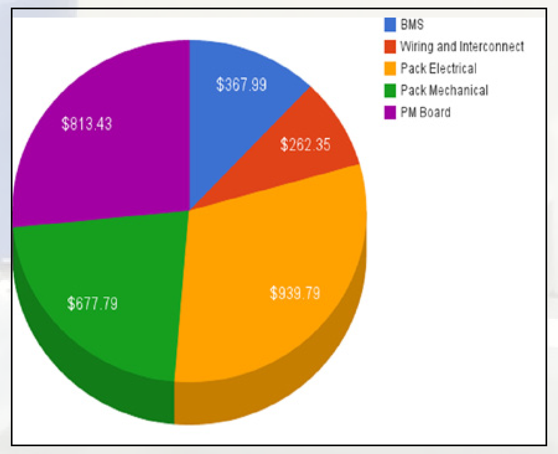
Lafayette Formula Electric Vehicle Team 2014

For more information please visit our website:
http://sites.lafayette.edu/ece492-sp14/

Introduction

The 2014 Lafayette Formula Electric Vehicle team continued the work of the LFEV 2013 team. Our goal this year was to get one out of four battery packs needed competition ready so that next year's team could simply fabricate the three additional battery packs without any design needed. We also aimed to use the research done by last year's team to create a proposal for the acquisition of an electric motor and motor controller so that next year it can be implemented and tested as a whole system. In previous years a lot has been accomplished but nothing has been developed to a competition ready stage. We felt that if we provided a working motor, controller, and a working battery pack, the LFEV 2015 team would have enough to be able to compete in next year's competition.

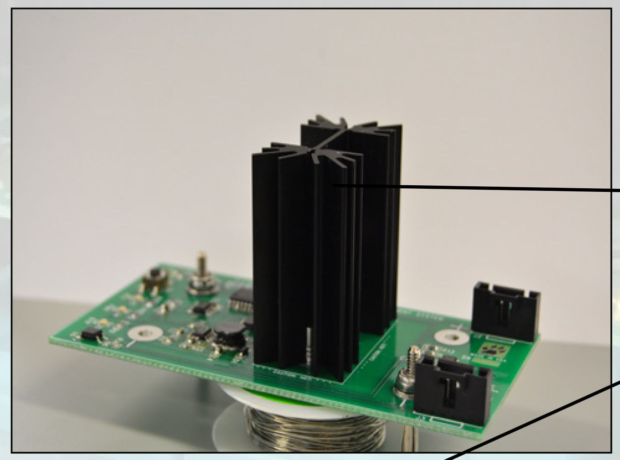
Budget

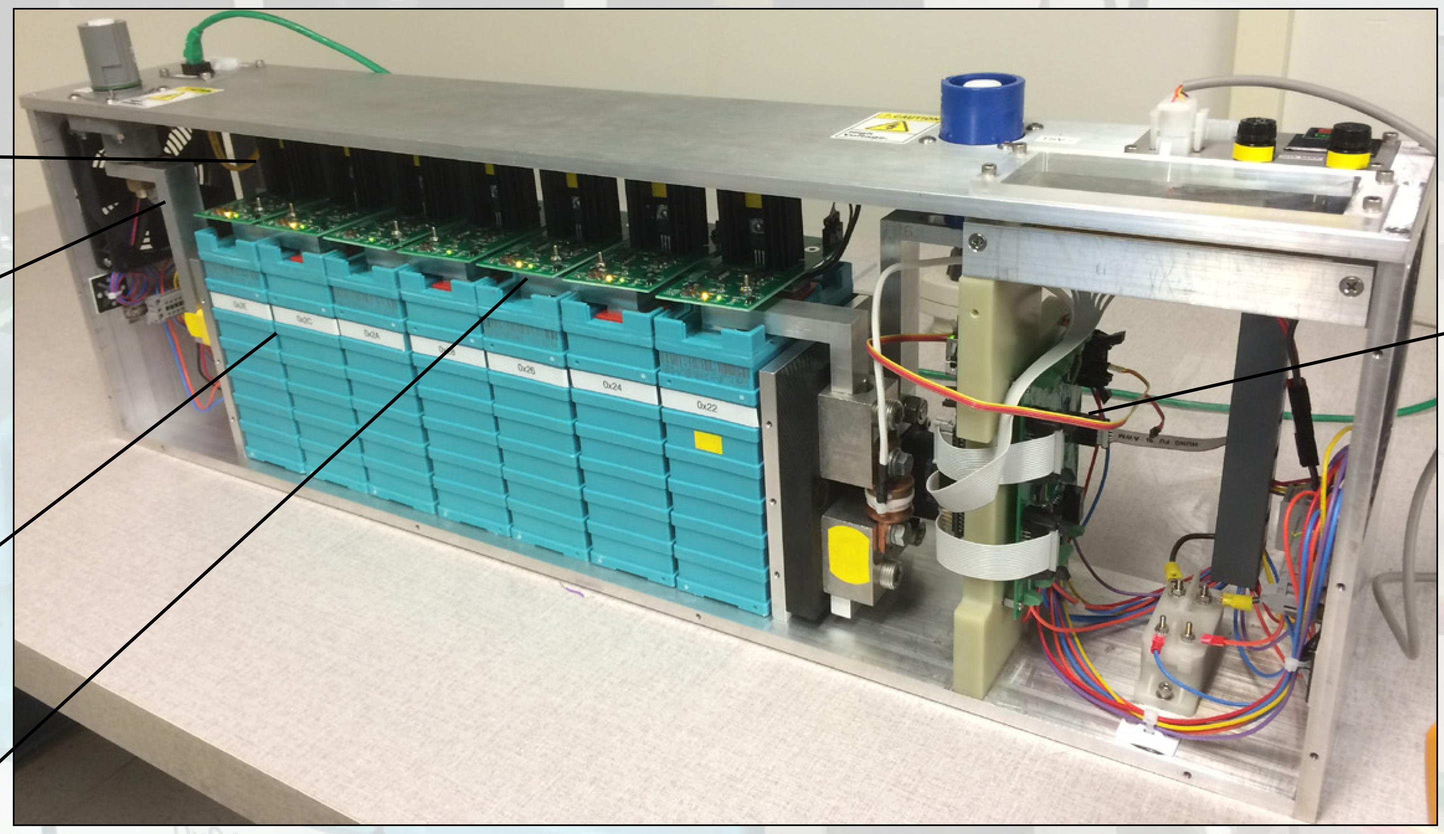


Our team spent a total of $3,061.35 of our allotted $3000 budget. We had planned for $900 for the total cost of the pack components, but ended up spending way over the allotted amount. This can be attributed to unforeseen costs of the pack parts. We over budgeted in other areas namely the AMS and PM boards, which kept us only slightly over budget. We went over budget to buy extra LED boards in case of failure, rather than jeopardizing our end product.

Change in Heat Sink

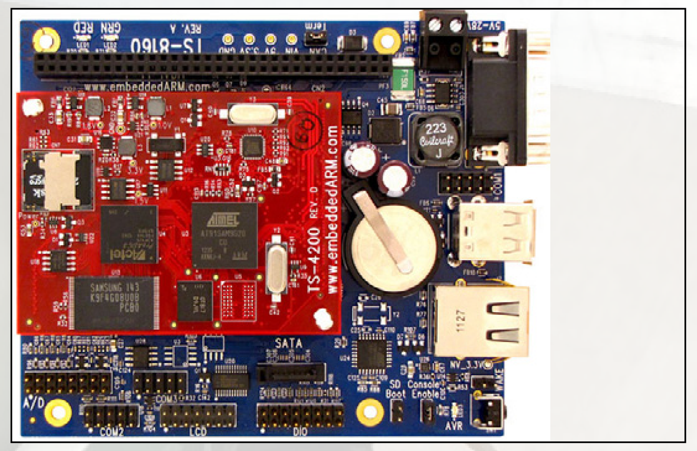
We decided to improve upon the heat sink design put in place last year by reducing manufacturing time and assembly time. The new heat sink we used consisted of only one part and one screw, and can be soldered directly to the Accumulator Management System board. Since the power dissipation of this heat sink wasn't quite enough, we added a fan to operate during charging to keep the system within the safe temperature range.

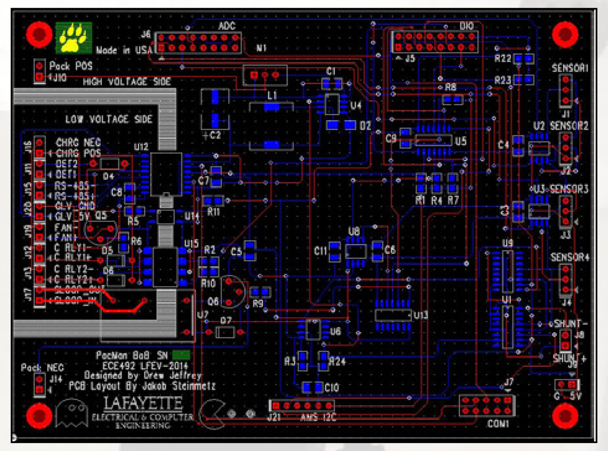




PacMan

The Pack Manager (PacMan) is responsible for monitoring and controlling pack-level parameters, including plug and forget charging. It consists of an industrial, low-power, ARM microcomputer, the TS-8160-4200 from Technologic Systems, and a custom-designed breakout board to interface the computer with the pack's sensors and the outside world.





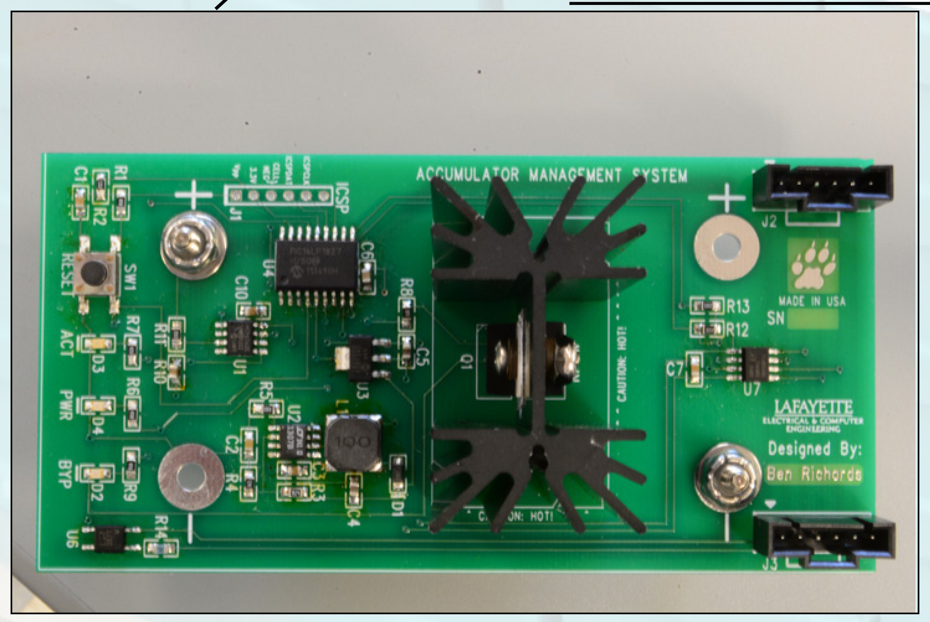
Reducing Mechanical Connections

The 2013 pack used five unnecessary metal to metal connections that could be eliminated using larger pieces of material specifically machined for the layout we designed. We oriented the components in such a way as to eliminate the need for those extra connections while maintaining the ability to assemble all the parts. This proved to be a challenging task and many revisions were made before a design was agreed upon. These new parts can be seen coming off the battery cells and going up to the large connectors towards the middle of the pack. In addition to reducing the number of parts, this also reduced the overall current path resistance. We were able to successfully reduce the resistance to half of the 2013 pack.

Change in Layout

In an effort to minimize the overall length of the pack, we oriented the cells side-by-side with the long faces touching as well as moved all the connectors to the top of the pack. This will allow for the battery packs to be mounted on the car between the wheels next to the driver. This decision allowed the connectors to be more accessible once the packs are in the car.

Accumulator Management System

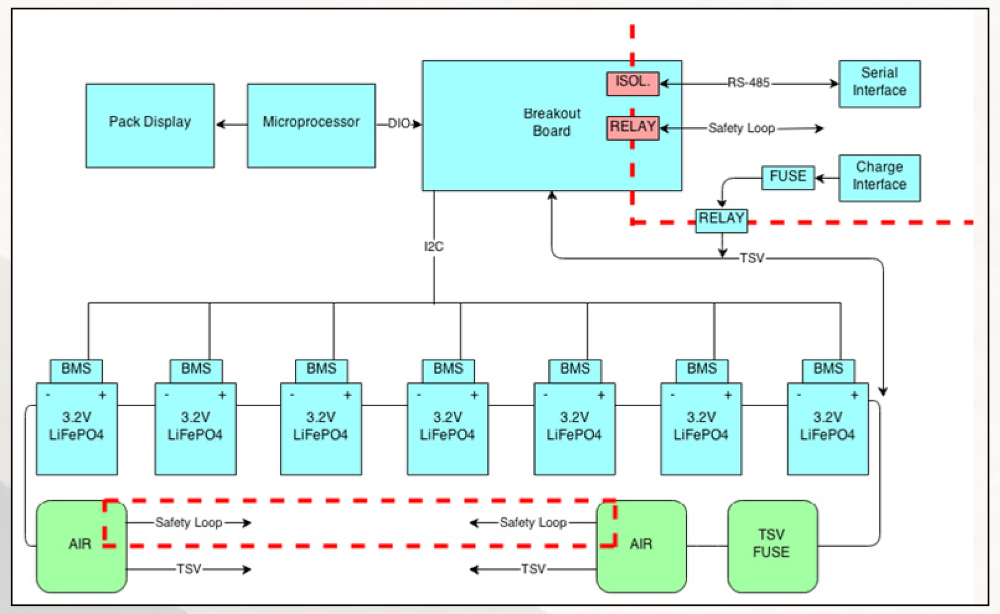


The main purpose of the AMS board is to monitor the parameters of its given cell and relay this information back to the pack manager board. Using I2C it reports these values when polled. This AMS board also controls the cell bypass when told to do so by the PacMan. Each AMS board has its own microcomputer in order to digitize the cell data per cell, rather than having the main PacMan board converting all the analog signals. This significantly reduced the number of interconnections needed throughout the Battery Pack.

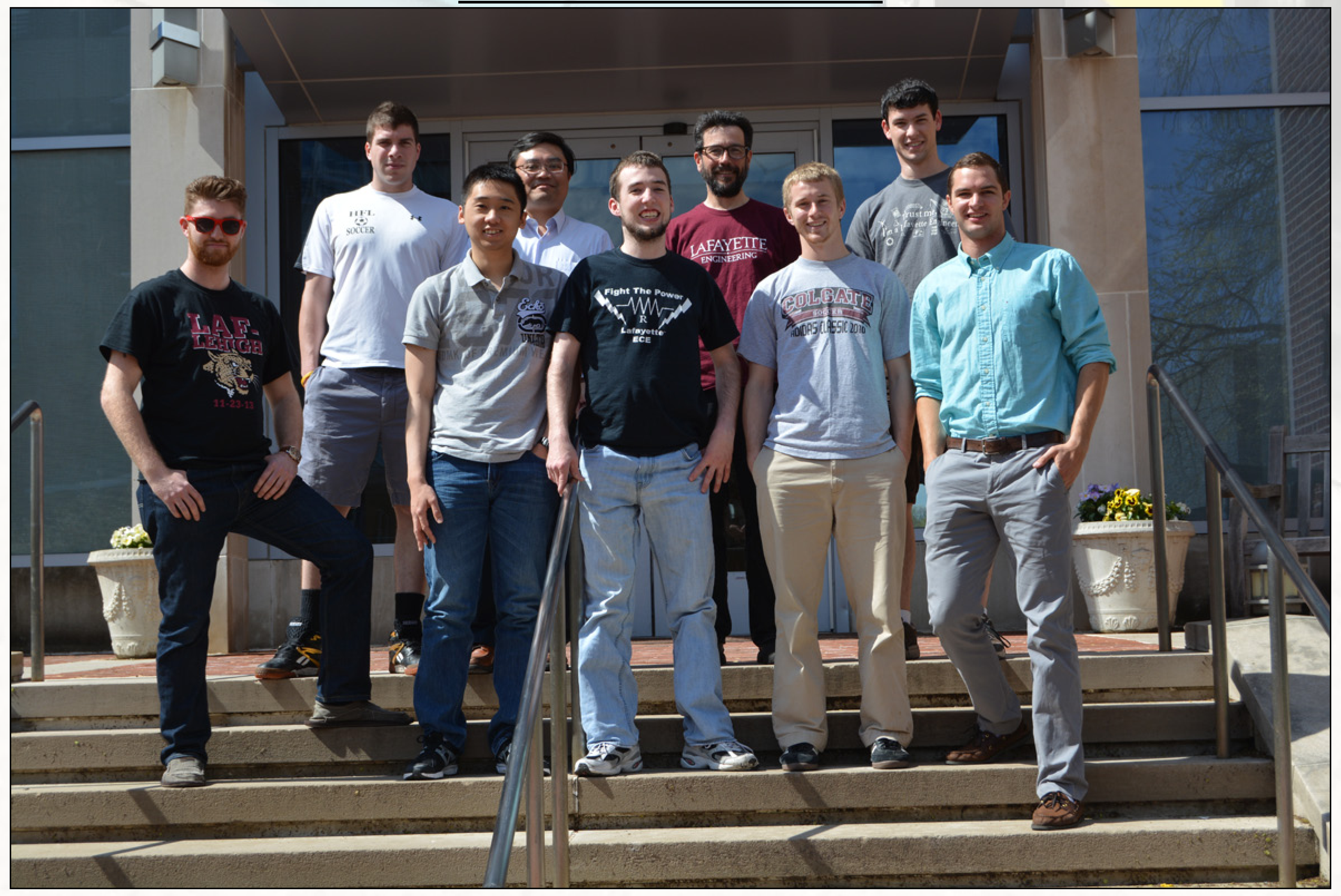
Software

The main purpose of the Battery Pack software is to check the safety of the pack, continuously polling the Accumulator Management System for each individual cell. If an unsafe voltage or temperature is detected, the pack safety loop is opened. Information gathered from the AMS boards is displayed via the LCD board on the pack, as well as output to the Central SCADA system. The second purpose of the software is to aid in charging. Voltages of individual cells are monitored and bypassed if the voltage is too high compared to the other cells being charged. The software also responsible for calculating the overall pack state of charge and displaying the information on the LCD board. IT communicates with each of the seven cells AMS boards via I2C, and with the Central SCADA system using RS-485.

System Overview



Team Introduction



Left to Right: Rob Lombino, Constantine Deir, Naing Htet, Professor Yih-Chuong Yu, Drew Jeffrey, Professor Chris Nadovich, Ben Drake, Ben Richards, Jake Steinmetz

Motor Proposal

The MCS and test stand had been researched in previous years, but made significant strides towards the actual acquisition this year. The AC-50 AC Induction motor manufactured by High Performance Electric Vehicle Systems was selected based on is performance and compatibility with the Formula EV specifications. Extensive simulations were done on this motor to assure that it would perform to the standards we were looking for.

Additionally, we researched the equipment necessary to run and test the motor. One of the most important items was a dynamometer which we need in order to run load tests on both our motor and final four-pack configuration. We also researched a power supply that could supply the motor for independent testing.

Currently pending approval, the purchasing of this motor and the test configuration will provide valuable insight towards producing an effective battery pack. This will advance the project with the hope that we will compete in the near future.