Aspiration Assisted Motor-Driven Biopsy Needle

Report: 1-21-2025

1. **Work Planned to be Completed:**

This week, my work was concerned primarily with (1) refinement and completion of the circuit/general code, (2) investigation of filtering methods, and (3) hopefully the beginning of serious PCB design.

1. The circuit that was shown and demonstrated for the previous semester was very rushed so there are many features with bugs or implemented poorly. I hope that I will be able to resolve any standing issues and finish implementing features such as the MSC. However, development using the RP2040 is still proving challenging. Bugs that are most demanding are: bouncing inputs, inconsistent interrupts and timers, and conditional deadlocks.
2. The current data that is read from the brushed DC motor we are using is currently very noisy, making analysis rather difficult. It would be ideal that this could be reduced using software and hardware filtering methods. Immediate solutions are an RC filter on the circuit assuming (1) is completed, low pass filtering, and moving average filtering. Other options are available but these are immediate solutions that can be easily tested.
3. PCB design is eventually going to be the main focus for this semester. Assuming all goes well with (1) and (2), I can hopefully begin working on this more seriously with proper deliverables.
4. **Work Completed:**

I have spent the past week working on the code for the current circuit and have run into many bugs / issues that have prevented me from getting to the MSC. Button presses are now implemented using interrupts with a simple debouncing algorithm and issues with having multiple GPIO interrupts have been resolved. Current issues are the motor\_outputA interrupt not catching several falling edges which is throwing off the count used for positional and RPM data. Other issues are with variable inputs. After discovering damaged pins on the board preventing the ADC from working correctly, I was able to get a functional input. The only issue is that passing this to the line of code that drives the motor causes the circuit to deadlock. This will require more investigation. At this point it might be better to move back to an Arduino product just so that the circuit will be feature complete and PCB design can begin quicker. Rewiring wouldn’t take very long and most of the code is already existent in the previous file. I should be able to adapt improvements made since then quickly. Additionally, the added time could help with testing, general user design, and potential battery implementation.

A screenshot of a computer program

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***Figure 1:*** *Lots of print debugging and use of comments to disable line-by-line in order to isolate issues. This has been very time-consuming.*

Aside from completing the circuit, I have also been looking into software filtering methods. So far, I have implemented the moving average filter and a simple first order low pass filter. They have several parameters that can alter their strength but so far, I’ve used some of Darren’s current data to test the effects. The code for it is implemented in C++ so it should be near 1:1 to get it working in real time. However, it could also be done using a separate application potentially.

A computer screen shot of a program

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***Figure 2:*** *Simple software filter implementations in C++.*

*A screenshot of a computer screen

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***Figure 3:*** *Software filter implementation results.*

Unfortunately, given the state of (1) there was no real opportunity to begin any real work with the PCB. Hopefully that will be possible soon. The only other form of completed work for today is the Doxygen integration which was completed over break. Although, a lot of it still needs to be filled out, the actual system is in place:

A screenshot of a computer

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***Figure 4:*** *Doxygen – automated documentation for our code organized in HTML format.*

1. **Future Work:**

Next up for things to do is to finish the circuit MSC and all. If not done with the RP2040, this will be done with a product like the Arduino NANO where development is all but guaranteed to be quick so that PCB design can begin immediately. Additionally, I would like to refine and make final decisions regarding filtering, flush out documentation, and revisit the ideas regarding the battery.

**Current CEN4908C Due Dates**

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