Report on Battery Management System [Module-2]

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1. What is a BMS why is it Important?

Batteries are the most important propellant today. With increasing power density, the volatility of the batteries increase. There have been many cases of spontaneous outbreak of fire through such batteries for example, The most widespread example of this is the Lithium ion batteries, which is applied in applications from inverters at home to powerful power sources for vehicles each one of which requires very high levels of safety. Lithium ion batteries need intricate monitoring of the incoming and outgoing charge. When the each lithium ion cell is connected in a series or parallel configuration the resultant battery pack as a whole should charge and discharge equally thereby preserving its state of health and protecting from over-discharge or charge. Battery Management system (to be referred as BMS) serves the following purpose.

- Prevent cells from over-current.
- Prevent cells from under-voltage.
- Prevent cells from high temperature thermal runaway.
- Balance each and every cell in the battery pack for the same amount of charge.
- Data logging of current and voltage data.

2. Application definition & Requirements

2.1 Application

The problem statement requires us to make a BMS for the power-train of an electric vehicle with a total of 400 cells configured as 40s10p meaning 40 cells are connected in series and corresponding 10 cells are connected in parallel.

2.2 Table of Requirements

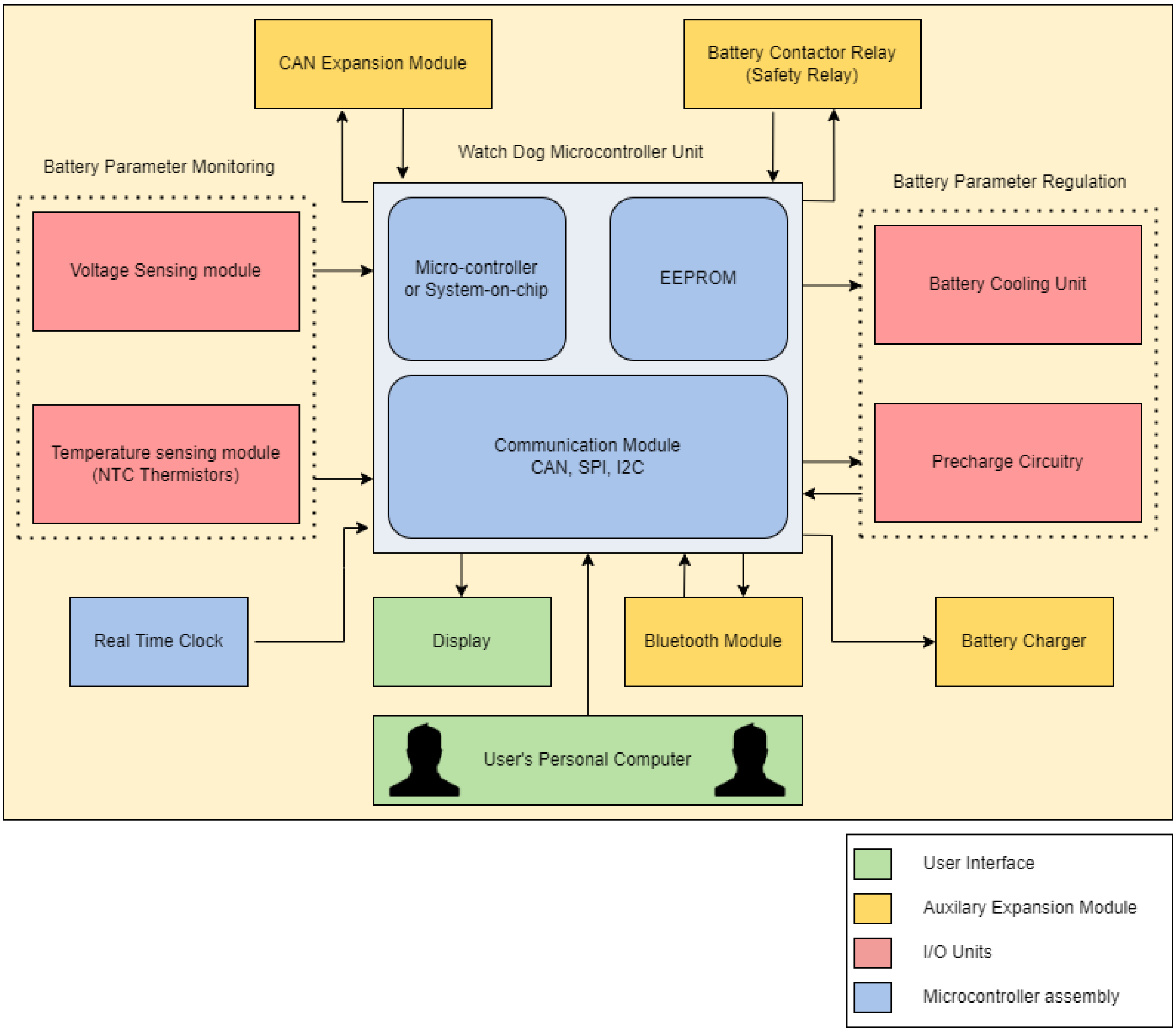
High Level Requirements

Requirement ID	**Design Consideration**
HLR-1	Maximum 40 sensing wires
HLR-2	Thermal Runaway protection (>65ºC)
HLR-3	Under-voltage protection (<2.5V)
HLR-4	Over-current Protection (>200A)
HLR-5	Maximum Voltage (180V)
HLR-6	Watchdog Embedded System for DAQ

Low Level Requirements

Requirement ID	Low Level ID	Design Considerations
HLR-1	LLR-1	The wire resistance shall be less than 0.05Ω
	LLR-2	Wire positive locking
	LLR-3	CANBUS Support
	LLR-4	Error Signal LED
HLR-2	LLR-1	Use NTC thermistor (10K)
	LLR-2	Voltage divider with 10KΩ
HLR-3	LLR-1	500 Ω/V Galvanic Isolation
HLR-4	LLR-1	Use Hall Current Sensor.
HLR-5	LLR-1	Contactor Shutdown switch
HLR-6	LLR-1	CANBUS support
	LLR-2	Fast floating point calculation
	LLR-3	ARAI Approved
	LLR-4	Expansion module support

3. Block Diagram of the Embedded System



4. Sub-system Level Design Details

The Battery Management System is a system which requires prompt and real-time monitoring of fuses, voltages, and current.

The different subsystems are as follows:

- Software
  - RTOS for multi-channel and multi-sensor monitoring.
  - Component to Component and User to Component CAN Bus signal enabled.
  - Modularity within the software for battery parameter variables.

    - Temperature Monitoring
    - State of Charge and State of Health monitoring.
    - BMS Error diagnosis firmware.
    - Easy to understand error codes.
- Hardware
    - Galvanic Isolation between the sensor and MCU.
    - SoC with 20+ sensing channels.
    - Fused sensing terminals.
    - PCB traces appropriately calculated for the maximum design current.
    - High EMI and Noise immunity.