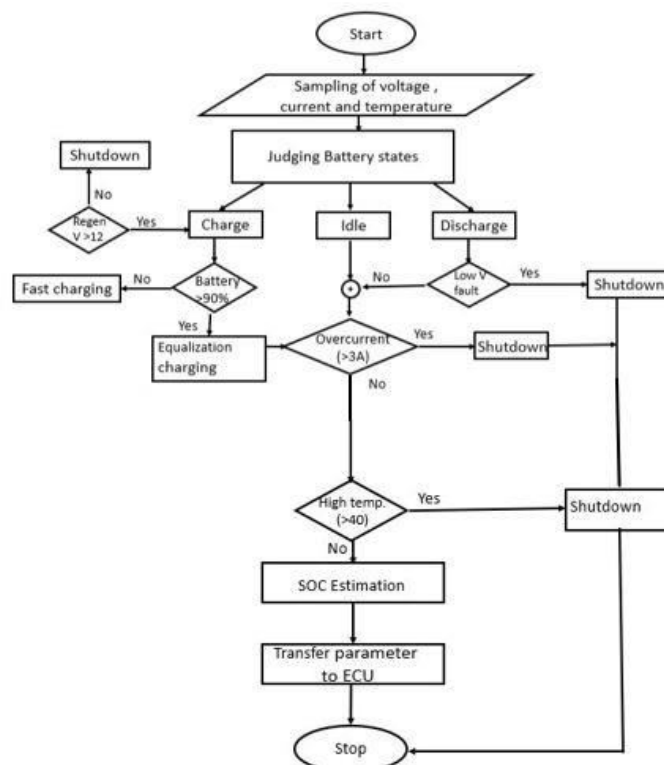


Figure 3. Flowchart of BMS code

IV. EXPERIMENTAL RESULTS

Hardware implementation of proposed design was depicted in the following figure.4

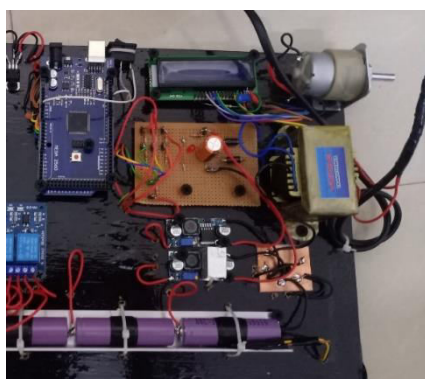


Figure 4. Prototype of BMS



Figure 5. LCD Display



From figure 5:

- (i) Cell voltage < 90%, fast charging gets activated.
- (ii) Cell voltage \geq 90%, equalization charging gets activated.
- (iii) Battery temperature > 40°C, high temperature detected.
- (iv) On short circuiting, overload relay gets activated.

V. CONCLUSION

Our work depicts the background of electric vehicles, lithium-ion batteries and BMS. Li-ion batteries were utilized as an energy storage system in electric vehicles. The limitations of early battery models were reviewed from literature surveys. An improved battery management system was proposed by monitoring individual cell voltage, temperature, current and cell equalization. Regenerative braking was also utilized to increase the life span of battery. This model was simulated in Proteus design suite and results were discussed. Prototype for the proposed system was also implemented.

REFERENCES

- [1] V.M Dileepan; J. Jayakumar "Performance Analysis of Lithium Batteries" 2017 International Conference on Innovations in Electrical, Electronics, Instrumentation and Media Technology (ICEEIMT).
- [2] Valentin Totev; Vultchan Gueorgiev "Efficiency of Regenerative Braking in Electric Vehicle" 2020 21st International Symposium on Electrical Apparatus & Technologies (SIELA).
- [3] M. Brandl; H. Gall; M. Wenger; V. Lorentz; M. Giegerich; F. Baronti; G. Fantechi; L. Fanucci; R. Roncella; R. Saletti; S. Saponara; A. Thaler; M. Cifrain; W. Prochazka "Batteries and Battery Management System for Electric Vehicle" 2012 Design, Automation & Test in Europe Conference & Exhibition (DATE).
- [4] William Kevin Siagian; Daniel Fernando Purba; Asrilani Sipahutar; Indra Hartarto Tambunan "Design and Implementation of Battery Management System for On-Grid System" 2018 International Conference on Control, Electronics, Renewable Energy and Communications (ICCEREC).
- [5] Dongping XU, Lifang Wang, JianYang "Research on Li-ion Battery Management System" 2010 International Conference on Electrical and Control Engineering.



**Impact Factor:
7.512**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 ijirset@gmail.com



www.ijirset.com

Scan to save the contact details