sdmay19-47: NSF Lab furnace control system
Week 5 Report
October 11- October 21

Team Members
Adam Matthews — *Embedded Systems Engineer, Report Manager*
Kevin Lang — *Electrical Engineer*
Jeremy Hartl — *Hardware Engineer*
Christopher Pohlen — *Software Engineer/Gitlab Moderator*
Nick Brylski — *Systems Engineer*

Summary of Progress this Report
We decided to use the Arduino Mega for the following reasons.
- Mega has 4 serial ports, so we can connect the Mega to the RPI and two Omega Temp controllers (OTC)
    - Uno only has 1
        - Software serial is currently being used but it is not recommended when using multiple serial ports -- uses polling
- Mega has an integrated 16-channel 10-bit ADC, more than enough for the 7 mass flow controllers (MFC) we need to do analog reads on
    - Uno only has a 6-channel DAC, one short
- Mega operates on 5V, meaning it can do analog reads up to 5V
    - The Arduino Due we were considering operates at 3.3V

We decided we will need to make our own shield for the arduino with the following chips
- 2-channel RS232 transceiver (2 omega temp controllers)
- 8-channel DAC (7 MFC's)
- User input buttons etc..

We decided to display readouts over Raspberry Pi
- Easy to program GUI in Rpi
- Wide range of displays to choose from (HDMI)

Pending Issues
- **DAC**
    - We need to find a DAC to control the mass flow controllers, there are 7 of them
    - 8 channel DAC with minimum 8-bit (max 1% full-scale accuracy)
        - MFC are 1% accurate over 0-5V
    - This DAC needs to be programmable via SPI or I2C, we don't enough pins for parallel
        - SPI or I2C? The are more SPI dacs than I2C. What other considerations?
    - For now it should be through-hole, eventually surface mount

- **User Input**
  - We are unsure where in the system to handle input from user controls
  - We have two feasible locations, RPI and Arduino Mega
  - Best option seems to have the user input be funneled into arduino as it is much more reliable for GPIO than the RPI
  - Should we send any data out of the Pi? Or just have it for a display?

Plans for Upcoming Reporting Period

We want to focus on software this period

- A basic GUI needs to be made for displaying the current readouts from the temperature controller--lots of work here. Going to be done in python
  - MFC readouts will come later when we the DAC integrated into prototype

User input

- More ideas on the hardware we need for user input, buttons knobs etc..
- We need to buy some of digikey and start testing

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Adam Matthews	• Set up Arduino IDE on RPI • Debugged issues in communication from Arduino to RS232 on breadboard to OTC • Wrote programs in C and Python to test communication from Arduino and RPI, respectively, to OTC	7	26
Kevin Lang	• Worked on developing GUI in python to read temp	3	18
Jeremy Hartl	• Worked on max 3223 chip and capacitor connections • Looked into displays and how best to communicate with them	3	21
Christopher Pohlen	• Worked on GUI development on raspberry Pi	3	18
Nick Brylski	• Built and debugged hardware prototype • Identified key system requirements, created block diagram for system • Identified arduino Mega & RPi as suitable solution	11	30

Gitlab Activity Summary

Nothing to report.