Research on Test Platform of Lithium Battery Management System based on LabVIEW

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Abstract: With the application and popularization of new energy electric vehicles, the research and design of lithium battery management system is of great practical significance to ensure the normal operation of battery pack and vehicle safety, and improve vehicle performance. This paper first analyzes the design of the lithium battery management system, then designs the upper computer control system, and finally verifies the effectiveness of the lithium battery thermal management system through the system test.

1. Introduction
In recent years, with the enhancement of people’s demand for environmental protection, all walks of life are vigorously carrying out energy conservation and emission reduction. With the continuous increase of car ownership in China, the problem of exhaust pollution is increasingly serious. Therefore, driven by the market demand and technological progress, the application of electric vehicles is more and more extensive, which has become the development trend of the future automobile industry. One of the most important core components of electric vehicle is its battery system, and lithium battery has been more and more used in electric vehicle because of its high energy density, relatively light weight and other advantages. However, lithium battery will generate heat in the work. If no measures are taken, too long time will lead to high temperature of lithium battery, leading to safety risks. Therefore, the research and design of lithium battery management system is of great practical significance to ensure the normal operation of battery pack and vehicle safety, and improve vehicle performance.

2. Design of lithium battery management system

2.1 Equalization circuit design
The voltage balance system of lithium battery is very important for preventing the short board effect of battery, prolonging the battery life and improving the efficiency of lithium battery management system. It includes two balance systems: active balance and passive balance. The former technology is more complex, while the latter has low efficiency, but it is widely used because of its simple design and easy implementation. Figure 1 below shows the circuit diagram of a passive voltage equalization system.
Compared with passive equalization, active equalization is more conducive to control the loss of battery energy, but it still needs to improve the efficiency of capacity transfer. Active equalization includes capacitor equalization, as shown in Figure 2, inductive equalization and voltage equalization. The control principle of capacitive and inductive equalization circuit is relatively simple, but the energy transfer efficiency is not high; although voltage equalization circuit can achieve point-to-point energy transfer, but the cost is high and the structure is complex.

In view of the advantages and disadvantages of the above active equalization circuit, a double-layer active equalization circuit is designed, which consists of a single-layer active equalization circuit realized by super capacitor and a rated single-layer active equalization circuit realized by fly back transformer. The two-layer active equalization circuits complement each other, which can improve the energy transfer efficiency for different active equalization needs.

2.2 Thermal management design
As mentioned before, the lithium battery will generate heat in the process of discharge, so if the lithium battery management system does not have a heat management system, it is easy to cause overheating of the lithium battery, causing potential safety hazards. The framework of lithium battery thermal management system is shown in Figure 3.
2.3 Charging module design
Special modules should be used for lithium battery charging, otherwise the service life of lithium battery will be seriously reduced. In the charging process, if the voltage is low, in order to reduce the impact on the internal lithium battery, trickle charging is needed to protect the lithium battery. If the voltage is high when charging, because the battery can bear a large current at this time, constant current charging can be used to improve the charging efficiency and speed. When the battery is about to be fully charged, it needs to be changed to constant voltage charging to avoid over charging, so as to protect the battery.

3. Design of upper computer control system

3.1 Upper computer programming environment
Because of the humanization of the LabVIEW operation interface, the designer can design the LabVIEW programming interface at will according to the user's demand. Therefore, LabVIEW is used as the upper computer programming environment to realize the functions of the upper computer by using its sequence structure, condition structure and event structure. With the Ni acquisition card and camera, various acquisition control systems can be completed to meet the design requirements.

3.2 Design of communication mode
USB serial universal bus is used because of its fast transmission speed, high reliability of signal transmission data, interface support plug and play with unified interface standard. Visa-open is used to connect USB interface with LabVIEW. The command is sent to the lower computer through USB, and the lower computer receives the command, including voltage and current, balance mode and the working state of the thermal management system. Finally, the data is sent to the notifier with high reliability and easy to operate.

4. System testing and effectiveness analysis
The waveform of voltage data uploaded by USB is shown in Figure 4 below. The charging system has a very high working efficiency. When the lithium battery is fully charged, the charging circuit is cut off, and the lithium battery can be recharged in time when it is over discharged.
In addition, the efficiency of the cooling system is also relatively high, which can reduce the temperature in a short time, so as to protect the circuit and avoid a series of hidden dangers caused by overheating of the system.

5. Conclusions
With the continuous popularization and development of electric vehicles, it is of great practical significance to study the battery management system, which is one of the common battery systems with lithium battery function. Therefore, it is necessary to study the test platform of lithium battery management system. This paper designs a lithium battery management system based on active equalization, which integrates active and passive equalization, voltage, current detection, charging and system cooling functions. Finally, the security and reliability of each module of the lithium battery management system is verified on the host computer.

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References
[1] Li Qiwei. Design of lithium battery management system for explosion-proof electric vehicles [J]. Industrial and mining automation, 2017, 11 (4): 5-9.
[2] Zhang song, Zhang Huilin, Jin Yanfei et al. SOC estimation strategy of a 150 V mining lithium battery management system [J]. Power technology, 2017, 45 (1): 41-43.
[3] Zou Mingsen. Fault diagnosis of lithium battery management system of electric vehicle [J]. Internal combustion engine and accessories, 2017, 66 (10): 59-60.
[4] Shao Tiantian, Li Qiwei. Design and implementation of battery management system for coal mine backup power supply based on ltc6804-2 [J]. Coal mine machinery, 2017, 38 (1): 135-137.
[5] Wang Fengbo. Research on management system of medium-sized lithium-ion battery pack based on ad7280a [D]. Shanghai University, 2016, 3 (11): 27-28.
[6] JARVIS，LISA.BMS grows its fibrosis portfolio.[J].Chemical & Engineering News, 2016, Vol.94(45): 15-16.