

Proposal for Master Thesis

# Intelligent and Modular Battery Management System (IMBMS)

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## *Introduction:*

Battery management system is a system that implements the optimal use of a battery in a portable device [1]. BMS, which is an acronym for Battery Management System, consists of different modules with different functionality. DC/DC converter, charger and cell balancer are the common components. During battery management operation, measurements are taken, analyzed, transmitted and finally the battery is managed. BMS manages a battery pack in three ways [3]. These are monitoring (protection), balancing and thermal management. In battery monitoring, the battery is kept from damage by using the safe operation area (SOA). Battery monitoring provides a full protection to the pack [3]. In battery balancing, the battery pack's performance is maximized by balancing the cells [3]. Thermal management attempts to bring the temperature into its safe area. Battery management system for multi-battery chemistries is preferable. Some of the battery chemistries are LFP (LiFePO<sub>4</sub>), Li-Ion, Li-Polymer, NiMH, NiCd and (SLA) Sealed Lead Acid batteries.

In battery management system, multitasking should be implemented. There are two ways which are real-time operating system (RTOS) and simple multitasking scheduler [4]. RTOS simplifies code writing with flags for inter process communication and implements prioritized scheduling. Its disadvantages are it needs more code space, RAM resources and has learning curve which includes a lot of details for control and task switching. Simple multitasking scheduler equips the programmer with full control over the code generated. It needs a small amount of memory. Its disadvantages are the programmer has to decide the processing time and has to be on top of how the code should work. There are many RTOSs which can be classified based on the platform (ARM, x86, PowerPC, ATmega...) and license (open source license, non free software license). Some of the popular RTOSs are Free RTOS, Unison RTOS, Contiki RTOS, and QP...

## *Motivation:*

In PMC project, where EO2 is enhanced, a BMS that can manage multi-cell battery packs is required. The BMS should be scalable and implement RTOS.

## *Goal:*

The goal of this master thesis proposal is to design and develop a modular, fault tolerant and intelligent battery management system that can manage multi-cell battery packs. This battery management system can supervise charging, discharging, balance the cells, protect battery package and communicate. The charging and discharging operations are performed based on the parameters such as current, voltage, temperature, SOC (state of charge) and DOD (depth of discharge). The communication between BMS and vehicle is required to facilitate

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human or machine control. For debugging purpose, communication between BMS and workstation is required. To implement modularity, Communication between BMS modules is required. The proposal will be implemented with STM32f107  $\mu$ C. Instead of writing a multitasking scheduler, RTOS will be adapted.

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  - BMS software
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- Conclusion
  - Conclusion

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- Outlook (Future research)
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- Appendices

### *References:*

[1] H.J. Bergveld. Battery Management Systems Design by Modeling. Page: 9. Netherlands: Royal Philips Electronics N.V. 2001

[2] Battery Management System

<http://www.mpoweruk.com/bms.htm> (Accessed: 18 March 2012)

[3] David Andrea, Battery Management Systems for large Lithium-Ion Battery Packs. USA: ARTECH HOUSE, 2010

[4] Multitasking for PIC micros

<http://www.best-microcontroller-projects.com/multitasking.html> (Accessed: 17 April 2012)