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STABILIZING THE THERMAL TEMPERATURE OF LITHIUM BATTERIES USING PELTIER PLATE FOR EV VEHICLES

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ABSTRACT

Lithium batteries have become widwly used in energy storage systems. Since adverse operating temperatures can impact battery performance, degradation, and safety achieving a battery thermal management system that can provide a suitable ambient temperature environment for working batteries is important. This paper provides a review based on previous based on previous studies, summarizes the electrical and thermal characteristics of batteries and how they are affected by the operating temperature, analyzes the relative merits and specific purposes of different cooling or heating methods, and provides many optimization mrthods. Moverover, because low power consumption, a high temperature regulation capacity, and excellent temperature uniformity are desired for every battery thermal management system, we also present control strategies that can contribute to thermal management. It is indispensable to establish criteria to evaluate battery thermal management systems. We subsequently summarize the characteristic parameters for the analysis of various battery thermal management system desig s. Finally, we provide an outlook for the development of lithium-ion battery thermal management systems.

KEYWORDS: Battery Life, Battery Thermal Management System (BTMS)

INTRODUCTION

Electric vehicles (EVs) and hybrid electric vehicles (HEVs) have been widely regarded as the most promising solutions to replace the conventional internal combustion (IC) engine-based vehicles, and the recent years have seen a rapid development of HV and HEV technologies. Batteries have been widely applied as the power supply for Evs and HEVs due to the advantages such as high energy density, low environmental pollution and long cycle life. On the other hand, batteries require particular care in the EV applications. Improper operations such as over-current, over-voltage or over-charging/discharging will cause significant safety issue to the batteries, noticeably accelerate the aging process, and even cause fire and explosion [1]. Therefore, the battery management system (BMS) plays a vital role in ensuring safety and performance of batteries.

Key technologies in the BMS of Evs include the battery modelling, internal state estimation and battery charging. An effective battert model is crucial in battery behaviour analysis, battery state monitoring, real-time controller design, thermal management nad fault dignosis. Besides, some battery internal states, such as state of charge (SOC), state of health (SOH) and internal temperature, cannot be measured directly, while these states play important role in managing the operation of batteries, and thus need to be monitored using proper estimation methods. Further battery charging is also of great importance in BMS due to its direct impact on the operation safety and service availability of battery. A well-designed strategy will protect batteries against damage, limit temperature variations as well as improve efficiency of energy conversion. Slow charging has negative effect on the availability of EV usage, but charging too fast may adversely lead to large energy loss and temperature rise

[2]. Large temperature variation further leads to rapid battery aging and even causes overheating or super-cooling, which will eventually shorten the battery service life [3].

This paper aims to give a brief review of the key technologies especially for battery modelling, state estimation and battery charging in the BMS of Evs. Recent approaches to tacklethe problem of battry modelling of the electric and thermal characteristics are surveyed first. These established battery models are used to capture battery electric and thermal behaviours. Then the corresponding independent or joint state estimation methods of battery SOC and inernal temperature are also reviewed. On the basis of battery models and estimaed inernal states, battery charging approaches are discussed, together with optimization algorithms for improving the performance of these charging approaches.

With growing concerns on over fossile fuel depletion and the increasing price of crude oil, electric vehicles have gained more interest as a mode of transportation [1]. Various electric vehicles have been developed in recent years, including pure electric vehicles (Evs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs).

LITERATURE REVIEW

With growing concerns over fossile fuel depletion and the increasing price of crude oil, electric vehicles have gained more interest as a mode of transformation [1]. Various electric vehicles have been developed in recent years, including pure electric vehicles (Evs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs).

One keen focus area in the ongoing development of electric vehicles is their energy storage systems. At present, lithium-ion batteries are used extensively for automobiles. They include Li-Co lithium-ion (LCO), Li-Fe lithium-ion (LFP), Li-Mn lithium-ion (LMO), and Li-NiCoMn lithium-ion (NCM) batteries. When batteries are charging/discharging, various complicated reactions occur. In addition, the thermal behaviours of the batteries are coupled to these reactions [2]. Electrochemical reactions affect the heat generation rate, and higher temperatures further increase the speed of the electrochemical reactions [3]. To optimize their performances, it is necessary to understand the characteristics of the specific battery.

As previous research has shown, battery performance is highly dependent on the working ambient temperature. Batteries have a higher request in the working ambient temperature. For example, the battery state of health (SOH) is influenced by temperature significantly. Battery life may be reduced by 2/3 in hot climate during aggressive driving and without cooling [4]. If a lithium-ion attery operates at a lower ambient temperature long-term, high specific surface area SOH [5]. With a battery temperature exceeding the stable point, severe exothermic reactions occur uncontrollably [6]. In addition, if a battery approaches thermal runaway, only 12% of the total heat released in the battety is enough to trigger thermal runaway in adjacent batteries [7]. This is the biggest risk during the use of lithium-ion batteries.

Numerous methods have been proposed in previous studies to improve the cooling performance. For air or liquid cooling, for example, increasing the coolant velocity or the size of cooling structure may benefit the average temperature uniformity. However, the cost of such optimization increases the pack volume, resulting in a larger power consumption of the battery thermal management system (BTMS). There have been no uniform standards created to judge cooling/heating designs, and few researchers have demonstrated the features of different cooling/heating strategies and determined the conditions for which they are suitable.

PROPOSED SYSTEM

A. Objective

The main objective of this project is to minimize the thermal temperature of batteries and increase the life of batteries.

B. Block Diagram

Below is the modular approach for the proposed

system-

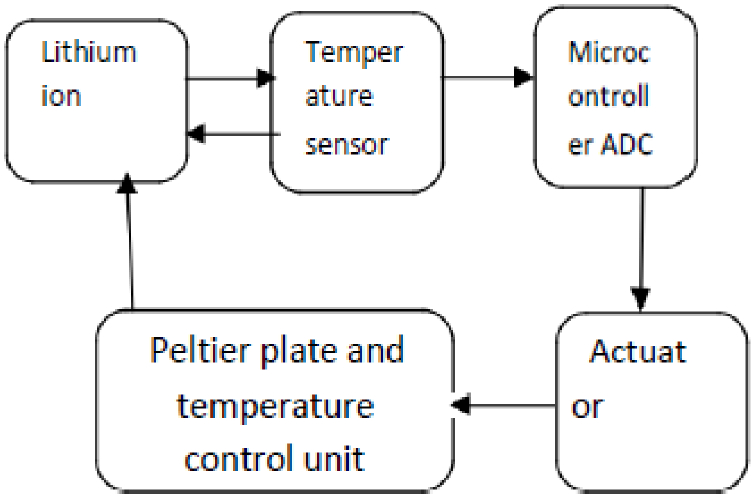

Figure no II.1. Block diagram of the proposed system

Numerous methods have been proposed I previos studies to improve the cooling performance. For air or liquid cooling structure may benefit the average temperature and temperature uniformity. However, the cost of such optimization increases the pack volume, resulting in a larger power consumption of the BTMS. There have been no uniform standards created to judge cooling/heating designs, and few researchers have demonstrated the features of different cooling/heating strategies and deterned the conditions for which they are suitable.
Propsed design uses peltier plate to control the thermal heat of lithium-ion battery. First temperature is measured by temperature sensor and given to microcontroller unit that will convert to digital form from analog one. Also microcontroller will compare the battery temperature and generates the actuators signal in pwm form to control the peltier plate voltage/ current so as to cool the battery. Design complies a very compact size which can be fitted in any vehicles easily with low cost design.

C. Scope of the Proposed System

Batteries have been widely applied in many high-power applications, such as electric vehicles (Evs) and hybrid electric vehicles, where a suitable battery management system (BTMS) is vital in ensuring safe and reliable operation of batteries. This paper aims to give a brief review on several technologies of BMS, including battery modelling, state estimation and battery charging. First, popular battery types used in Evs are surveyed, followed by the introduction of key technologies used in BMS. Various battery models, including the electric models, thermal models and coupled electro-thermal model are reviewed. Then, battery state estimations for the state of charge, state of health and internal temperature are comprehensively surveyed.

CONCLUSION

By using this prototype model one can keep battery temperature low in any conditions which in turn increase in battery life. Electrical and thermal characteristics of batteries and how they are affected by the operating temperature can be summarized. Relative merits and specific purposes of different cooling or heating methods can by analyzed.

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