Bio-DAQ

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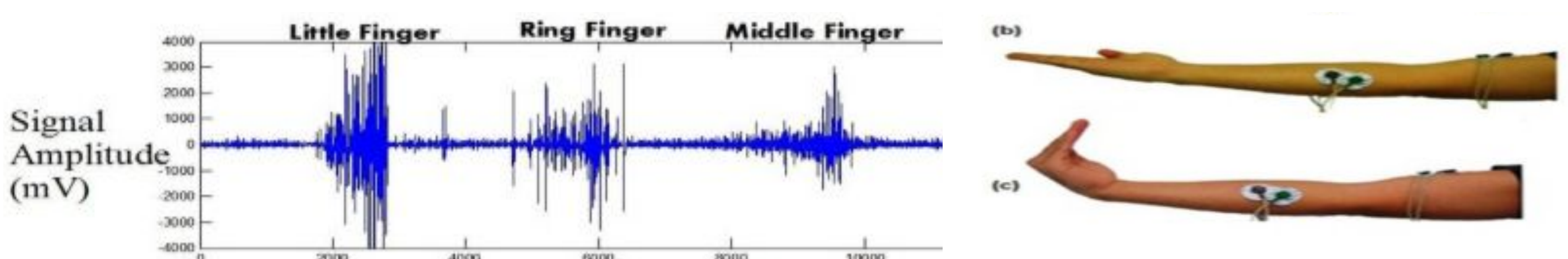
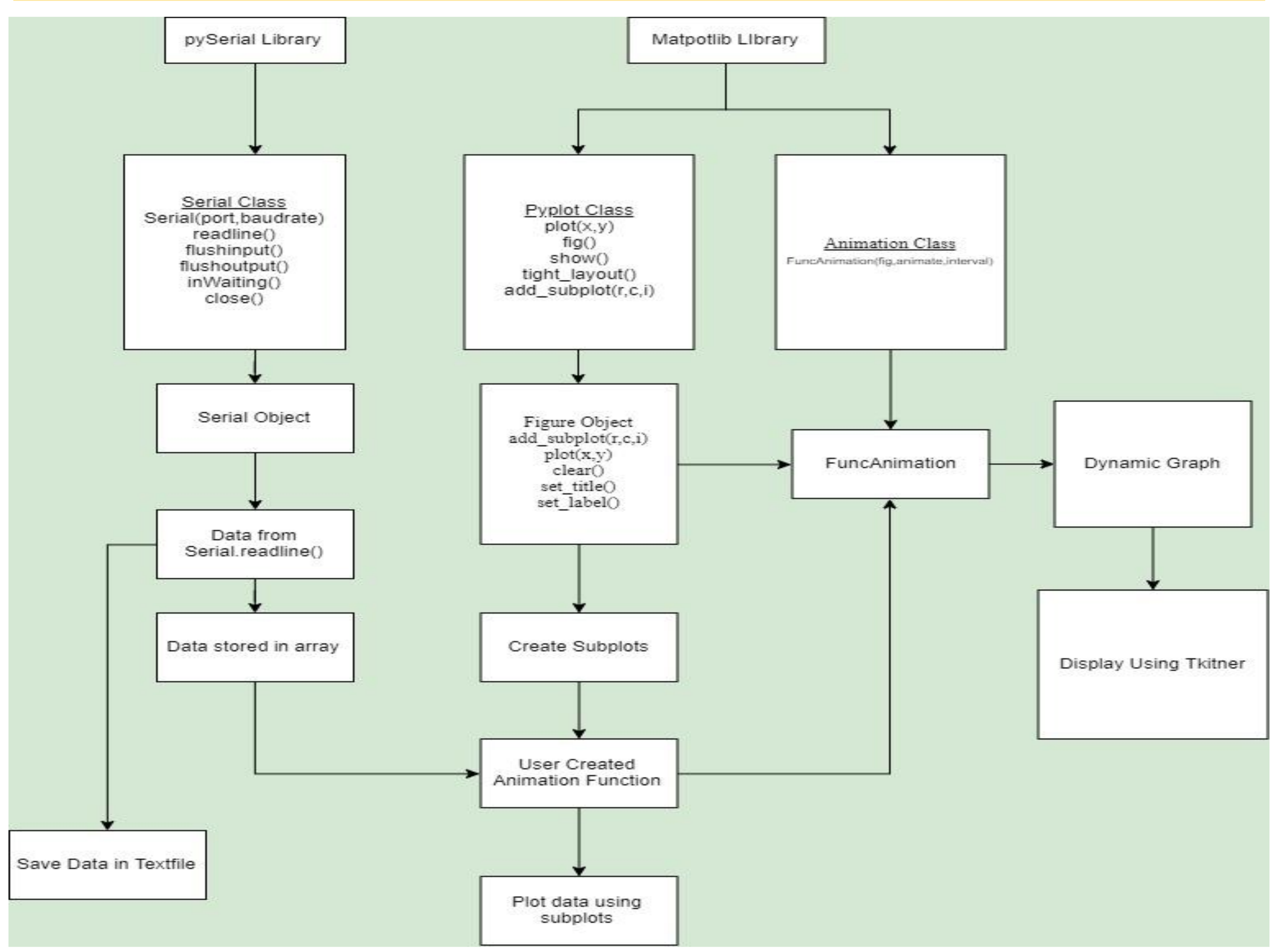
BACKGROUND/PURPOSE

Electromyography, or EMG, is the study and implementation of electrical signals produced by action potentials during muscle activation [1]. Throughout the body, there are various biological processes that can be examined to determine electrical biomarkers that signify bodily functions. Other important signals can spawn from the dipole movement of the pupils or the activity of an individual's brain. As the Bio-DAQ project aims to capture such signals, the focus is placed on EMG due to the vast documentation available on the subject. Acquisition of EMG signals are also quite critical as they can be developed for assistance of patients with prosthetic solutions. The field of biomedical signal acquisition is continuously expanding. Besides the immediate medical applications, processing of biological signals can be expanded for use in other environments, such as gaming [2]. With the inherent potential of biological data acquisition, it is desired to continue advancements in the field.

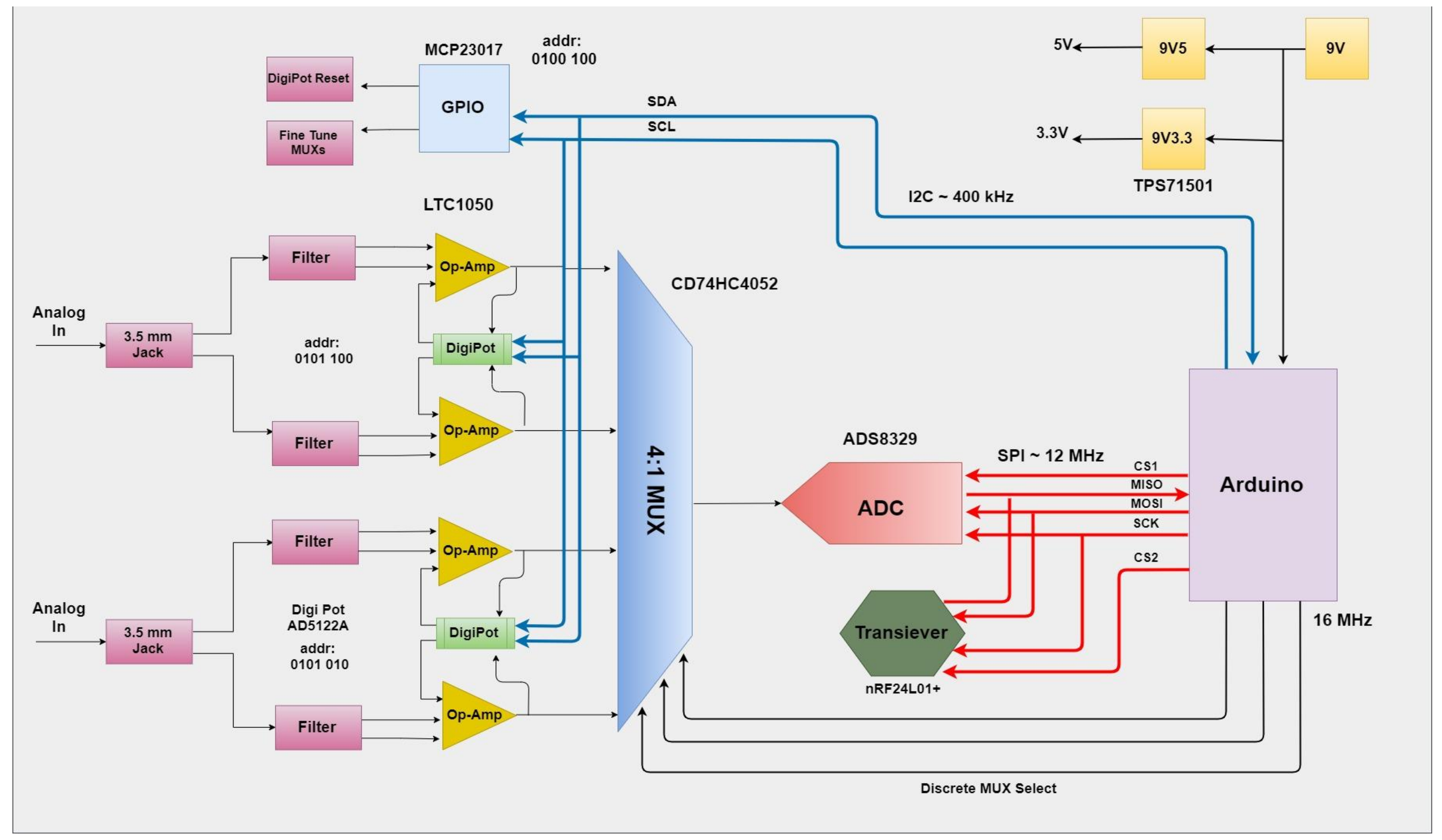
The goal of Bio-DAQ is to create a real-time programmable multi-channel data acquisition system. The center point of the architectural design is based around the ADC. For the purposes of the project, the best ADC structure was determined to be built on successive-approximations [3]. With proper chip selection and connections, the Bio-DAQ will amplify, sample, and display biological signals in the 1 μV to 1 mV range. The capability of the system to meet these demands will be demonstrate by identifying muscle contractions via EMG electrodes. Further development in the system pushes for a final goal of recording analog myoelectric signals and using tested recognition techniques during data processing to determine specific movements [4].

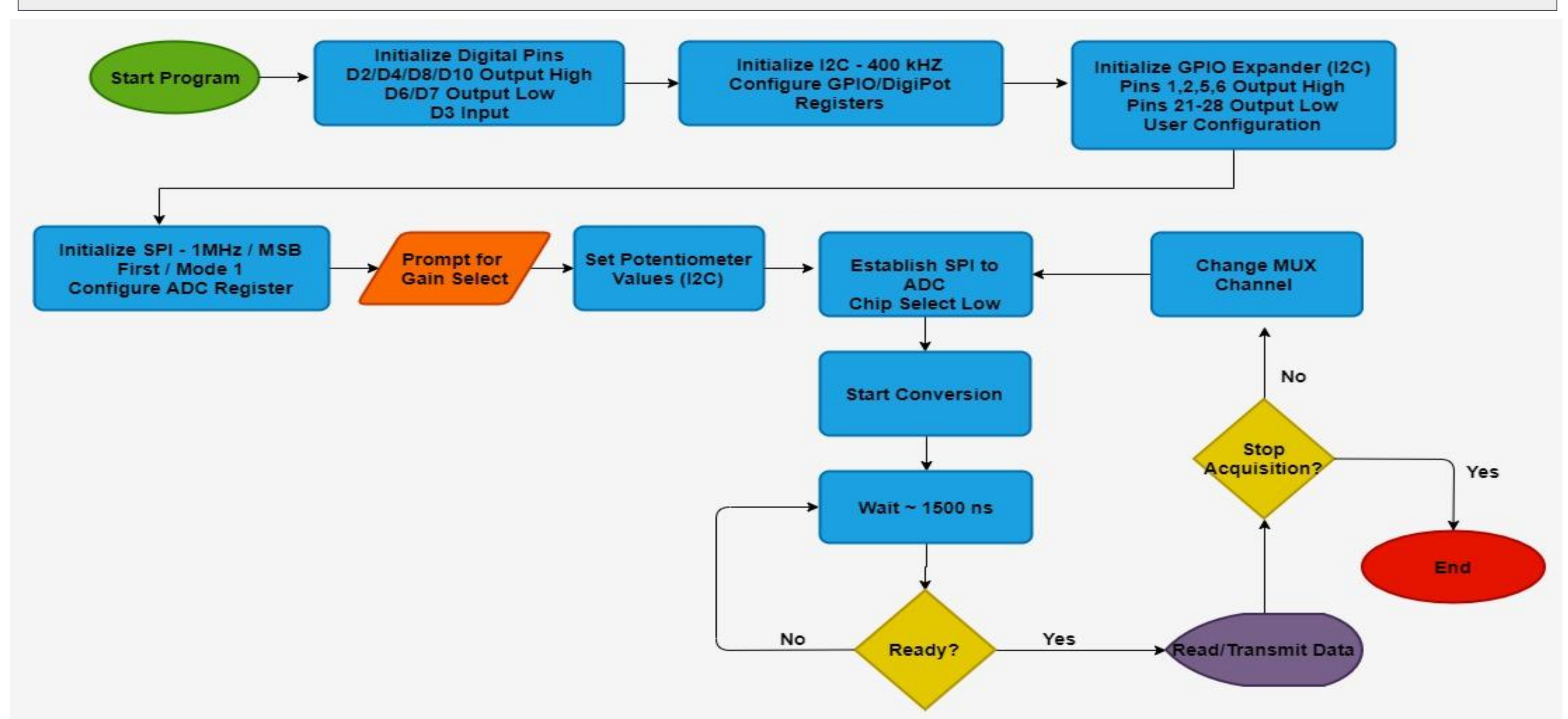


SOFTWARE



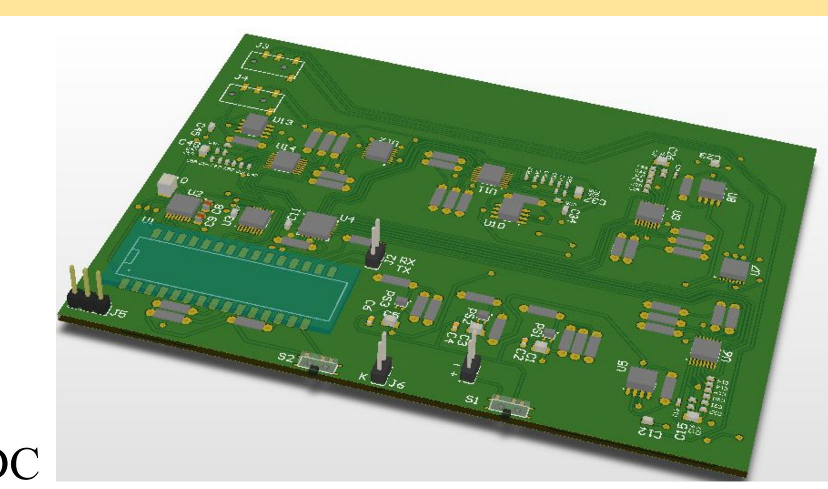
SYSTEM ARCHITECTURE





MATERIALS

- Raspberry Pi
- 2-Layer PCB
- Arduino Nano 33 IoT
- AD5122 Digital Potentiometers
- TI TPS71501 Linear Regulators
- MCP23017 - 16-Bit I/O Expander
- AD LTC1050 Zero-Drift Op-Amps
- TI ADS8329 - 1 MHz, 16-Bit SAR ADC
- TI CD74HC4052 - 4:1 High-Speed MUX's



TIMELINE

Completed	Week 4/5	Week 6/7	Week 8/9
Created initial PCB	Update PCB	Setup Wireless Connection	Final System Tests
Reconfigured Amplifiers	Update BOM	Perform Prelim Tests	EMG Signal Tests
Updated system for use with Nano	Send PCB in for Fab	Update GUI	
Tested signal filter designs			

REFERENCES

[1] M. Jamal, "Signal Acquisition Using Surface EMG and Circuit Design Considerations for Robotic Prosthesis," in *Computational Intelligence in Electromyography Analysis – A Perspective on Current Applications and Future Challenges*, G. R. Naik, 2012. [E-book] Available: IntechOpen e-book.

2] L. van Dijk, C. K van der Sluis, H. W. van Dijk, and R. M. Bongers, "Learning an EMG Controlled Game: Task-Specific Adaptations and Transfer," *PloS one*, vol. 11, no. 8, August 2016. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4996424/. [Accessed Oct. 22, 2019].

[3] W. Kester, "Which ADC Architecture is Right for Your Application?" *Analog Dialogue*, vol. 39, no. 1, June 2005. [Online]. Available: https://www.analog.com/en/analog-dialogue/articles/the-right-adc-architecture.html. [Accessed Oct. 12, 2019].

[4] D. A. Reyes López, H. L. Correa, M. A. López, and J. E. Duarte Sánchez, "Expert committee classifier for hand motions recognition from EMG signals," *Revista chilena de ingeniería*, vol. 26, no. 1, pp. 62-71, 2018.

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