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Design of Smart Battery Management System for Electric Vehicle

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ABSTRACT

The Battery is the most basic part of the Electric Vehicle, which serves as a major source of energy and gives it sustainable mobility. In electric vehicles, the technology that is highly recognized and used for energy storage is based on lithium chemistry. Nevertheless, the room for research is still open. This involves the collection of materials for the development of cells. The development of algorithms and the design of electronic circuits for a better and more efficient use of batteries is also one area of study. It is important to keep an eye on the critical operating parameters of the battery during charging for the optimum output of the batteries. A battery management system (BMS) is one of those mechanisms for monitoring internal and ambient battery temperature, current, voltage, and charging and discharge operations. Within this paper we speak about some of the popular battery control methods and framework. We also speak about the state-of-the-art device criteria for optimum battery efficiency and its general architecture.

Keywords : Electric Vehicle, Lithium-Ion Battery, Battery Management System, Energy Storage System

I. INTRODUCTION

Late innovative work advancements recommend that the cutting edge high-energy Litium Iron (LIB) showcase is to get energy transport later on. Regardless, the key obstructions to EV adoption are viewed as significant expenses and low adaptability, particularly in the wellbeing and drive extend gave by EV batteriesThe battery packages that contain a battery and BMS account alone for 40 % of the general expense of one vehicle among all the segments of the EVs. Indian EV organizations including Mahindra and Ashok Leyland right now rely upon imported LIBs or BMS, prompting a considerable ascent in costs. The expense of these merchandise is high.

BMSs are regularly utilized in workstations, PC and cell phones for compact gadgets, yet these BMS models are not reasonable for an application of EV. At the point when restricted to compact hardware, the quantity of cells required for the battery pack of an EV is exceptionally expanding. The BMS of an EV should subsequently be created so that the information delivered by each and every cell in the bacterium pack can be observed.

The essential functions of a BMS include:

(a) Signaling the wellbeing status, including protection, use, execution and battery life;

(b) Identifying and controlling the deficiency of each individual cell in the battery pack;

(c) Alert the client to an unordinary state, similar to voltage overheating or overheating.

(d) Temperature control for better management of intensity utilization.

Current BMs are just ready to refresh the accuse condition of constrained information listing functions. The Data Cataloging function sorts each bm information. In addition , it additionally remembers limitations for the estimation of wellbeing status and rest of life that are fundamental for arranging a battery substitution. Present day BMSs are equipped for estimating a large portion of the battery bundle's significant attributes (tension, current and temperature). Be that as it may, it is important to appraise all the more exactly a few highlights like voltage fluctuations and limit diminishing by a BMS. More work on BMS certainly will address the disadvantages and improve their proficiency with the end goal of upgrading client IT experience, subsequently expanding the penetration of IT on Indian markets.

As per the 2016-202 report on the Global and China Power Battery Managements, BMSs' market size will arrive at 7.25 trillion dollars by 2022, contrasted with the 2015 report of 1.98 billion dollars. The compound is required to arrive at 20.5 percent yearly development rate. In 2015, the biggest portion of the BMS showcase was possessed by North America, Europe , Asia-Pacific and the world.

Indian EV makers can import distinctive EV parts along with the BMS in Indian nations to make sure about huge scope EV arrangements by 2030. Worldwide EP makers will likewise have the option to broaden their incorporated plant exercises in India in the long haul. Most producers of electric transports make their own BMS. Shrewd BMSs, as BYD, Youtong, Proterra and EBUSCO, are delivered on the electric transport. By correlation, Wuzhoulong Motors offers BMS to the main lithium iron phosphate producer Optimum Nano.

In 2015, in accordance with the administration wide Make in India activity, KPIT innovations propelled the first savvy electric manufacturers in Quite a while. KPIT additionally fabricates BMSs in-house. Ashok Leyland got electric transports to India 2016 when they were imported from France batteries and BMSs. The transient options for bona fide EV fabricate with imported batteries and BMSs ought to be assessed top to bottom. Indigenously created progressed BMSs will permit the advancement of enormous scope EVs and safe operation of armadas in India for the drawn-out situation. A propelled BMS can be created in India through refined innovative work. The Make in India activity will add to the general expense of EVs by lessening LIBs' indoor yield potential alongside BMS.

The lithium-ion batteries once in a while need support over their life expectancy, which is a preferred position different batteries don't have. No modified cycling and no effect on battery memory are required. In addition, the lithium-ion battery is more qualified for electric vehicles in light of the fact that both lead corrosive and NiMH battery release rates are not exactly a large portion of the release rate. Those have a few downsides with respect to the lithium-ion batteries. Lithium ions are substantial. For each case, we need a protection gadget to guarantee these batteries are working securely. The Battery Management System (BMS) limits the greatest voltage of every cell while charging, and keeps it from falling underneath an edge while emptying. In addition, BMS tracks cell temperature and manages the day by day charging and release flows.

The proficiency parameters for lithium-ion cells are vital to temperature and voltage. In the zone checking "Stable Operating Area" the working voltage, current and cell temperature should consistently be protected in the green box. Whenever worked outside the security zone, the cell might be for all time harmed. The batteries can be charged over their evaluated tension or stacked beneath the necessary voltage. Overabundance flows stream if the endorsed most extreme constraint of 4.2 V was surpassed during charging and lithium plate and overheating would be activated. Through over-stacking the cells or holding the cells for a long time, the cell voltage will typically dip under its low breaking point (2.5 V), which could gradually kill the anode.

Cell balance guarantees that the charging on the cells inside the chain is equivalent to that on more vulnerable cells for the whole life expectancy of the batteries. Because of yield resiliences or conditions with a rising charge-release period, minor variations appear to increment in multi-cell battery chains. Poor cells can be overstretched during charging until they come up short, making the battery breakdown rashly. So as to powerfully explain the issue, the BMS can utilize one of the three cell adjusting systems to try and out cells and to forestall overpressure of individual cells, thinking about cell age and working conditions: the actuated adjusting plan, the pasive equalization plot and the charge sharing plan.

II. LITERATURE REVIEW

Lithium solar-powered batteries are commonly used. Due to a perfect other alternative, local energy independence, cost and reserve funds [5], this innovation has pulled into more consideration, particularly for an electric vehicle. For example, there are a number of critical factors in Li-ion batteries, such as robustness, reliability and well-being that should be targeted in all manner of versatile implementations [6]. The Li-ion batteries not only benefit from high power efficiency and high energy density, but they also have a remarkable ability and advantage of a very low discharge rate of about 6 to 10%, longer life cycle[7], high release current and terminal voltage, as well as non-memory impact. Furthermore, if Li-ion batteries are partially discharged even after charging, the memory-free effect would have no effect on usable power. Since electric vehicles have a high voltage and current requirements, Li-ion technology-based batteries are considered for use in comparison to other rechargeable batteries as they offer high voltage drive capacity.

The battery pack consisting of a large number of cells which are attached in either parallel (P) or a serial (S) connection[9] is used to provide high current and voltage to the load while applying "electrical vehicle (EVs)" and "plug-in hybrid electric car (PHEVs). This combination of a cell in the battery pack may be 1S2P, 1S3P, and 2S2P [10, 11]. A 13-modul battery pack with 2S2P is used in an electric IIUM car. According to the studies described in [12] [13], this technology represents the most important prerequisite for making a battery operational in the electric vehicle industry in the best "charge to weight" approach. It received a simple replacement of Batteries based on Ni-MH. Li-ion's one more advantage is the memory effect that is not available here, resulting in an improvised life cycle.

The Battery pack is a non-straight system, the usable limit is determined by the excessive temperature, under load, or over charging, and the cycles of charge-discharging. The battery pack should be administered by the executive's battery framework in order to provide the safe activity and ideal execution method[14]. At the end of the day, it makes good use of the battery, ensuring the most intense execution, considering the state and commitment of the present battery pack [15]. The battery management system is used mainly as a connection between various modules including the battery and device loading and charging source [16]. It also helps in improvisation in the performance of the vehicle and optimizing the operation in a safe manner.

The software and hardware management battery management system must consist of the following parts: SOC estimate, thermal control, balance of charges, communication and charging, discharge. In practice, the BMS collects all the key data, such as SOC, temperature, voltage and current, from a sensor, connected to the battery pack and moves the exact hardware during recharge and release operation. This article aims to establish the board structure for a remote battery to monitor the operation of the evaporation warm management system in order to maintain the temperature of the battery at 40 ° C and balance the cells' SOC with maximum variety of (0.75 ± 5%) Ah.

Proper and Exact estimations for state of charge (SOC) has always been a crucial issue in the construction of BMS for EVs. Precise and efficient analysis is not only need for the evaluation of the durability estimation of a battery, but it also gives some crucial analytical data, such as the remaining useable time or energy [16].

Eventually we can say that SOC gives us the idea about the driving range of the vehicle or the remaining power of the battery in EVs. A battery management system (BMS) performs monitoring of the battery internal and ambient temperature, current, voltage and controlling the charging and discharging operation. In this way, precise SOC estimation of Li-particle battery is a precarious assignment since it can't be straightforwardly surveyed utilizing any physical sensor [17]. Currently, the Li-ion battery SOC estimation is an interesting issue for analysts. A combination of SOC estimation procedures has been accounted for throughout the most recent decade.

III. IMPLEMENTATION

External power is a solution to the problems of energy loss and reliability of conventional battery balance systems when charging the small SOC cells / module from external sources. For that reason for instance, electric power generated by an ICE[18] or a solar panel (PV). Only because of the limits of area available for PV plant is it not at this stage possible to use solar power to power the vehicle as a whole. Although solar electricity is restricted, however, the battery balance can be used with solar power.

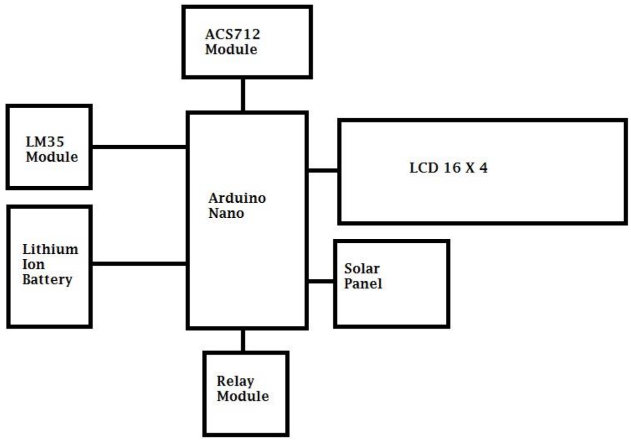

Figure 1. Block Diagram

A solar-powered battery equilibration system is proposed for this proposed system. A block map for the device is shown in Figure 3.1. It has 3 operation modes: (1) Solar and electric power will remain stored in an enclosed container during parking and charging of the truck for the high voltage battery modules. (2) On a sunny day, on low-voltage or SOC modules or on balanced modules, the whole battery pack is charged with solar energy. When solar energy is difficult to absorb, for example in dry, rainy weather or at night, the cell charges low voltage battery modules. Since the energy used to charge the active battery comes from an energy source separate from the battery pack, an additional energy loss can be avoided by the battery pack when it is balanced. The energy used for battery balancing is "safe," too, since it uses solar energy collection.

IV. CONCLUSION

This work originally depicted electric vehicles, lithium-ion batteries and BMS in the past. The overview of the BMS is subsequently addressed, including definition, priorities, functions and topologies. A segment was discussed below on battery models and BMS hardware concepts. There have also been early limits to battery models and other inconvenience to BMS hardware systems. This study then presented its objectives and outlines.

In this study, the Autoplastic effect of both batteries, temperature and the fading force effect were taken into account, a better battery model. The experiment was simulated and discussed by Matlab / Simulinke. A new BMS hardware framework was introduced based on a TI BMS concept. Through incorporating a user interface, thermal management systems and the new monitoring functionality, it enhanced the original program.

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