

Battery Monitoring System

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Abstract—The efficient working of an electric vehicle depends on the type of battery used. The Lithium ion battery has proven to be the battery of interest for manufacturers because of high charge density and low weight of Lithium ion. Li-ion battery state cannot be measured; it can only be estimated depending on the factors- voltage, current and operating temperature. It is very important that the batteries should never be over charged or under discharge at any stage which is why it is necessary to monitor its voltage and current. To overcome this issue a Battery Management System (BMS) has been developed followed by a Battery Monitoring System. The primary task of BMS is to calculate voltage of each battery cell which requires extraction of relatively small differential voltages from very high common mode voltages which require amplifiers and this data is sent to the user by a monitoring system.

Keywords— Battery, Current, Temperature, Voltage.

I. INTRODUCTION

A Battery Management System is an electronic device that monitors and controls the charging and discharging of batteries. The Lithium ion battery are the most preferable ones when it comes to Electric vehicle because of its high charge density and low weight and also size. The battery discharges faster in hot climates than in normal room temperature, so if the current increases it will gradually lead to an increase in temperature. There are a lot of cells arranged together to form a battery and each and every cell needs to be monitored for efficient working. The batteries are supposed to be connected in series for equivalent voltage to pass across it. So, in this circuit we have Li-ion battery manager IC ISL94212 in conjunction with ESP8266 microcontroller. The BMS calculates State of Health (SOH) and State of Control (SOC). A well designed BMS has accuracy of minimum value 2mV and maximum of 0.2mV. The BMS has a few functions; they are as follows:

1.1 Discharging Control

The battery cells need to be discharged when uneven parameters interrupt. It is also important to maintain the energy in battery cells.

1.2 Charging Control

For Li-ion battery a two-stage charger is used. In the first stage it maintains constant current. In the second stage it maintains constant voltage. All this depends on the data sheet of the battery.

1.3 State of Health

The capacity of battery depends on voltage, current, durability and operating temperature. It is used to calculate the operating range of the system.

1.4 State of Charge

It is a measuring quantity which determines the fuel gauge of an EV.

SOC = TOTAL CHARGE INPUT / MAXIMUM CAPACITY

1.5 Cell Balancing

It is a very crucial factor the working of the battery depends on equivalent battery cells. In this voltage across battery remains constant. Cell balancing is of two types – Active and Passive type. Active type cell balancing is when stronger cells charge the weaker ones whereas Passive type cell balancing where cells are forced discharge.

1.6 Thermal Control

In thermal system oil can be used in a battery pack, it helps adjust temperature on itself and hence maintain the overall temperature.

1.7 Power from Battery itself

The battery charges and discharges itself as per the requirement of the battery pack.

1.8 Less Ideal Power

A BMS needs to be powered continuously but consuming less energy so as to not drain the battery. So, when an EV is left uncharged for a long time it tends to drain the battery.

1.9 Galvanic Isolation

BMS provide galvanic isolation between Battery pack and Electronic Control Unit (ECU). The ECU and BMS must communicate through Local Interconnect Network(LIN) bus.

1.10 Data Logging

The BMS needs to contain data from its installation period and should be updated automatically. It should also track charge cycles and charge time of battery pack.

1.11 Accuracy

The cells when charged or discharged affect the voltage across it. It is necessary that the cells maintain constant voltage across it.

1.12 Processing Speed

The BMS should calculate cell voltage, SOH, SOC and other corresponding factors.

The Battery Monitoring System consists of two modules beginning with the Management module where in the efficiency of the battery are tried to be maintained and the details of the battery are provided to the user.

II. MATERIAL AND METHOD

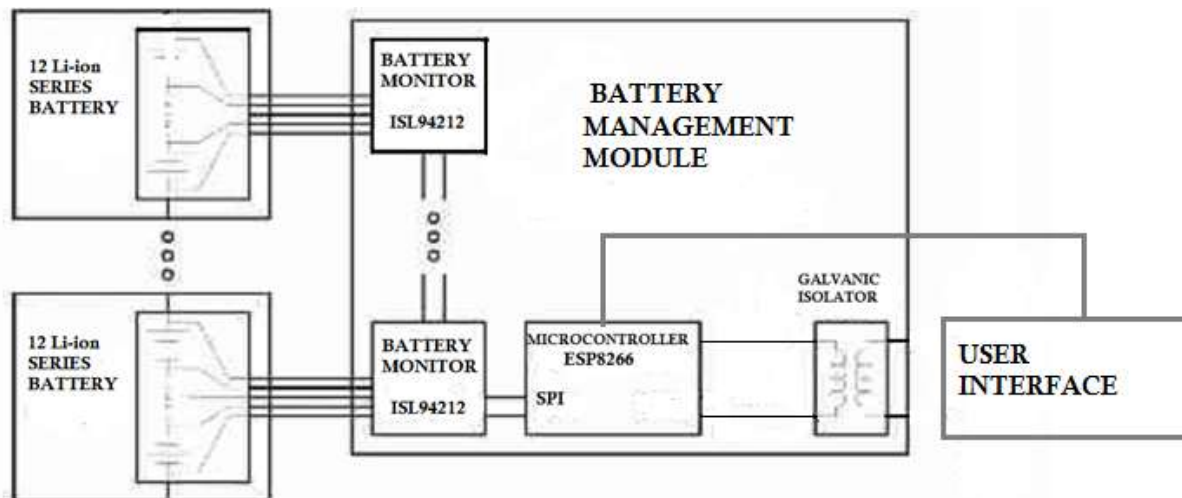


FIGURE 1: BLOCK DIAGRAM OF BATTERY MONITORING SYSTEM

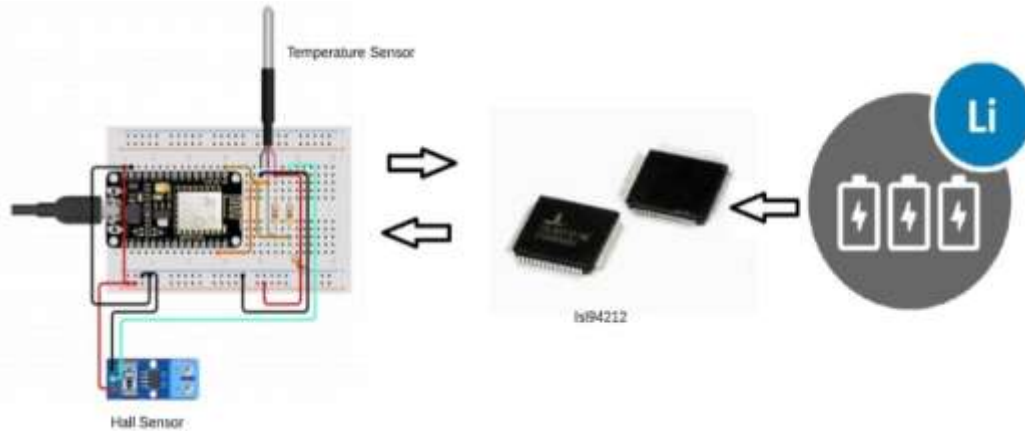


FIGURE 2: SIMPLIFIED VERSION OF THE CIRCUIT

III. DESIGN METHODOLOGY

The Li-ion battery pack is connected to the battery management module. It consists of an ESP8266 microcontroller which acts as a remote host that helps to receive information from the other components in the management system.

The ISL94212 module provides the ESP with the information of the battery such as its individual cell voltage and also manages the individual battery level maintaining constant voltage and current.

The sensor such as the hall sensor and the temperature provide with the real time and accurate current, voltage and temperature values of the battery pack.

With the pre embedded mathematical equations in the microcontroller it calculates the State of Health (SOH), State of Charge (SOC), Operating temperature range and other crucial statistics of the battery.

The output of the monitoring system will be provided to the user by a software application. The monitoring module consists of ESP8266 which has inbuilt Wi-Fi which can be connected to any display device

IV. EXPECTED RESULT



FIGURE 3

FIGURE 4

The estimated output will be in the above form. It will be a complete software application based for U.I.

V. CONCLUSION

Electric vehicle is the future of transportation system. A BMS is a helping hand to control the internal working of an EV. In this project we have considered CAN bus instead of LIN bus only to overcome the problem of processing speed. Depending on the situation we can modify the circuit for different types of electric vehicles such as BEV, HEV and PHEV. We have tried to overcome maximum of the drawbacks of the models available in the market currently and in a cost-effective manner.

REFERENCES

- [1.] Zhao, J., et al., Design and full-car tests of electric power steering system, in Computer and Computing Technologies in Agriculture, Volume I, D. Li, Editor. 2008, Springer US. p. 729-736.
- [2.] Tie, S.F. and C.W. Tan, A review of energy sources and energy management system in electric vehicles. Renewable and Sustainable Energy Reviews, 2013. 20: p. 82-102.S
- [3.] Xuebing Han, Mingguo Ouyang, Languang Lu, Jianqiu Li. A comparative study of commercial lithium ion battery cycle life in electric vehicle: Capacity loss estimation. J. Power Sources 2014;268:658-69.
- [4.] Barbara Stiaszny, Jörg C. Ziegler, Elke E. Krauß, Mengjia Zhang, Jan P. Schmidt, Ellen Ivers Tiffée. Electrochemical characterization and post-mortem analysis of aged LiMn₂O₄-NMC/graphite lithium ion batteries part II: Calendar aging. J. Power Sources 2014; 258:61-75.
- [5.] Batteries for Electric Cars; Challenges, Opportunities, and the Outlook to 2020; The Boston Consulting Group Inc.: Boston, MA, USA, 2010; Available online: <http://www.bcg.com/documents/file36615.pdf> (accessed on 20 July 2011).
- [6.] Andrea, D. Battery Management Systems for Large Lithium Ion Battery Packs, 1st ed.; Artech House: London, UK, 2010; pp. 22-110. 7
- [7.] Meissner, E.; Richter, G. Battery monitoring and electrical energy management precondition for future vehicle electric power systems. J. Power Sources 2003, 116, 79-98.
- [8.] Kumar, Ashish, "Schaem: A method to extract statechart representation of FSMs", Advance Computing Conference, 2009, pp. 1556-1561.
- [9.] Liao Y G, Fu D T, "Design and development of a teaching tool for lithium-ion battery management system," Conference for Industry and Education Collaboration, 2015, pp. 1-12.
- [10] Dai Haifeng Z X, "A smart current and voltage acquisition system with high accuracy for EV applications," International Journal on Smart Sensing and Intelligent Systems, December 2012, pp. 1-19.
- [11] T. Huria, M. Ceraolo, J. Gazzarri, and R. Jackey, "High fidelity electrical model with thermal dependence for characterization and simulation of high-power lithium battery cells," Electric Vehicle Conference, Mar 2012, pp. 1-8.S