Executive Summary – Jonah Boe

Contributions

My contributions to the PolarFire project were mainly in two areas. The primary contribution was to get the PCB last semester project team had designed, assembled and tested for use with the PolarFire FPGA board. This was critical to the project and was initially a bottleneck in the project as not much in depth testing could be done without it.

Initially I went in search of a company that could assemble the board for us. This would have freed me up to help the team with other aspects of the project, but due to the outbreak of COVID-19 possible options for outsourcing assembly were limited. Those companies that were available were also outside of the US, and their turn around times would have conflicted with our scheduled project timeline. I decided it would be fastest to assemble the PCB in house. This meant I had to learn how to create a heating profile on the schools reflow oven for the low melting point of the solder past being used.

Having been advised not to attempt reflowing both sides of the board (as parts on the back would fall off when placed in the oven upside-down) I decided to only reflow the side with the FMC connector, and to do the rest by hand.

After soldering the board together, I proceeded to test as many combinations of leads as I deemed critical. This included any leads that came in close open proximity to one another at any point in the boards design, weather through vias, pads, or small component footprints. I only encountered a handful of errors, and quickly resolved each. Later when the client deemed on of the solder joints unacceptable, I resolved that issue as well.

Upon testing the PCB with a power supply, it was clear that there was a short between the 3.3-volt power supply pin and ground. I believe this error had not been noticeable earlier, because one jumper had not been in place when I first tested the board. After resolving this error, I noticed that the MOSI and MISO lines of the SPI bus had formed a short somewhere on the board. This error took an entire day to track down and resolve as the SPI bus has many connections on the board.

With the PCB finally complete I moved on to helping the rest of the team on the software side. I began by helping Chris Porter developing an LCD test for the display implemented on the custom PCB. I initially started with a test that simply wrote “Hello World” to the display, but Chris suggested making it more modular so that other tests could write data to the display. This made sense as that was more in line with the desired final product. In addition, the FPGA was also being used by Spencer Cheney to develop the LVDS UART module. This meant that all of my developments would not get tested until a couple days later (in part due to the fact that we had very limited access to the room were the supplies were stored).

When I finally had the got the chance to debug the LCD did not work properly and nothing was displayed. It turned out that Chris was having problems with the GPIO at the time and the solution for his problem had to do with the way nets were being set up in Libero. We hunted around and found a similar problem with the SPI setup. After resynthesizing everything we were still not getting any output

on the LCD. Using an oscilloscope however, we were able to confirm that the proper signals were being sent over.

With the remainder of the semester I used my time trying to debug the LCD test, helping Chris debug the GPIO, and preparing the final material. Spencer Cheney and I put together the better portion of the final report, presentation, and poster. In addition, because I had handled the hardware portion of the project, I was also the financier and put together the final documentation there as well.

Future Suggestions

The most frustrating thing about this project was just getting familiar with the resources. I really felt like a waterfall of information at first. If this project is handed off to another project group, I would suggest looking at the README.md file provided in the root directory of this thumb drive. It has instructions on where to start.

On the hardware side of things there's nothing else that needs to be done, unless some future error is discovered.

As far as the LCD test goes, we were informed the last week of the semester that NASA uses this screen a lot and probably already has tests for it. I had focused on it because it was going to be so involved with every other sensor on the board. In addition, it was a very visual way of testing the functionality of the SPI module built in Libero.

I'm not certain if any more development is needed by NASA on the LCD. If anyone does try to debug our code further, a good place to start would be with how we were writing to the LCD. In the datasheet it has commands for writing to the onboard GCRAM. Using this method is how the test is currently written. In addition, there are commands for advancing a cursor on the screen. This is was I have been trying to implement to see if it makes a difference. In addition, there is a command to set the contrast. We did NOT have success getting it to display simply by adjusting this, though it may be worth noting somewhere down the road.

Timetable

All weeks include leadership training and one 1-hour team meeting

Week	Time	Work Done
Week 1	14.1	Research PCB assembly options, find solution to VGA problem, get familiar with project
Week 2	13	Order/obtain tools for assembly, review schematic for errors
Week 3	13.4	Start becoming familiar with code-base, look into LVDS UART
Week 4	13.4	Worked on soldering PCB
Week 5 – 6	21	Finished soldering PCB, tested connections, got clone of codebase setup on personal machine
Week 7	15	Resolved project cloning errors, Reviewed Libero tutorial
Week 8	6.5	Finished reviewing Libero tutorial, started reviewing SPI tests
Week 9	13.4	Re-soldered ADC, wrote on LCD test
Week 10	13.8	Added functionality to LCD test, Re-soldered ADC again in order to resolve issue with power supply, resolved issue with I2C MOSI shorted to MISO
Week 11	11.5	Worked on debugging GPIO and LCD tests

Week 12	13	Worked on debugging GPIO and LCD tests, started preparing deliverables
Week 13	13	Prepared all material for submission
Total	161.1	