Haptic Feedback Gaming System:

Project Presentation

Project Team:

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ENSC 305/440
Simon Fraser University
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Contents

Motivation

- Video game popularity
  - First Person Shooter (FPS) genre

Motivation

- FPS team-activity popularity

Paintball

- Realistic
- Expensive
- Too messy

Laser Tag

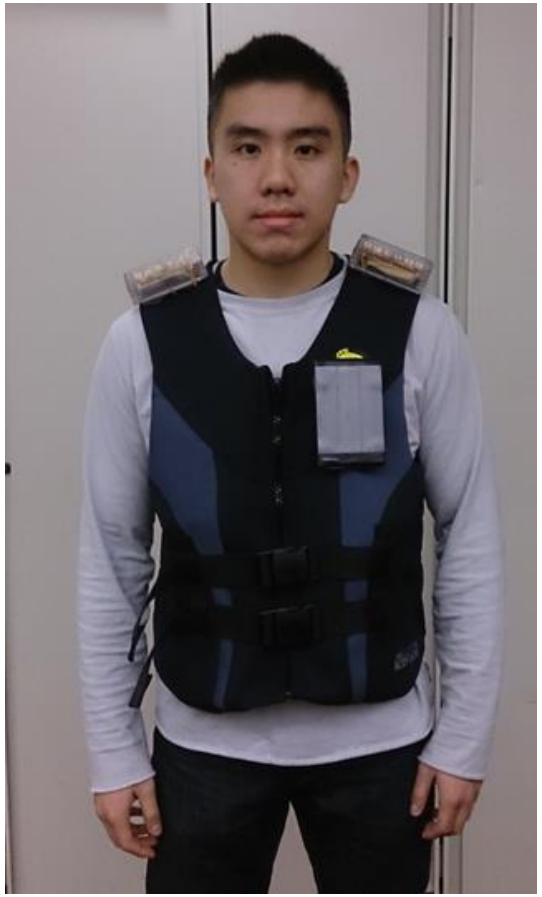
- Inexpensive
- Unrealistic

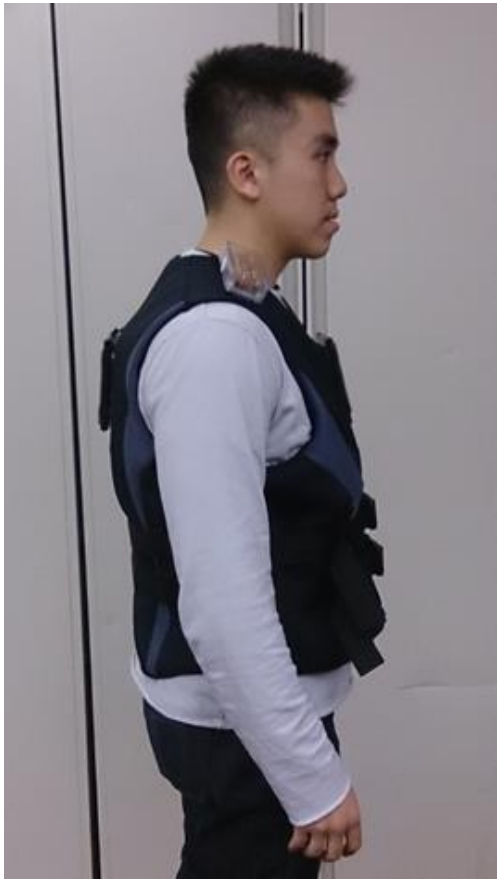
Motivation

- Build upon action oriented gaming
  - First Person Shooter (FPS) games
- Combine best aspects of Paintball and Laser Tag
- Popularity of foam-dart guns
- Radio Frequency Identification (RFID) technology
- Improve gaming realism
  - Haptic Feedback Gaming System (HFGS)

Motivation

- Our project is to build a HFGS
  - “360° Nexus-Series Haptic-System” (360-NS-HS)





Motivation

360°

player awareness of their environment

Nexus Series

Use of RFID system

Haptic System

Feedback stimulant for wearer

Motivation

- Users shoot each other with darts
  - Physical and visual feedback employed
  - Simulate modern FPS game into a real-life counterpart
- Promote
  - Active lifestyle
  - Social Skills
  - Strategic thinking

Project Overview

Project Overview

Company

Market

Competition

Financing

Schedule

Who we are

- RealSim Tech
  - Combination of Realistic and Simulation
  - Development:
    - gaming systems that provide heightened gameplay “realism”
    - technology that advances gaming systems

Project Overview

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Schedule

Kamyar Javanmardi (CEO)

- Chief-Editor of documents
- Enclosure system development and support

Anthony Nguyen (CFO)

- Finance Management and Sourcing
- Feedback system development

Nielven Jay Olis (CTO)

- Product Design and Integration
- RFID System development

James Fong (COO)

- Operations Management
- Hardware Programming

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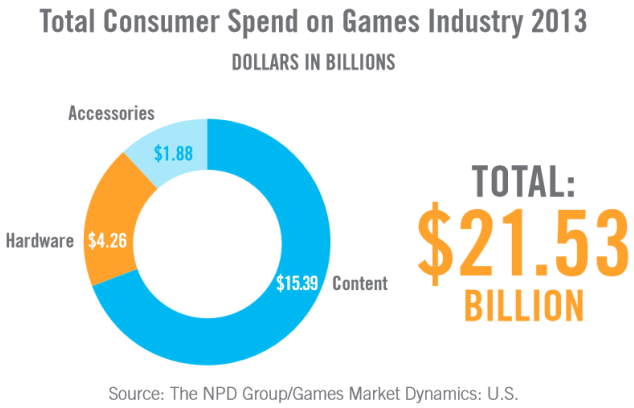
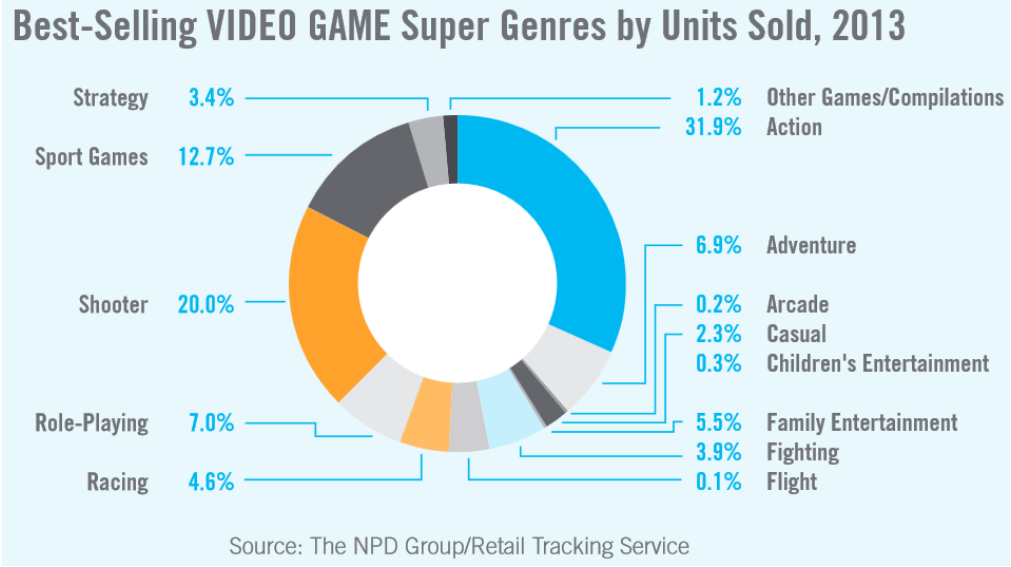
- Video game industry
  - $21.53B spent in 2013
  - > 50% units sold are action/strategy oriented games



Source: The NPD Group/Games Market Dynamics: U.S.



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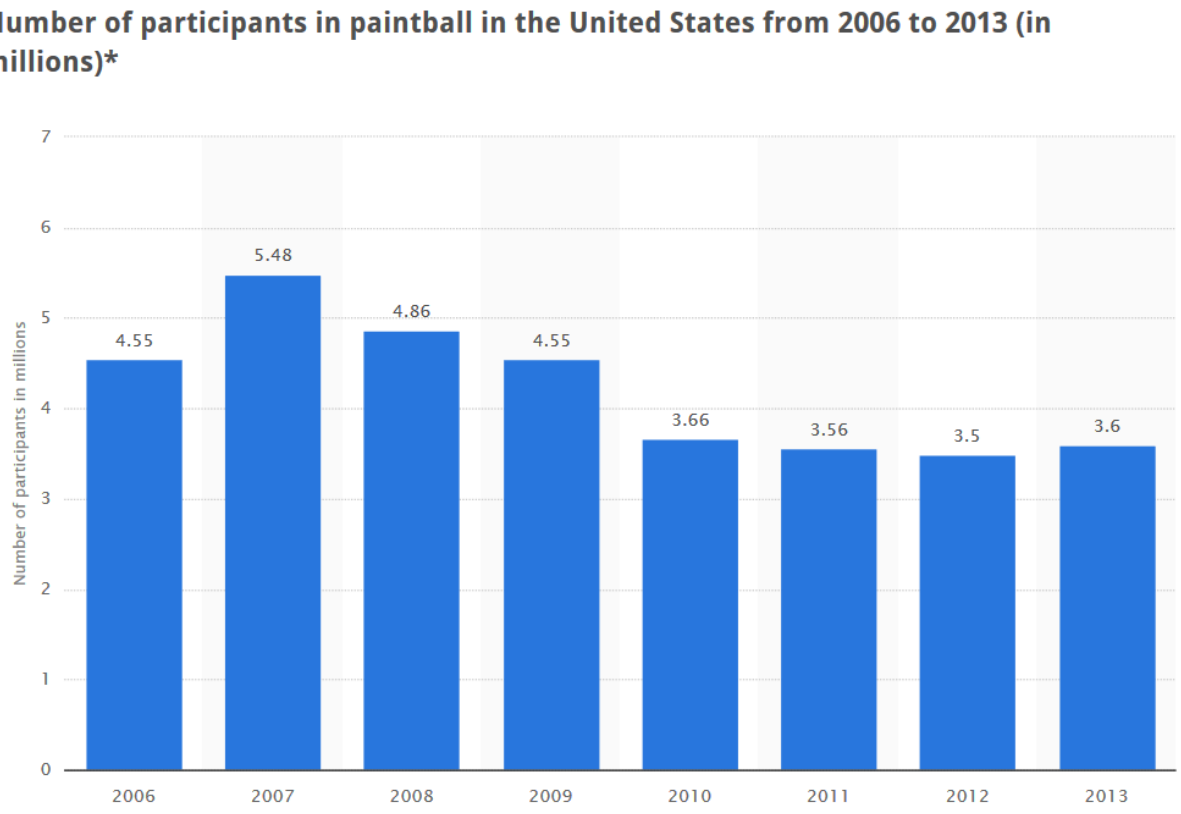
- Paintball enthusiasts
  - New competition to boost market



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- Paintball
  - Liquid Ammunition/Airsoft guns
  - Limited venue
  - Expensive
- Laser Tag
  - Infrared technology (IR)
  - Recreational Centers
  - Lack of physical feedback

Project Overview

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- Projected vs Actual cost
  - Low Frequency RFID system

Equipment	Estimated Cost	Actual Cost	Comments
Parallax RFID Readers x 2	$120	$105.13	
Parallax RFID Transponder Tags	$30	$37.35	
Arduino Microcontroller	$50	$77.41	Purchased Mega 2560 in place of Uno
Vibration Motors	$50	$28.80	
LED strips	$30	$0	Chose cost effective design
Vest + paddings	$50	$52.49	
Foam blaster + ammunition	$30	$16.79	
Enclosures (LEDs, Arduino, circuit)	$30	$45.33	
Miscellaneous (wires/protoboard, electronic/non electronic components, adapters)	$50	$65.98	
Contingency	$80	-	
Total cost	**$520**	**$429.28**	

Project Overview

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- LEDs
  - Cheaper design, same effectiveness
- Microcontroller
  - Switched to Mega for extra serial ports
- Shipped components
  - Purchased extra
- Enclosures
  - Pricey

- **Overall, below projected budget**

Project Overview

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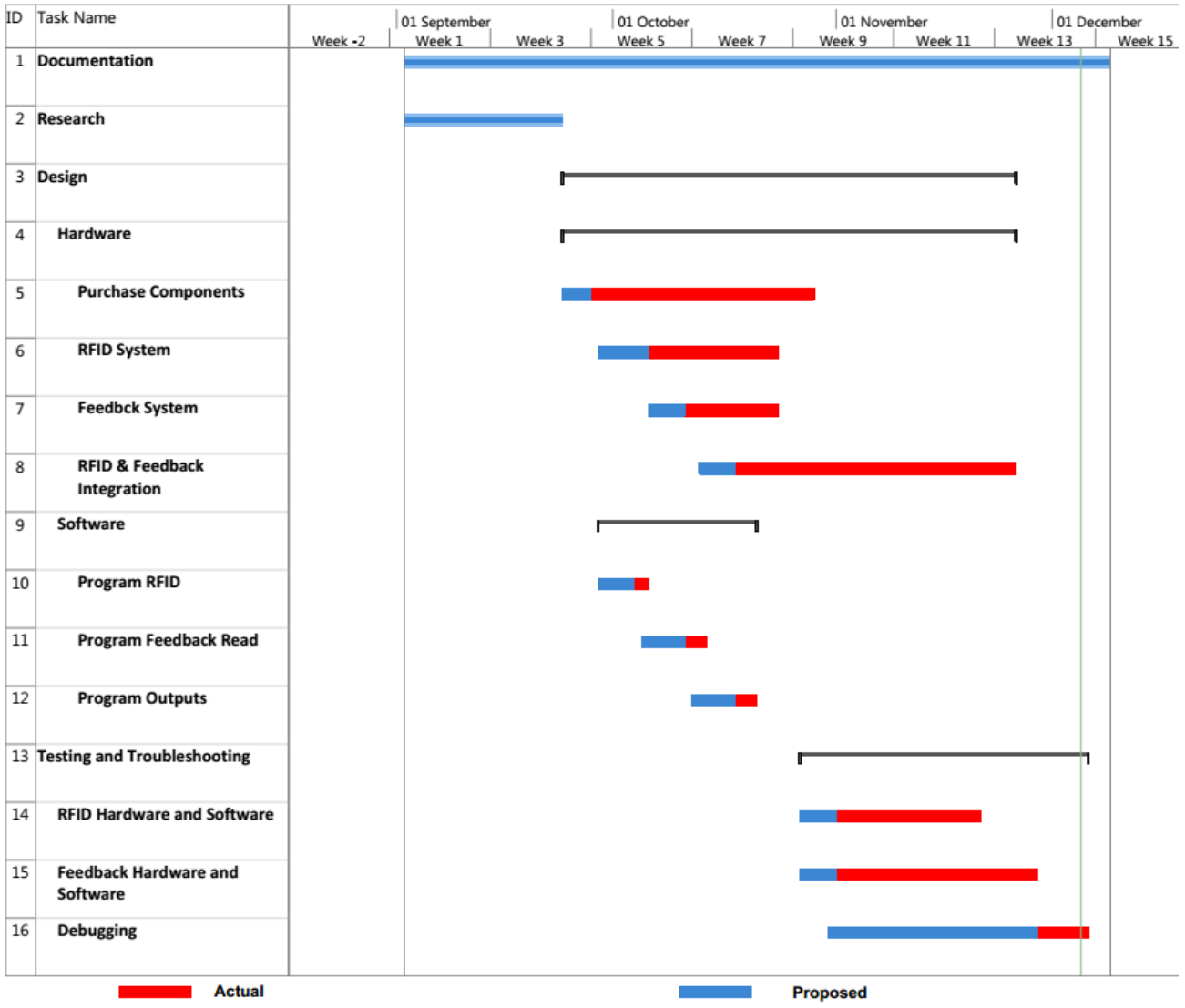
Project Planning and Schedule



System Design

System Design

Overview

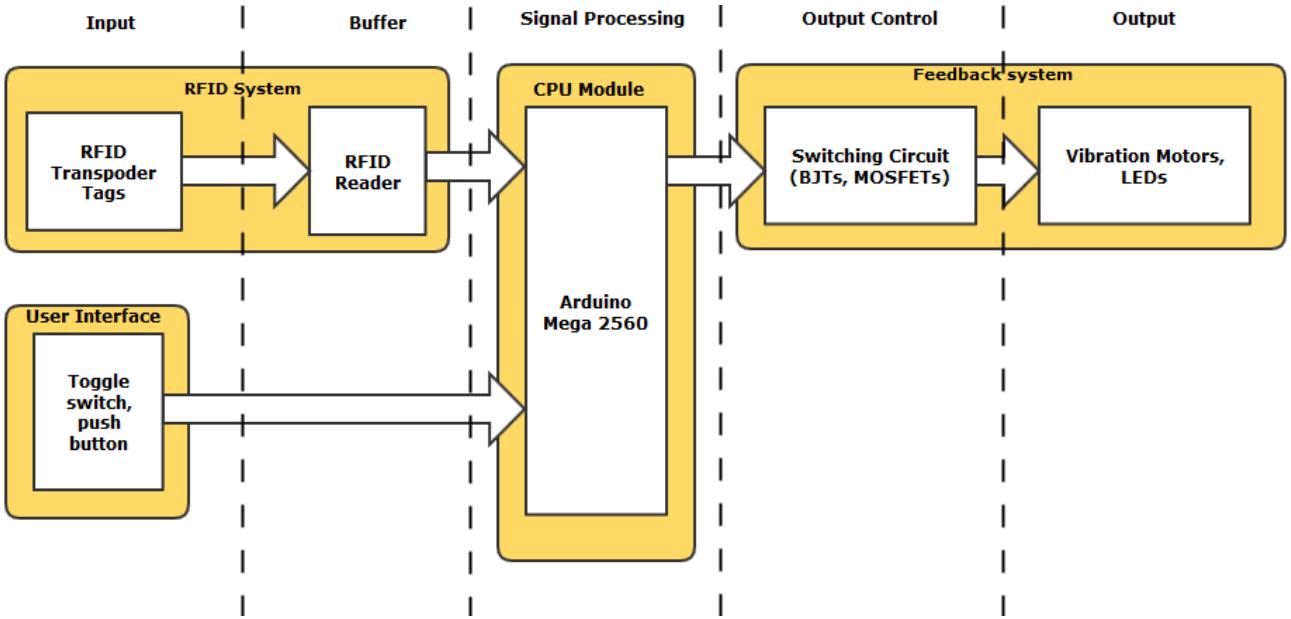
RFID System

CPU Module

Feedback System

Vest Enclosure

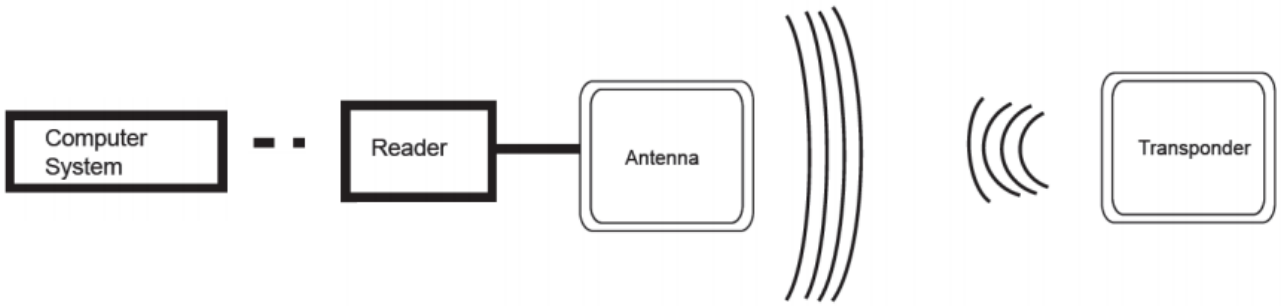
- Signal processing behaviour set by user
- Input: Darts embedded with RFID-Tags
- Output: Haptic and Visual Feedback



High-Level System Diagram

System Design

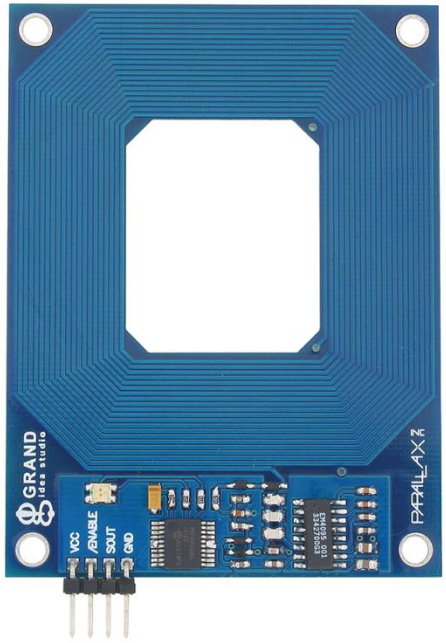
- Radio Frequency Identification
  - Form of auto-identification
  - Typical Uses
    - Animal tracking
    - Inventory
    - Access control



RFID System

System Design

- Prototype uses Low-Frequency (125-kHz) RFID System
  - Low read time (~0.5 s)
  - High-Frequency RFID system would enable faster read times (~0.125 s)



System Design

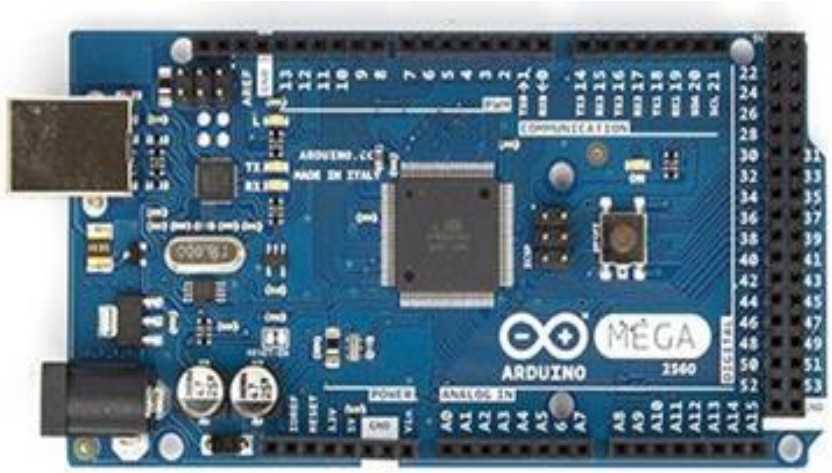
- Foam-dart embedded with RFID Tags
  - 12.4 mm diameter
  - Tip lined with Velcro
- Multiple RFID readers for multiple targets
  - Susceptible to reader collision

*Solution: Alternate reader enable states.

System Design

Microcontroller

- "Brain" of the entire system
- Arduino Mega 2560



System Design

Arduino Mega 2560

- Controls the flow between the RFID system input and Feedback system output
- Multiple serial port
- Utilize Arduino open source software
- Powered by 9V battery

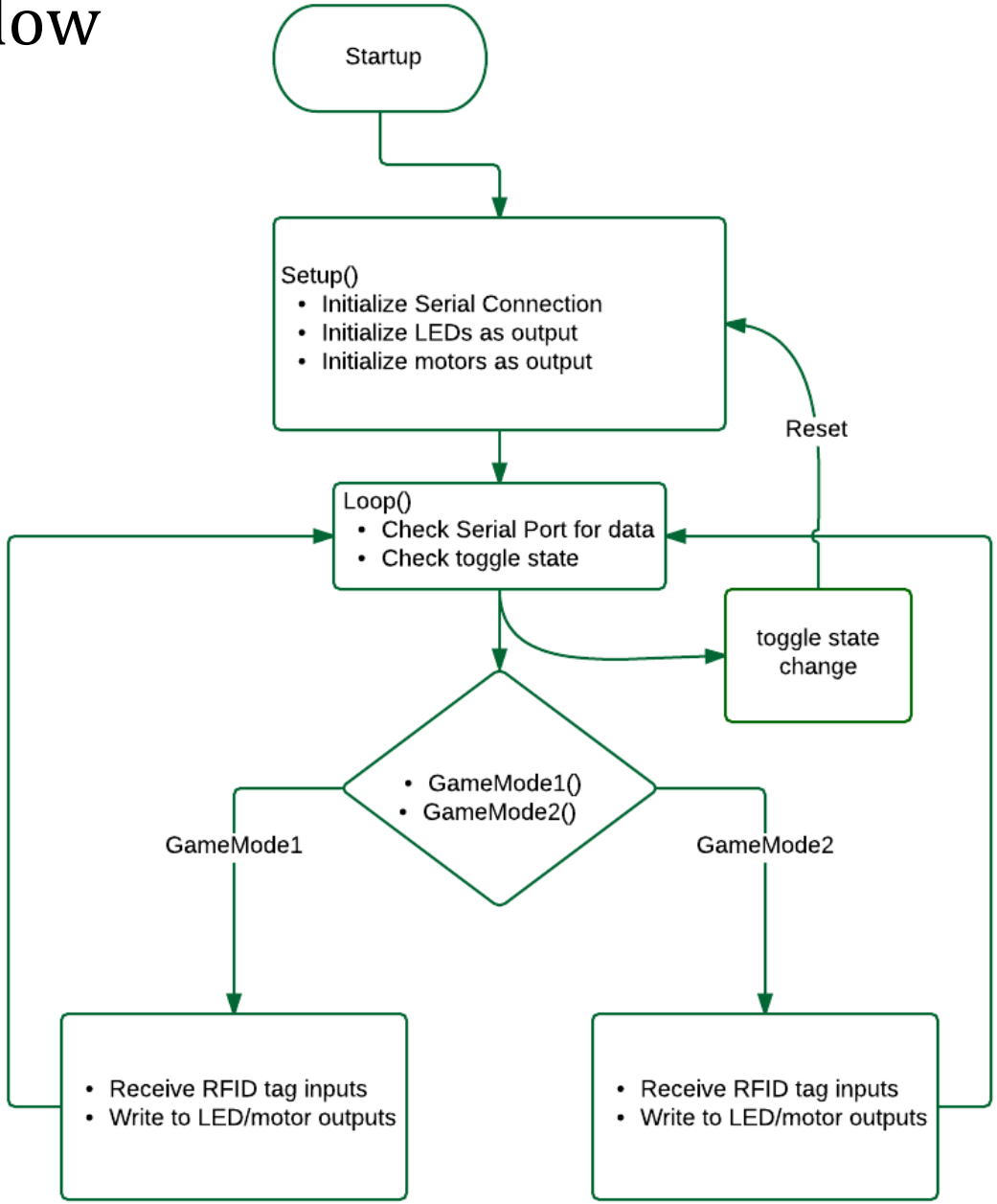
System Design

Software

- Workflow
- Two game modes
  - Game Mode 1 (1 health)
  - Game Mode 2 (3 health)

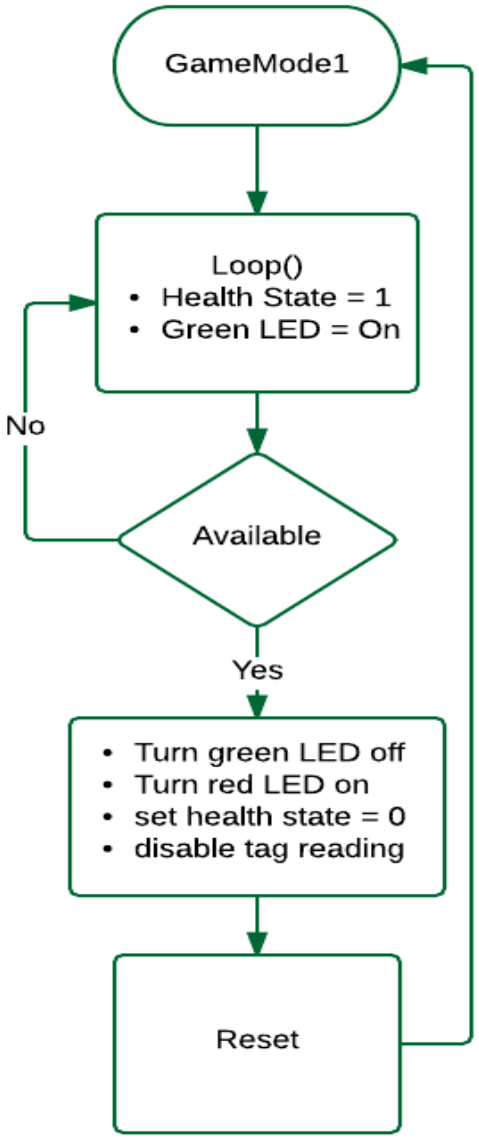
System Design

Workflow



System Design

Game Mode Algorithm



System Design

Overview

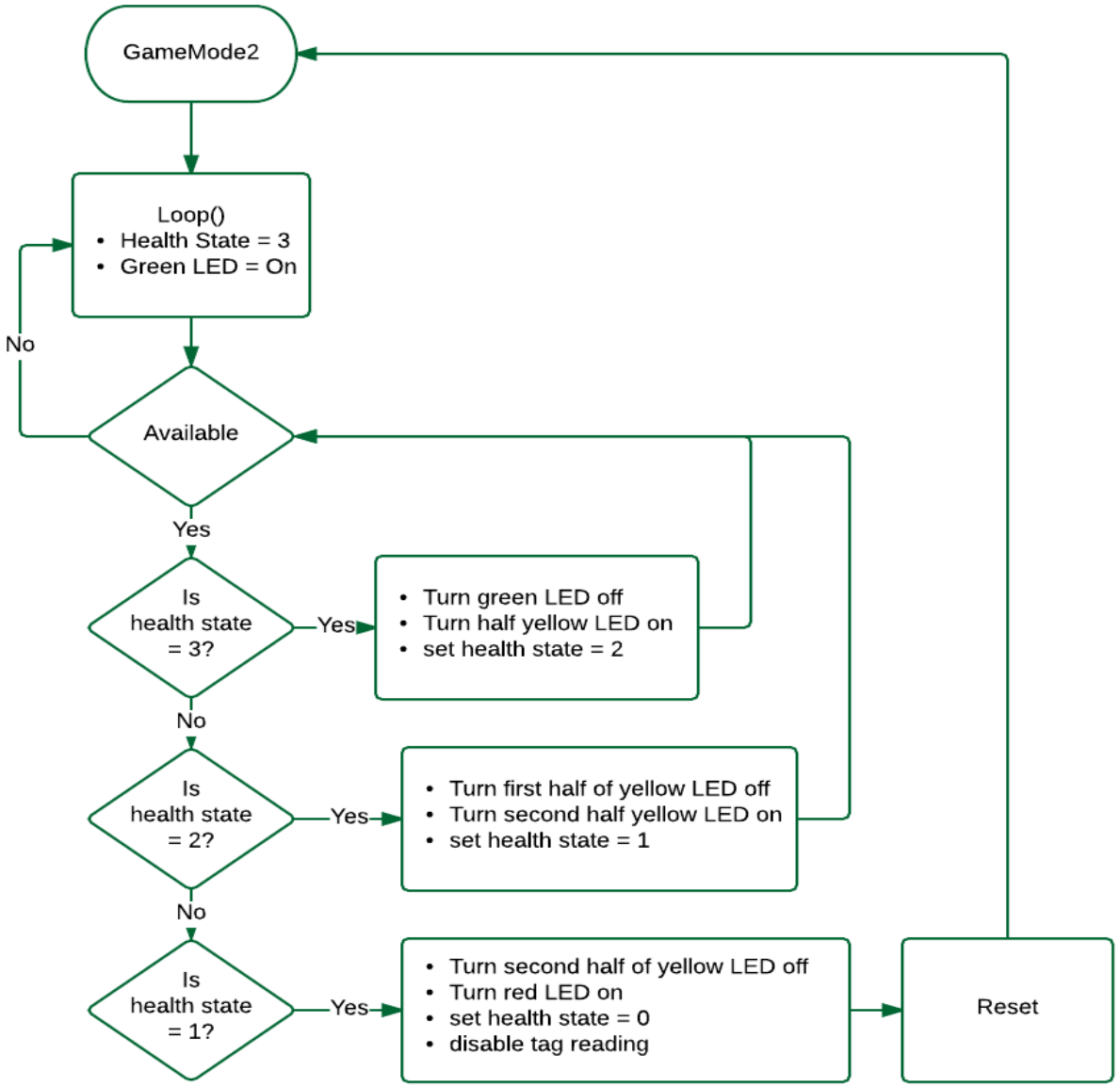
RFID System

CPU Module

Feedback System

Vest Enclosure

Game Mode Algorithm cont'd



System Design

Overview

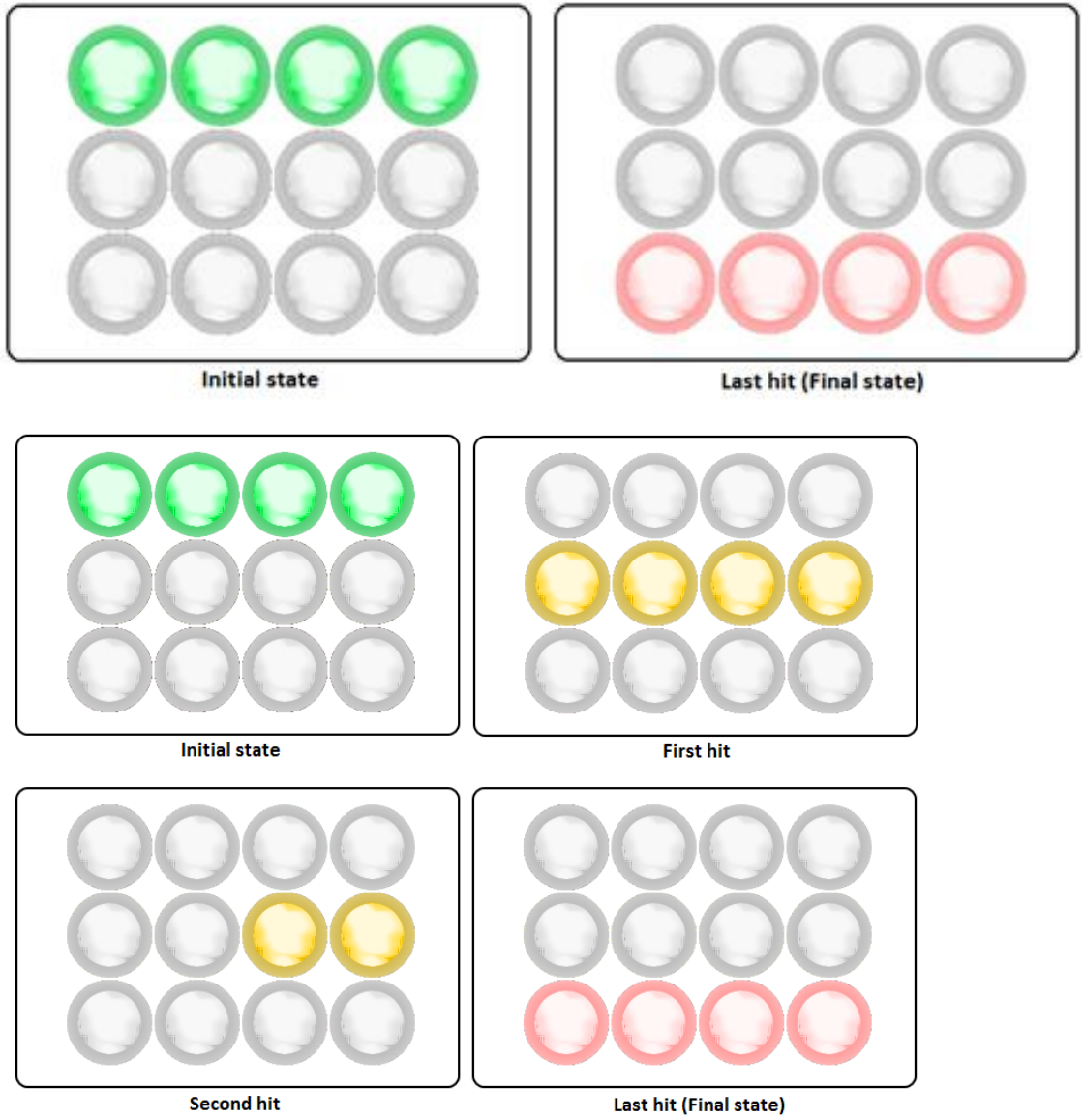
RFID System

CPU Module

Feedback System

Vest Enclosure

Game Mode Algorithm cont'd

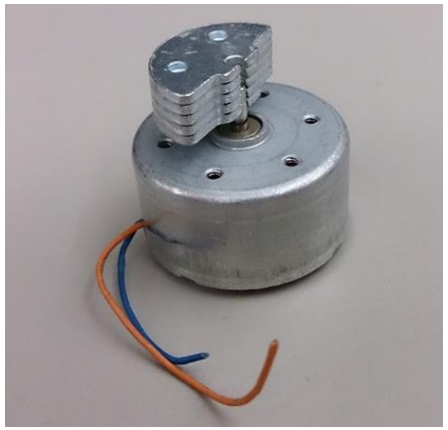


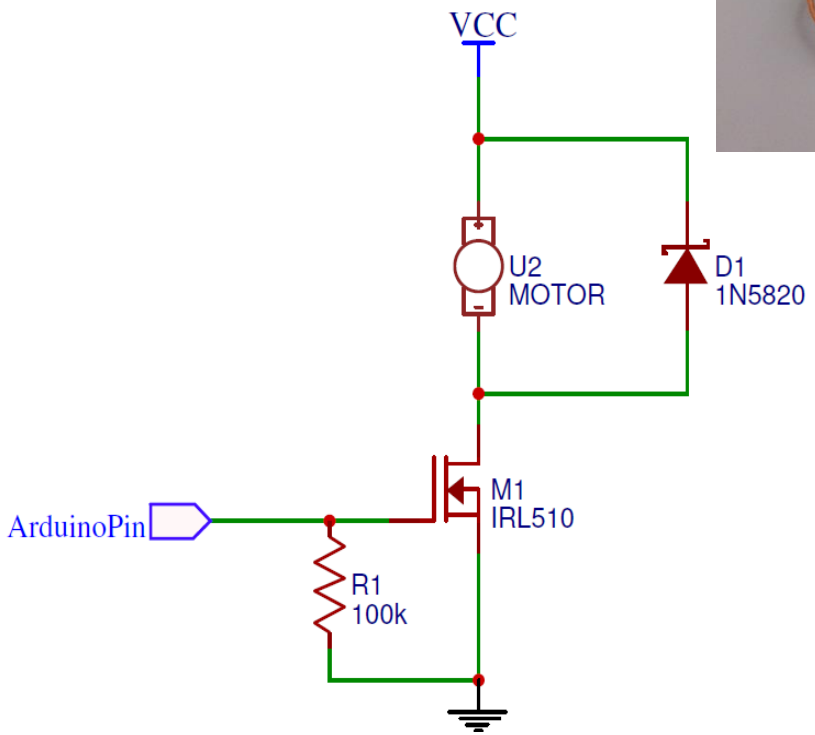
System Design

Toggle Switch and Reset Button

System Design

- Haptic Feedback System
  - Vibration Motors
    - Front & Back
    - Response to tagged dart

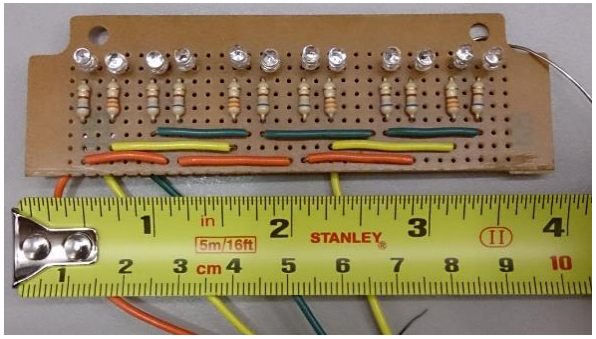




Vibration motor circuit

System Design

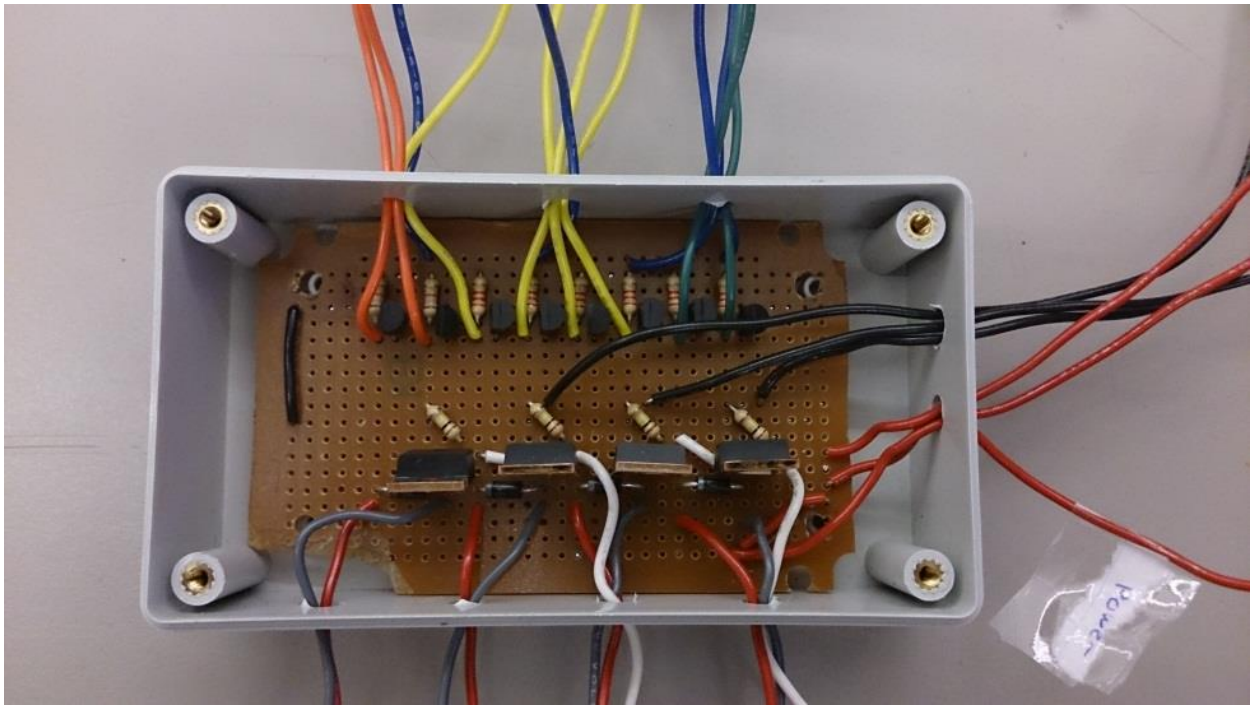
- Visual Feedback System
  - LEDs acts as health meter
  - Visual feedback for non-wearer



LED circuit schematic

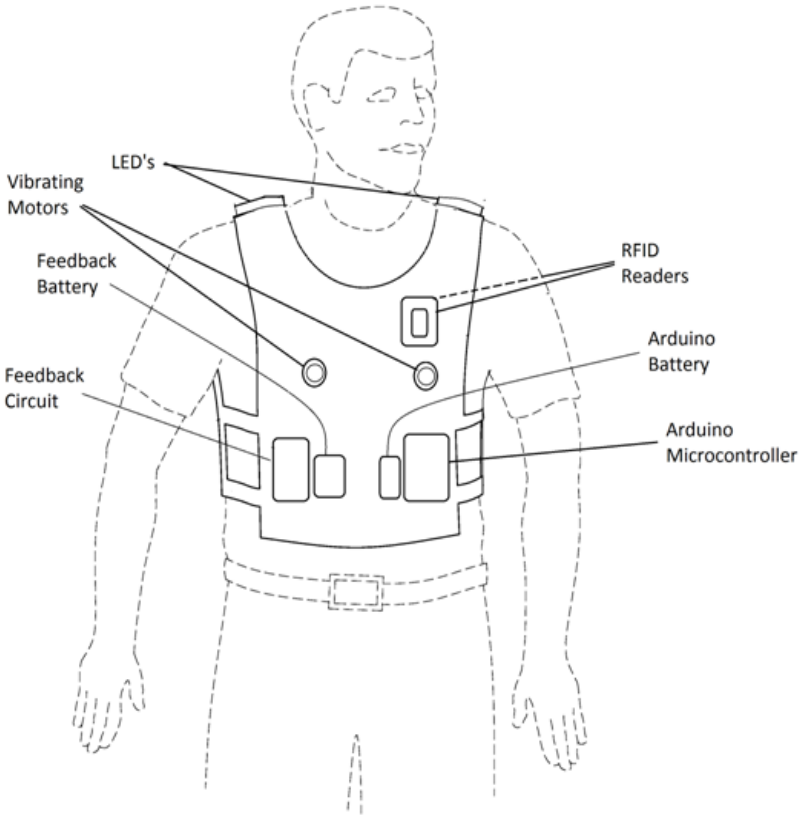
System Design

- Switching Circuit
  - Motors & LEDs powered by 4 AA batteries
  - Control signals to Arduino



System Design

- System components enclosed
- Integrated and Assembled onto vest



Full Prototype Model of 360-NS-HS

System Design

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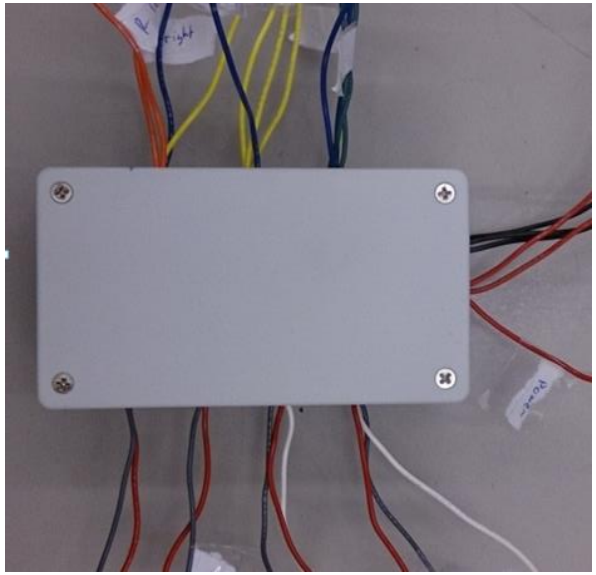

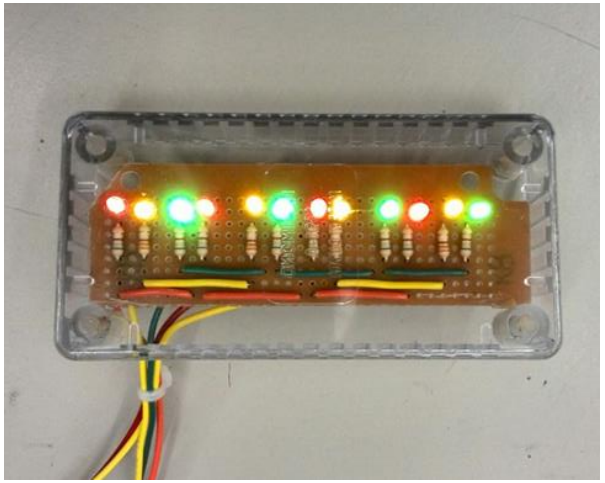

System Design

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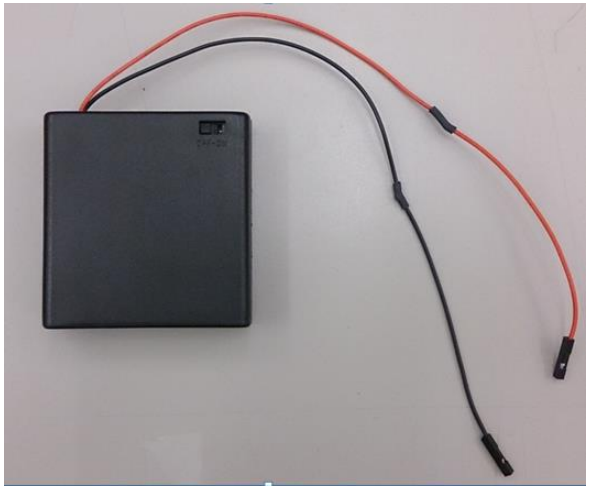

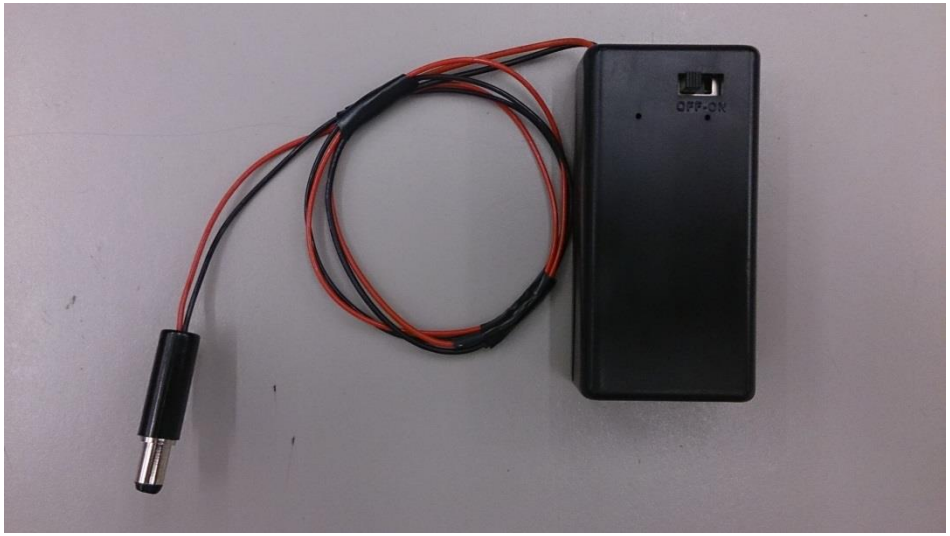

Product Plans

Product Plans

Lessons Learned

Future Plans

- Reader read-speed hinders performance of the HFGS
- Reader interferences poses challenge of having multiple readers
  - Limits target options

- More research
- Project & time management
- Prepare for the worst

Product Plans

Lessons Learned

Future Plans

- Innovate technology:
  - Address issues of performance limitations of the HFGS
- Add upon the HFGS
  - Custom helmet for HS
  - More targets
  - Custom dart-gun
  - 3-D haptic feedback

Conclusion

- Created a Haptic Feedback Gaming System
  - Integration of RFID, Microcontroller, and Feedback system to create a realistic tactical experience.
- Learning achievements
  - RFID technology
  - How to integrate various systems
  - Proper documentation writing
  - Team dynamics
  - Having fun while building project

Acknowledgements

- Dr. Andrew Rawicz
- Steve Whitmore
- Jamal Bahari
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- Mona Rahbar
- Fred Heep
- Engineering Student Society Endowment Fund

References

[1] 12.4 mm Round RFID Tag. (2014). [image] Available at: http://www.parallax.com/product/28445 [Accessed 8 Dec. 2014].

[2] 2014 Essential Facts About the Computer and Video Game Industry. (2014). 1st ed. [ebook] entertainment software association, pp.10,13. Available at: http://www.theesa.com/wp-content/uploads/2014/10/ESA_EF_2014.pdf [Accessed 8 Dec. 2014].

[3] After paintball The Big Bang Theory. (n.d.). [image] Available at: http://www.fanpop.com/clubs/the-big-bang-theory/images/27901106/title/after-paintball-photo [Accessed 8 Dec. 2014].

[4] Arduino Mega 2560. (2014). [image] Available at: http://arduino.cc/en/Main/arduinoBoardMega [Accessed 8 Dec. 2014].

[5] Counter Strike - Global Offensive. (2014). [image] Available at: http://cdn.hifipanda.com/51a48bbf21a4c46405.jpg [Accessed 8 Dec. 2014].

References

[6] Greater NY's Laser Tag Rankings. (2013). [image] Available at: http://www.barneystinsonblog.com/greater-nys-laser-tag-rankings/ [Accessed 8 Dec. 2014].

[7] RFID Card Reader – Serial. (2014). [image] Available at: http://www.parallax.com/product/28140 [Accessed 8 Dec. 2014].

[8] Statista, (2014). *Paintball: number of participants U.S. 2013 | Statistic*. [online] Available at: http://www.statista.com/statistics/191920/participants-in-paintball-in-the-us-since-2006/ [Accessed 8 Dec. 2014].

Questions