**Software Architecture**

**System requirements:**

The battery management system consists of three main functions to complete the task.

**Balance system**

This system requires keeping all cells in the same charge level in charge and discharge operation the objective of the software is to calculate the balance thresholds and handle balance times.

**Protection system**

This system requires keeping the pack cells in a safe operating area and preventing the system from exceeding the limitations of voltage and current. The software aims to monitor these variations and send flags to contractors or fuses.

**Monitoring systems**

This system displays the state of charge, state of health, and system status. The aim of the software is to deal with graphical display LCD.

**Software Modules**

Due to reliability, we will divide the system into modules. In each module, we will put a microcontroller unit and communicate with each other by CAN reducing the EMI effect. Each microcontroller has modules specified to do the required task in a usable way.

In the master control unit:

Communication management module: CAN communication module only.

Math functions modules: compute balance threshold by taking the average and compute the state of charge by integration.

DIO modules: to control the protection contractors and to control charger and pre-charger circuits.

In the battery module system:

Communication management module: CAN and SPI communication modules.

Data acquisition module: organize and collect data in a readable way.

In the Monitoring Module system:

Communication management module: CAN and SPI communication modules.

LCD module: to deal with data packets send to and come from the LCD

**Static Design:**

Components:

1. Battery monitor and balance IC “LTC68”.
2. Protection contractors and relay.
3. LCD display.

Communication between components:

At the battery module level, the communication between LTC and the controller is SPI protocol and between this controller and the main microcontroller is CAN protocol.

At the monitoring module, the communication between the controller and the LCD display is by SPI protocol, and between this controller and the main microcontroller is CAN protocol.

At the main microcontroller, it communicates with other systems by CAN protocol.

Inputs and outputs of the systems:

**The battery module level**

Inputs: balancing thresholds.

Outputs: voltage and temperature measurements.

**The monitoring module**

Inputs: system status and data.

Outputs: configuration settings.

**The main microcontroller**

Inputs: voltage, temperature, and current measurements. System configuration settings

Outputs: balancing threshold, state of charge, system status. Actuating signals to contactors and relays. Indication signals

**Flow Chart**

Graphical user interface, application

Description automatically generated