ET NavSwarm – PCB Design

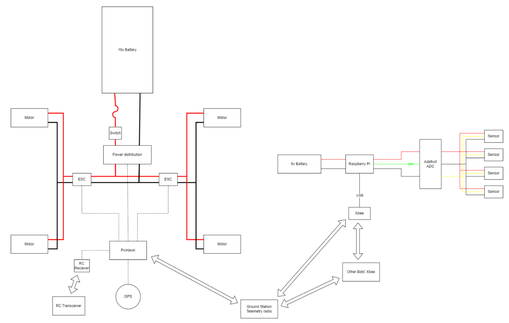
Nick Snyder, Nate Cannon, Anuj Joshi, Cooper Montgomery, Sam Muldrow
Department of Electrical and Computer Engineering, University of New Hampshire, Durham, NH 03824

Introduction

ET NavSwarm is an interdisciplinary group with the end goal of sending a swarm of small autonomous rovers to another planet to prospect for materials. The group is now implementing the particle swarm algorithm to all the rovers to communicate with each other. Some areas for improvements the group have identified are active battery monitoring and hardware longevity.

Rovers

Swarm of Five Rovers



Wiring Diagram and High-Level Schematic of the Rovers

Results

Delays were faced in the development of this board. From finding out of stock chips to simple spelling errors for part numbers while trying to send the fabrication and assembly order. The MOSFET driver ICs and the 5V buck regulator IC are among these chip shortages from the fabricator. This has resulted in looking toward other part marketplaces for the necessary components.

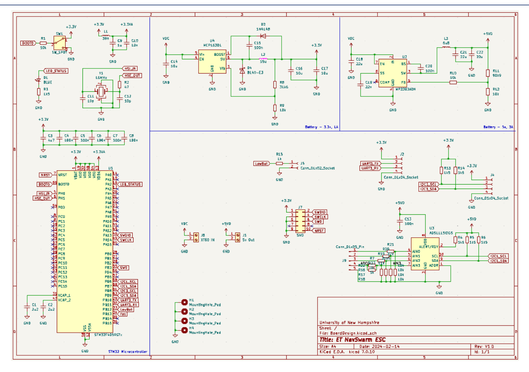
Methodology

My focus was on motor control and how to increase the reliability of the rovers. I chose to design an all-in-one printed circuit board to control the motors and watch battery health. I created my designs in Kicad and fabricated the boards with the help of JLCPCB out of China. My goals were to design an easy to program motor controller with enhanced battery monitoring to alert the users of failing or degrading batteries.

Designs

Features:

- I²C
- UART
- SWD
- XT60 power input
- 16 MHz external clock



Schematic

Conclusions

Designing a PCB is a valuable skill for engineers rarely taught in the classroom. YouTube videos, application notes, and datasheets were combed through for optimal layouts for buck regulators or ensure steady DC for the MCU. Looking at components on quality speed controllers helped narrow the search. A version 2.0 would include higher current capabilities for the MOSFET drivers and the 5V output.

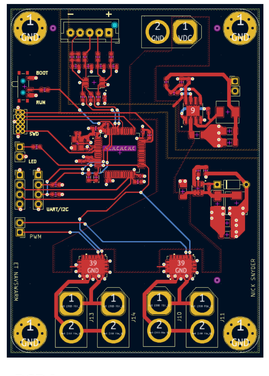
Data

This design is centered around the STM32F4 MCU. This is a very capable chip with variations found in high power speed controllers for electric bikes. A buck regulator circuit powers the MCU while it sends and receives data on an I²C network for reading the cell voltages of the battery and displays it to an LCD along with interfacing with the MOSFET driver ICs. Another buck regulator circuit supplies power to an external Raspberry Pi and Arduino for autonomous capabilities.

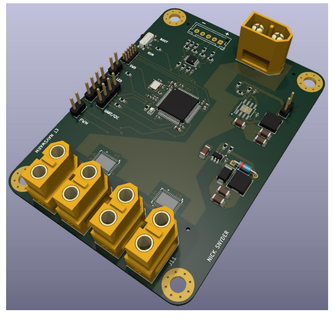
Printed Circuit Boards

Features:

- 4 layers
- 2 internal PWR/GND planes
- HASL (lead)
- FR4
- Dimensions: 65mm*90mm



PCB Layout



Ray-traced render of PCB

Acknowledgements

Jim Abare, TSC Staff
Qaioyan Yu, Ph.D., Advisor
May-Win Thein, Ph.D., Advisor
Electric Vehicle Organization, Student Organization

References

Phil's Lab, YouTube Channel
Texas Instruments, Datasheets
ST Microelectrics, Application Notes