Aftermarket Child Detection for Car Seats

Design Review 5

Presenting:
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Our Team

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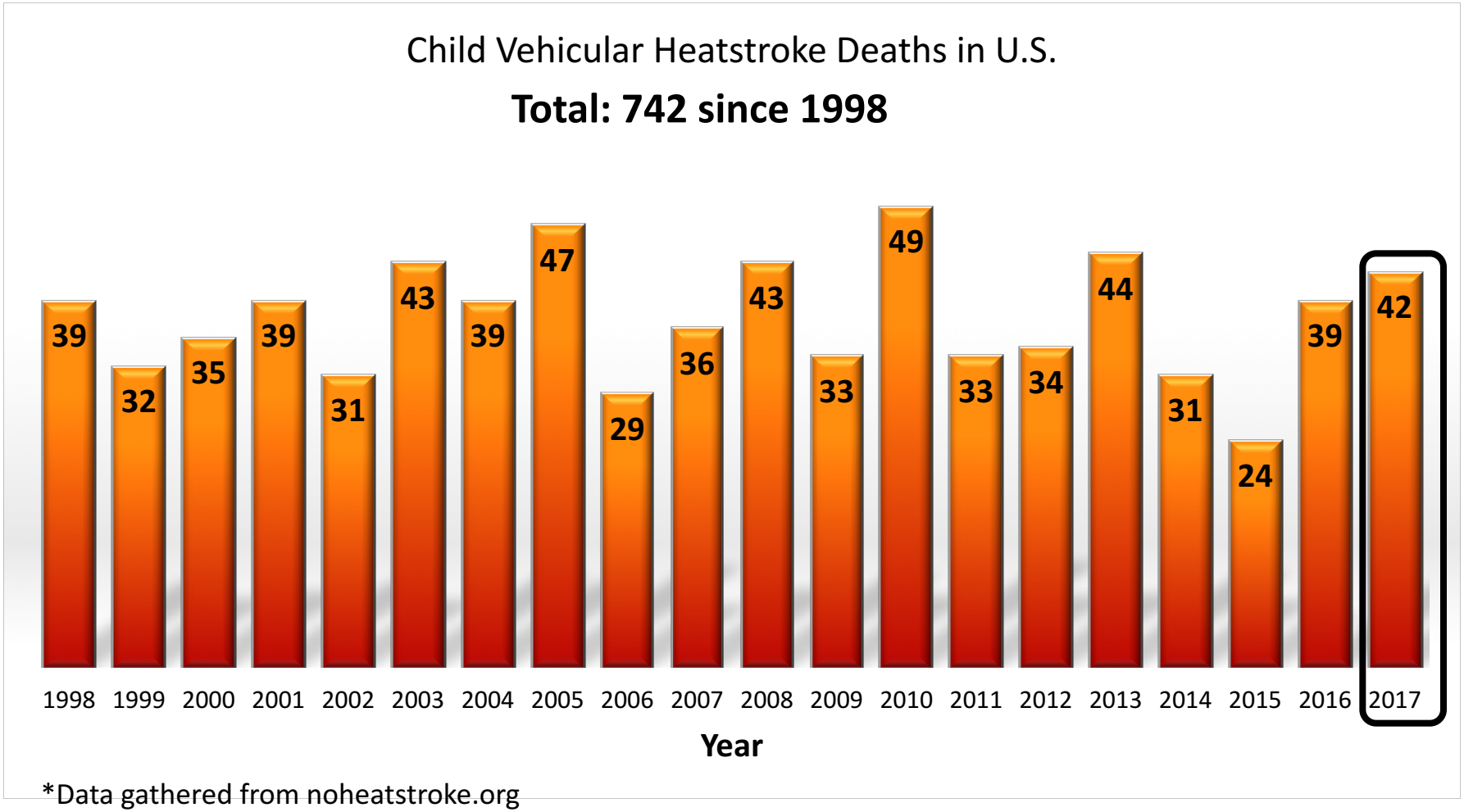
Overview

- Project Summary & Scope
- Targets & Systems
- Concept Selection
- Hardware Design
- Software
- Shark Tank
- Conclusion

Project Summary

- Problem: An average of 37 children die each year due to vehicular heatstroke
- Objective: Design a system that detects when an infant is in a vehicle and subject to dangerous temperatures
- Project Expectations: Create a working prototype that is simplistic and robust in design, while keeping cost as low as possible.
- Funds Available: $1000

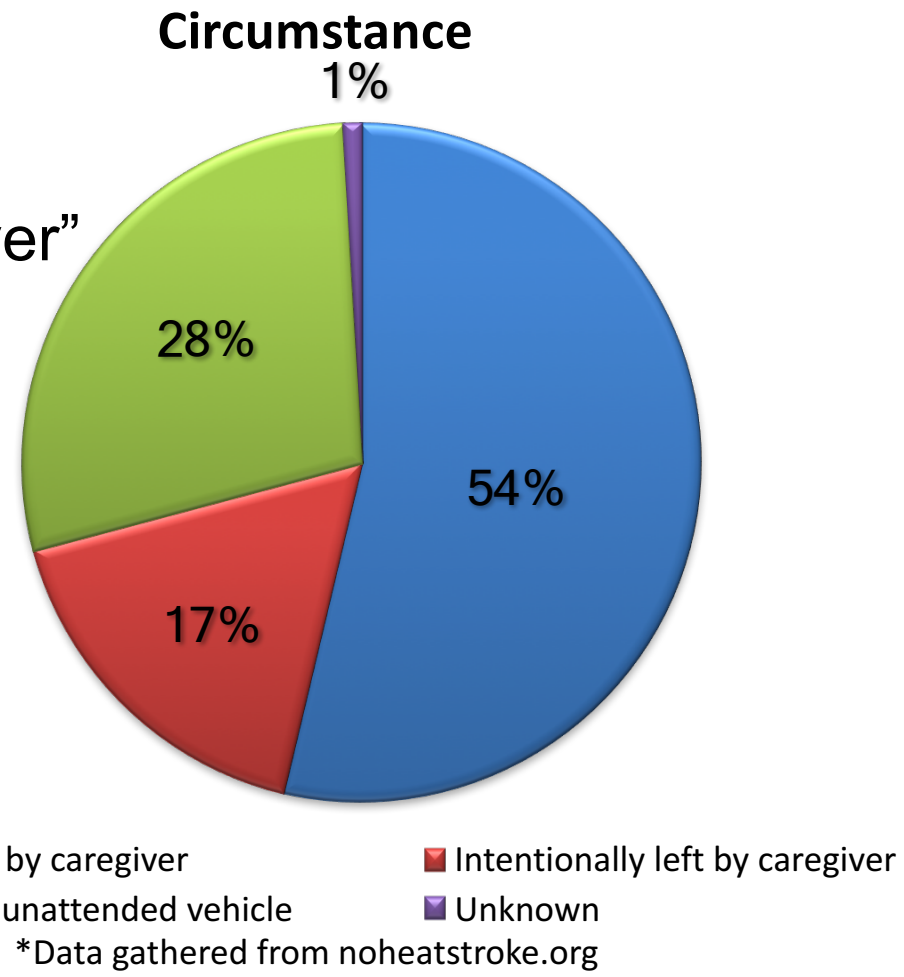
Background



*Data gathered from noheatstroke.org

Background

- Focusing on:
  - "Forgotten by caregiver"
  - "Intentionally left by caregiver"
- 71% of all cases



Project Scope

➢Develop a device that detects a child left in an unattended vehicle that is subject to dangerous conditions

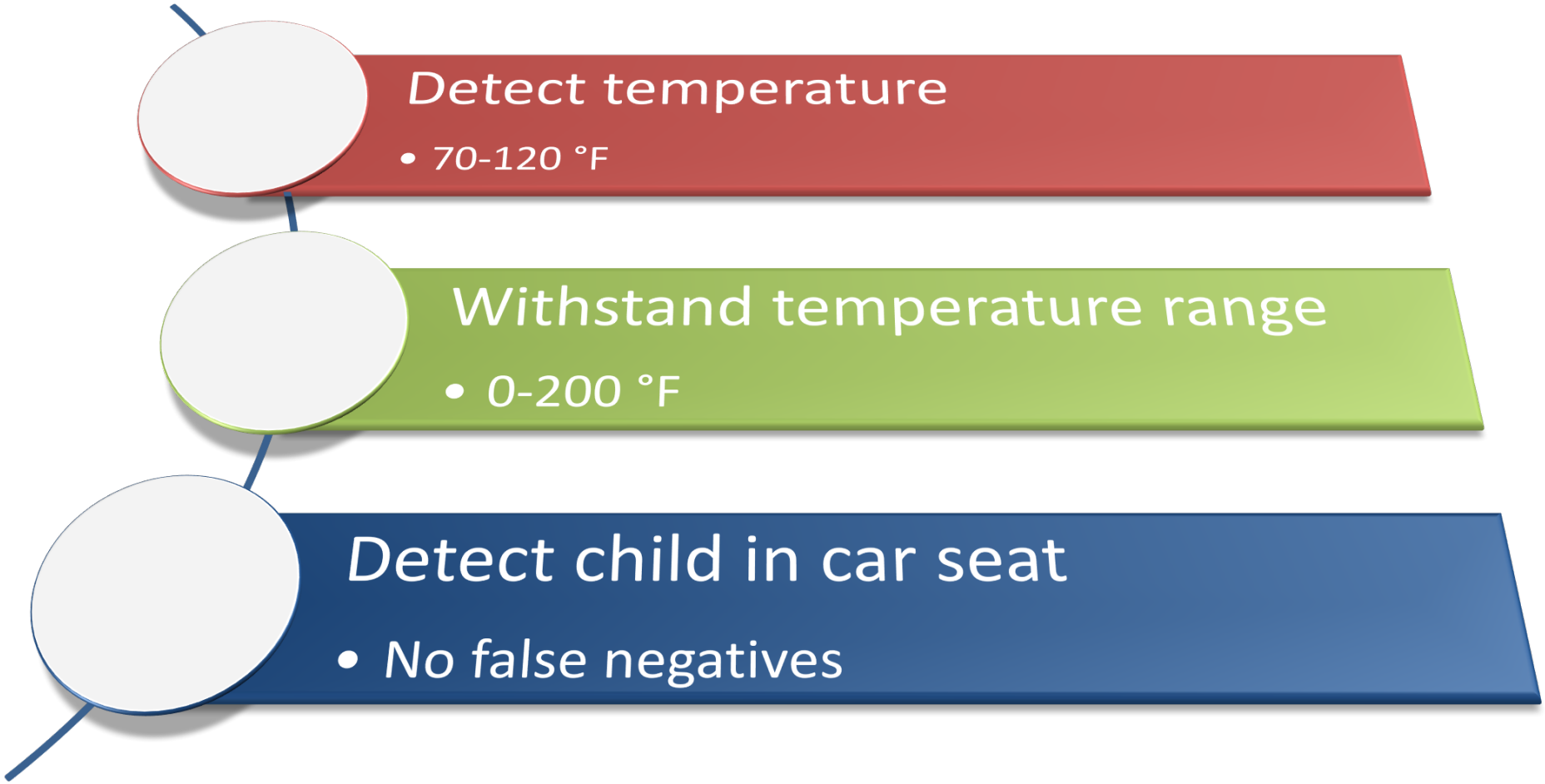
➢Primary goals:

- Reduce infant fatalities
- Develop prototype
- Device needs to have Universal Adaptability
- Must be suitable for given environment

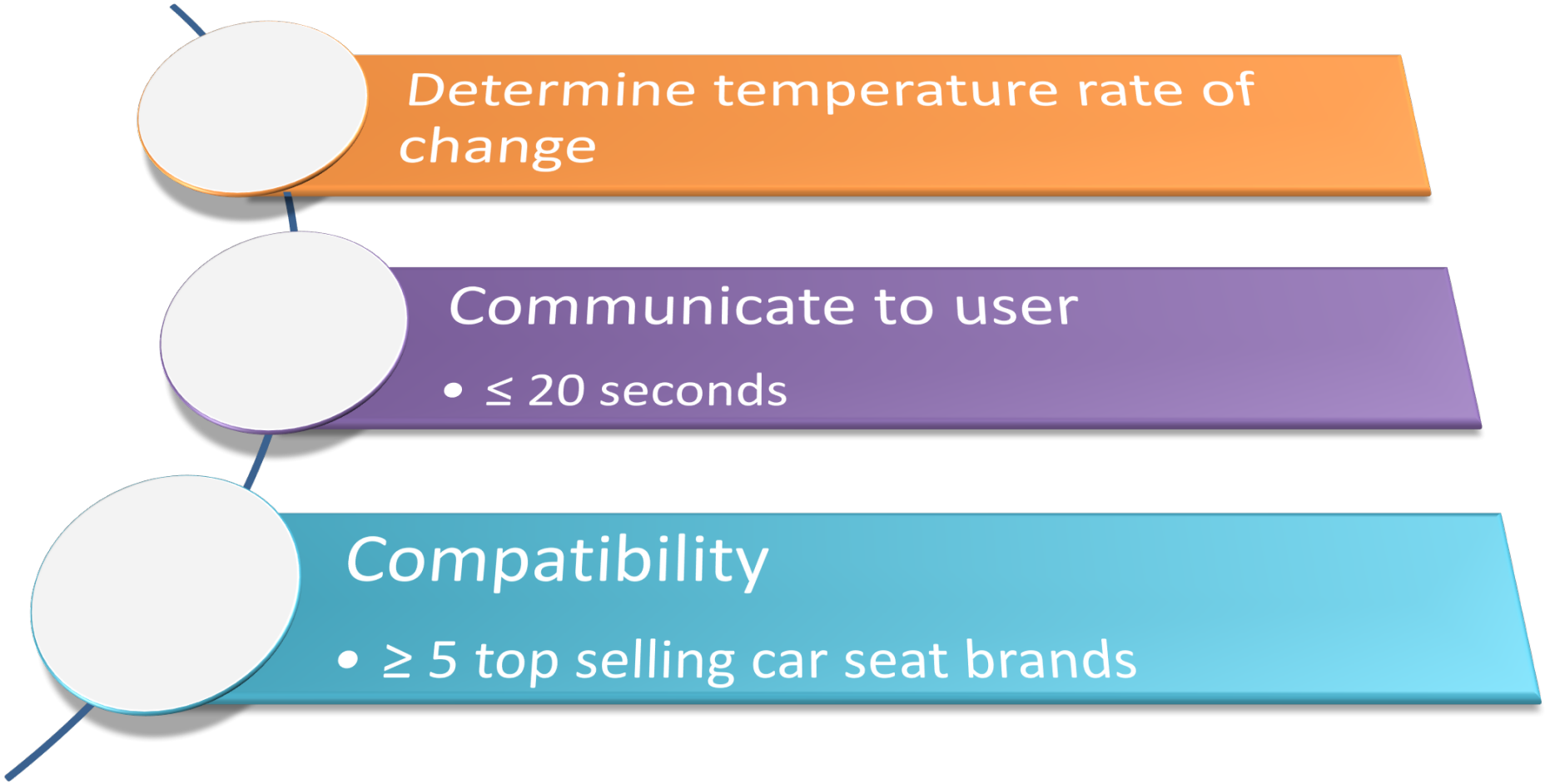
Project Scope

- Primary Market:
  - Parents/guardians of children between 0 – 5 years old
- Secondary Market:
  - Car seat manufactures, car manufactures, and other baby product manufacturers

Targets


Detect temperature
• 70-120 °F
Withstand temperature range
• 0-200 °F
Detect child in car seat
• No false negatives

Targets


Determine temperature rate of change
Communicate to user
• ≤ 20 seconds
Compatibility
• ≥ 5 top selling car seat brands

Device Systems

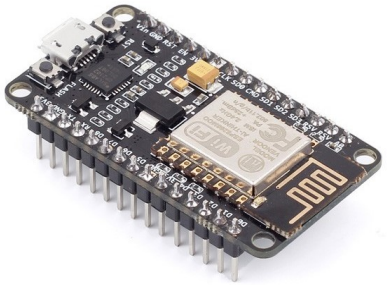
1. Vehicle Interior Temperature Sensing
2. Child Detection
3. Dangerous Temperature Calculation
4. Threatening Condition Indication
5. Response Initiation

Concept Selection Summary

	DT	WT	DC	TROC	CTU	COM
NTC Thermistor	✓	✓	-	-	-	✓
Harness clip	-	✓	✓	-	-	✗
Pressure Switch	-	✓	✓	-	-	✓
Temp Extrapolation	✓	-	-	✓	-	-
Verify Threatening Conditions	✓	-	✓	✓	-	-
Key Fob Alarm	-	✓	-	-	✓	✓
Cellular	-	✓	-	-	✓	✓

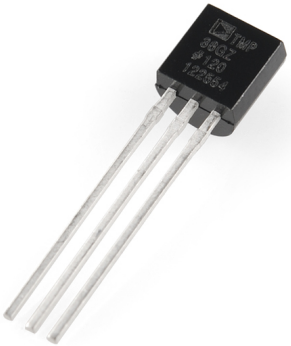
Hardware

Vehicle Module



ESP8266 Microcontroller

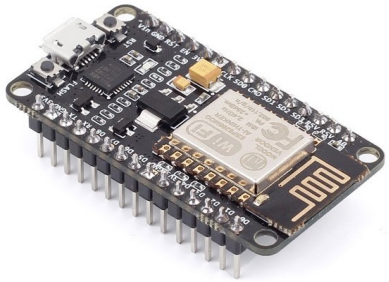
Pressure Mat



TMP36 Temperature Sensor

AA Battery Holder

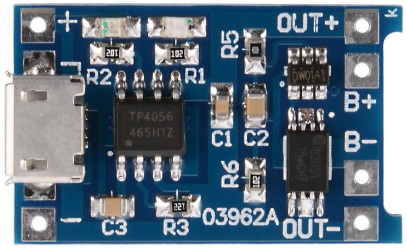
Key Fob



ESP8266 Microcontroller

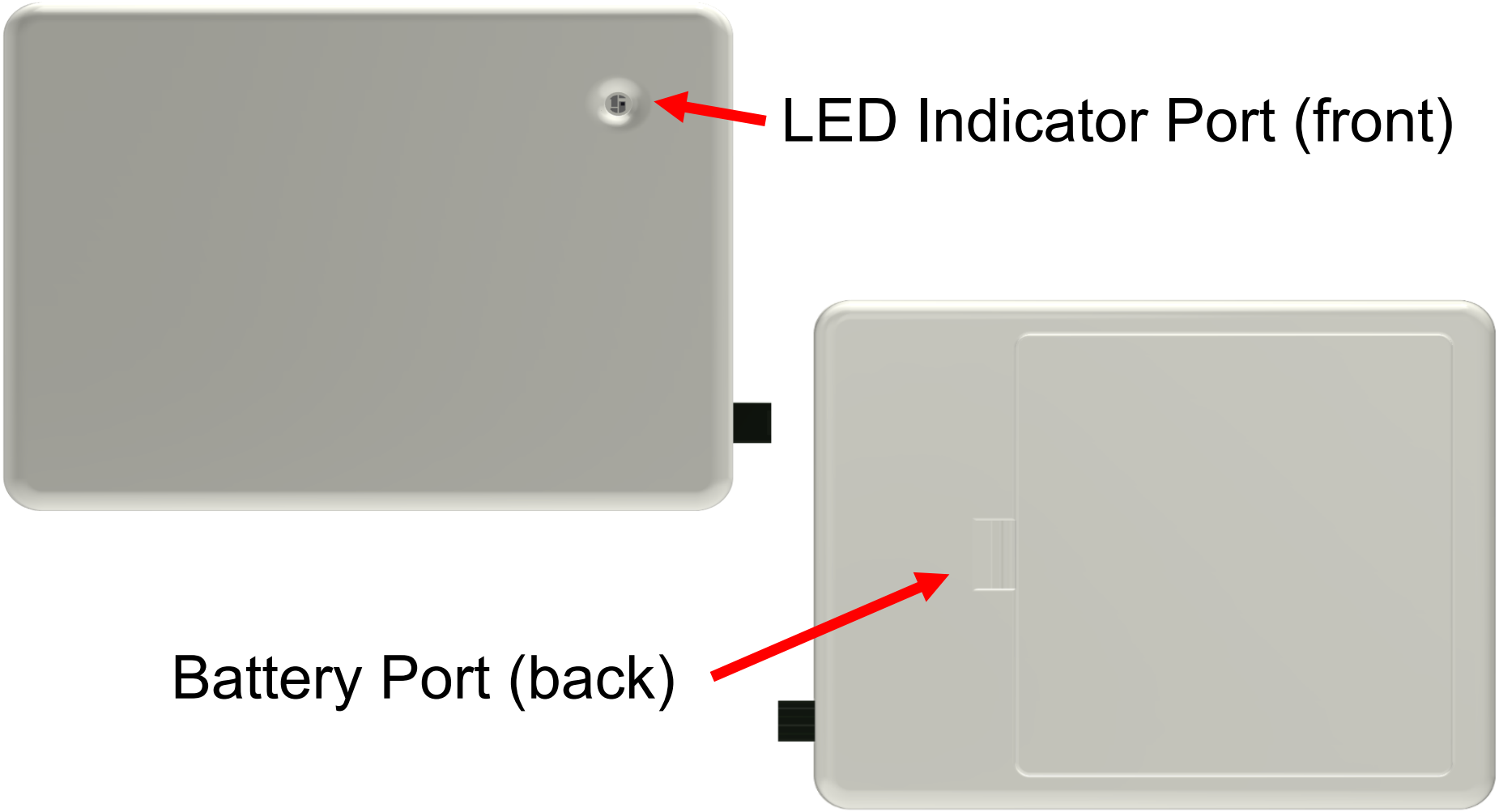
Piezo Alarm

3.7V 800mAh LiPo Battery

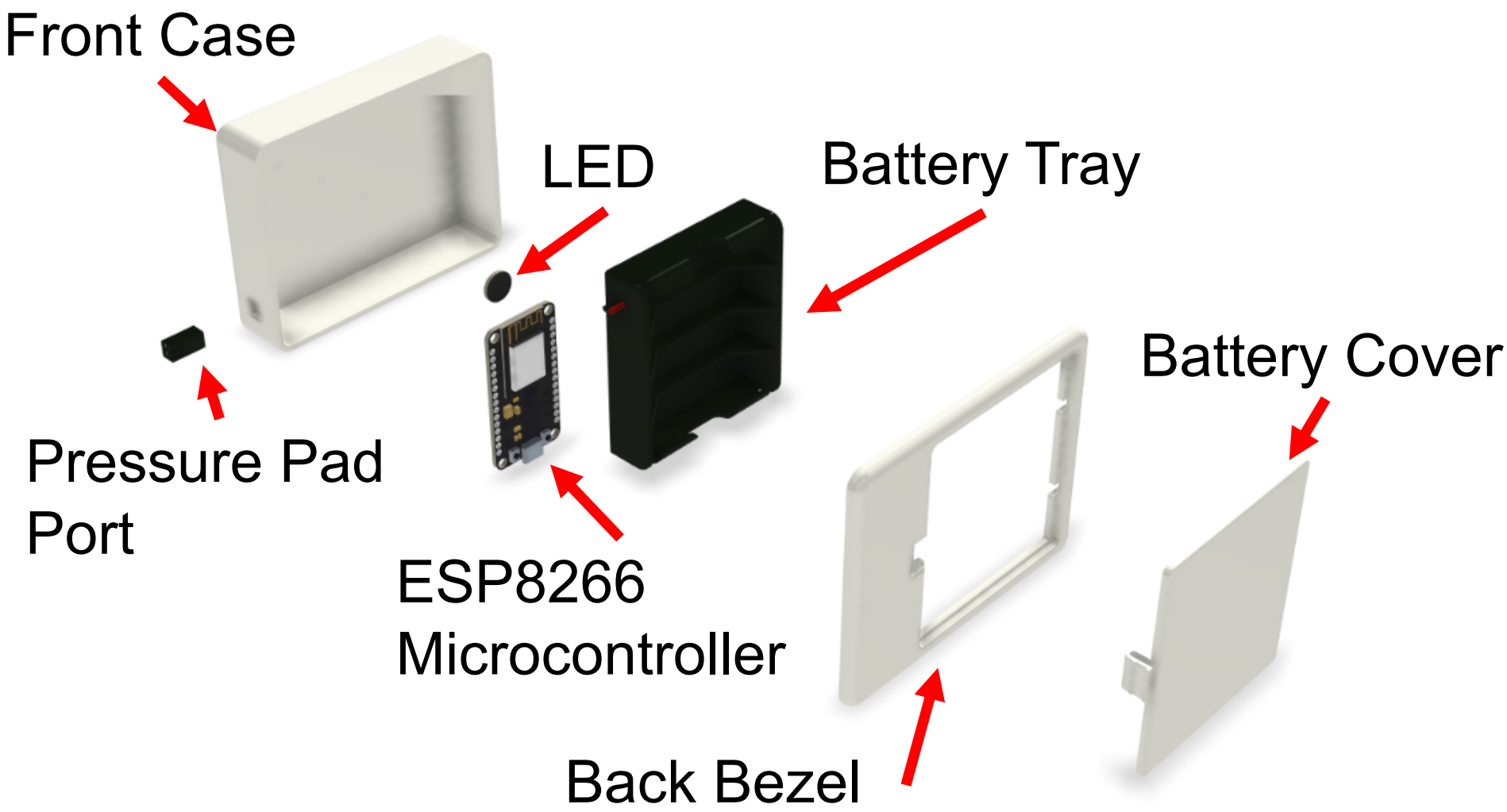


TP4056 Charging Board

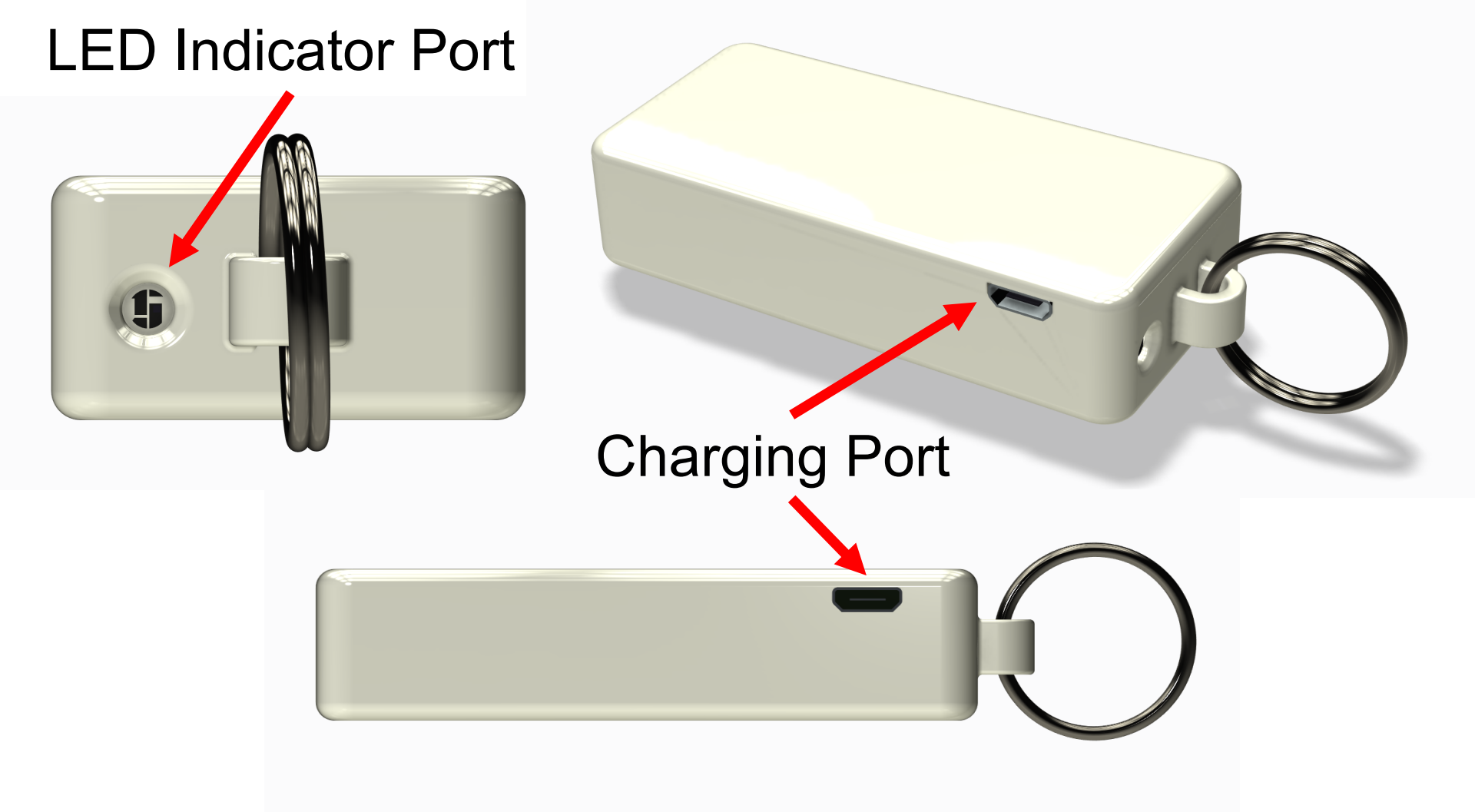
Vehicle Module Housing



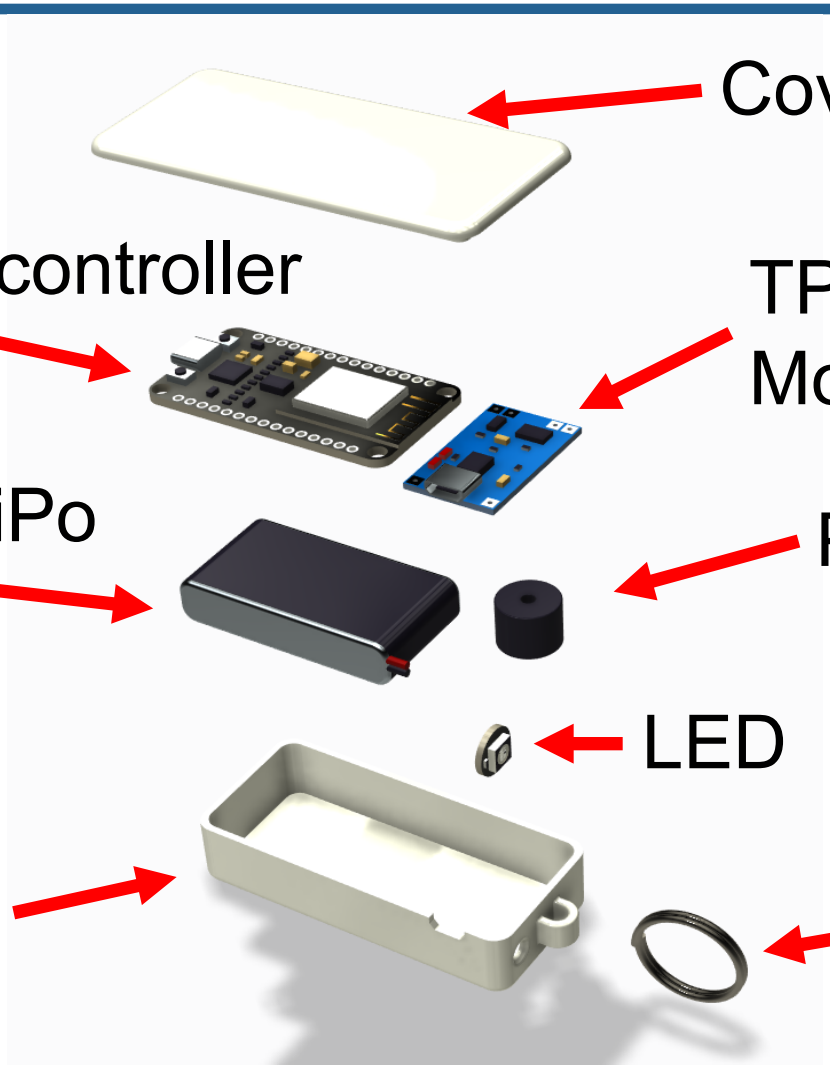
Vehicle Module Housing



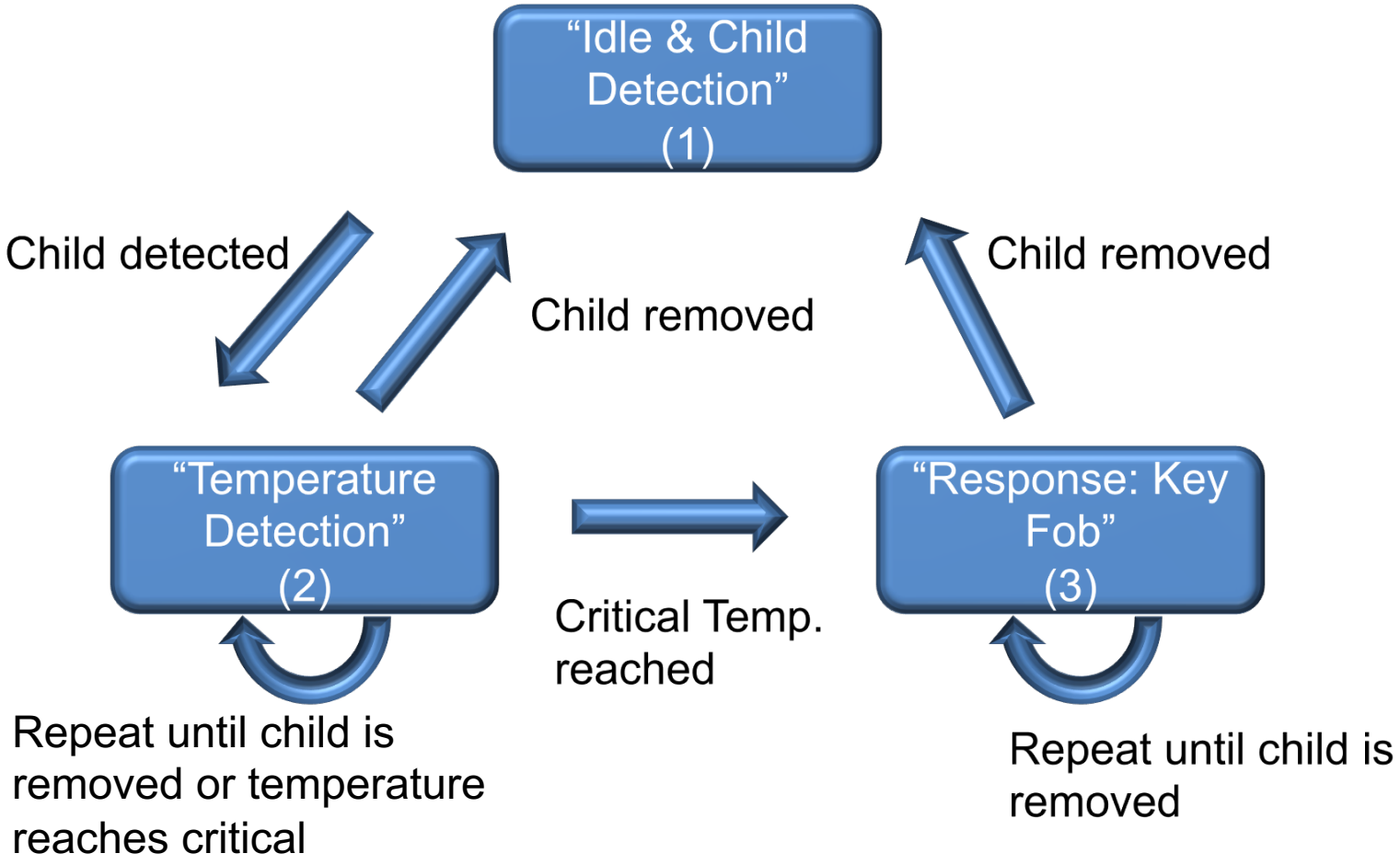
Key Fob Housing



Key Fob Housing



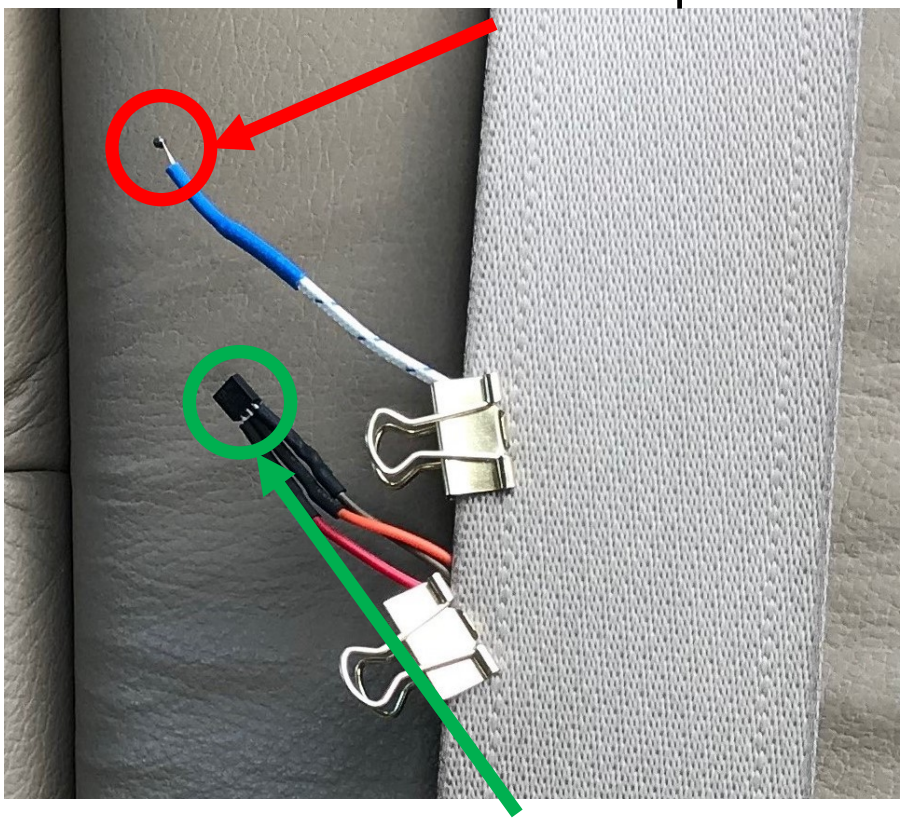
State Diagram for Software Design



Temperature Experimental Setup

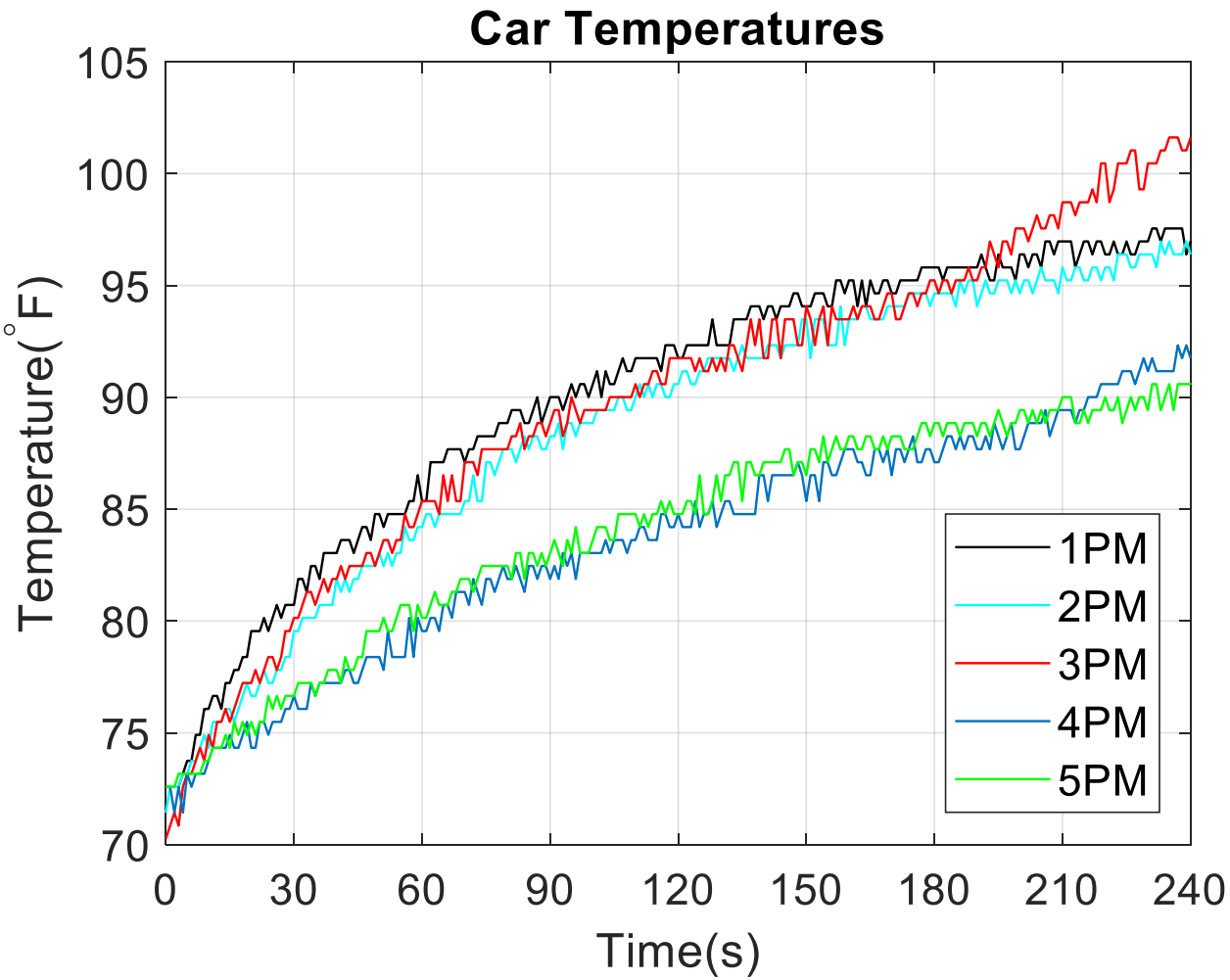
- Vehicle placed in direct sunlight
- Temperature recorded in the back seat of a sedan with no window tint
- Weather: Partly cloudy
- Ambient Temperature: 76°F-80°F
- Vehicle interior air allowed to cool to 72°F before shutting off the engine

Multimeter Thermocouple



TMP36 Temperature Sensor

Vehicle Temperature Data



Shark Tank Timeline

- 1st Round- March 9th Business Model Canvas ✓
- 2nd Round- March 29th Preliminary Business Pitches
- Final Competition- April 13th

Shark Tank Goals

- Gain experience in a “business pitch” environment
- First place prize of $1200
- Winnings will go towards research/development of smart phone compatibility

Shark Tank

- Learning from InNOLEvation mistakes
- Most effective points to communicate are:
  - Extensive design review process
  - Capabilities beyond any products available right now
  - Possible partnerships (i.e. wireless carriers)
  - Initial focus on current scope defined by senior design, then explore possible expansion

742

Children have died due to vehicular heatstroke since 1998.

37

Average number of innocent deaths we will continue to see each year.

100%

Of these are preventable.

COMPETITIVE ASSESSMENT

Driver's Little Helper

User will set this device like an alarm to remind him/her to remove the child

General Motors' Rear Seat Reminder

A reminder will appear on the dashboard of the car to "Check the rear seat" ONLY if the rear door was opened within 10 minutes of engine ignition

No Temperature Monitoring!

Conclusion

- Functioning prototype has been created
- Testing in various conditions has been accomplished
- Project goals have been met while staying within scope, and well under budget
- Future goals include:
  - Proximity Alarm
  - Smart Phone Compatibility

Questions?

References

NTC Thermistor [Digital image]. (n.d.). Retrieved November 7, 2017, from https://leeselectronic.com/en/product/91189.html

Pressure Switch [Digital image]. (n.d.). Retrieved November 7, 2017, from https://www.rehabmart.com/product/pal-pads-switches-38511.html

Gravitech. (n.d.). XBee PRO ZB ZigBee Mesh Module 2.4GHz 63mW with Wire Antenna [Gravitech online store.]. Retrieved November 3, 2017, from http://www.gravitech.us/xbprozbmo250.html

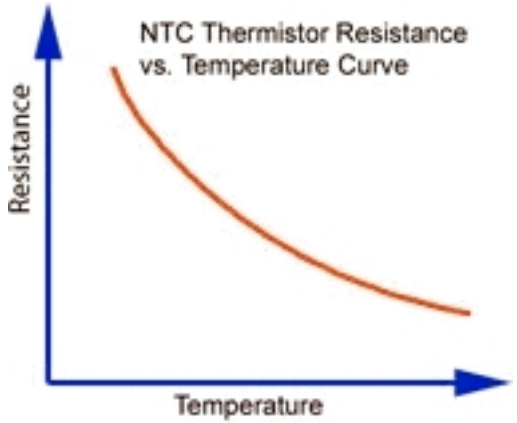
Vetco Electronics. (n.d.). Piezo Speaker Module for Arduino [Vetco Electronics online store.]. Retrieved November 3, 2017, from https://vetco.net/products/piezo-speaker-module-for-arduino

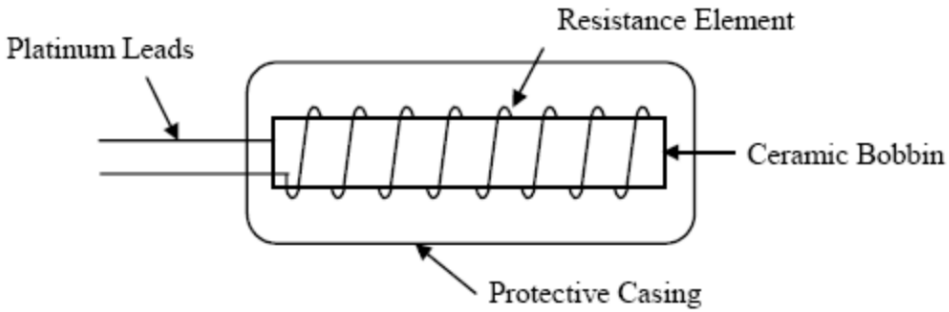
Arduino. (n.d.). Arduino GSM Shield 2 (Integrated Antenna) [Arduino online store]. Retrieved November 5, 2017, from https://store.arduino.cc/usa/arduino-gsm-shield-2-integrated Antenna

AK9750 Human Detection IR Sensor Module [Digital image]. (n.d.). Retrieved November 7, 2017, from https://www.digikey.com/en/product-highlight/a/akm-semi/ak9750-human-detection-ir-sensor-module

Temperature Sensors

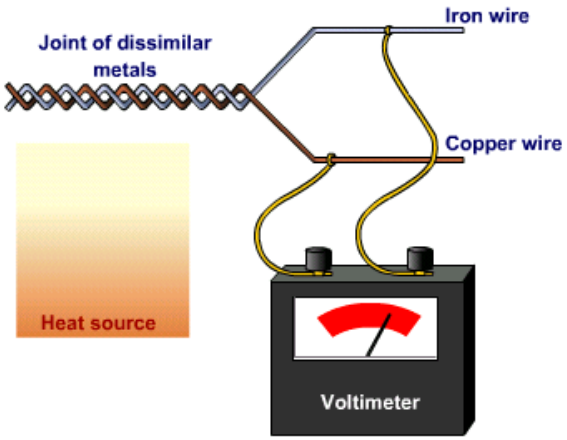
- Negative Temperature Coefficient Thermistor
  - Pros- High accuracy and inexpensive
  - Cons- Requires linearization
- Resistance Temperature Detector
  - Pros- Highest accuracy
  - Cons- Expensive and fragile



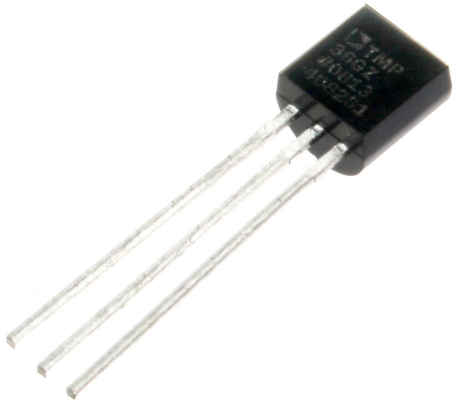


Temperature Sensors

- Thermocouple
  - Pros- Widely used, large temperature range, and inexpensive
  - Cons- Least accurate (+/- 5ºC)

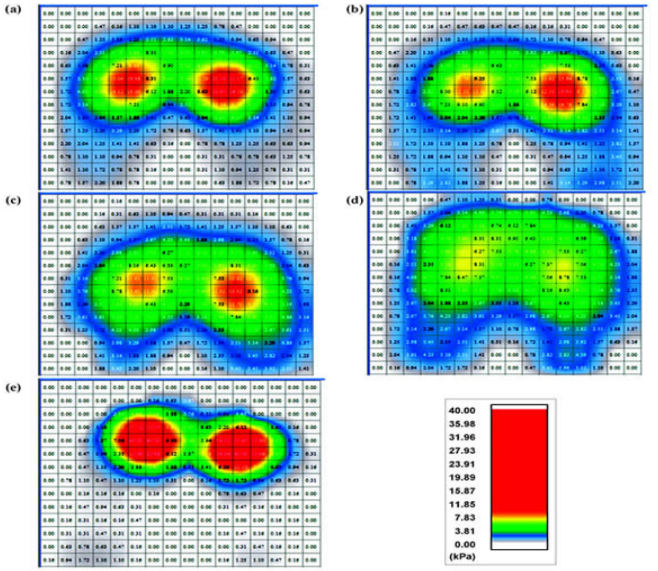


- Semiconductor Based Sensor
  - Pros- No linearization required
  - Cons- Least accurate (+/- 5ºC), response time of up to 60 seconds



Pressure Sensor

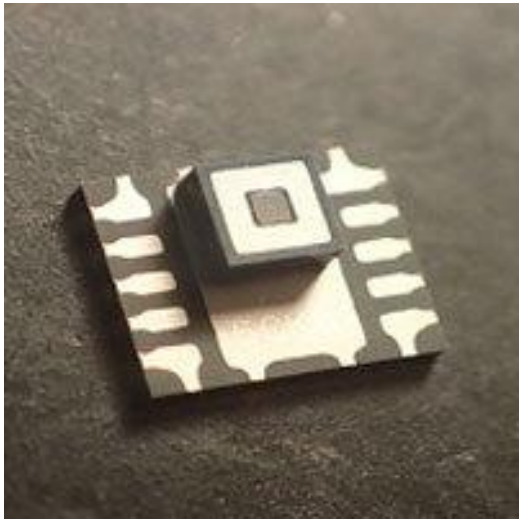
- Pros
  - Simple installation
  - Detects difference of object vs. child in the car seat
- Cons
  - Expensive
  - Requires microcontroller to handle large amounts of data
  - Requires complex programming



Pressure Map (Sensor Products Inc.)

Coupled Motion & IR Sensor

- ➢ Pros: If one system fails, the other systems can still detect the presence of a child
- ➢Cons: Complex design, higher cost and difficult setup



AKM Human Detection IR Sensor Module (AKM)

Temperature Threshold Switch

- Similar to a household thermostat
- If a certain temperature range is reached in the vehicle, the algorithm will apply the assigned response for that range.

Color	Danger
	Low
	Medium
	High

Temperature Range 3

Temperature Range 2

Temperature Range 1