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DESIGN AND DEVLOPMENT OF ARDUINO BASED SMART BATTERY MANAGEMENT SYSTEM

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Abstract

This paper gives a smart battery management system for lithium-ion battery banks used in any device. Its miles incorporated with a diagnostic, size, and tracking device for enhancing Lithium-ion battery performance as much as its efficiency and conservation. This depend calls the want for studies on traction batteries as an insatiate demand exists for smaller device with light-weight and transportable equipment. It's far tremendous that batteries are strictly assessed and diagnosed earlier than having them rented or exchanged for their condition to be particularly maintained. The dimension of the battery's state-of-charge and State-of-health is derived from its load voltage, no load voltage, load cutting-edge, and temperature at some stage in experimentation. The estimation of State-of-Charge, State-of-health, Discharge rate, and ultimate beneficial existence are then derived by means of using the concept of correlation and regression from the yielded real-time parameters. In this project we are dealing with the Battery Management System which are used in many industrial and automotive applications to make the battery operations more efficient. The main functions of a Battery Management System are Battery protection in order to prevent operations outside its safe operating area. To increase the life span of li-ion based battery pack. To design an effective system with the help of Arduino NANO to monitor state of batteries.

Keywords: Battery, Amp hour, Arduino Nano, MOSFET.

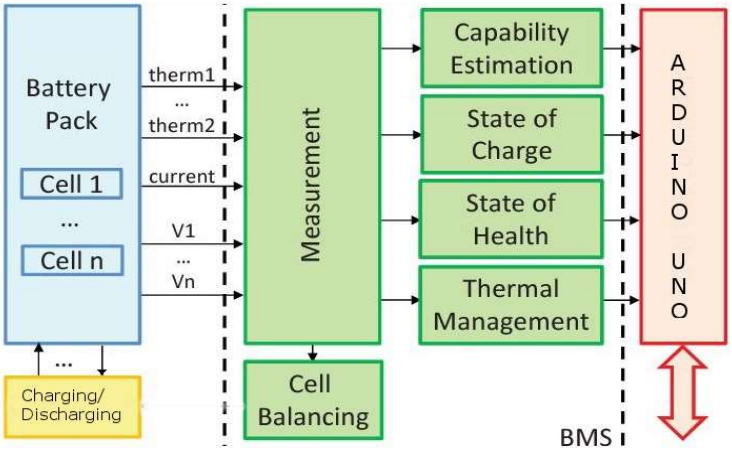
1. Introduction

Determining the overall performance of batteries is crucial for first- rate manipulate and battery control for many corporations. Recent rising markets inclusive of renewable energy want excessive performance batteries that may efficaciously and successfully store the energy. Demand for battery control systems is currently developing and help attain pinnacle performance for those markets. Those systems permit determination of how long the battery will remaining below given masses and assist expect the overall
performance of the battery. This size will tell in actual time the ultimate fee of the battery. Battery Management Systems enhance safety and efficiency. Generally, a Battery Management System is an analogue and/or digital electronic hardware device complemented with specific software, that is added to a battery system. The primary function of a BMS is to fulfil safety requirements. But there's more to it. Objectives related to the more efficient usage of battery cells

and a prolongation of their lifetime are also being increasingly integrated into the design of BMS.
Minimal requirements for a Battery Management System.
While there is no unique definition of a BMS, the world does seem to agree that it should be designed with a minimal set of requirements.

- It must measure individual cell voltages
- It must measure temperatures at different points as close as possible to the battery
- It must measure currents flowing through it
- It should communicate information to control units and undertake action to ensure the battery will be operated within safety limits
- It should balance battery cells passively or actively
- It should provide thermal management
- It should be able to detect and isolate faults
- It should protect against short circuits

2. Block Diagram Of Arduino Based Battery Management System:



Battery Management System (BMS) is an electronic system that manages a rechargeable battery to ensure it operates safely and efficiently. BMS is designed to monitor the parameters associated with the battery pack and its individual cells, apply the collected data to eliminate safety risk and optimize the battery performance. Here is the block diagram of Arduino based battery management system. In this we connect n number of cells which are connected in series to get a desired voltage and capacity depending on the application. So, we need to design a circuit which can measure a temperature of individual cell, current flowing in the battery pack while charging and current flowing from the battery pack while discharging and individual voltage of cell so that we can achieve cell balancing which is extremely important in battery pack containing multiple number of cells in series. A microprocessor such as Arduino NANO is to be programmed so that it can take input of various parameters of the battery pack as I mentioned before and calculating things like capability estimation i.e. how long the battery pack last for a given load, state of charge i.e. current charging capacity of the battery , state of health i.e. it figure out the condition of battery as compared to its ideal condition and thermal management so that battery pack shouldn't over heat while charging and discharging which can be a serious fire hazards.

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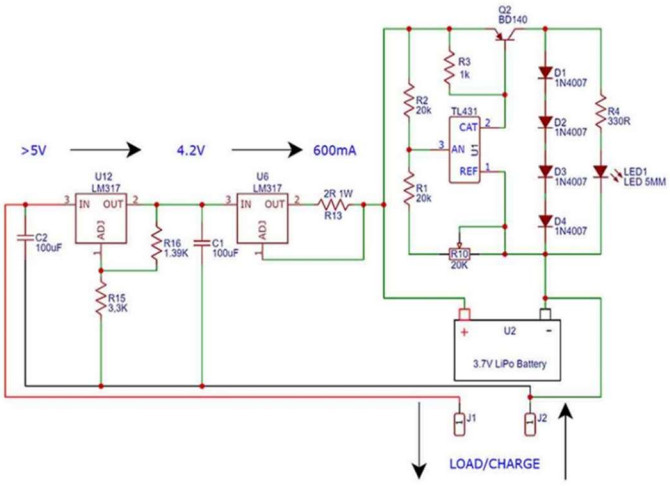
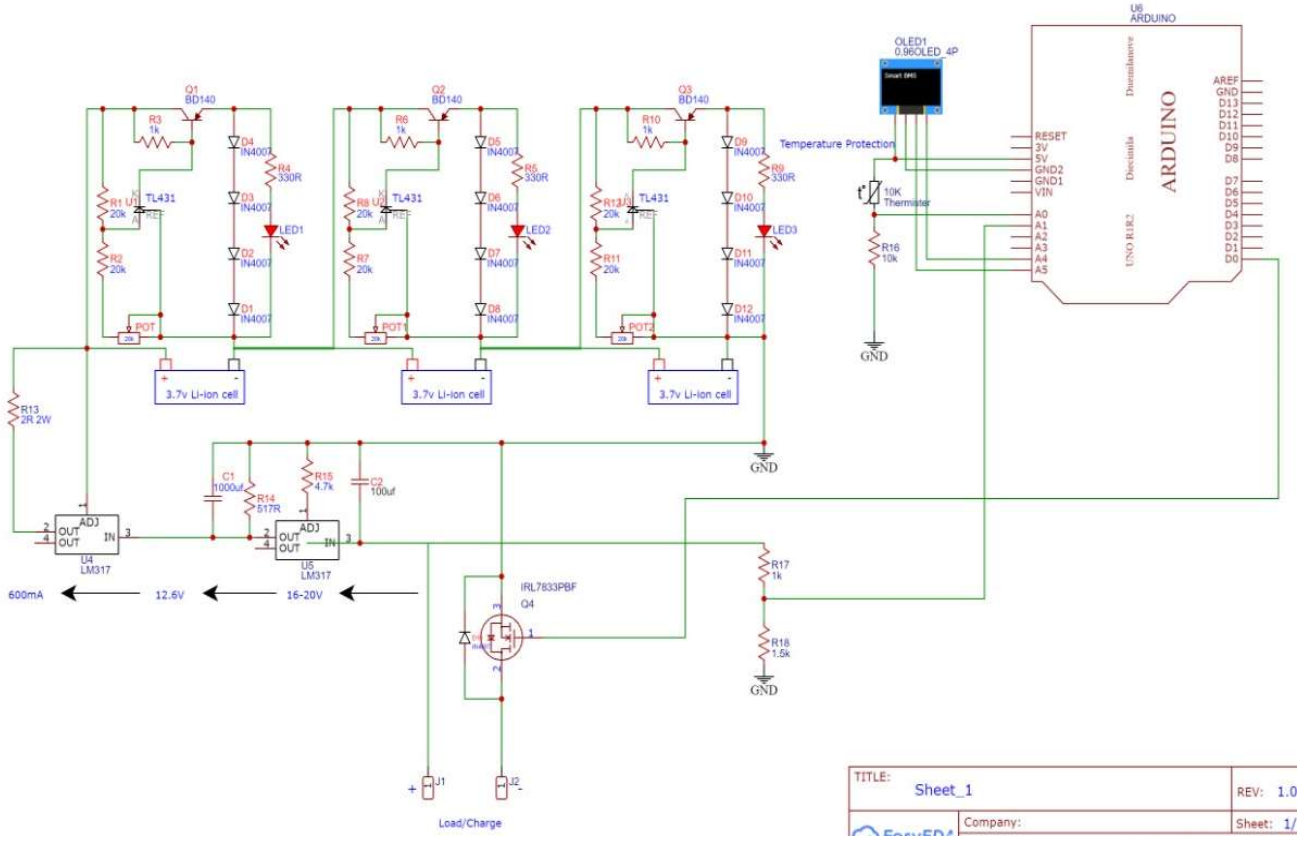
3. Proteus Simulation Circuit Of Arduino Based Battery Management System:



We have a PNP transistor connected in series with 4 diodes that will simulate a load. At the base of the transistor, we have a ZENNER reference diode (TL431) which will get open at a certain voltage value and by that connects ground to the transistors base and when the transistor is active, we bypass the battery and waste the power on the diodes instead. This ZENNER diode is the TL431 and it has a reference pin, so by adjusting the potentiometer we can set this reference to be at 4.2V, that's how we select when the charging process will stop.



The working of the 3S charger is exactly similar to that of the 1S charger with some added functionality to achieve individual cell balancing. All the cells in the battery have their own transistors and reference diodes because of which if one cell is charged faster than other cells in the battery it will independently stop charging without interfering with the charging of the other cells.

4. Technical Specification:

Sr.No.	Equipment's	Specification
1.	Lithium- Ion cell	3.7V, 2500 mAH
2.	Power MOSFET	IRL7833PBF
3.	Arduino NANO	ATMEGA328P NANO
4.	PNP Transistor	BD140 (Up to 1.5 A)
5.	LM317 in voltage regulator mode	V_{out} = 1.25 – 37 V $V_{in} - V_{out}$ = 3 – 40 V
6.	LM317 in current regulator mode	I_o (MAX) = 1.5 A I_L (MIN) = 3.5 mA
7.	TL431	2.5 – 36 V (1000 mA)
8.	IN4007 DIODE	1A – 30A
9.	POTENTIOMETER (20 K)	0 – 20 KΩ
10.	RESISTOR	1KΩ,1.5KΩ,4.7KΩ, 10KΩ, 20KΩ
11.	THERMISTORS	10 KΩ
12.	CAPACITORS	1000µF & 100µF
13.	Wires, Protection Equipment	-

5. Result

The main goal of Battery management system is to keep the battery within the safety operation region in terms of voltage, current, and temperature during the charge, the discharge, and in certain cases at open circuit. Based on this work, specific challenges faced by Battery management system and their solutions were presented as a foundation for future research. Based on the particular situation, different strategies can be applied to upgrade and optimize the performance of Battery management system. In this way we are developing the system model for battery management in electric vehicle by controlling the crucial parameters such as voltage, current, state of charge, state of health, state of life, temperature. It is every important that the Battery management system should be well maintained with battery reliability and safety. This present paper focusses on the study of Battery management system and optimizes the power performances of battery pack. Moreover, the target of reducing the greenhouse gases can greatly be achieved by using battery management system.

References

[1] Y. Gao, X. Zhang, Q. Cheng, B. Guo and J. Yang, "Classification and Overview of Commercial Lithium-Ion Battery Charging Strategies," IEEE Access (2019)

[2] Y. Wu, W. Li, Y. Wang and K. Zhang, "Predictions of Useful Life of Lithium-Ion Batteries Using Bat-Based Neural and Particle Networks," IEEE (2019).

[3] H. Ren, Y. Zhao, S. Chen and T. Wang, "Design and implementation of a battery management system with active load balance based on online SOC and SOH estimates online," Elsevier Energy, (2018).

[4] Y. Wang dan Y. Liu, “Electronic Control System Design and Test of Pure Electric Vehicle Battery Management System,” dalam IEEE, (2011)

[5] Deng, Y.; Ying, H.; E, J.; Zhu, H.; Wei, K.; Chen, J.; Zhang, F.; Liao, G. Feature parameter extraction and intelligent estimation of the State-of-Health of lithium-ion batteries. Energy 2019

[6] Harris B. Mathews, Soumya Saraswati “Coordinated Supply of Solar and Wind Energy Using MPPT to Power Micro-Grids along with Battery” International Journal of Science and Research (IJSR) ISSN: 2319-7064 ResearchGate Impact Factor (2018)

[7] W. Chen, J. Liang, Z. Yang and G. Li, "A Review of Lithium-Ion Battery for Electric Vehicle Applications and Beyond," Energy Procedia, (2019).

[8] D. D. Artakusuma, H. Afrisal, A. I. Cahyadi dan O. Wahyunggoro, “Battery management system via bus network for multi battery electric vehicle,” dalam 2014 International Conference on Electrical Engineering and Computer Science (ICEECS), Kuta, Indonesia, 2014

[9] Xiong, R.; Sun, F.; Gong, X.; Gao, C. A data-driven based adaptive state of charge estimator of lithium-ion polymer battery used in electric vehicles. Appl. Energy 2014.