



Atrial Fibrillation Screener

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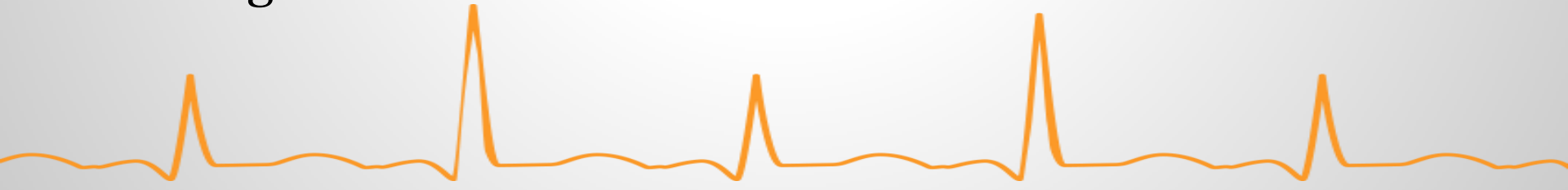
Client - Dr. Philip Bain

Advisor - Dr. John Webster



Outline

- Client Description
- Problem Statement
- Design Specifications
- Impact
- Past Work
- Fabrication
- Testing
- Budget



Advisor and Client Information



Dr. Philip Bain - Client

Dean Clinic, Internal Medicine

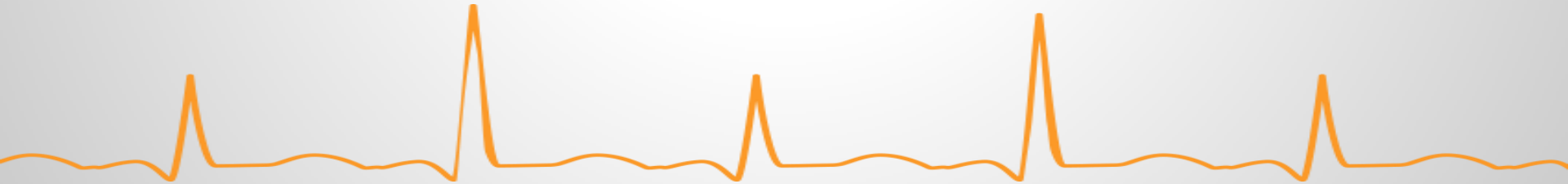
Dr. John Webster - Advisor

BME Faculty



Problem Statement

- Atrial fibrillation (afib) is a common, vastly under diagnosed heart condition caused by disorganized electrical signals [1]
 - Leads to an increased risk of ischemic stroke, heart failure and fainting spells [3]
- Current diagnosing methods are expensive and take valuable time for medical professionals to perform and to interpret results
- The goal: fabricate an afib screener that is inexpensive, easy to carry, user-friendly and can accurately screen for afib



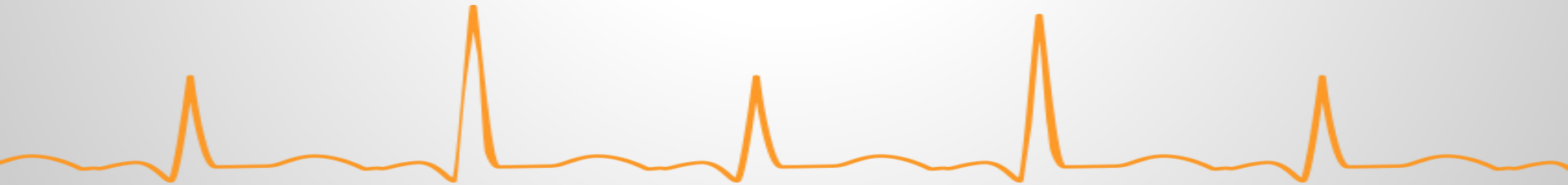
Product Design Specifications

- Must be able to accurately detect atrial fibrillation
- Must require minimal training
- Must be portable and durable
- Must provide immediate feedback
- Must display waveform taken during test
- Must be priced competitively

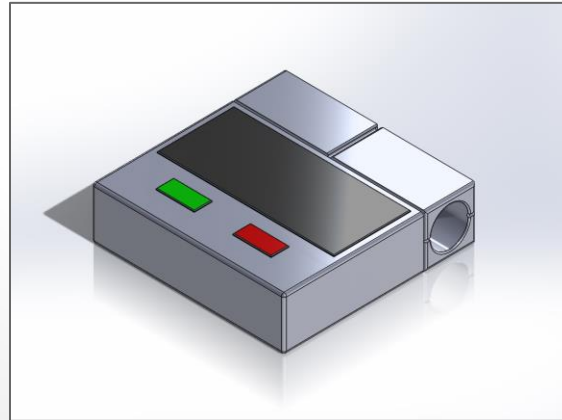
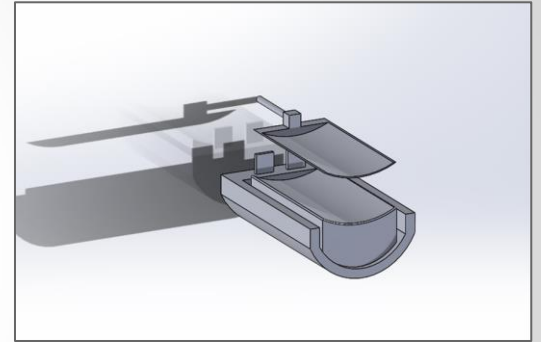


Afib by the Numbers

- 4 to 5 fold increased risk of ischemic stroke
- 2.3 - 5 million Americans over the age of 65 (8%) are affected by afib [4]
- 5,000 in Dane County alone



Previous Prototypes

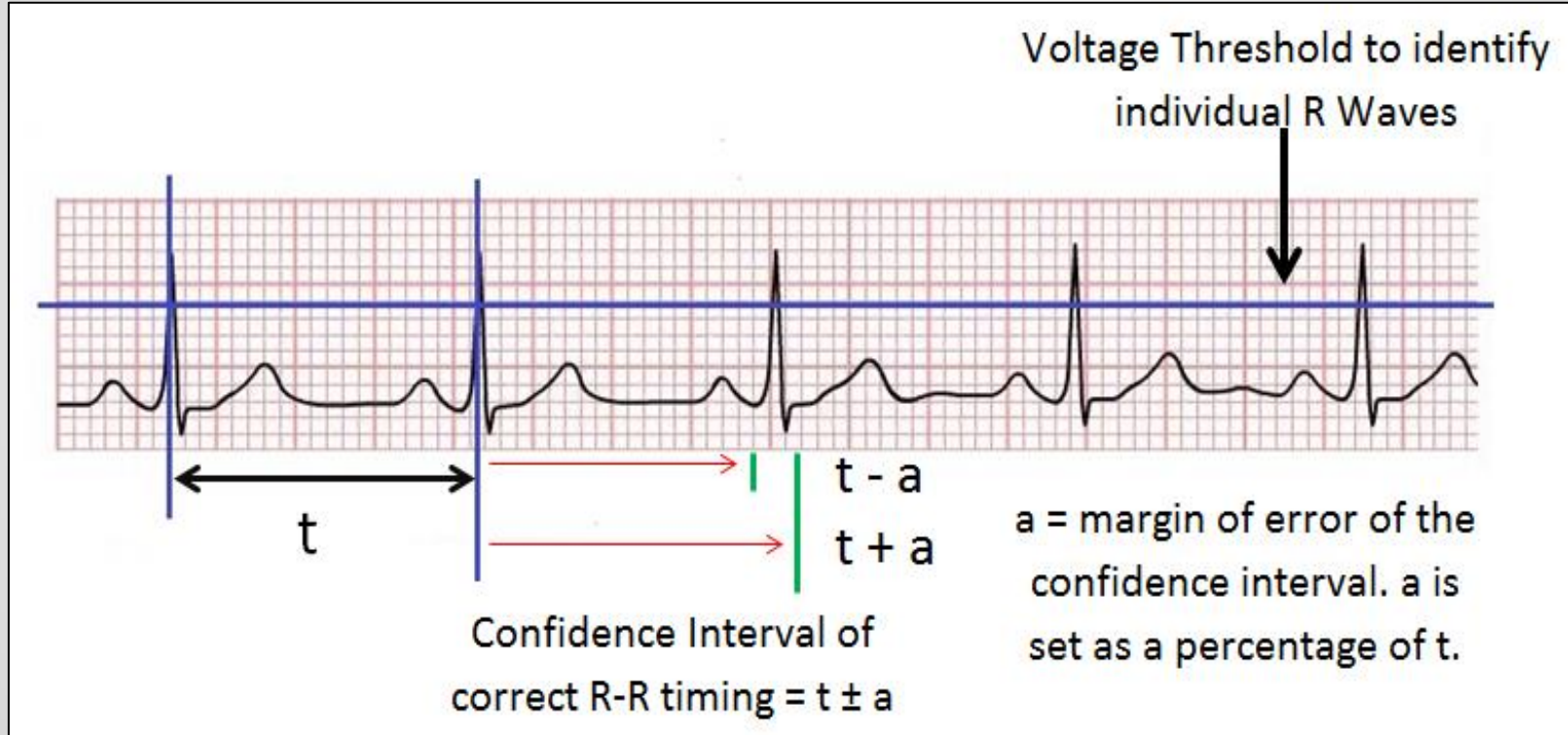


Atrial Fibrillation Detection Algorithm

- 30 second test
- Three optimized thresholds
- Signal processing allows code to read non-ideal signals with artifact from electrodes
- 98.5% accurate



Atrial Fibrillation Detection Algorithm

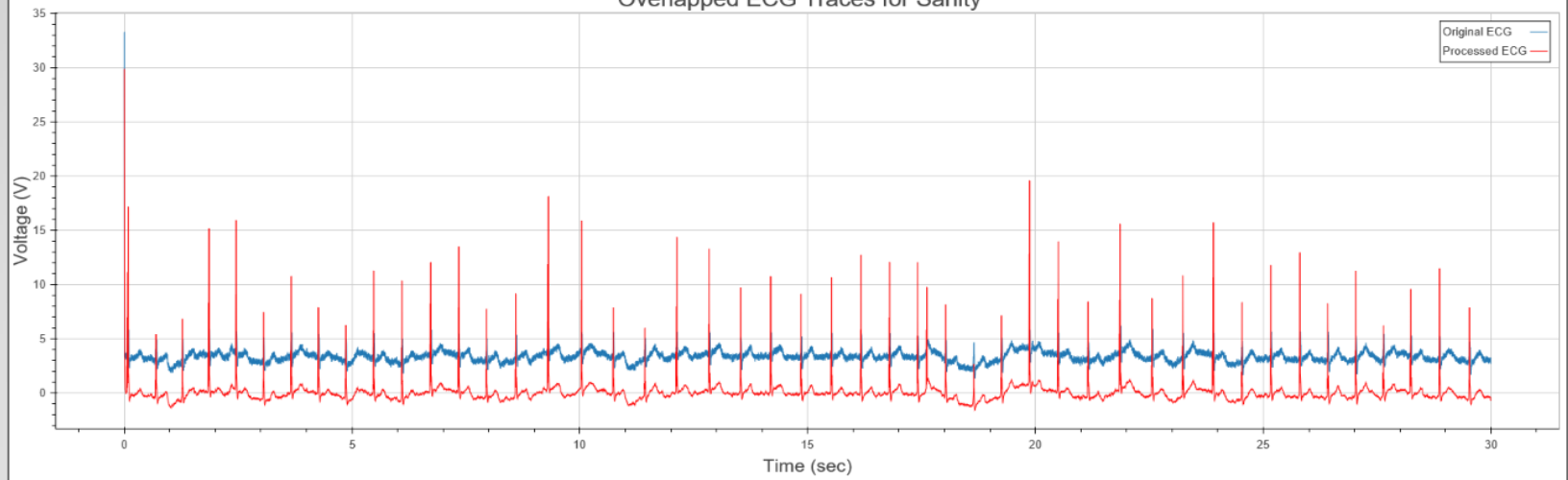


Last Semester: Signal Processing

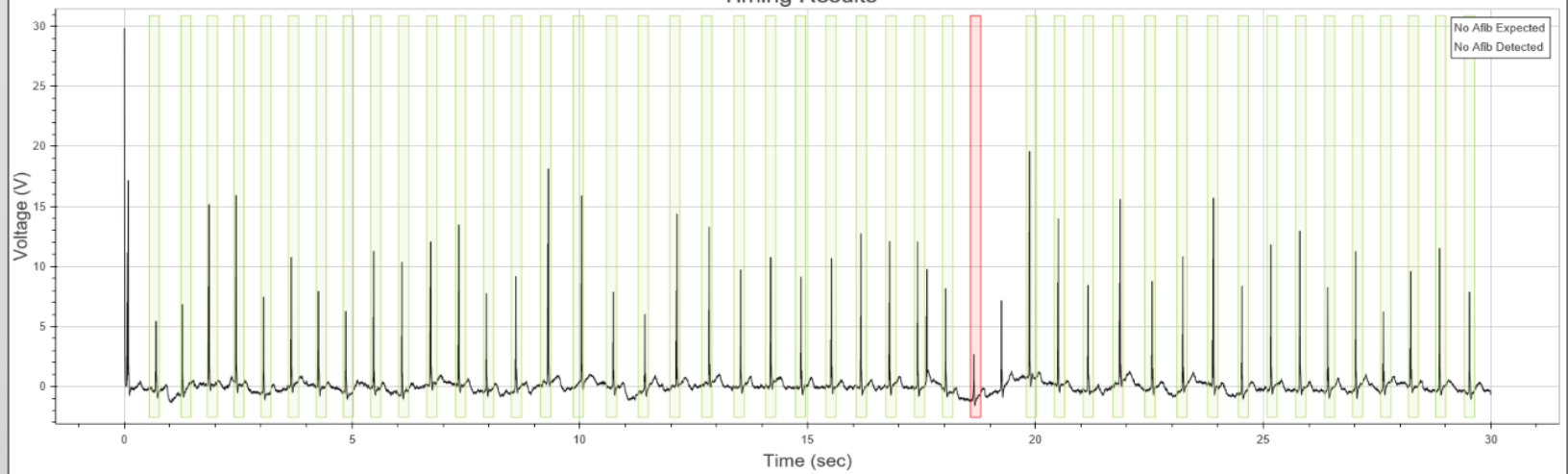
- Improved signal processing
 - Triangular smoothing algorithm [2]
 - Increased R-wave signal differences
 - Eliminated T-wave being identified as a R-wave
- Created waveform output for touch screen
- Application for running algorithm



Overlapped ECG Traces for Sanity

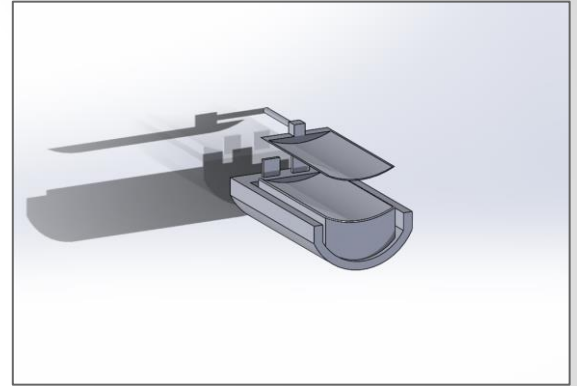


Timing Results

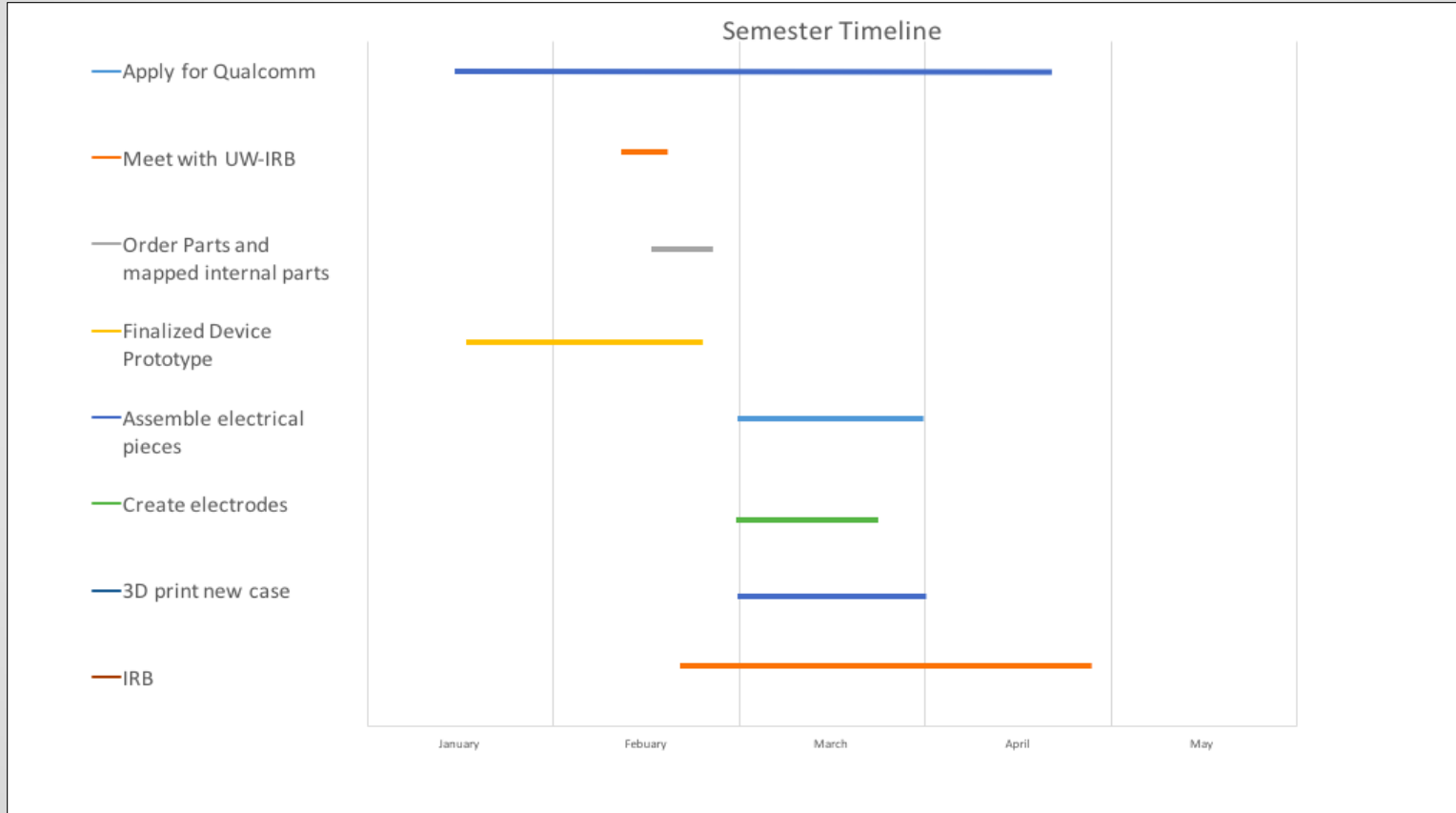


Last Semester: Lessons Learned

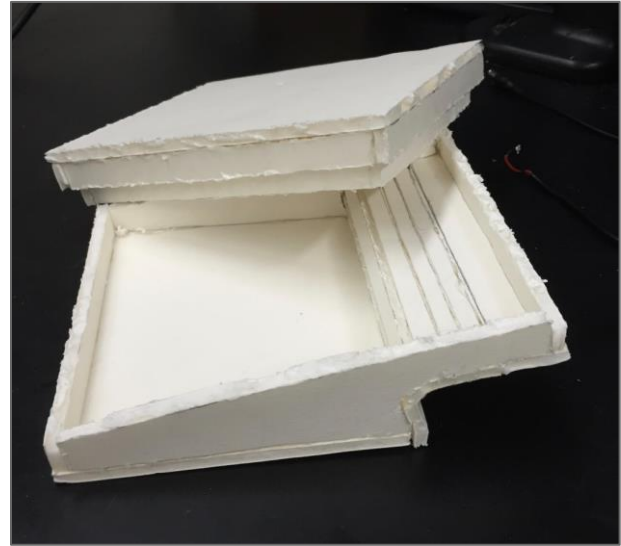
- Electrode ease of fabrication
 - epoxy-titanium connection
 - titanium-pulse oximeter connection
- Arduino-display interface
 - memory considerations
 - lack of native display driver



This Semester's Timeline

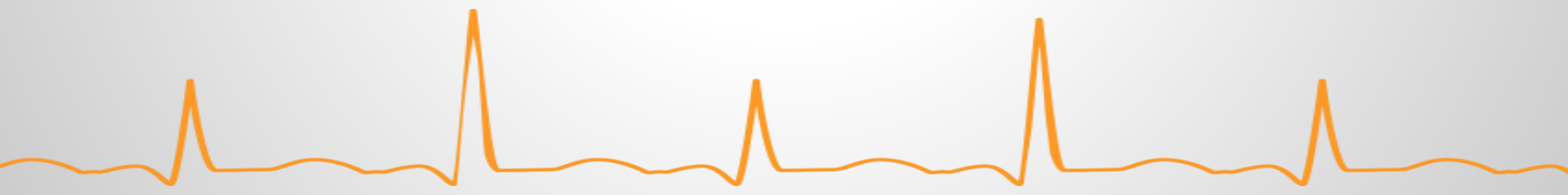
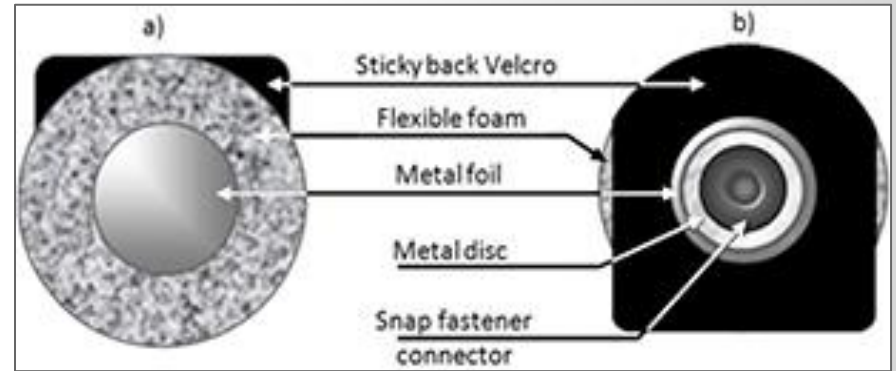


New Case Design



Electrodes

- Titanium/stainless steel [5]
- Pure-silver electrically conductive epoxy
- Snap fastener-linked
- Contoured to match user's fingers
- Ergonomic placement



Electrical Components: Raspberry Pi

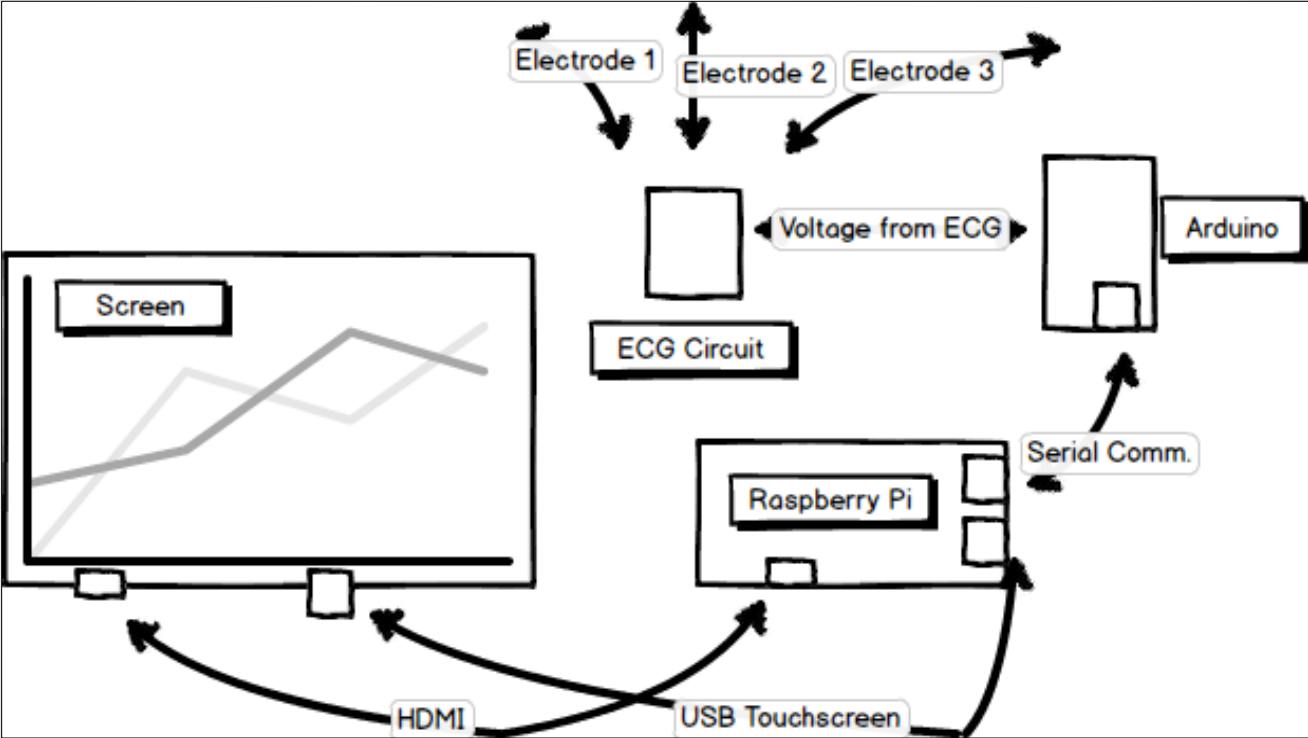
- Linux Distribution
- Python Programming Language
- Large Memory
- 4 USB ports
- HDMI video output
- Powered with 5V
- No analog input - Arduino pro-mini



Electrical Components



Electrical Wiring Diagram



Budget

1. 1 Raspberry Pi 2 Model B
2. 1 HDMI 5 in Display With Touchscreen
3. 1 Ultra Thin HDMI Cord
4. 1 USB A to Micro Short Cord
5. 1 USB A to Up-Angled Micro Short Cord
6. 1 USB to TTL Serial converter
7. 1 Raspberry Pi Wifi Dongle
8. 1 Sparkfun ECG
9. 1 Arduino Pro Mini
10. 1 Lithium Ion Battery
11. 1 Arduino 1 1 DC/DC Boost Converter
12. 1 Titanium Sheet
13. 1 Stainless Steel

Total: \$246.16



Acknowledgments



Client: Dr. Philip Bain

Advisor: Dr. John Webster

Past Advisor: Dr. Jeremy Rogers

Department of Biomedical Engineering



References

[1] Atrial Fibrillation. (2008). Retrieved December 3, 2014, from Atrial Fibrillation Teaching File

[2] O'Haver, T. Intro. to Signal Processing:Smoothing. February 18, 2016.

<http://terpconnect.umd.edu/~toh/spectrum/Smoothing.html>

[3] National Heart, Lung, and Blood Institute. "What Is Atrial Fibrillation?" September 18, 2014.

<http://www.nhlbi.nih.gov/health/health-topics/topics/af/>.

[4] Wyndham, Christopher. "Atrial Fibrillation: The Most Common Arrhythmia." Texas Heart Institute Journal. 2000 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC101077/> .

[5] Meziane, N., S. Yang, M. Shokouejinejad, J. G. Webster, M. Attari, and H. Eren. "Simultaneous Comparison of 1 Gel with 4 Dry Electrode Types for Electrocardiography." *Physiol. Meas.*

Physiological Measurement 36.3 (2015): 513-29. Web.



Questions?

