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Design and development of less than 1Kw Lithium rechargeable battery pack

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Abstract

Lithium-ion batteries have been used in energy storage systems (ESS), electric vehicles (EVs), etc. due to their high safety, fast charging and long lifecycle. This paper aims to improve the convenience of users by changing the wired battery stack used in the battery pack, wirelessly using RFID, reducing the internal volume of the battery pack, reducing the size of the battery pack. In this paper, we propose a battery management system which can provide the flexibility of battery pack expansion and maintenance by using lithium ion battery, battery management system (BMS) and wireless communication for light weight of 1Kw small battery pack. Also, by flexibly arranging the cell layout inside the battery pack and designing to reduce the size of the outer shape of the battery pack.

Keywords: *Energy Storage System, Battery Management System, Lithium-ion battery, Battery Pack, State-of-Charge.*

1. Introduction

The aspect of promoting green energy expansion is renewed the utility of lithium secondary batteries by improving user convenience, reducing cost, and extending service life [1]. Currently, compared to various battery solutions in the secondary battery market, compared with the customers' needs, the range of demand market, investment scale, and marketing strategy, it is most likely to be a leading solution. Lithium secondary battery through the charging process when connected to the power grid can be used at the convenience of the consumer depending on the type of technology, it has a long life span that does not require additional maintenance. It is economical from the point of view of the total energy cost of lithium secondary batteries, even if the initial high usage fee is paid, because it is durable enough to guarantee 10 years of performance in a 365 days of continuous use environment. Lithium rechargeable batteries are convenient, environmentally friendly, and are advantageous to meet human needs [2]. If you use lead acid batteries, the battery pack becomes bulky. Conversely, if the lithium battery is used, the battery pack volume can be reduced. These batteries are being used in Energy Storage System (ESS) [4], Electric Vehicles (EVs),

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etc., due to their high safety, fast charge and long lifecycle characteristics. And now, the drones for agricultural use are being used. However, in the case of lithium secondary battery, overcharge and discharge, the gap structure in the lithium ion battery is destroyed, the battery life is shortened to prevent overcharging and overdischarge, a controllable cell balancing system must be used [3]. Also, design the wired battery stack used in the current battery pack by changing it to wireless type using RFID, and monitoring each cell by monitoring it [5]. For this reason, the monitoring system includes a number of connectors, cables, and electrical wiring that require frequent maintenance, and occupies a lot of space. Therefore, if the wireless system is adopted, the battery pack can be miniaturized because of space. This paper describes the use of lithium ion battery to solve various problems of 1Kw small battery pack, combination of BMS (Battery Management System) with wireless communication or wireless network, it can provide flexibility in expansion and maintenance. It is designed so that the cell layout inside the battery pack can be arranged flexibly and the size of the outer shape of the battery pack can be reduced. Figure 1 shows an example in which a wired battery stack is converted into a wireless format.

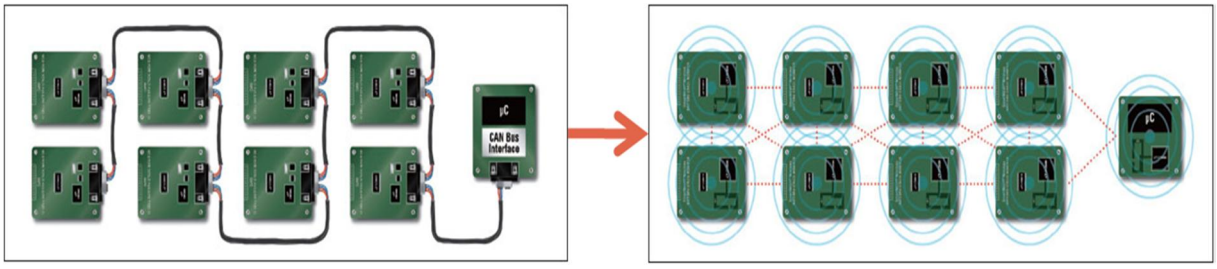


Figure 1. A block diagram of a wired battery stack converted to a wireless format (example)

In this paper, accurate state-of-charge (SOC) / state-of-health (SOH) by using time stamp can be. In addition, existing battery pack type provides BMS function only, there is no balancing function of each cell.

2. Research content

We designed a cell balancing algorithm that can uniformly control unequal cell voltages to prevent overcharging / discharging in advance. Also, we design the communication method between cells by changing to wireless method using RFID sensor. For this reason, the monitoring system is often equipped with connectors, cables, and electrical wiring that require frequent maintenance, and occupies a lot of space. Therefore, when the wireless system is adopted, the battery pack can be miniaturized because of space.

In this paper, a Li-ion battery is used to solve various problems of a 1Kw small battery pack, and the combination of BMS (Battery Management System) and wireless communication or wireless network provides flexibility of battery pack expansion and maintenance The cell arrangement in the battery pack can be flexibly arranged, and the size of the outer shape of the battery pack can be reduced. In addition, it is easy to develop the low cost battery pack by facilitating the weight, usability, and repair of the battery pack and developing it for the user's convenience.

As shown in fig. 2, the general BMS starts with the start of the entire circuit. The current sensor detects the charge / discharge and checks the voltage of the battery through the voltage sensor. The checked battery voltage balances according to the measured voltage level. This method has a high self-discharge rate because of continuous sensing.

However, the battery balancing method proposed in this paper is designed as shown in fig. 3 to solve

these problems.

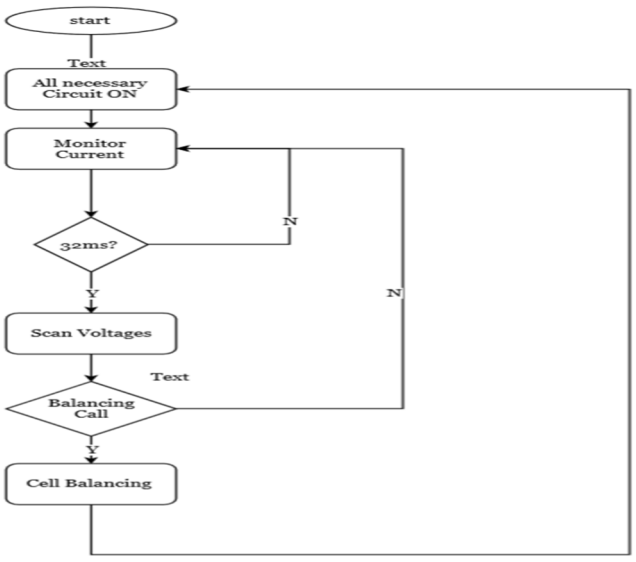


Figure 2. Typical battery pack operation flowchart

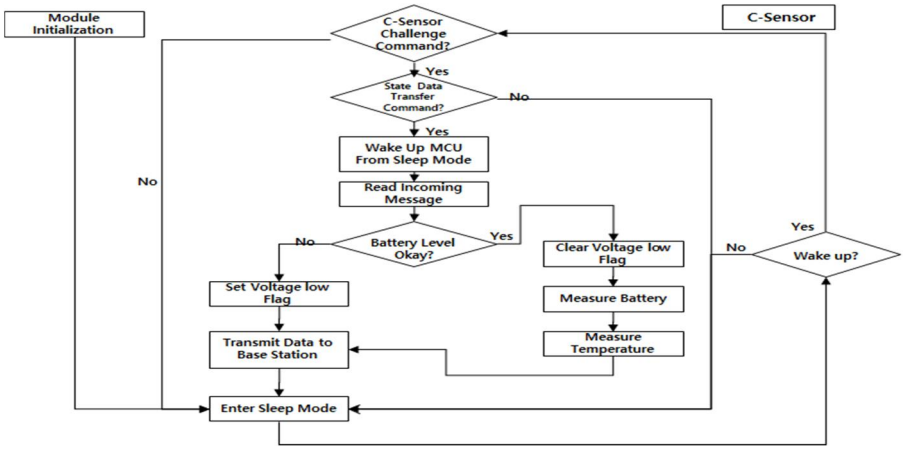


Figure 3. Battery Pack Operation Flowchart

The battery pack operation sequence shown in fig. 3 initializes the module of the BMS using the wireless communication in the standby state, and maintains the sleep mode. When the wake up signal is generated, the current change is checked through the current sensor when the current value according to charging / discharging is confirmed, the state of the battery is checked through the voltage sensor, and balancing is performed according to the voltage level. In addition, data that changes according to a predetermined period is transmitted, and when the balancing is completed, the apparatus enters the sleep mode again in the sleep mode. This method can control the sensing through the wake-up signal, thus reducing unnecessary discharge.

3. Content development and design

Figure 4 shows the charging / discharging circuit diagram, which is implemented to balance 8 cell packs. It is controlled by BMS IC chip as a whole, sets the register through i2C communication, sets the maximum / minimum value of battery's total voltage, the maximum / minimum voltage value is set for each cell, and when the cell is out of the total set voltage or the set voltage range of each cell during charge / discharge, it is operated.

The cell balancing method is typically a passive balancing method and an active balancing method. The advantage of passive balancing is that it is simpler and less costly than active balancing, but it has the disadvantage of dissipating energy as resistance, resulting in a lot of heat and slow balancing. The active balancing scheme is a technique of balancing by transferring energy from a high-SOC cell to a low-cell of a battery cell. However, the circuit configuration is more complicated than the passive balancing scheme, but the balancing efficiency and speed are advantageous [3]. In this paper, we use the passive method, because the battery pack to be developed is a 1Kw small battery pack, and we choose a method to simplify the cell balancing rather than the complex system.

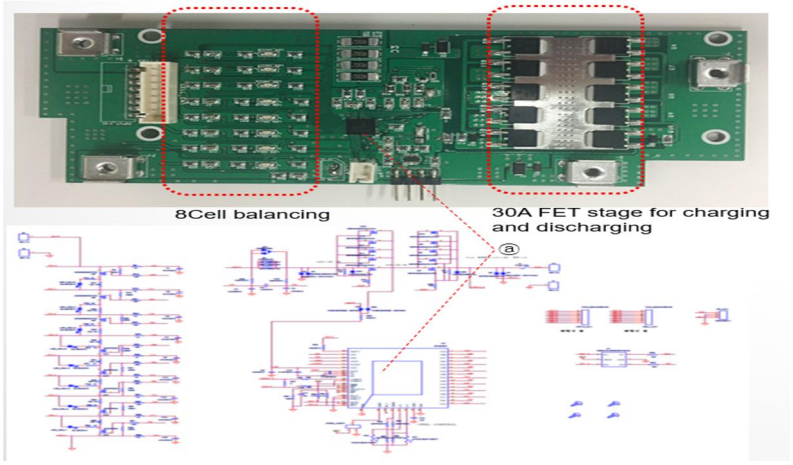
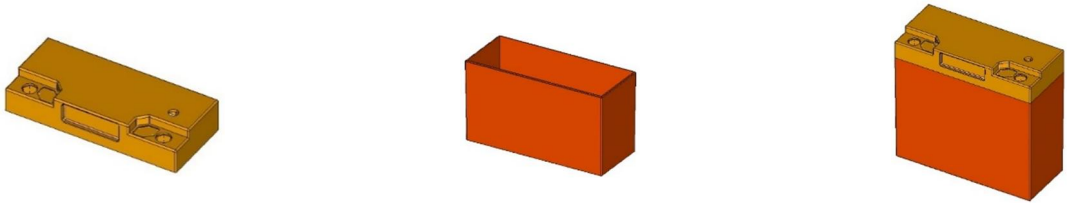


Figure 4. Charging / discharging circuit design and 8Cell pack balancing implementation

This paper describes a battery pack balancing method that uses a passive method to prevent charging / discharging for safety when measuring more than or less than a set value in one of eight cells, it is designed as shown in fig 4. The lithium battery used for development is 25V / 10A, and it can be used by regulating the voltage / current in the range of 250W depending on the situation.

Figure 5 shows the exterior design of the 1Kw small battery pack to be developed, taking advantage of its portability and practicality.



Battery pack cover Battery pack body Battery pack appearance

Figure 5. External design of the battery pack

This paper added additional video or UI layers to the video layer, adding dual-layer systems and multi-display systems to experience the sights, weather, maps, accommodation, festivals, and photo materials and more, we make it possible to add fun to the experience with a magnificent immersion and interaction with other interfaces.

4. Conclusion

The most common batteries currently in use are lead acid batteries. If you develop a 1Kw battery pack that you want to develop with lead battery, it will become bulky first and it cannot be used for a long time. A lithium ion battery was used to solve various practical problems in developing a 1Kw small battery pack for the purpose of this study. The combination of BMS (Battery Management System) and wireless communication or wireless network enables the expansion of battery pack and flexibility of maintenance. In addition, the cell arrangement inside the battery pack can be flexibly arranged, and the battery pack is designed and developed so as to reduce the size of the outer shape of the battery pack. In particular, additional data that can improve the accuracy of battery charge state (SOC) calculations can be collected from the BMS to improve the calculation of SOC and SOH with accurate timestamp data collection, and new sensors can be added to increase reliability We developed a low-power wireless communication-based battery pack.

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