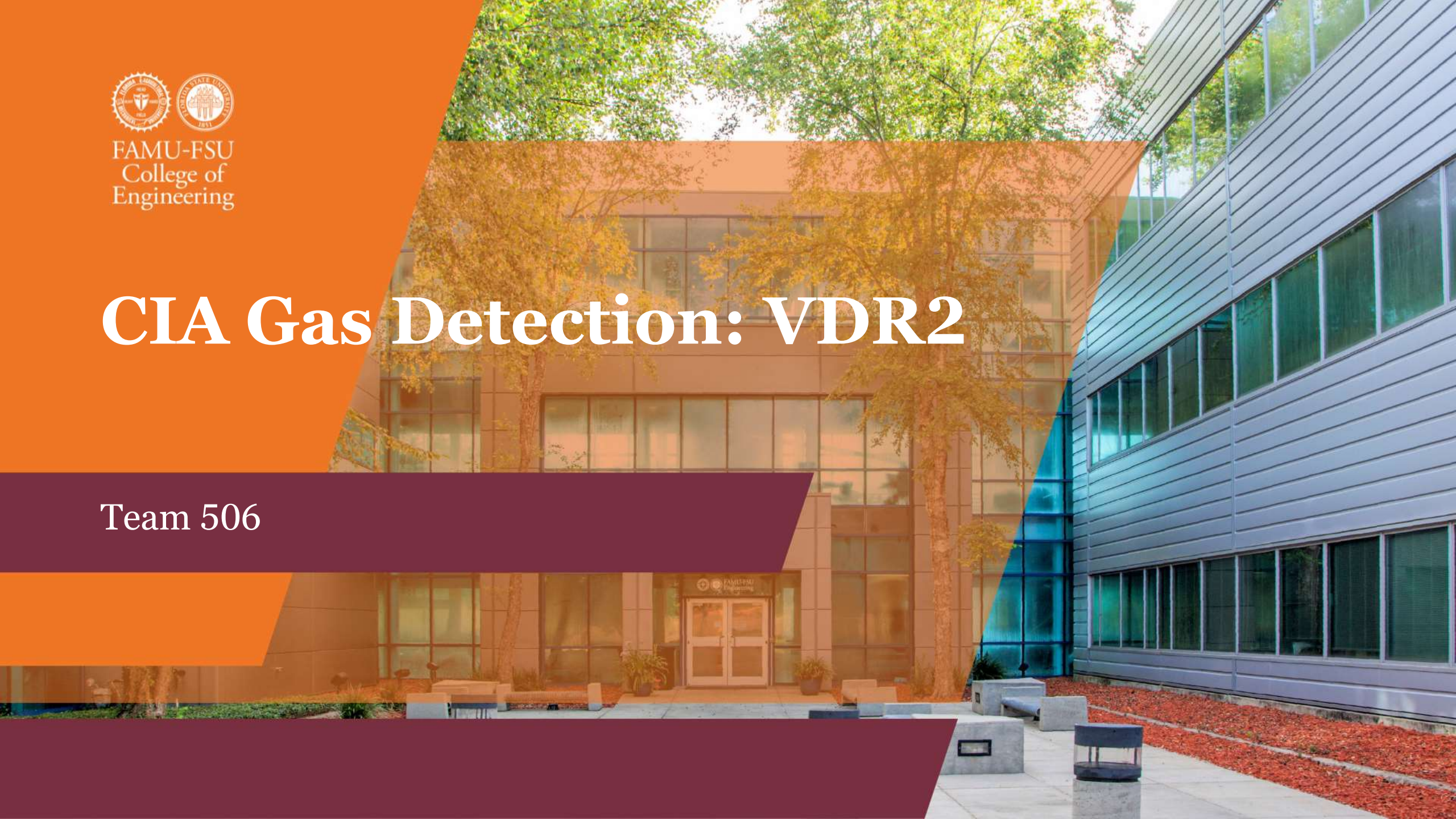

FAMU-FSU College of Engineering

CIA Gas Detection: VDR2

Team 506

Team Introduction

Shawn Butler
Manufacturing Engineer

Ben Labiner
Mechatronics Engineer

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Test Engineer

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Research Engineer

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Design Engineer

FAMU-FSU College of Engineering

Sponsor and Advisor

Engineering Mentor
Franklin Roberts
Central Intelligence Agency (CIA)

Academic Advisor
Shayne McConomy, Ph.D.
Senior Design Professor

FAMU-FSU College of Engineering

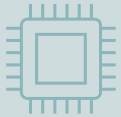
Objective

The objective of this project is to design a wearable gas sensor tailored for CIA search and rescue operations to improve user experience from existing sensors.

Project Background

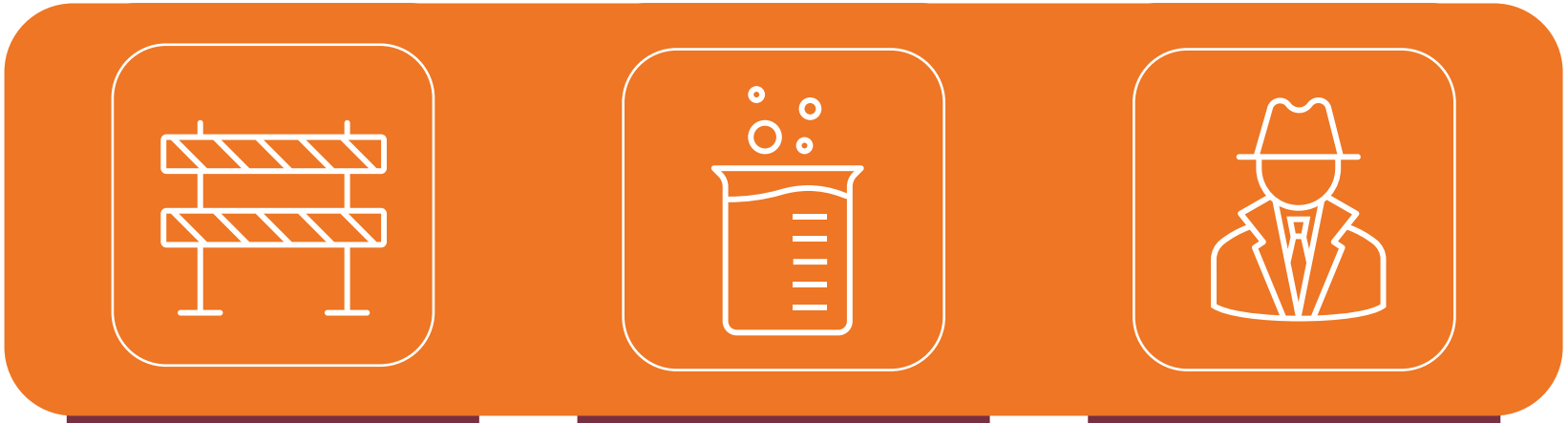
When buildings collapse, flammable or toxic gasses enter the air, making it dangerous for search and rescue responders to assist trapped survivors

Current gas detectors are hand-held and bulky, making them difficult to monitor and control when wearing response gear



A wearable gas detection and alert system would make it easier for first responders to focus on their job without needing to regularly check is the air surrounding them is potentially harmful

Assumptions

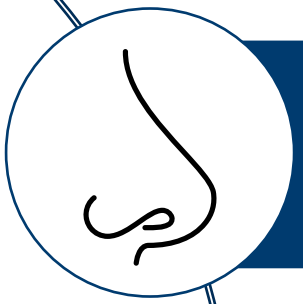


Product will be used in building collapse scenario

Only known gasses will be detected

There is no expectation of concealment

Key Goals



Sense

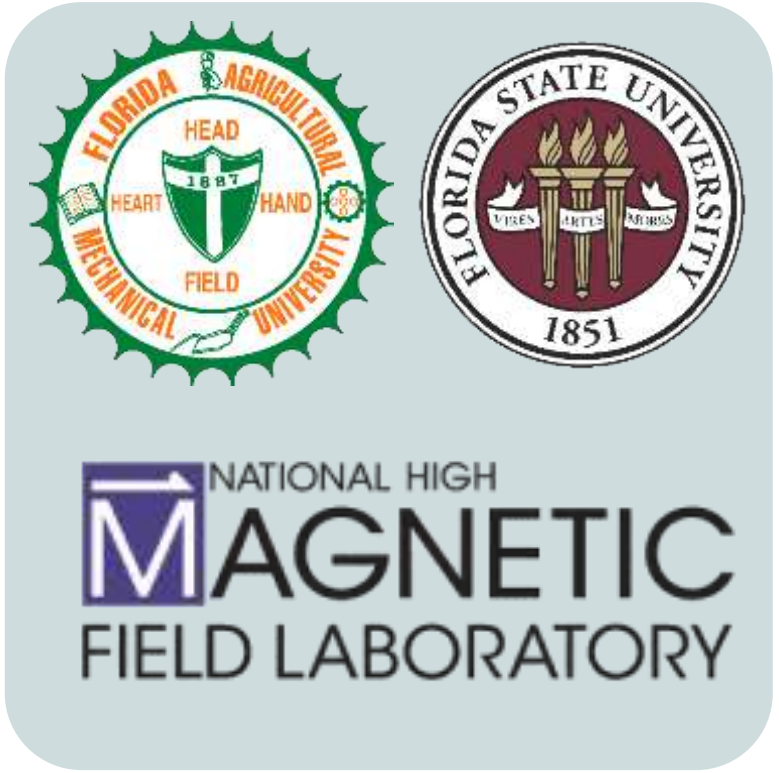
Notify

Protect

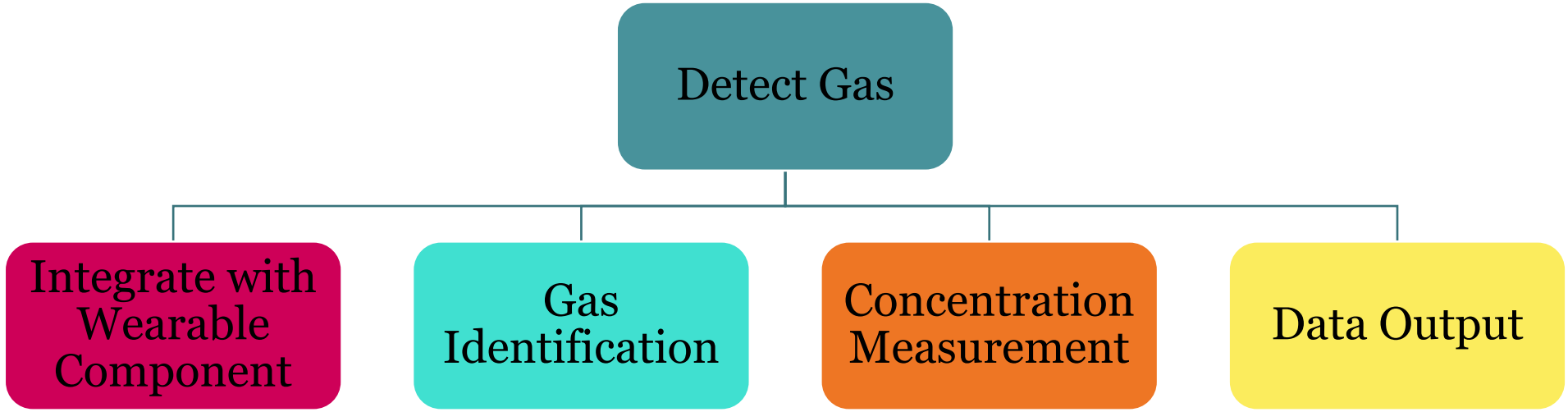
Markets

Primary Markets

Secondary Markets



Functions Hierarchy Chart

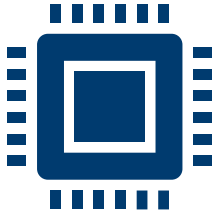


Customer Needs

- Device should be lightweight and not interfere with user mobility
- Primary purpose of device is to alert user
- Device should run for 18 hours continuously
- Device should withstand fall of 15ft
- Device should function from 20-100F

Targets and Metrics

Inputs



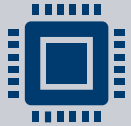
Computation

Outputs

Targets and Metrics

Inputs	Functions	Targets	Metrics
	Detect combustible gasses	High sensitivity	≤ 100 PPM
		Low detection time	≤ 2 Seconds
	Identify detected gasses	Correctly identify detected gasses	90% CI

Targets and Metrics



Computation

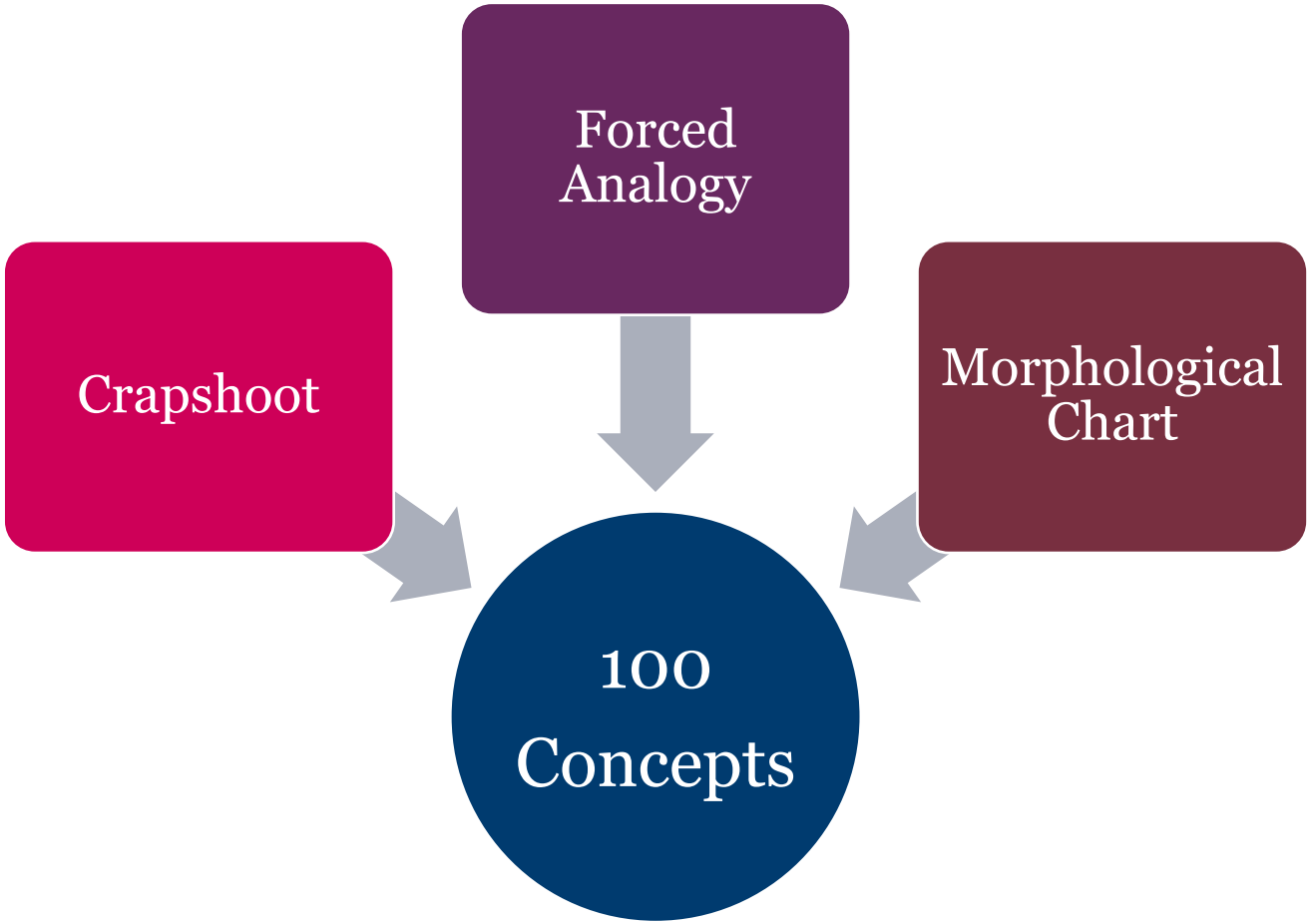
Functions	Targets	Metrics
Interpret sensor data	Process current air status	≤ 2 Seconds
Run statistical analysis on logged data and display	Run statistical analysis on logged data and display	≤ 10 Seconds 95% CI
Manage stored data	Regulate data stored to allow for full mission duration	Input data ≥ 10kb/s

Targets and Metrics

Outputs

Functions	Targets	Metrics
Send air data to notification system	Low lag time for live data	≤ 5 seconds
	Consistent display time for updated stats	15 ± 5 seconds
Send system status to display	Provide accurate data on system status	95% CI

Concept Generation



*Final concept will be integrated to Team 505

Medium Fidelity Concepts

VEST

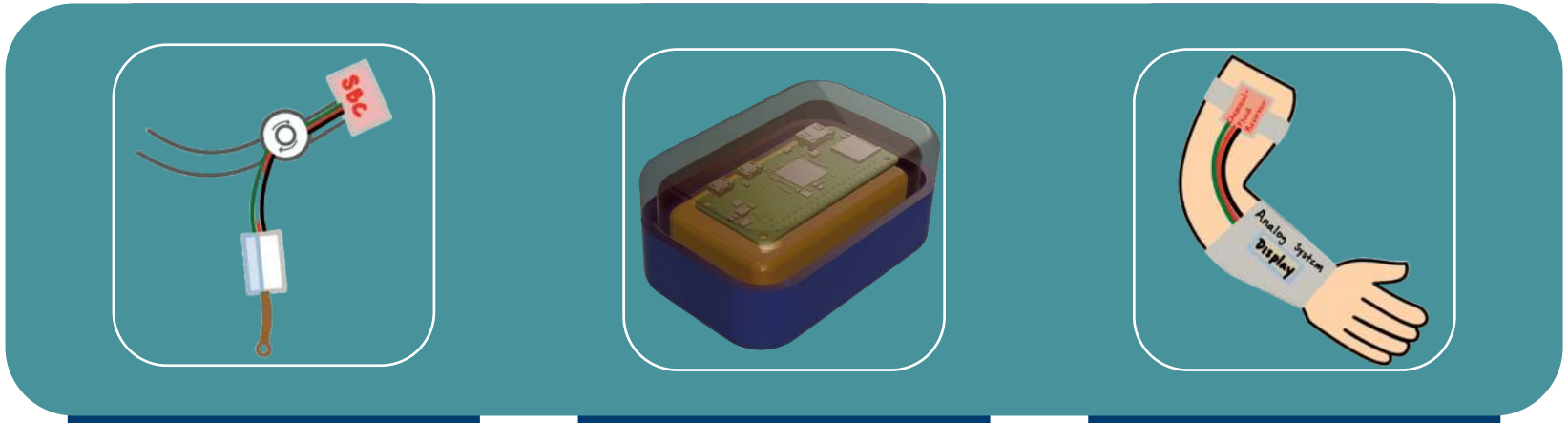
BOOT

BELT

WATCH

HAT

High Fidelity Concepts

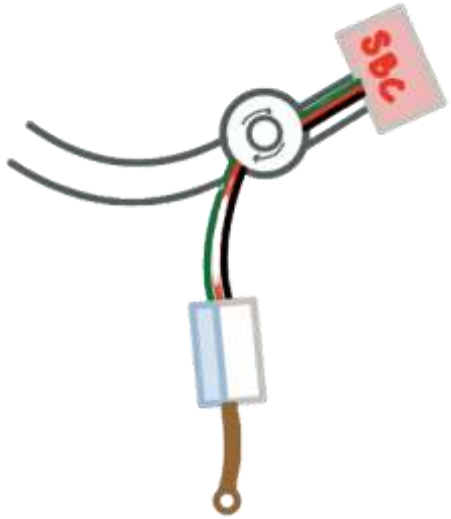


Waist strap/ belt mounted computer, battery, and sensors

Modular box for computer and battery with variable sensor configurations

Analog (chemical based) arm strap

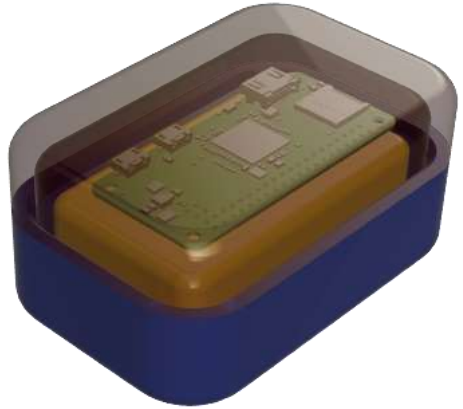
High Fidelity Concepts



Battery in a Waist Pack

- All components will be mounted on a waist strap to centralize weight and ease of access
- Components can be added to belts already worn by first responders

High Fidelity Concepts



Modular Computation Box

- Computer and battery will be stored in an isolated box and sensors will have variable mounting locations
- Computer box can be moved and mounted to user preference

High Fidelity Concepts

Arm Mounted Analog Sensor

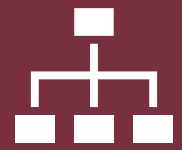
- A reservoir with chemicals that (non-combustively) react with desired gasses will be released onto arm test strips
- Concept will not rely on digital sensors to detect gasses

Concept Selection Tools

Binary Pairwise Comparison

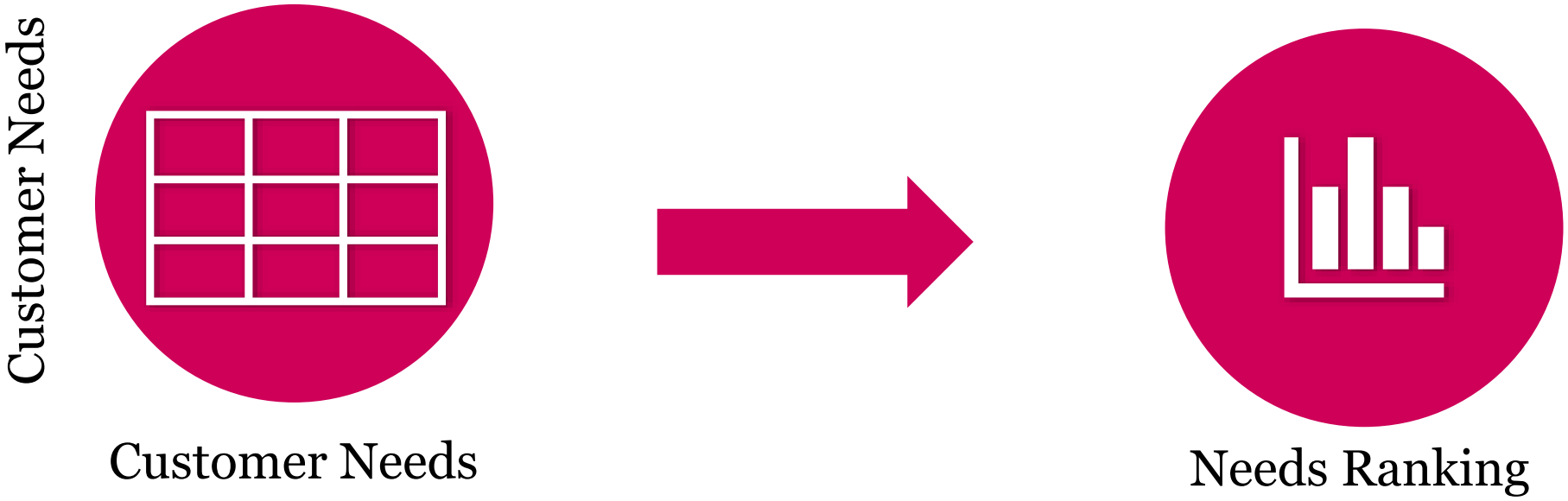
House of Quality

Pugh Charts



Analytical Hierarchy Process

Binary Pairwise Comparison



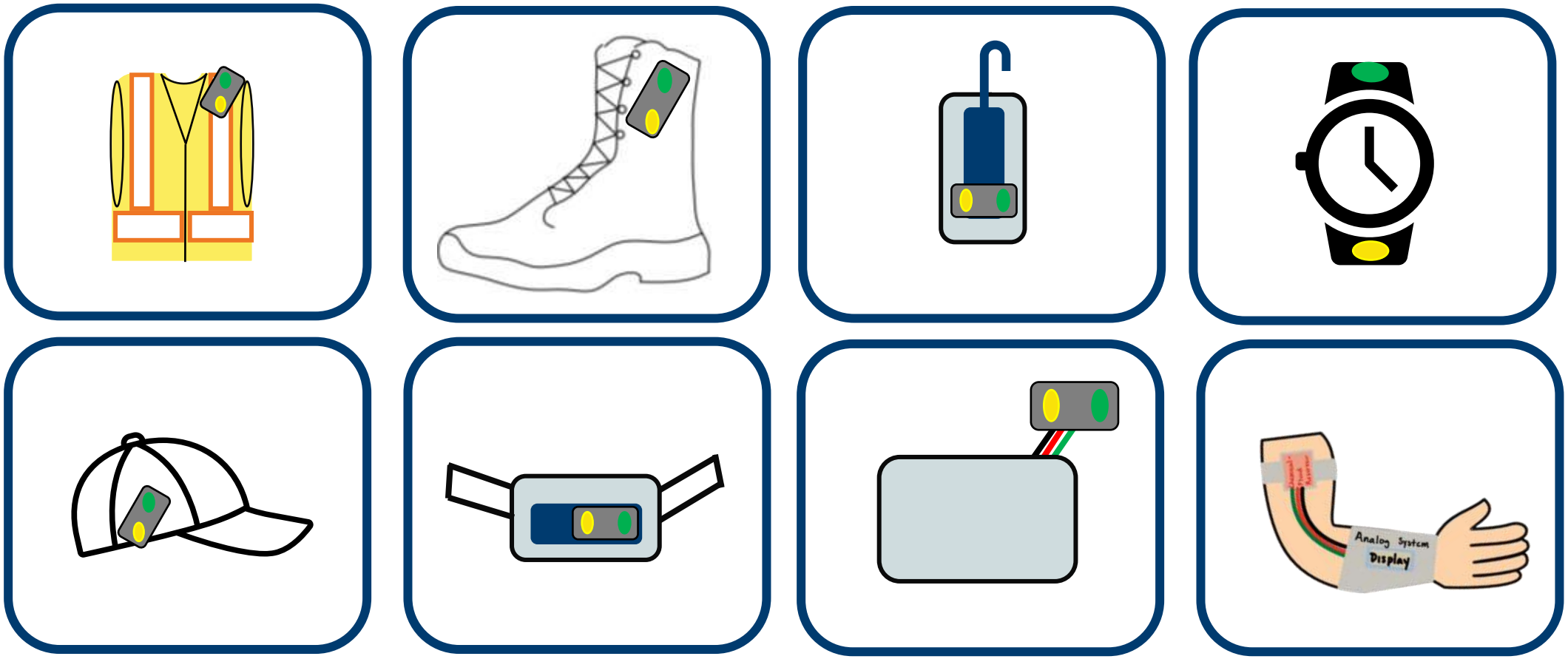
House Of Quality (HoQ)

Engineering Characteristics

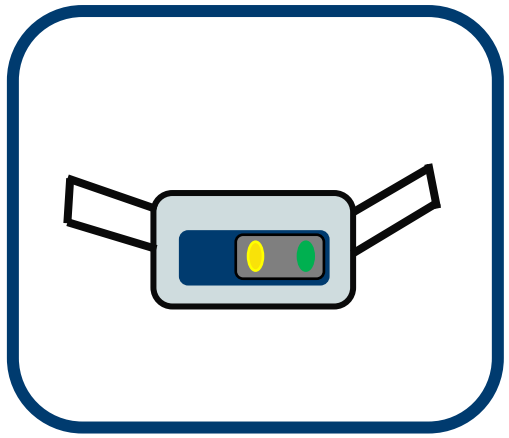
- Data Transmission
- Selectivity
- Durability
- Response Time
- Sensitivity
- Power Consumption
- Temperature Resilience
- Data Logging

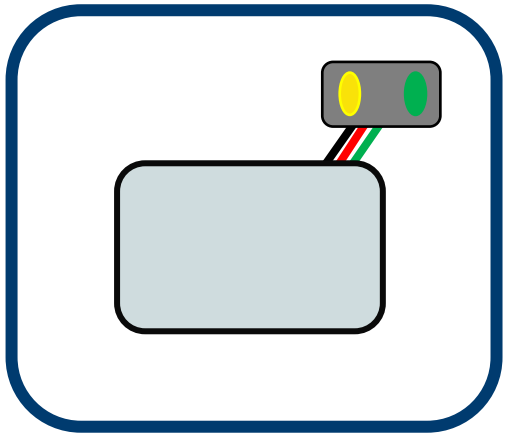
Pugh Chart

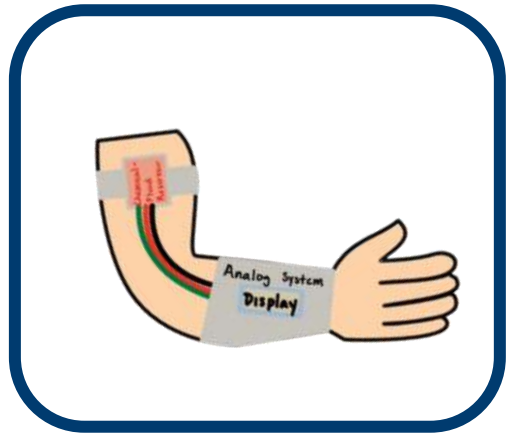
First Iteration



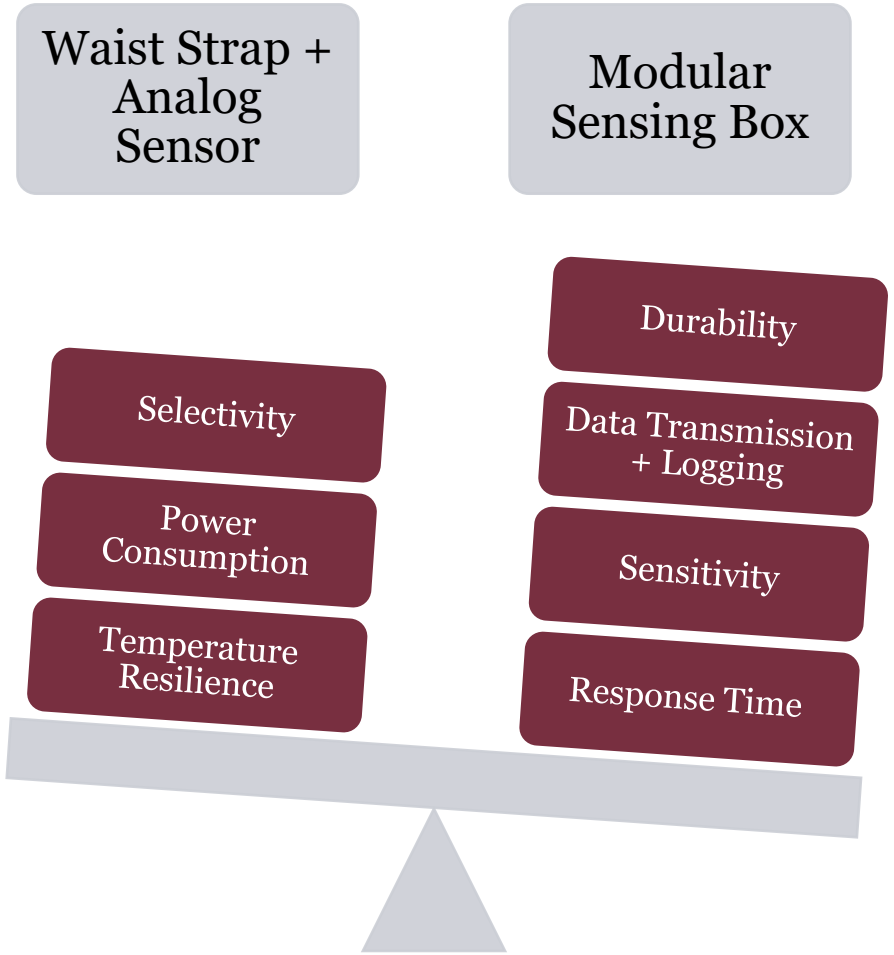
Pugh Chart
Second Iteration







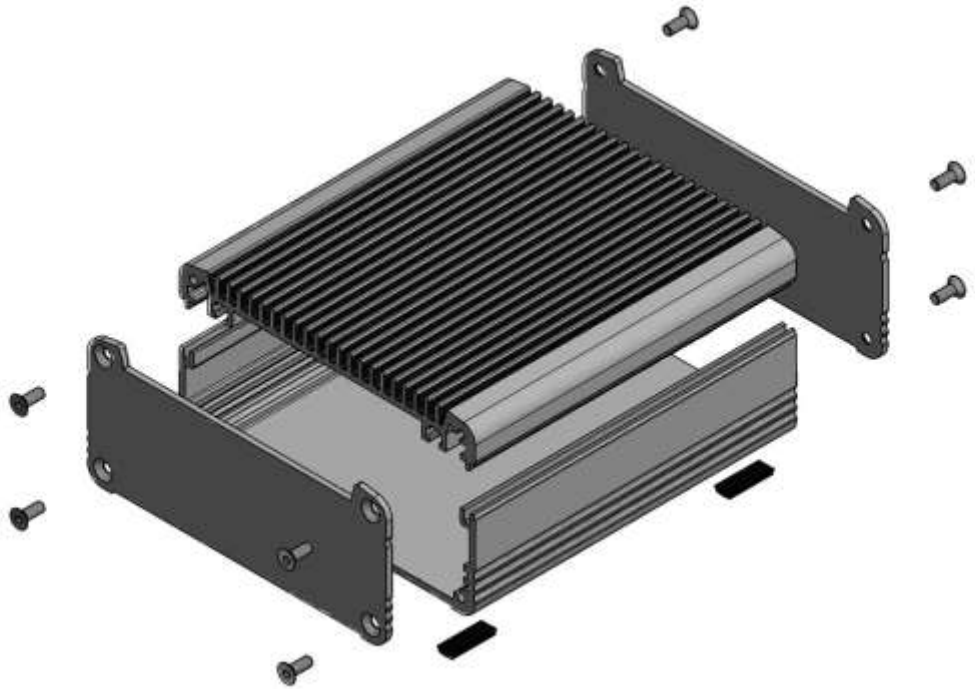
Analytical Hierarchy Process



Concept	Alternative Value
Waist Strap	0.19
Modular Box	0.44
Analog Sensor	0.37

Next Steps For Prototype

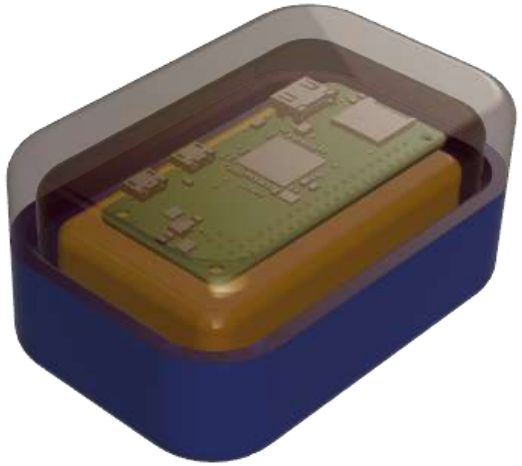
Design housing for battery and computer



Final Selection

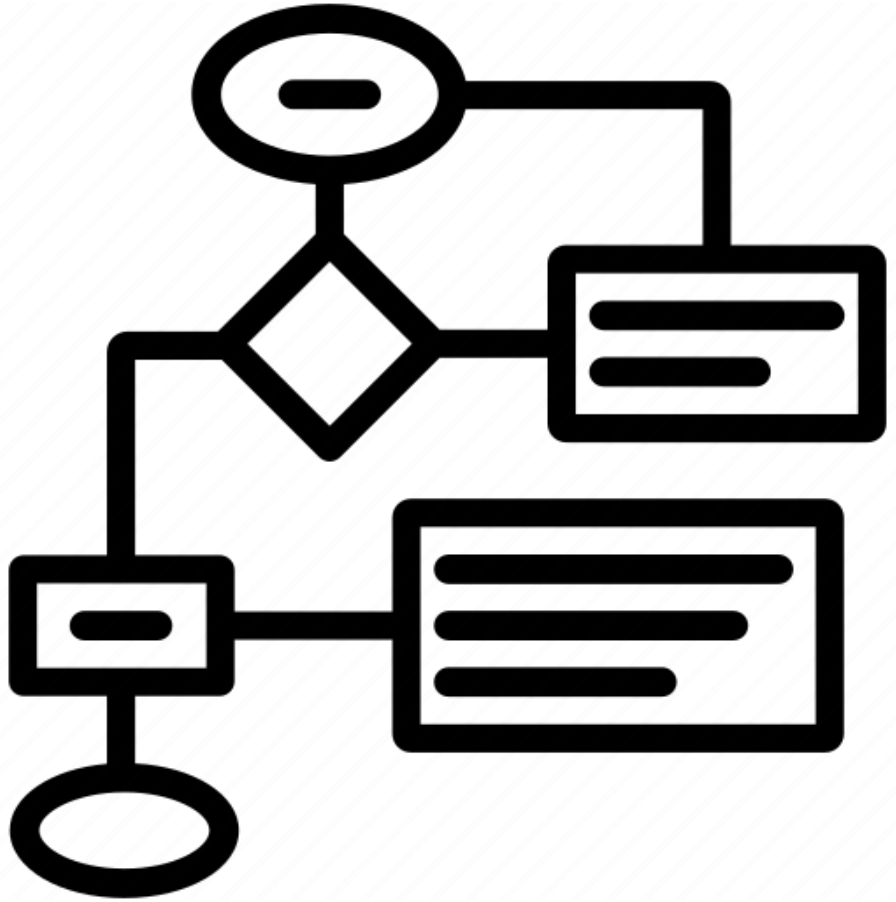
Modular Sensing Box

- Variability in mounting location and greater customizability in user experience
- Can be used with a wide range of potential wearable displays
- Sensors can be moved to appropriate elevations depending on situation
- Surrounding box can be used to spread heat as well as increase durability



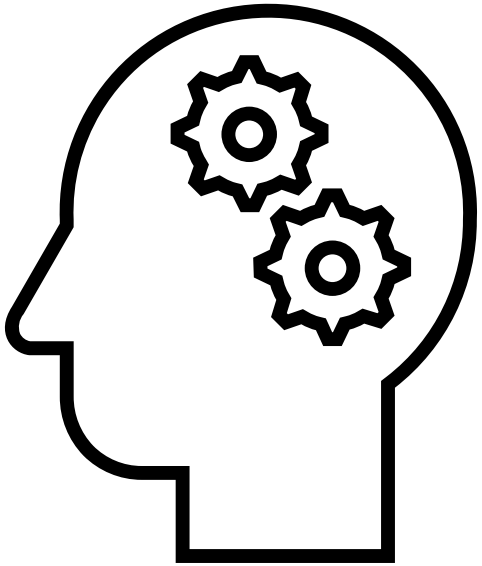
Next Steps For Prototype

Develop code structure for how data will be collected and analyzed



Next Steps For Prototype

Work with Team 505 to integrate sensors with wearable component



Questions?