FAMU-FSU College of Engineering

CIA Wearables

Team 505

4/4/2024

Team Introductions

Physical Design

Software & Coding

Integration

Kartika Ahern
Systems Engineer

Maxwell Orovitz
Design Engineer

Malachi Johnson-Taylor
Ergonomics Engineer

Eliot Hamilton
Materials Engineer

Patrick Molnar
Mechatronics Engineer

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Thank You to Our Sponsor

Team Sponsor

Franklin Roberts, Ben W,
Tawanna, and Ray Butler
Central Intelligence Agency

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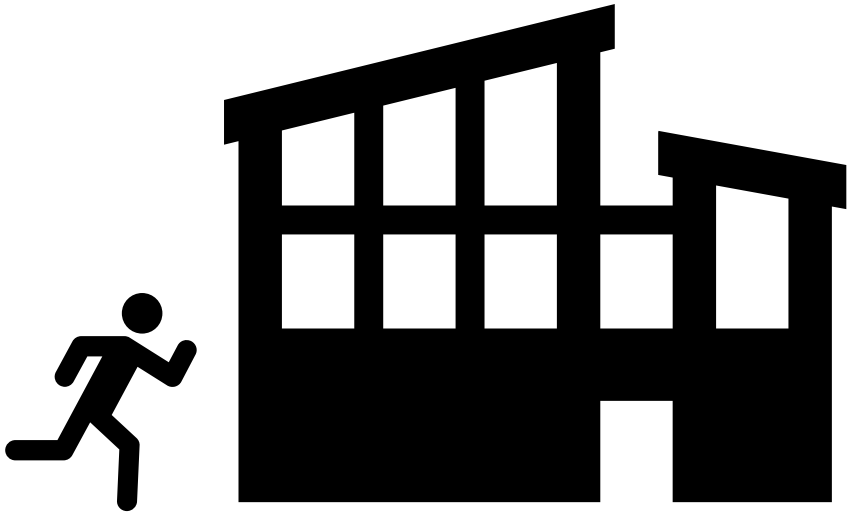
Objective

The objective of this project is to develop an innovative wearable for the CIA, featuring an integrated gas detector, as well as additional technology to aid in building collapse search and rescue missions.



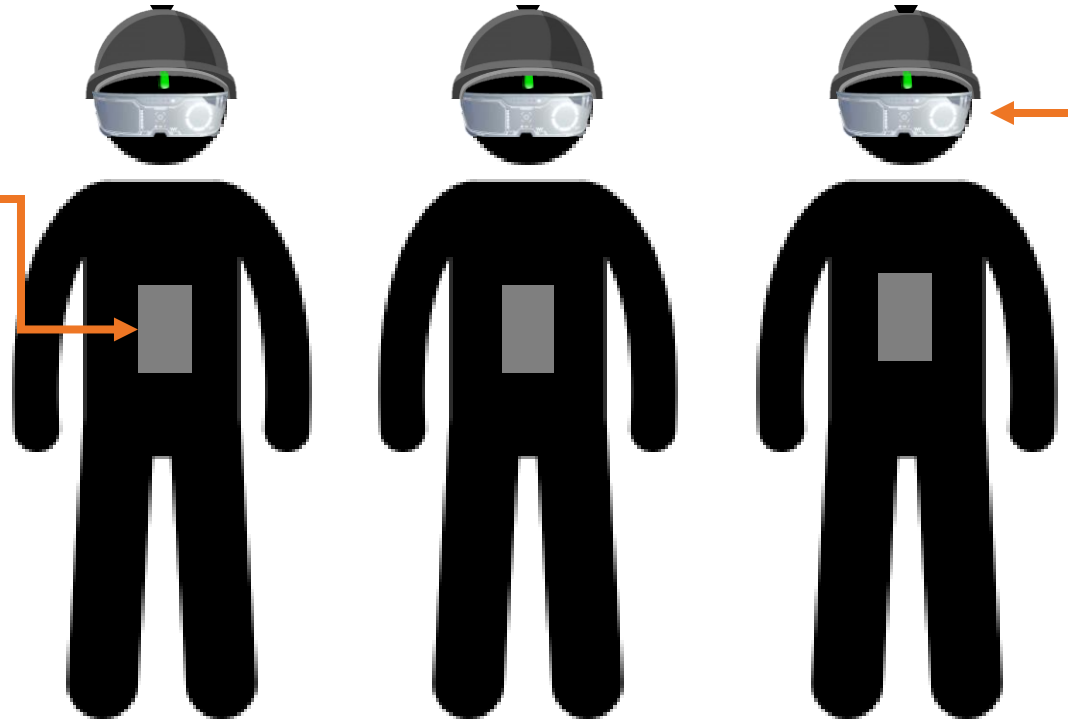
Background

Assumptions, Key Goals, Customer Needs & Critical Targets

Assumptions

Users will be wearing the same device and start missions fully connected

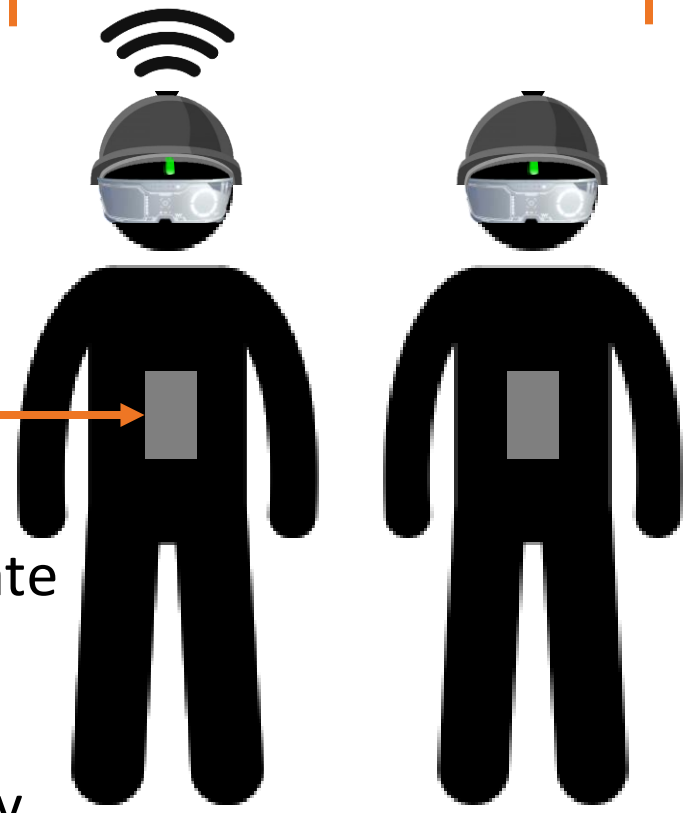
Team 506 will detect relevant gasses and calibrate their detector accordingly



Device will be worn over user optical equipment

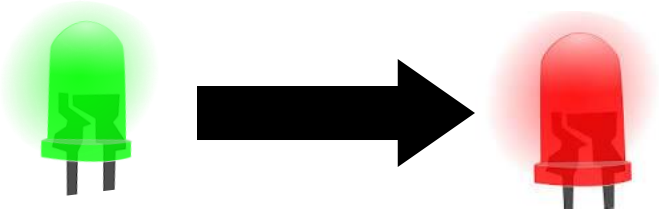
Key Goals

Develop a reliable and fully functional prototype



Successfully collaborate to implement a gas sensor into our wearable technology

Personal Alert Light



Surrounding Team Alert

Improve user safety and communication

Customer Needs and Targets

Safety

Sufficient Testing

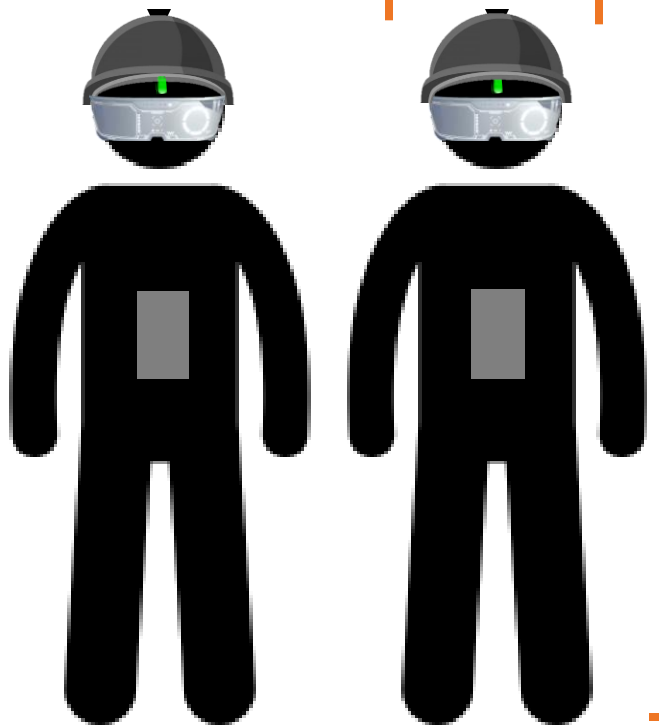
Accessibility

User Alert

Electronics

Sufficient Power

Team Alerts



Physical Design

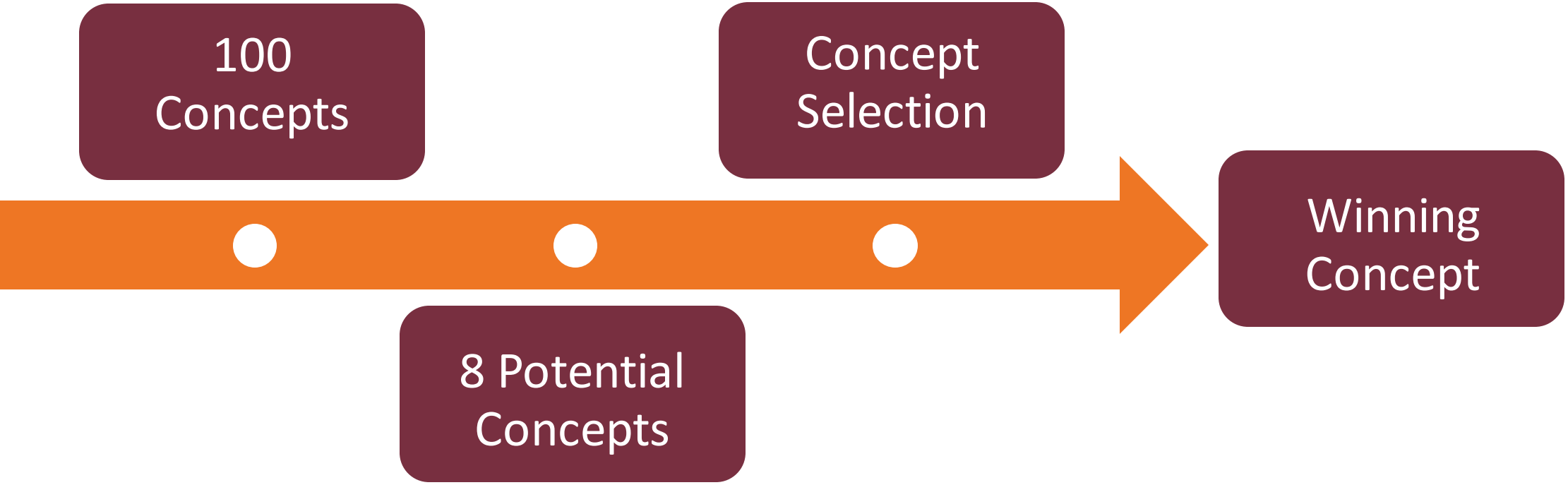
Durable

Lightweight

Comfortable

Kartika
Ahern

Concept Generation and Selection



Kartika
Ahern

Medium Fidelity Concepts

Concept #4:
Backpack + Goggle HUD

Concept #81:
Vest + Gas Mask with UI on Lense

Concept #74:
Back Brace + Helmet HUD

Concept #10:
Tech Sleeve

Concept #71
Backpack + Watch with UI

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Kartika
Ahern

High Fidelity Concepts

Concept #1:
Helmet HUD

Concept #2:
Back Brace + Arm Sleeve UI/Display

Concept #16:
Two Strap Backpack + Retractable UI/Display

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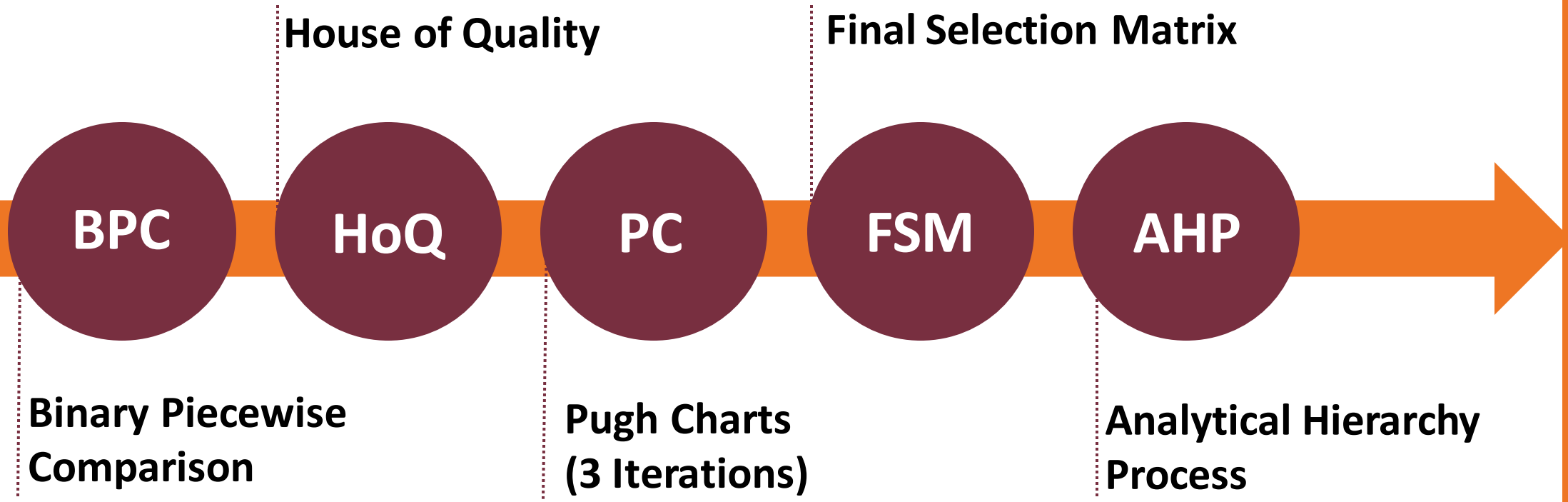
Malachi
Johnson-Taylor

Concept Selection Process



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Malachi
Johnson-Taylor

Concept Selected

Lightweight and Maneuverable physical design

Easy to See Displayed information

Central Location for Vital Collection

Helmet HUD

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Technical Overview

Helmet Design, Battery/Sensors, and Alerting system



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Malachi
Johnson-Taylor

Technical Overview

Helmet Design, Battery/Sensors, and Alerting system

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Comparable Base Designs

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Daytona Motorcycle Helmet

Visor Motorcycle Helmet

Construction Hard Hat

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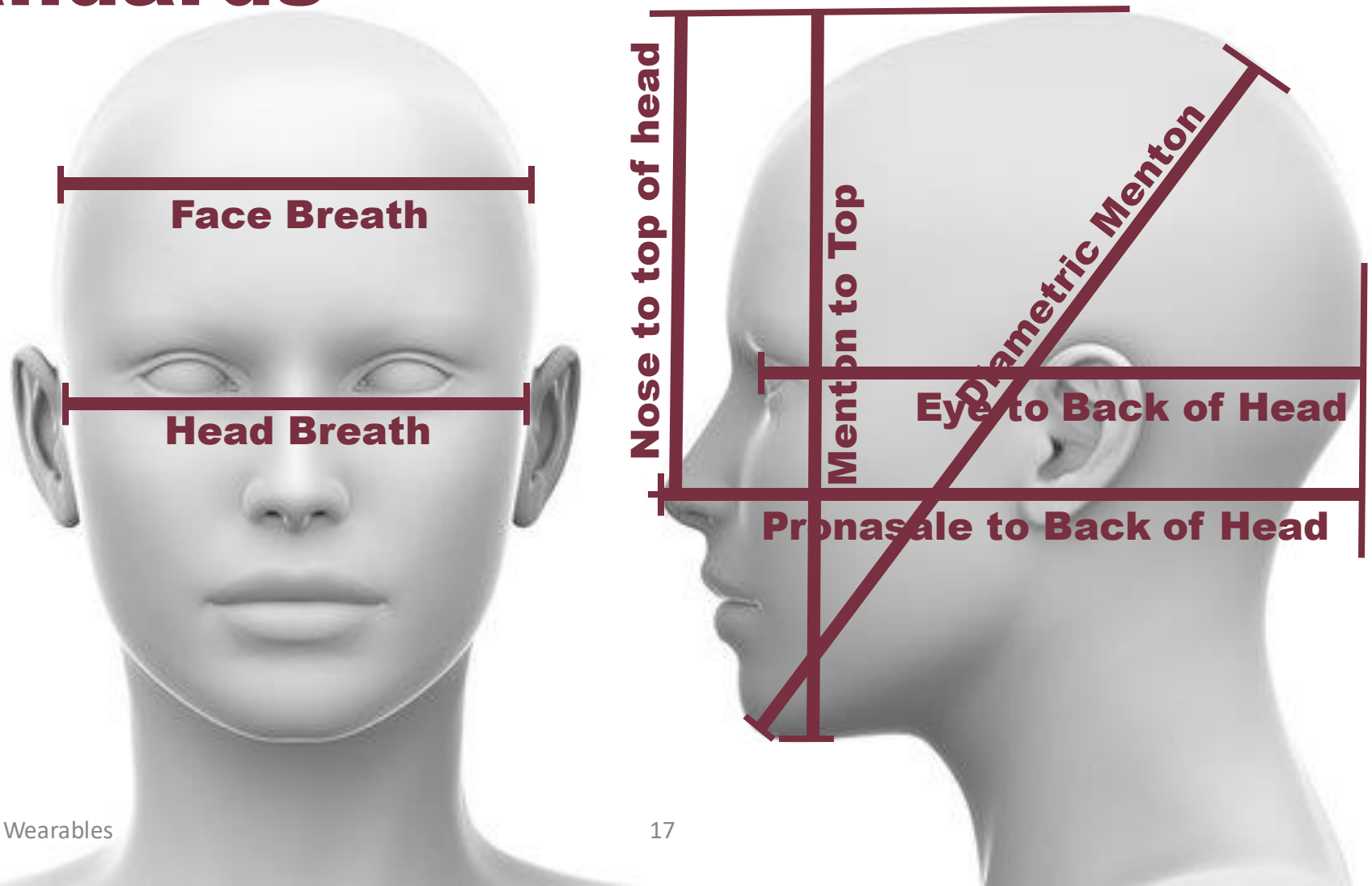
Helmet Design Standards

Malachi Johnson-Taylor



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Design Constraints & Analysis

Component Placement

Non-Invasive Display

Non-Restrictive Sizing

Weight < 8lbs

Malachi Johnson-Taylor

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Previous Designs

Maxwell Orovitz

1st Iteration

2nd Iteration

3rd Iteration

4th Iteration

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Helmet Design

Maxwell Orovitz

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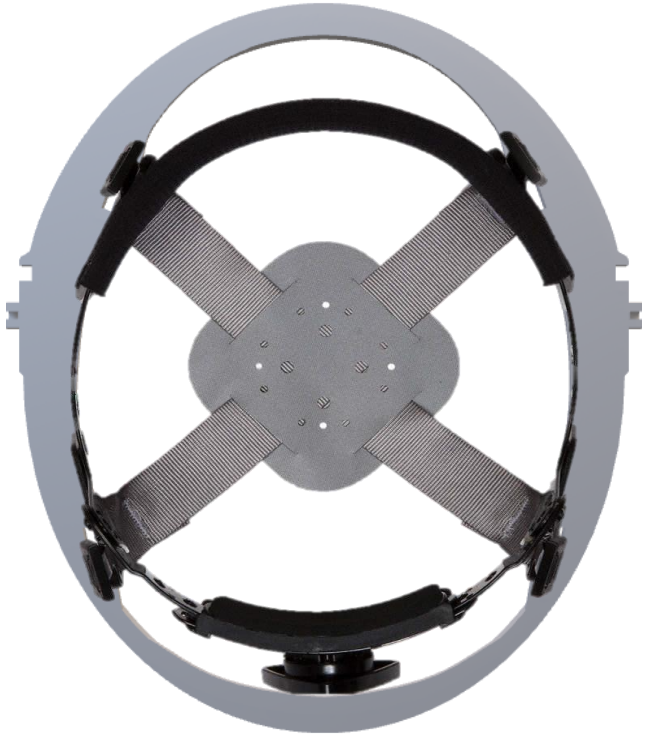
Helmet Design Attachments

Maxwell Orovitz



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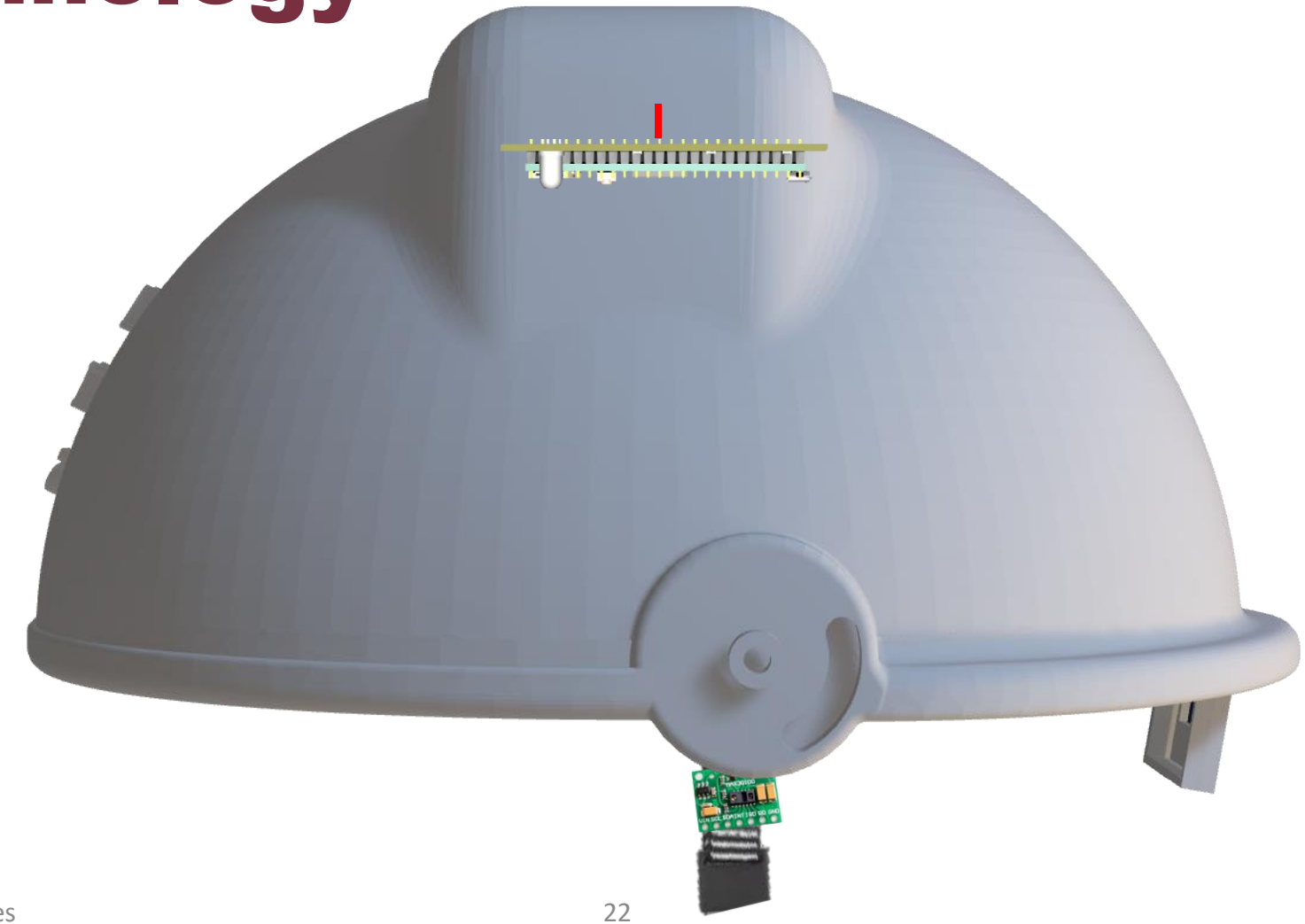
Helmet Design Technology



Maxwell Orovitz

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Materials Selected

Maxwell Orovitz

Shade/Inside

UV Exposure

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Materials Selected

Maxwell Orovitz

Why PLA?

The project was based on academic significance. Our final design would ideally be made with an impact proof ABS.

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Hardware Overview

Teensy 4.1 Microcontroller

- Small size
- Low current draw
- High processing power and low latency
- Has extra SDA and SCL communication pins

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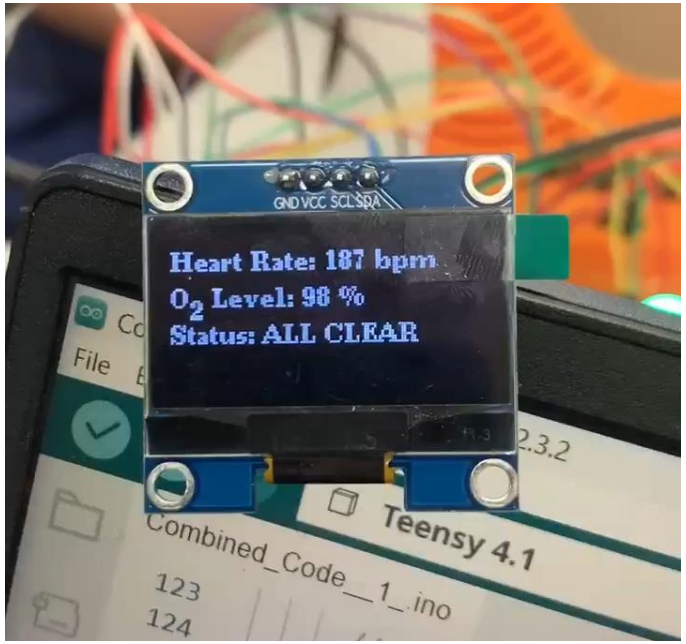
Hardware Overview

MAXREFDES117#: Heart-Rate and Pulse-Oximetry Monitor

- May be placed on finger or earlobe
- Compatible with Arduino
- Open-source heart-rate and SpO2 algorithm

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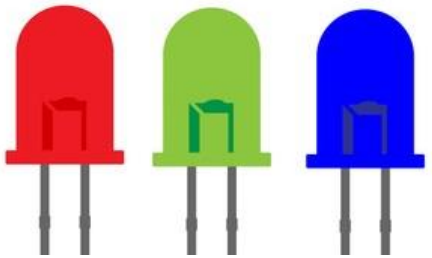
Hardware Overview

RGB LED

- Multiple colors with a single LED (red, green, and blue)
- Bright and visually easy to see
- Adjustability in color for different signals to users



SFM-27-W Buzzer

- Produces 100dB of sound at 12V
- Can adjust dB range and tone to suit search and rescue missions and different signals to users
- Can audibly hear multiple rooms away

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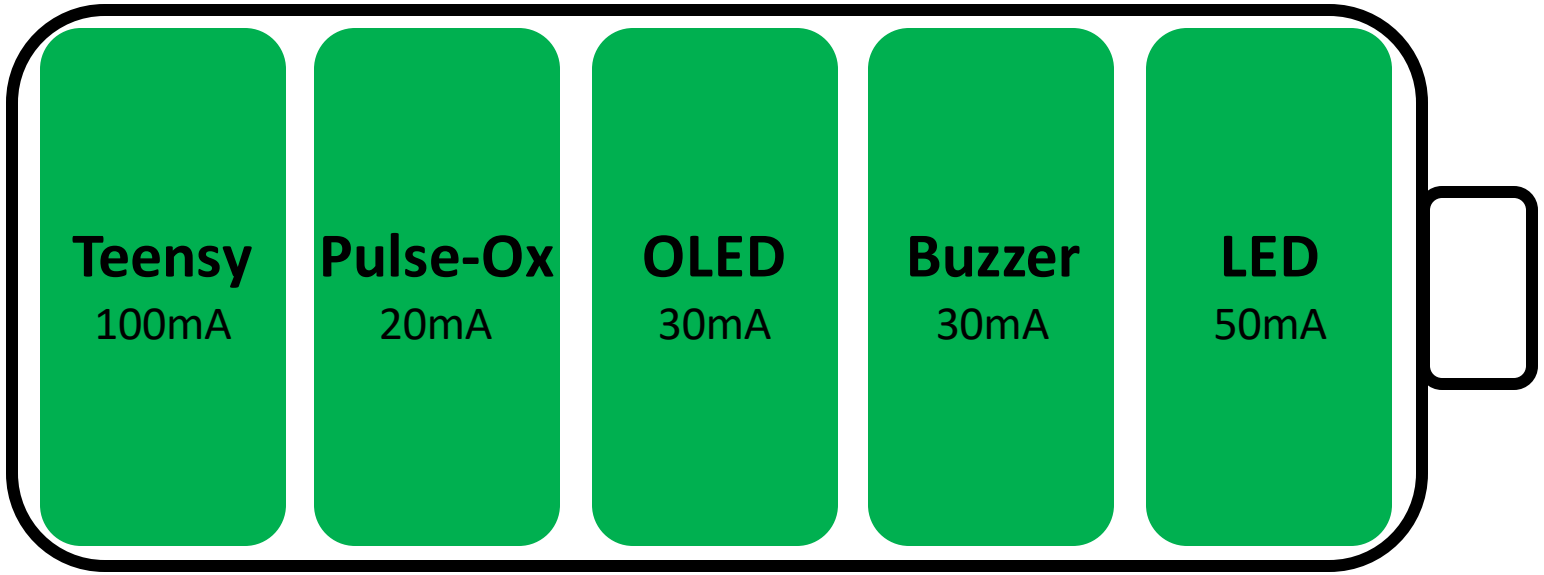
Patrick Molnar

Battery Overview



(100+20+30+30+50 mA)*(18 hr) = 4,140 mAh

Battery Overview

T-CORE Power Bank

- 6,000 mAh
- Easy to charge
- Long shelf life
- Helmet Safety
- Small and lightweight
- Display battery percentage

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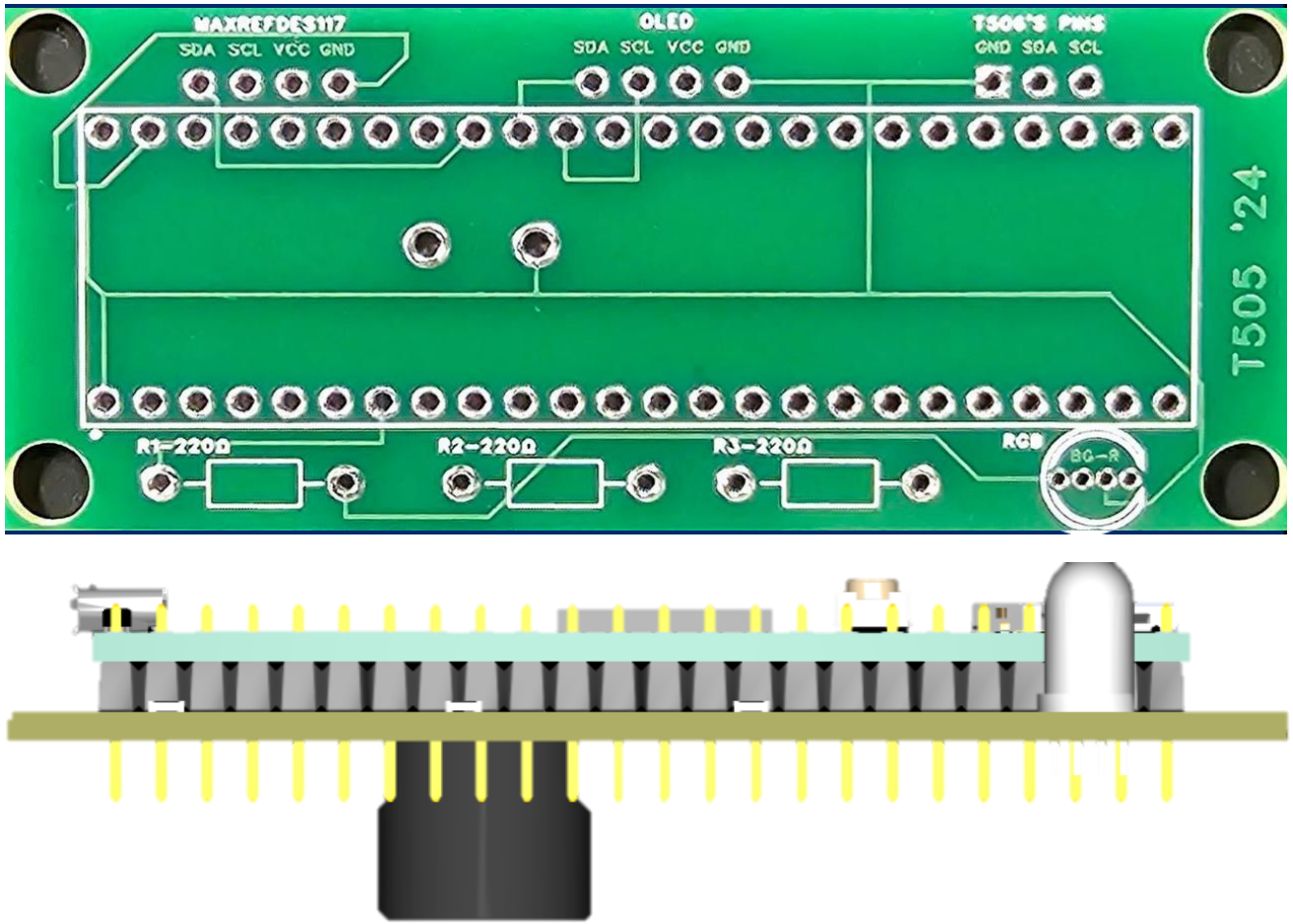
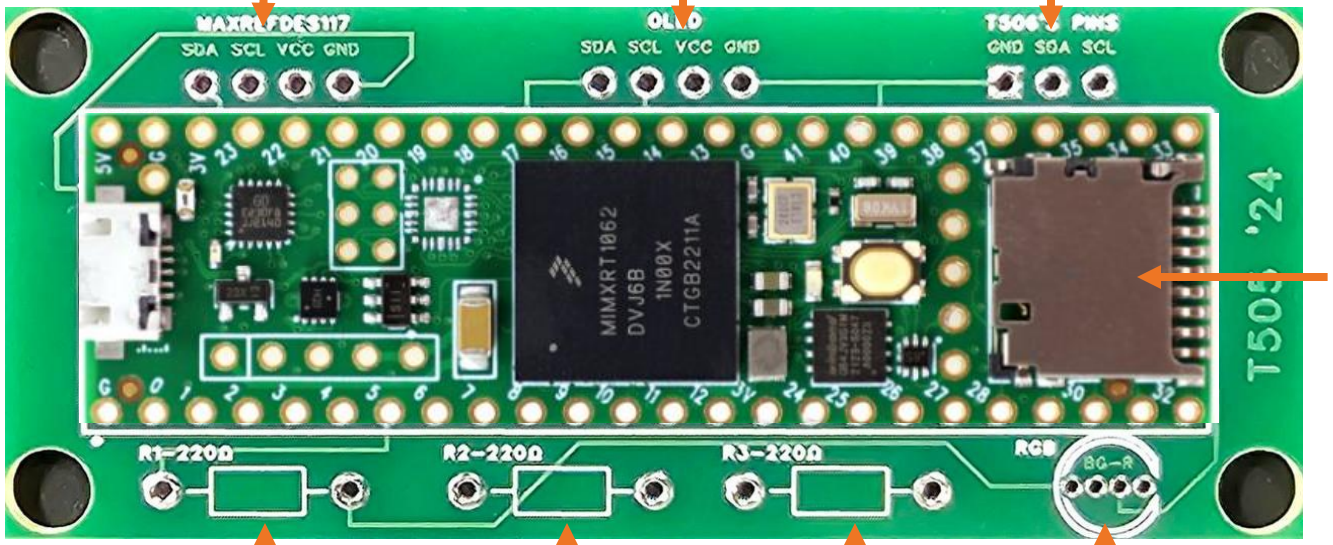
PCB Overview



PCB Overview



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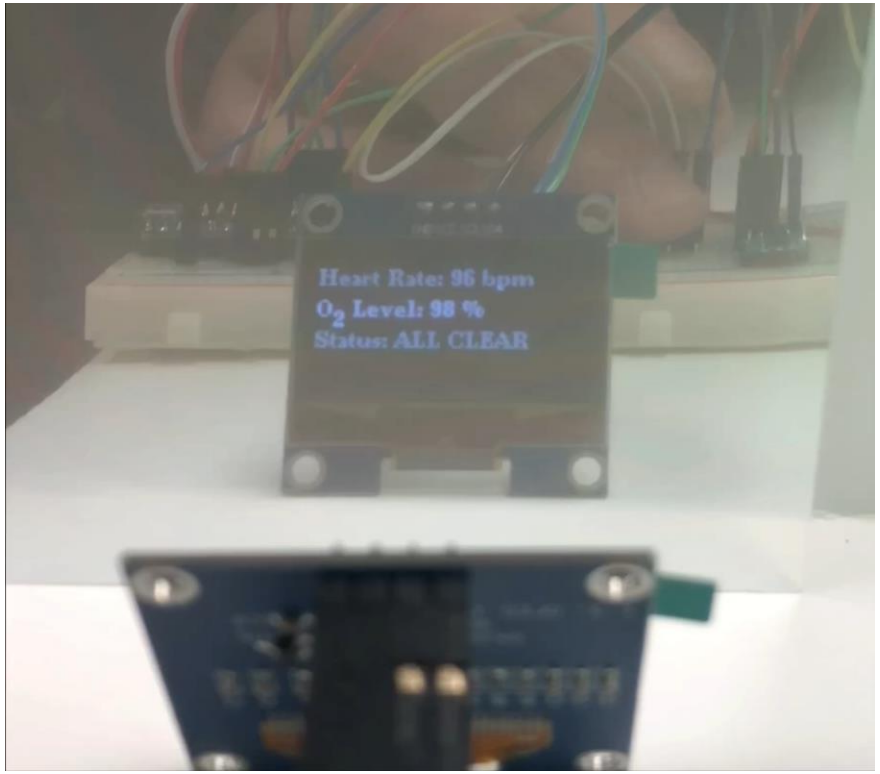
Patrick Molnar

HUD Overview



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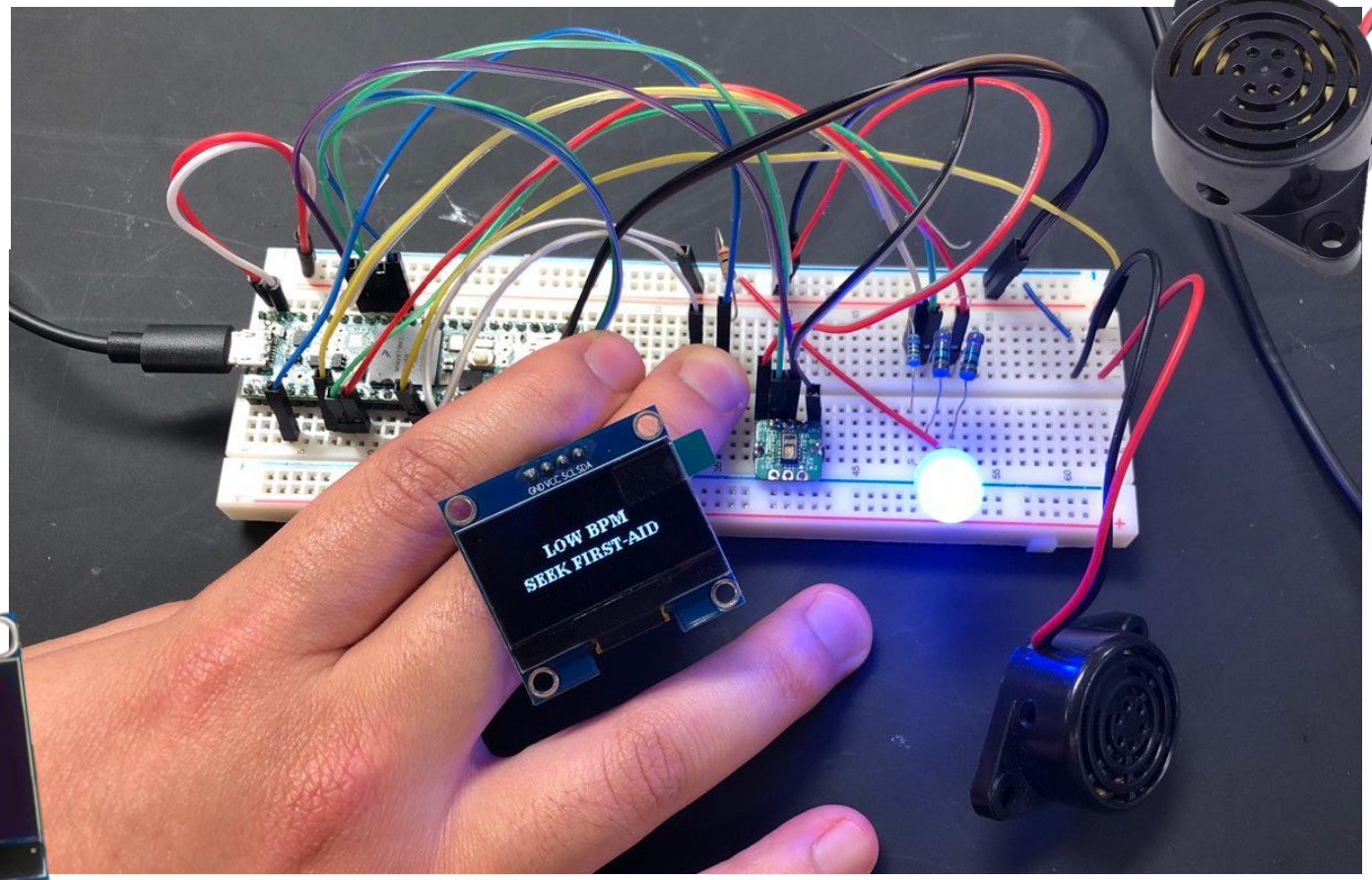
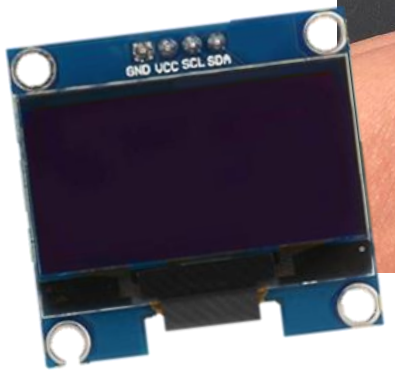
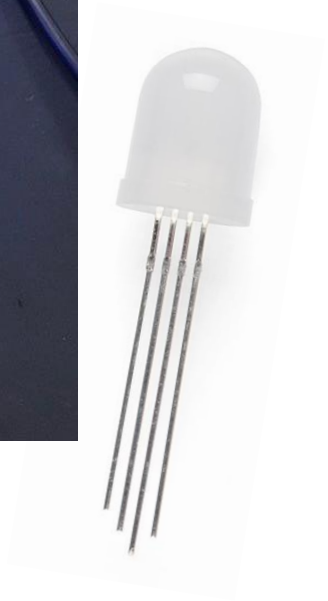
Alerting Overview







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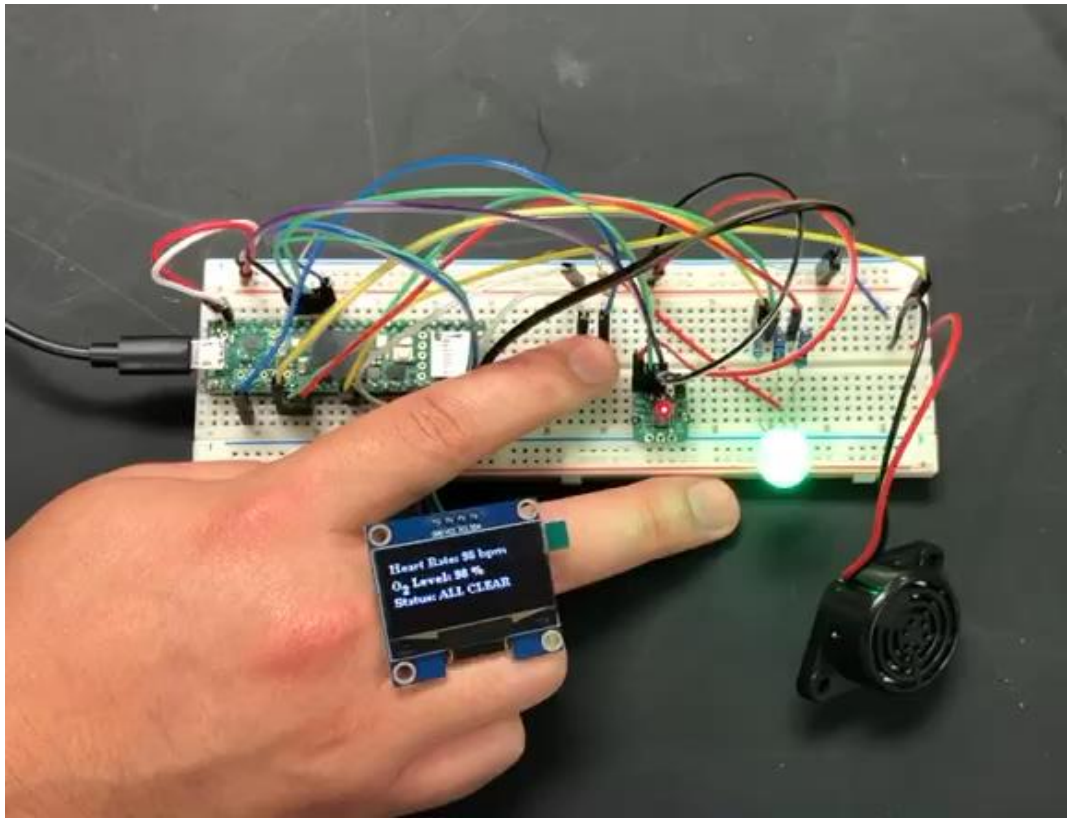
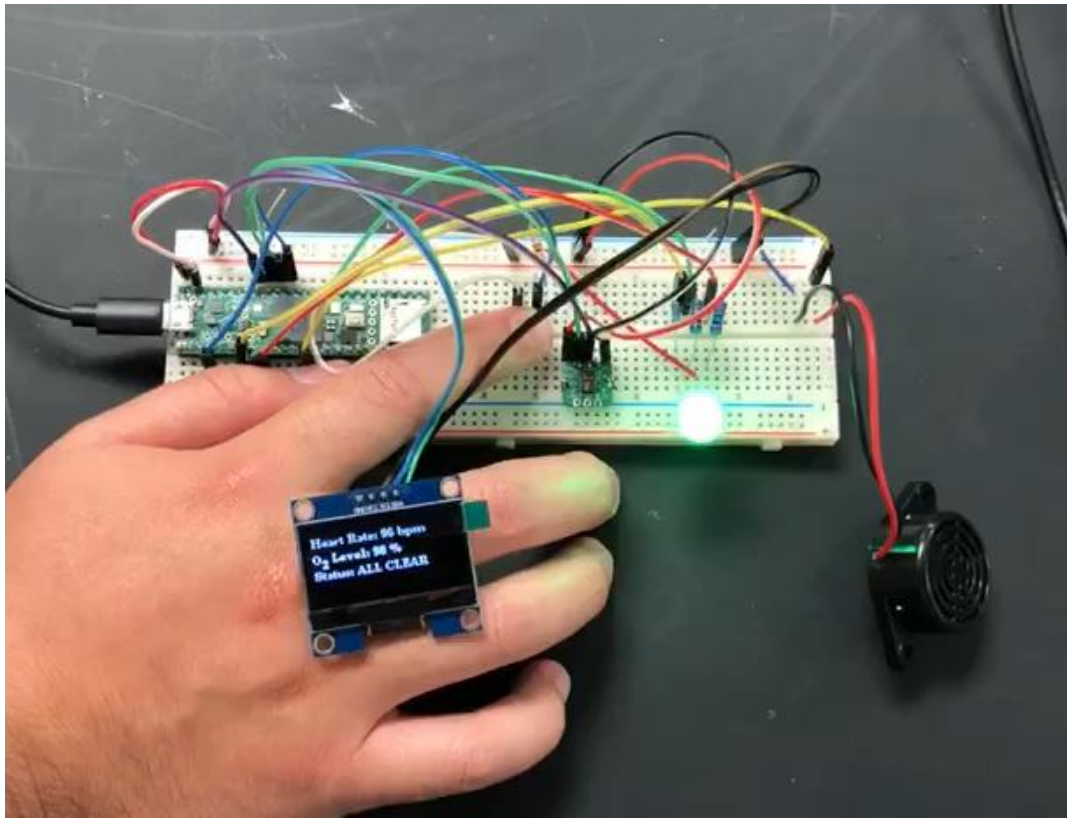
Alerting Overview Gas/Vitals



Gas Detected Alert



Low Vitals Detected Alert

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Integration with 506

Possible Concepts, Chosen Concept and Why

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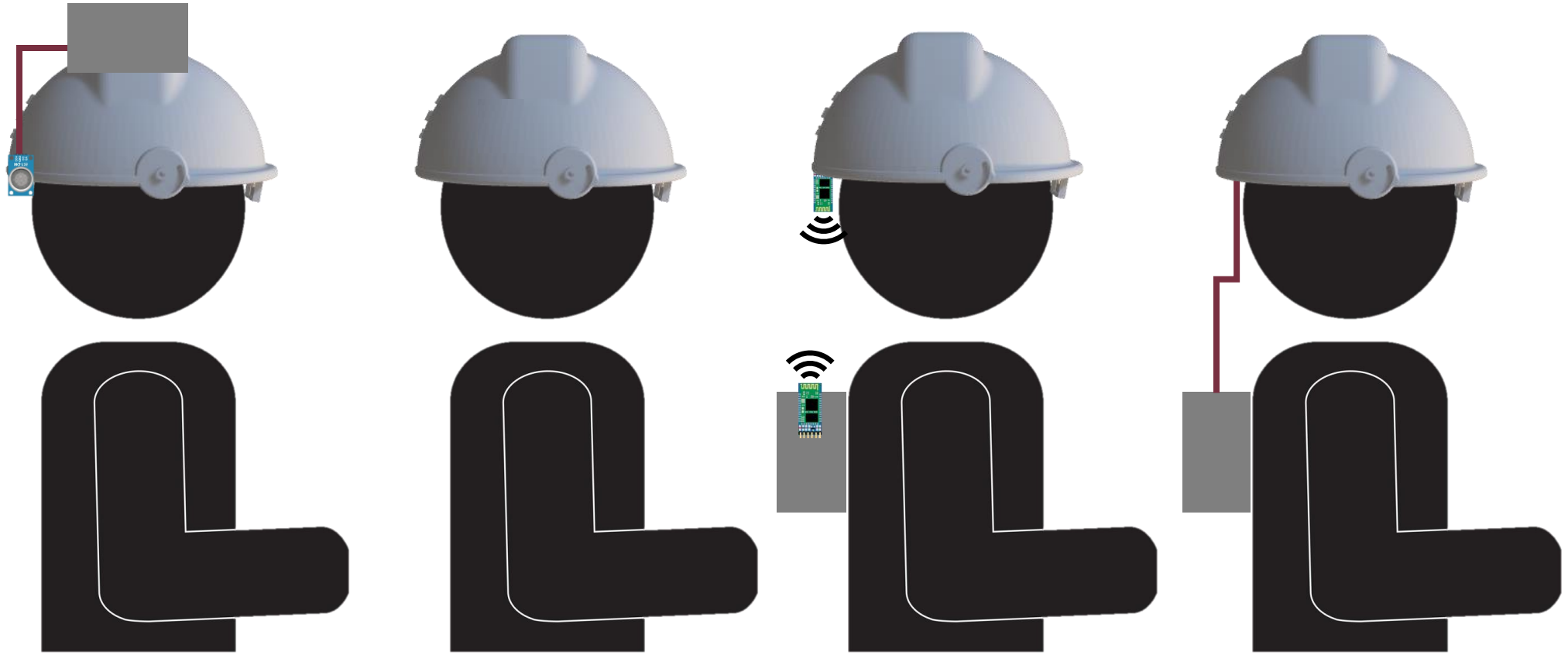
Initial Concepts



Integration with 506 Update

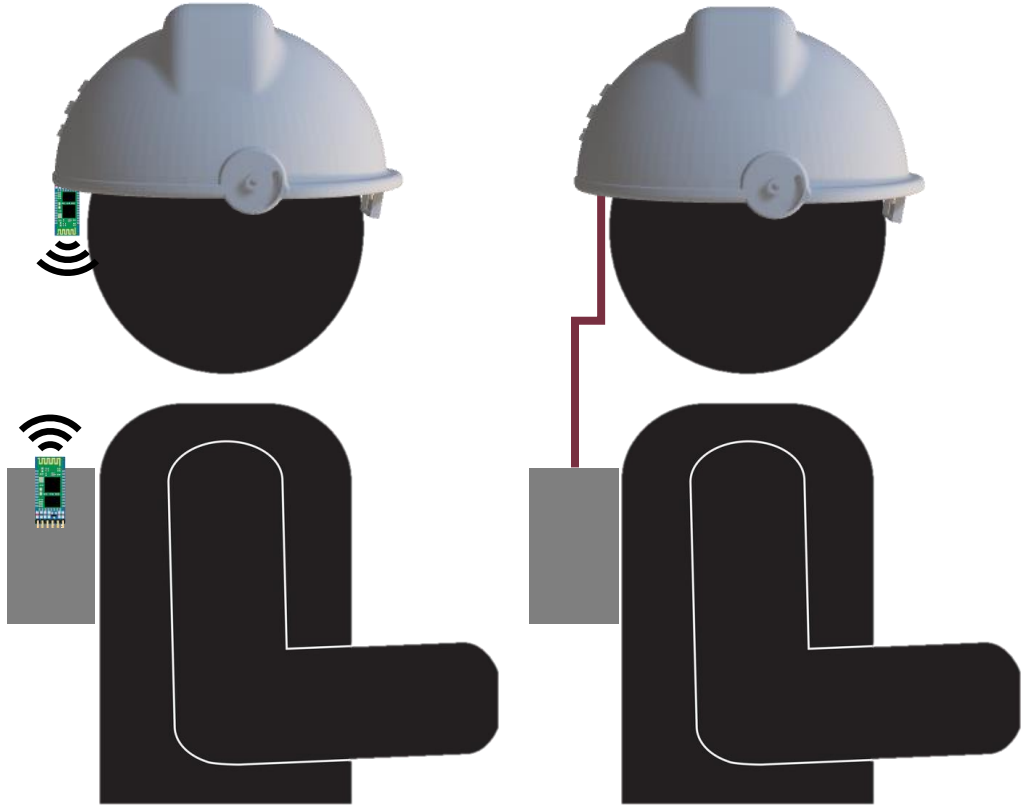
Bluetooth Connection:

Pros:

- No wires to tangle
- Better wearable design

Cons:

- Takes time to connect devices to each other
- Might connect to another user's device by accident



Wired Connection:

Pros:

- Easier to connect devices
- No chance of connecting to another device

Cons:

- Easy to tangle
- Wire wear and tear

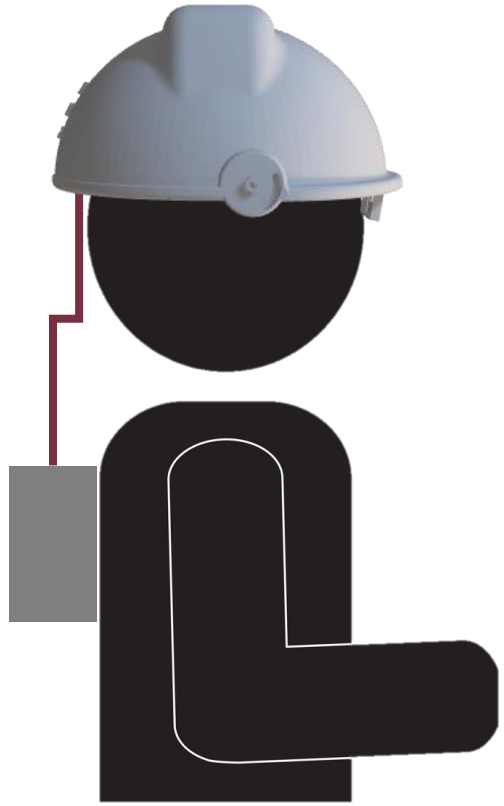
Integration with 506 Update

Winning Integration concept: **Wired Connection**

- Device will be wired to Team 506's gas detector
- HUD will intake values and display status
- Both teams utilizing Arduinos
- Team 506 can place gas detector where they please

Cautions taken to cons:

- Reinforcing connections at both ends
- Reinforcing Wire



Eliot Hamilton

End of Project Summary

Budget/Purchasing, Future Work, Lessons Learned

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Budget Overview

Component/ Material:	Cost :
Headgear	$12.49
Tinted Visor	$185
Reflective Film	$3.25
70% of Filament Roll	$19.99
Chin Strap	$11.19
OLED LCD	$8.49
Battery	$38.99
Heart Oximetry Monitor	$19.02
Teensy 4.1	$31.08

Running Total of Current Product:

$ 327.50

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
$ Exp	$0	$0	$0	$360	$0	$148	$253
% Exp	%0	%0	%0	%18	%18	%25	%38

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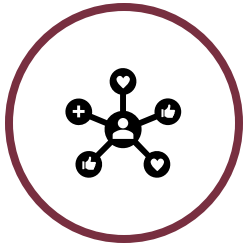
Future Work

Gather feedback from CIA operatives to target improvements

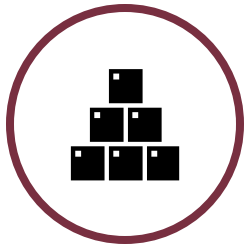
Add more sensors for detecting different dangers such as extreme temperatures



Upgrade HUD to communicate data back to a central area

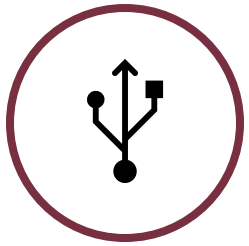
Use better materials to make the helmet stronger and potentially certifiable for use

Lessons Learned

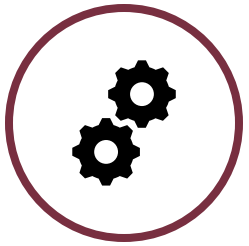


Foresight of PLA and materials needed in excess

Closer work schedule with sister team 506



Wire schematic before purchasing



Use base design and innovate upon it, don’t reinvent the wheel

Summary & Conclusion

Objective

Develop a wearable device capable of assisting in Search and Rescue missions

Constraints

Weight
Size
Accessibility

Integration

Connecting our device to 506 gas detector

Final Design

Thank you from Team 505!

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