EE/CprE 4910 – sdmay25-26
Week 9 Report
11/7/2024 - 11/14/2024

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

Summary

Unfortunately, our working prototype with the development board broke and we are no longer able to use it. Fortunately, we were able to get the data we were hoping for from tests we still ran with it. With this data, we've been able to better adjust our motor parameters and software design while simulations and schematic work continues. Our group was still able to show the videos during our successful in-person lightning talk that was delivered on Tuesday.

Accomplishments

- Did Python PWM pre-generation to make incredibly fast simulations – Marek
- Adjusted software design based on new developments – Bryce
    - Further research, testing, and project hurdles changes design
    - Skeleton code is starting to reflect changes
- KiCad schematic built, awaiting on software to get pinouts on MCU so we can move to layout – Jonah
- Presented the prototype in the in-person lightning talk

Pending Issues

The gate driver part of the STSPIN IC seems to be fried (some sort of short that now exists). The MCU part is fine and the rest of the board seems okay. We could replace the IC as a whole, which is difficult to solder, or buy a new development board from Detroit altogether. However, we may just move on and work on our first fully custom revision as software has the data they need and hardware is moving along. We just can't get any more testing data at the moment.

Individual Contributions

Member	Contributions	Week Hours	Cumulative Hours
Gavin Patel	Beginning investigation on FOC and FWC	6	48
Bryce Rega	Adjusted software design, some skeleton code	7	56
Marek Jablonski	Improved simulation setup and broke dev board	7	59
Jonah Frosch	Built Kicad schematic, selected power transistor	11	50.1
Long Yu	Documentation, search for MLCC capacitors	6	46

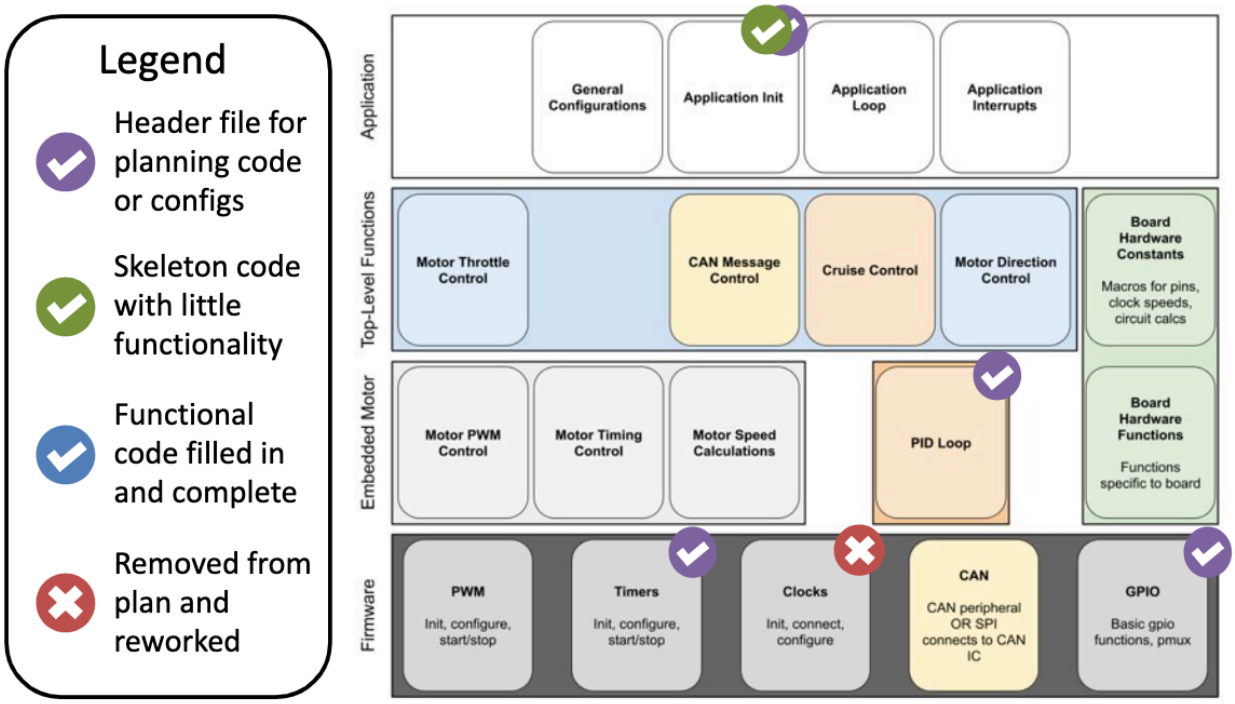
Upcoming Week

- Hardware
    - Start layout and finalize schematic
    - Select capacitor for high voltage bus and ensure we want to stick with our Transistor selection over Huang's Gallium nitride transistors
- Software
    - Visualize preliminary findings/plan for Field Oriented/Weakening Control
        - Some visualization of a plan of how Park/Clarke transformations play into getting a smoother drive and more accurate motor location guesses
    - Continue developing skeleton code and report with visual
        - High app level work and MCU firmware is main focus right now
    - Keep on reverse engineering the previously generated code
- Put together updated advisor presentation (one presentation per week)

Advisor Meeting Summary

- Better way to present software progress is having a Motor, then having the driver board with firmware, PID controller, driver of the motor, and some other things encompassed in the board. Then have the software interface to communicate between the board and hardware.
    - This was formed from a misunderstanding of the block diagram, maybe we start with a system diagram then explain further for full presentation.
- Need to look into how the gate driver broke, as typically it is because of ringing but this wouldn't make sense because we are operating at a low voltage compared to what its rated for
    - Talked about measuring ringing to see if that is the issue
    - Also need to be careful to make sure the probe can handle the higher voltage
- Silcon Carbine asked about, Marek said they can handle much higher voltages but are more expensive. Gallium Nitride was also recommended. Easy to break and expensive, but worth looking into for lower impedance (or smth electrical).
    - Then can use a gate driver with that to achieve goal
    - Gate driver voltage is lower so we can drive them faster to get good results
- Be careful because we need deadtime for gates, these have built in dead time so we dont need to worry about it. Once software is reliable then look into others. Rec that we stay with built in deadtime control and not needing to worry about it when we implement it. Not separate highside lowside driver
- Asked how good the timing is from the MCU but the frequency of the motor is wayyy lower than the frequency of the MCU so that is not a concern

Software Progress Tracker



The clocks file is removed since configurations will be done for their own MCU or board specific functions. New files for current sensing will be required at the second lowest layer. And ADC firmware file will likely need to be added. The DMA will probably be a configuration thing only so there probably won't be a separate file for that.