SES

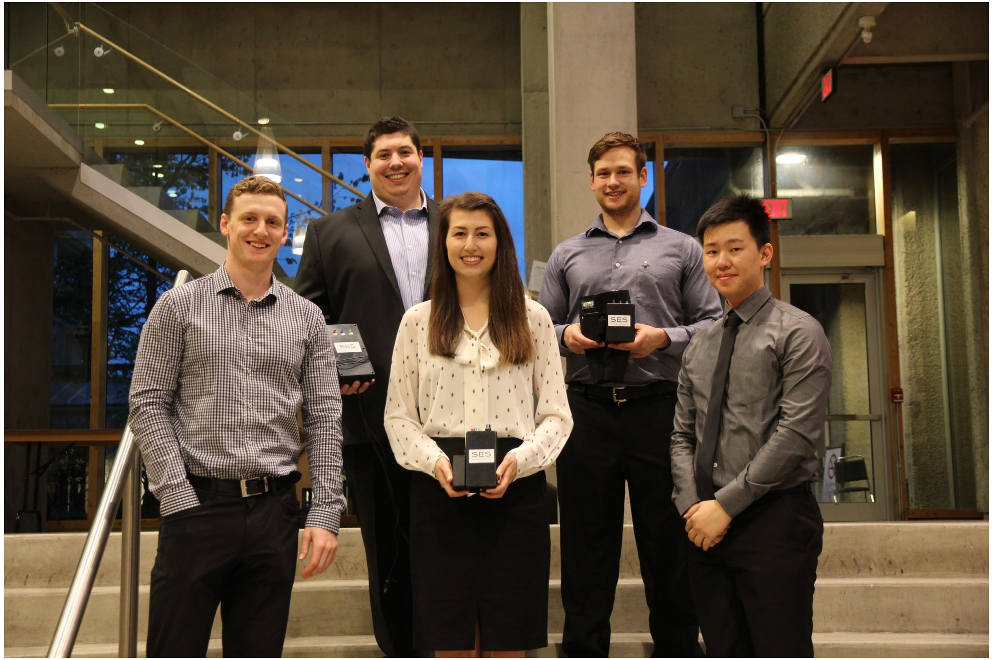
SURGICAL ELECTRONIC SOLUTIONS

MYOperator MK 1.0

April 14, 2016

The Team

- Gabrijela Mijatovic- COO
  - Hardware/Software Design, Documentation
- Jonathan Feng- CFO
  - Hardware Design, Finances
- Thomas Newton- CQO
  - Hardware Design
- Michael Wilkerson- CEO
  - Software Design
- Darren Zwack- CTO
  - Hardware Design, Manufacturing



Outline

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Background & Motivation

- Local ENT doctor mentioned problem
- Current devices all use pedals
- No wearable and wireless solution that we can find
- Created to increase productivity and operating room safety

Dr. Buonassisi Video

Target Market

- Anywhere there is an operating room that requires surgical tools:
  - Hospitals
  - Plastic Surgeons
  - Private Practices
  - Dental Offices
- $20-40 million USD market for medical foot pedals

Existing Solutions

- Current surgical tool activators require a physical pedal, whether it is wired or wireless
- Pedals get misplaced during surgery
- Wired pedals may be a tripping hazard

Project Overview

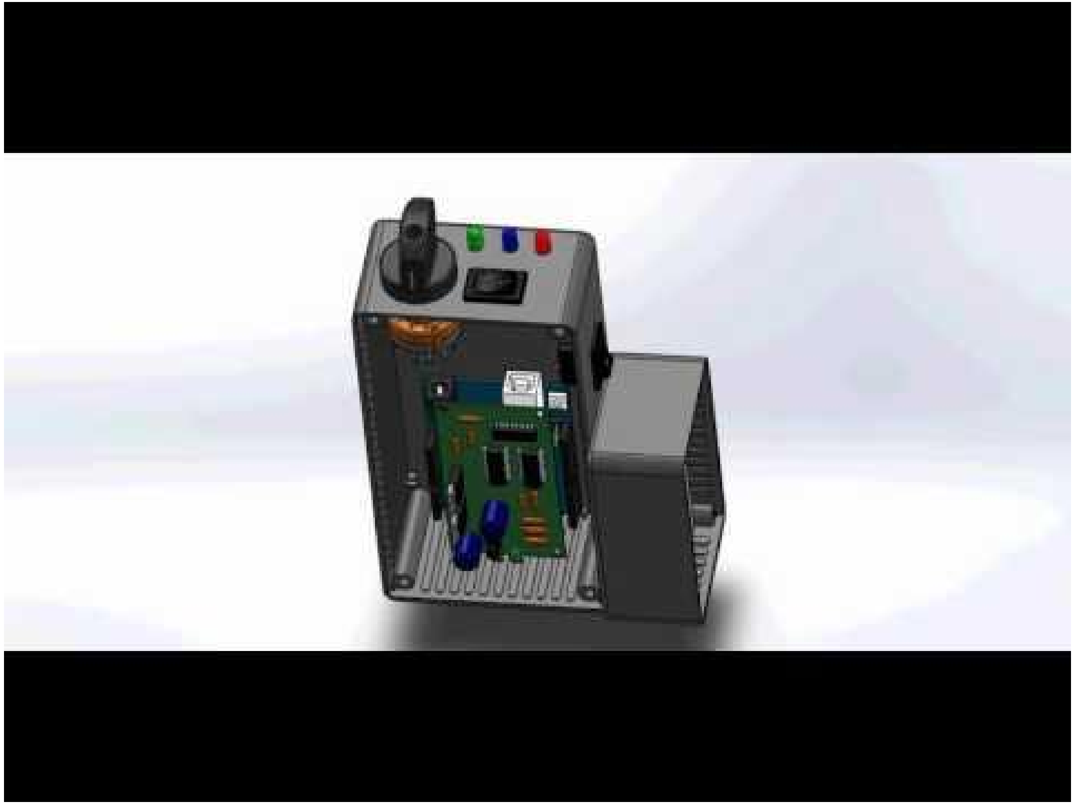
- Three major components in MYOperator
  - Calf Sleeve
  - Hip Station
  - Base Station
- Communicate wirelessly through Bluetooth

Hip Station

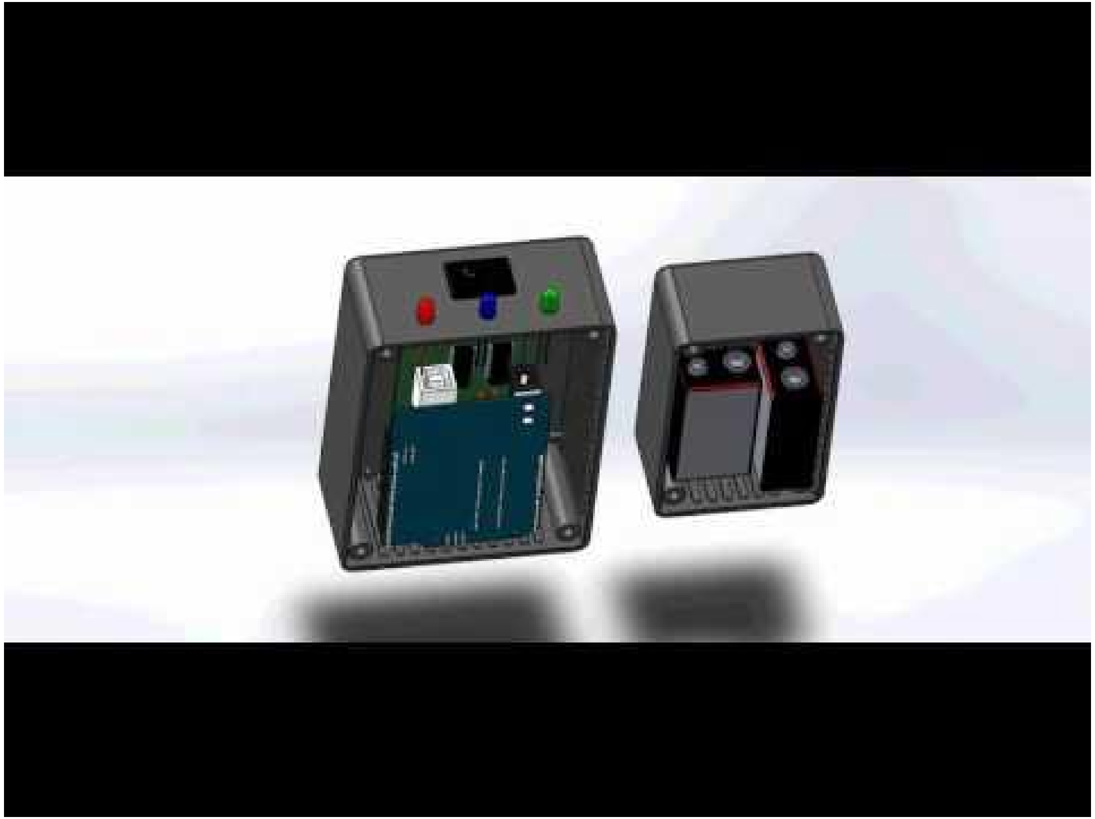
Base Station

Calf Sleeve

Hip Station

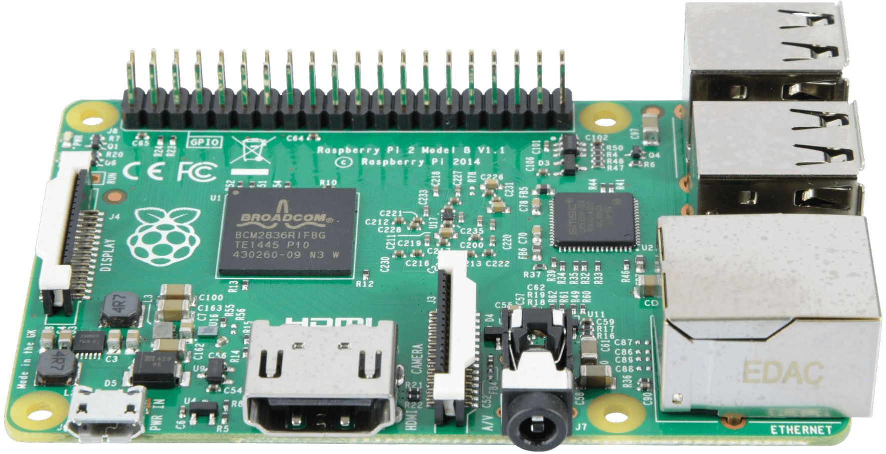


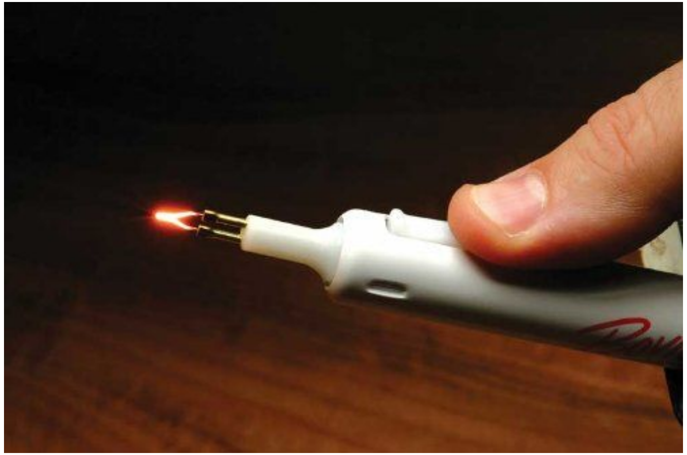
Calf Sleeve



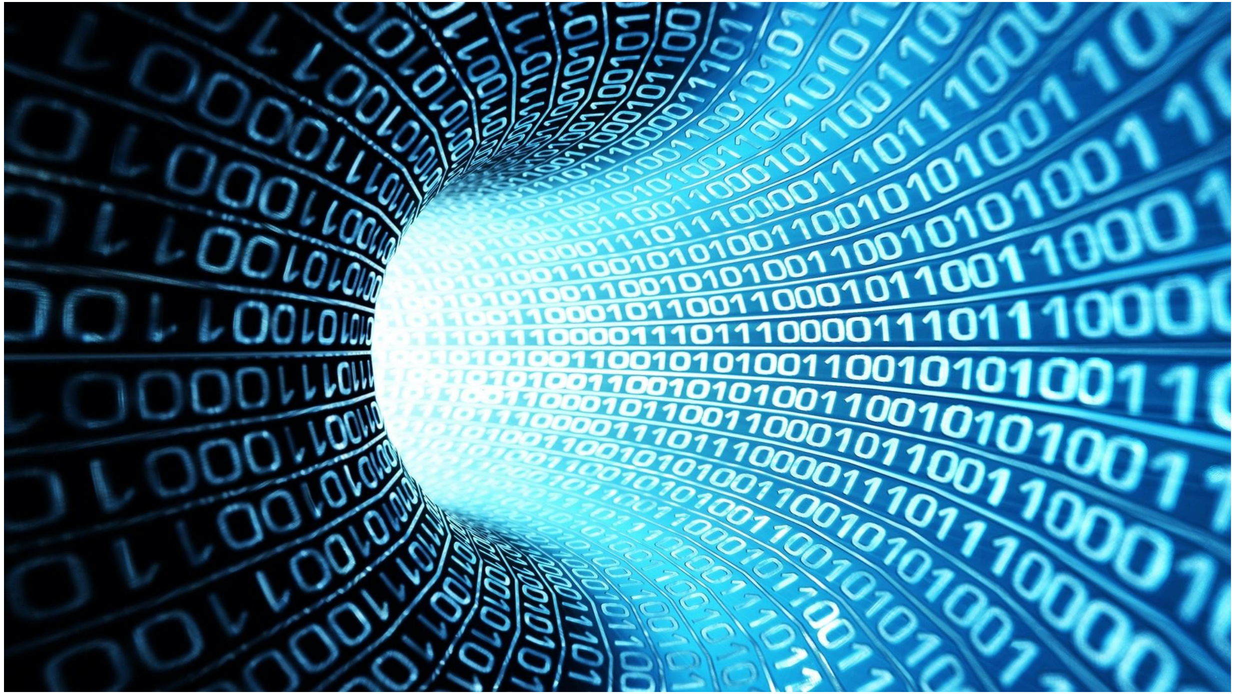
Base Station

- Calf Sleeve and Hip Station send information to Base Station to process
- Utilizes Raspberry Pi to process data
- When the Base Station receives the data from the Calf Sleeve and the Hip Station, it turns on the tool
- Located where the tool is and plugged into wall outlet





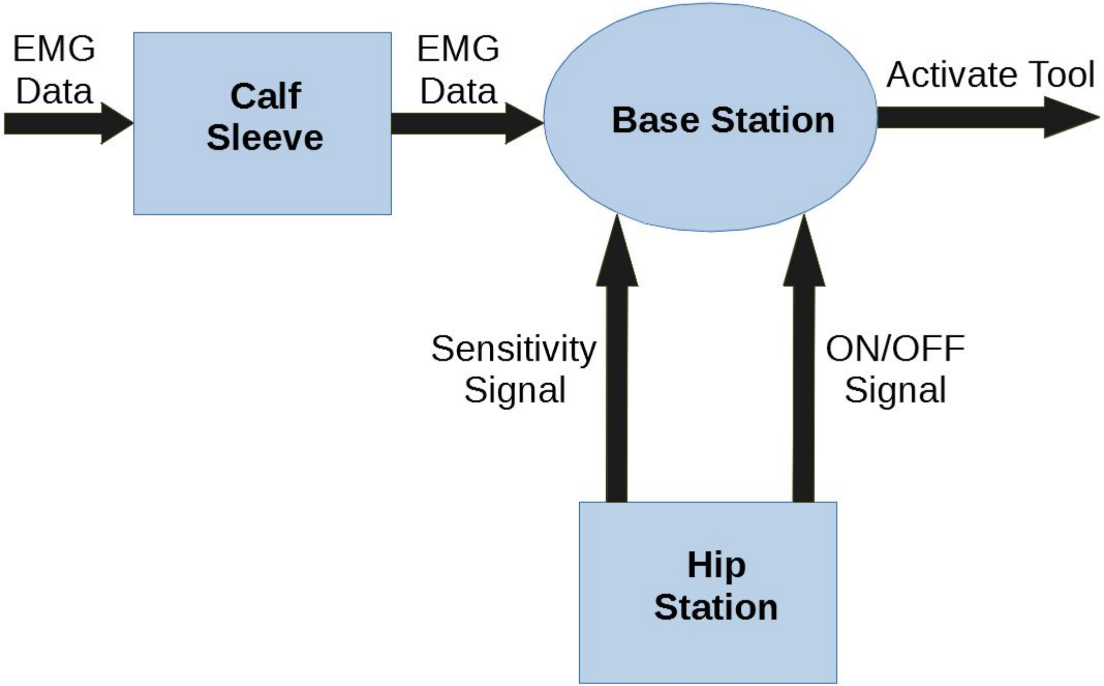
Software Design



Software Requirements

- Allow communication between components over a wireless protocol
- Handle the following user interactions:
  - Allow or disallow tool activation based on tool enable switch state
  - Activate the tool when the leg is flexed
  - Interpret sensitivity from a multi pole, multi throw switch
- Process EMG data and activate device within ½ a second

Software Block Diagram



Possible Solutions

- Operating Systems
  - Android
  - Linux
  - Windows
- Languages
  - Python
  - C#
  - C++

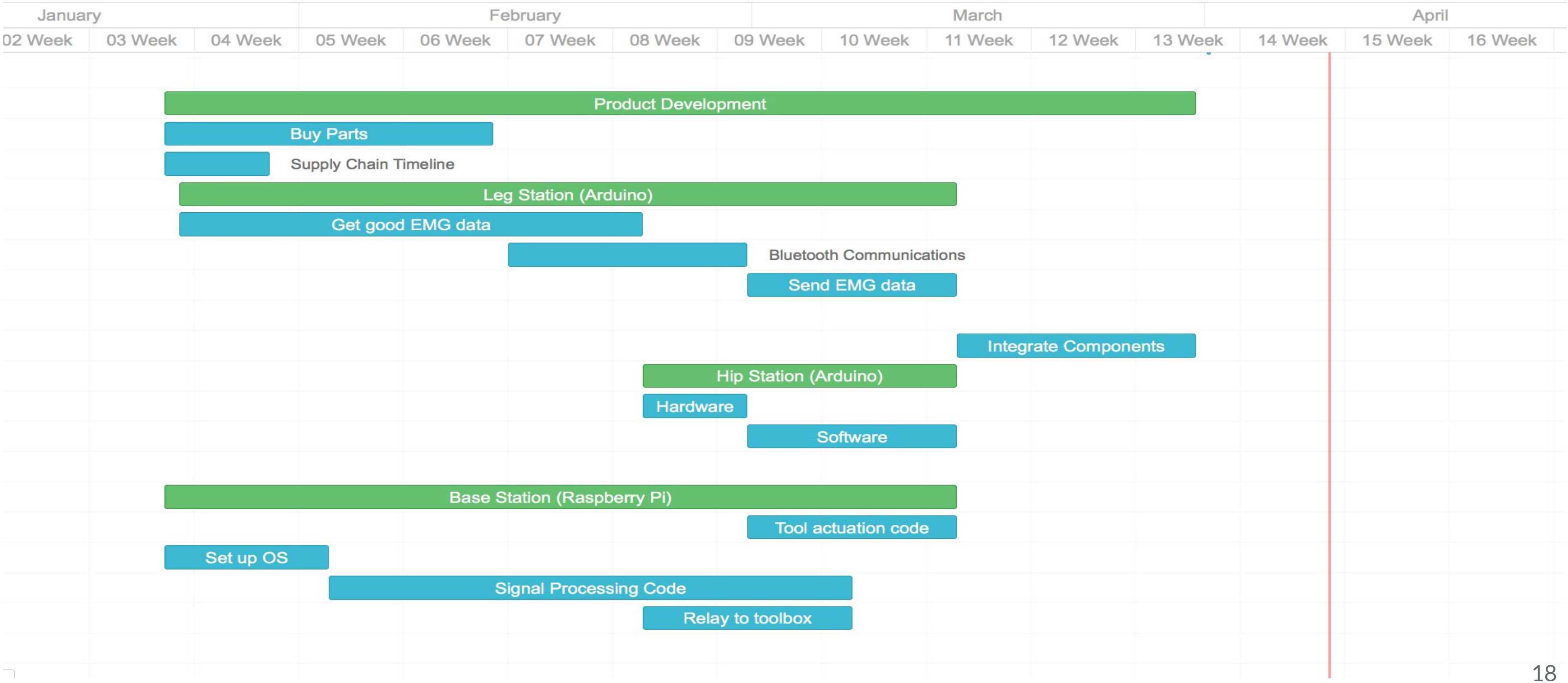
Our Solution

- Raspberry Pi 2 runs Windows IoT operating system
- Uses WinRT environment
- Windows Remote Arduino library allows Raspberry PI 2 to control Arduino GPIO and perform all major processing over bluetooth
- Each device treated as own object/class

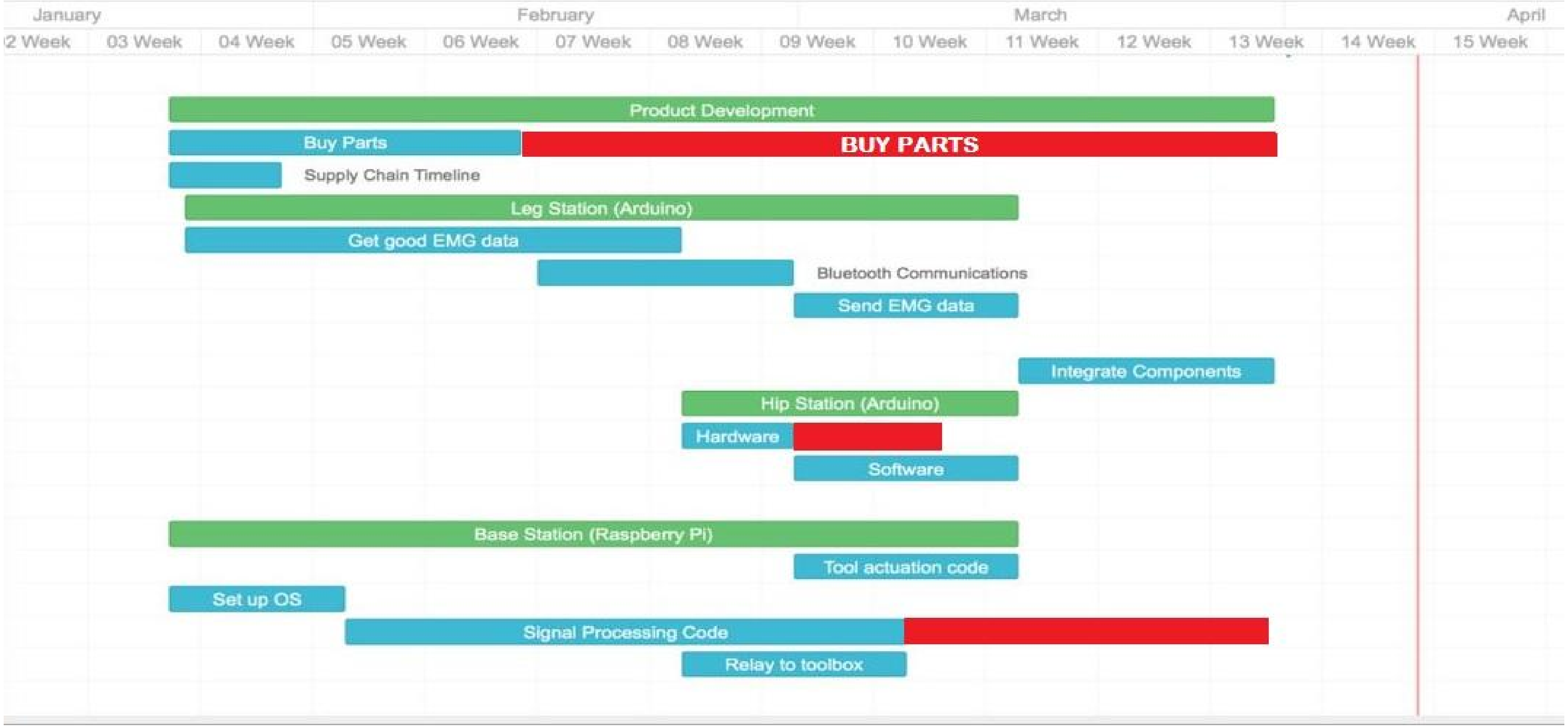
Design Progression and Challenges

- Setup version control for everyone to link to over internet
    - Tortoise SVN (client)
    - RiouxSVN(server)
    - **Major Challenge:** Finding an SVN server
- Find appropriate bluetooth dongles and antennas
    - CSR V4.0 (Raspberry Pi)
    - SparkFun Bluetooth Mate Silver and Gold (Arduinos)
    - **Major Challenge:** Bluetooth LE was not compatible with Windows Remote Arduino
- Connect Raspberry Pi to Arduino over Bluetooth
    - **Major Challenge:** Getting our C++ project to recognize the Windows Remote Arduino libraries
- Process EMG Data
    - **Major Challenge:** processing data fast enough

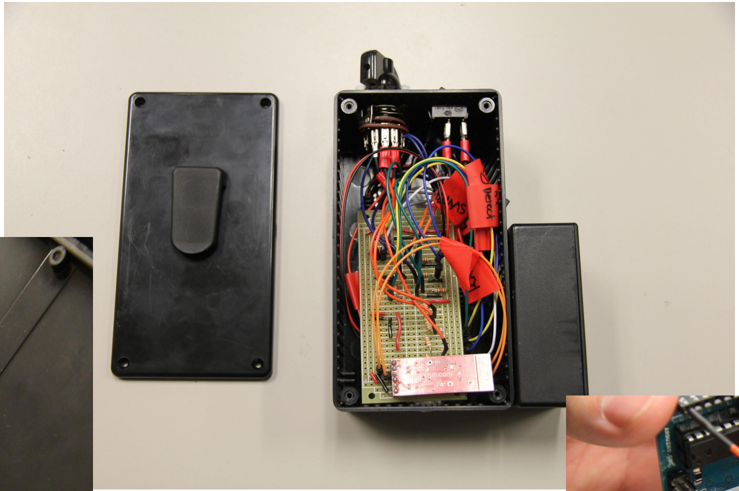
Scheduling & Timeline

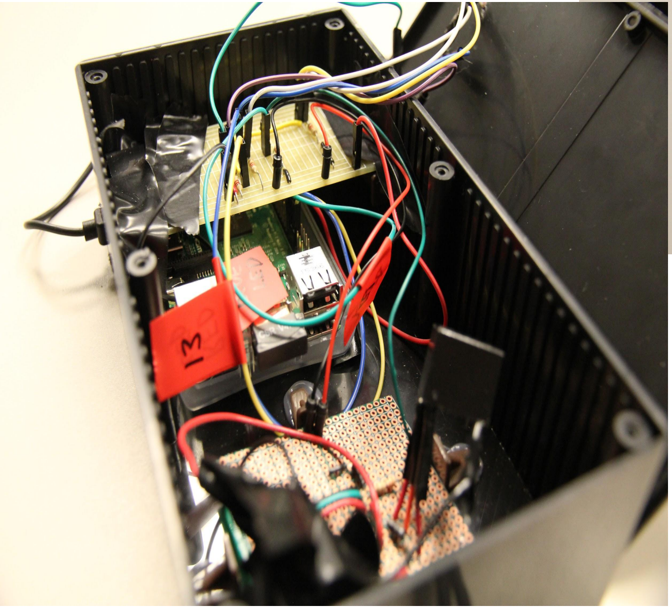


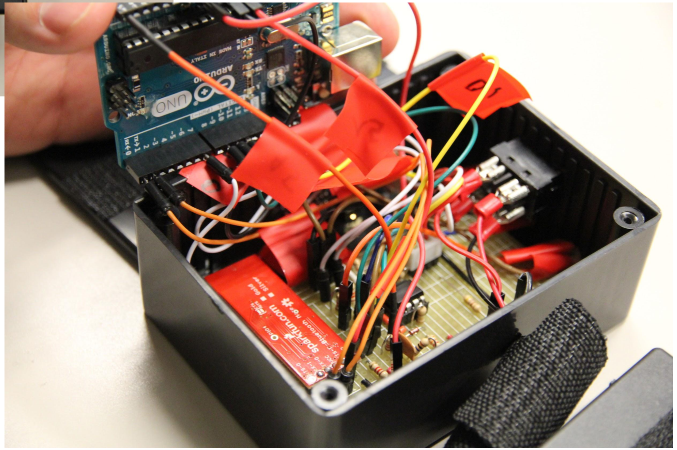
Scheduling & Timeline



Materials & Manufacturing







Budget & Funding

Component	Estimated Cost	Actual Cost
Arduino Uno	$33.00	$33.00
Bluetooth Hardware	$70.00	$165.00
Raspberry Pi	$60.00	$62.00
Grove EMG Kit	$185.00	$55.00
Enclosures	$200.00	$34.56
EMG Signal Processing Circuit	$100.00	$105.57
Prototype Boards	$50.00	$35.30
Miscellaneous components (batteries, electronics, switches etc.)	$120.00	$198.77
Total	$818.00	$689.20

Δ = $ 128.80

Budget & Funding (Cont'd)

- Initial source of funding from ESSEF: $626
- Will be requesting reimbursement from Wighton Fund
- Remaining costs to be split five ways if not covered by Wighton Fund

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Cost Benefit Analysis

- Wireless pedals cost between $95 - $250 USD
- Our product costs $690 CDN (~$537 USD)
- Cost of MYOperater can be reduced
- We know there is a market for our product

Team Learning

- We learned about the technical writing aspect needed to start a small business
- Documentation consumed a great deal of time
- Software development with the Raspberry Pi and Arduino
- EMG signal experience
- Group communication and dynamics
- Implementation and testing took longer than expected

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Future Work

- Design own PCB
- More compact
- Rechargeable battery
- More robust software
- ISO 13485 - Requirements for the design and manufacture of medical devices

Summary

- Designed new way of activating surgical tools
- Learned about Arduinos and Raspberry Pis
- Will make the whole system more robust in the future
- Hope to increase productivity and safety in the operating room

Dr. Buonassisi Video

Acknowledgements

- Thank you for your assistance, knowledge and support throughout this project!
    - Dr. Buonassisi
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    - ENSC 320
    - ENSC 330
    - ENSC 304
    - ENSC 201
    - ENSC 225
    - ENSC 425
    - ENSC 351
    - CMPT 128
    - ENSC 489
    - ENSC 440
    - ENSC 305

Q & A

References

BOVIE AARON950: http://ep.yimg.com/ay/yhst-47024838256514/aaron-950-60-watt-high-frequency-electrosurgical-generator-a950-17.gif
BOVIE AARON 950 FOOT PEDAL http://www.boviemedical.com/products_aaronaccessories_vet.asp
OR1: http://a3.files.psmag.com/image/upload/c_fit,cs_srgb,dpr_1.0,q_80,w_620/MTI3NTgyMjgwODIxNzQyMDQ2.jpg
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ESSS:https://scontent.xx.fbcdn.net/hphotos-xfa1/v/t1.0-9/11150163_810032302423686_3003813507966566712_n.jpg?oh=77c4517061ba48933de21b1b0a730dd9&oe=57B37827
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