EE/CprE 4910 – sdmay25-26
Week 8 Report
10/31/2024 - 11/7/2024

Cost-Effective and Easily Configurable High Voltage Motor Controllers for Automotive Use
PRISUM Solar Car Club, Jonah Frosch
Nathan Neihart, Cheng Huang

Summary

After hours of trial and error, the development board and generated code finally can spin the motor in either direction for a little under a minute without faulting. Of course, some errors persist, but as measurements improve and debugging continues, reliability will increase. With these updates and lessons learned from the previous advisor meeting, we find ourselves in a stronger spot than before and sporting a better plan for the rest of the semester. Here is a link to the motor spinning and another link with throttle control.

Accomplishments

- Fixed configurations used to characterize motor – Marek
    - Increased reliability with new inductance, resistance
    - Hall effect sensor parameters updated
- Fixed development board software to make motor run – Bryce
    - Worked with Marek to debug software; fixing errors in code generation
- Tested gate drivers with transistors in LTSpice
    - Identified the transistor for our rev 1 design, the IRFP4668
    - Identified gate driver for rev 1 design, the IR2132S
    - Discovered potential issues before they came true

Pending Issues

Our biggest current concern with the project is hardware lead times of custom Printed Circuit Boards from Detroit. Debugging code generated for the development board has proven to be more time intensive and difficult than expected. While debugging is rarely a simple process, the complexity and compatibility of this generated code makes it extra difficult to reverse engineer. Finally, one of our group members, Jonah, has been very ill recently so we've had to take some precautions, but he's getting better and should hopefully be fine by the end of the week.

Individual Contributions

Member	Contributions	Week Hours	Cumulative Hours
Gavin Patel	More code generation and editing software plan	4	42
Bryce Rega	Fixed dev board software	12	49
Marek Jablonski	Got motor spinning, lots of LTSpice Simulations	15	52
Jonah Frosch	Was *sick*, started KiCad Schematic work	3	39.1
Long Yu	Participated in and edited documentation	6	40

Upcoming Week

- Hardware
    - Create new simulation setup with mostly ideal gate drivers to run simulations much longer for long term behavior,
    - Starting schematic work based on simulation setup
- Software
    - Helping ensure dev board configuration setup is correct
    - Keep on reverse engineering the previously generated code
    - To show progress we can on the block diagram have an indicator to show where we are with the progress on the skeleton code
- Put together updated advisor presentation
- Develop the next sections of the Design Document

Advisor Meeting Summary

- Overview of project
    - Nominal power is 2 KW, max current 50 A
    - Talked about how we want to design to be able to share with other collegiate solar car teams or not, up to us.
- Overview of project scope and goals
    - No comments
- Overview of software updates
    - No comments
- Overview of hardware updates
    - Need to look into adding capacitors and Inductance measured to the LT spice model to make for a more accurate simulation
    - The inductance value seemed way too large
        - Need to add capacitance and remeasure inductor to ensure values are correct
    - Look into how much dead time, and rise time and fall time to use ideal model to be able to model faster for making the structure. Use ideal model to replicate model so you can simulate faster not using the driver.
    - Overall recommendation is to simplify model and see what type of design we want to go with.

    - Look into reserving footprint for rev 1 for power transistors to see which one we want to go with
    - Heat needs to be considered for the heatsink design
    - Looking at using heat sink we already have, need to consider electrical isolation for both board and heatsink
- Live demo
    - Planning to use GUI for this and for rev 1 with the same chip
    - Plan to do torque load curves under load later.
- Plan for next week
    - Hardware
        - Get simulation setup and make ideal model to run simulations in a normal amount of time
        - Starting schematic work
    - Software
        - Helping with configuration setup is correct
        - Keeping on reverse engineering the previous code that was generated
        - To show progress we can on the block diagram have an indicator to show where we are with the progress on the skeleton code
- Higher level
    - Needing higher level diagrams for power path, how components work together, signal path, inputs outputs.