Smart **A**lerts **F**or **E**veryone **Wheel**

“Steering you away from distracted driving”

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Section: 8

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Agenda

- Problem Overview
- Prioritized Customer Statements
- Concept Devp. and Selection
- Subsystems: Design and Testing
- Team Analysis
- Lessons Learned
- Future Plans
- Conclusion

What's the problem?

“Drivers under the age of 20 have the highest proportion of distraction-related fatal crashes.” - Center for Disease Control and Prevention

Cognitive **Manual** **Visual**

The SAFEWheel aims to curb these horrific statistics by

- Serving as a teaching tool for new drivers
- Reducing the chance of distracted driving
- Providing driving data to parents and insurance companies

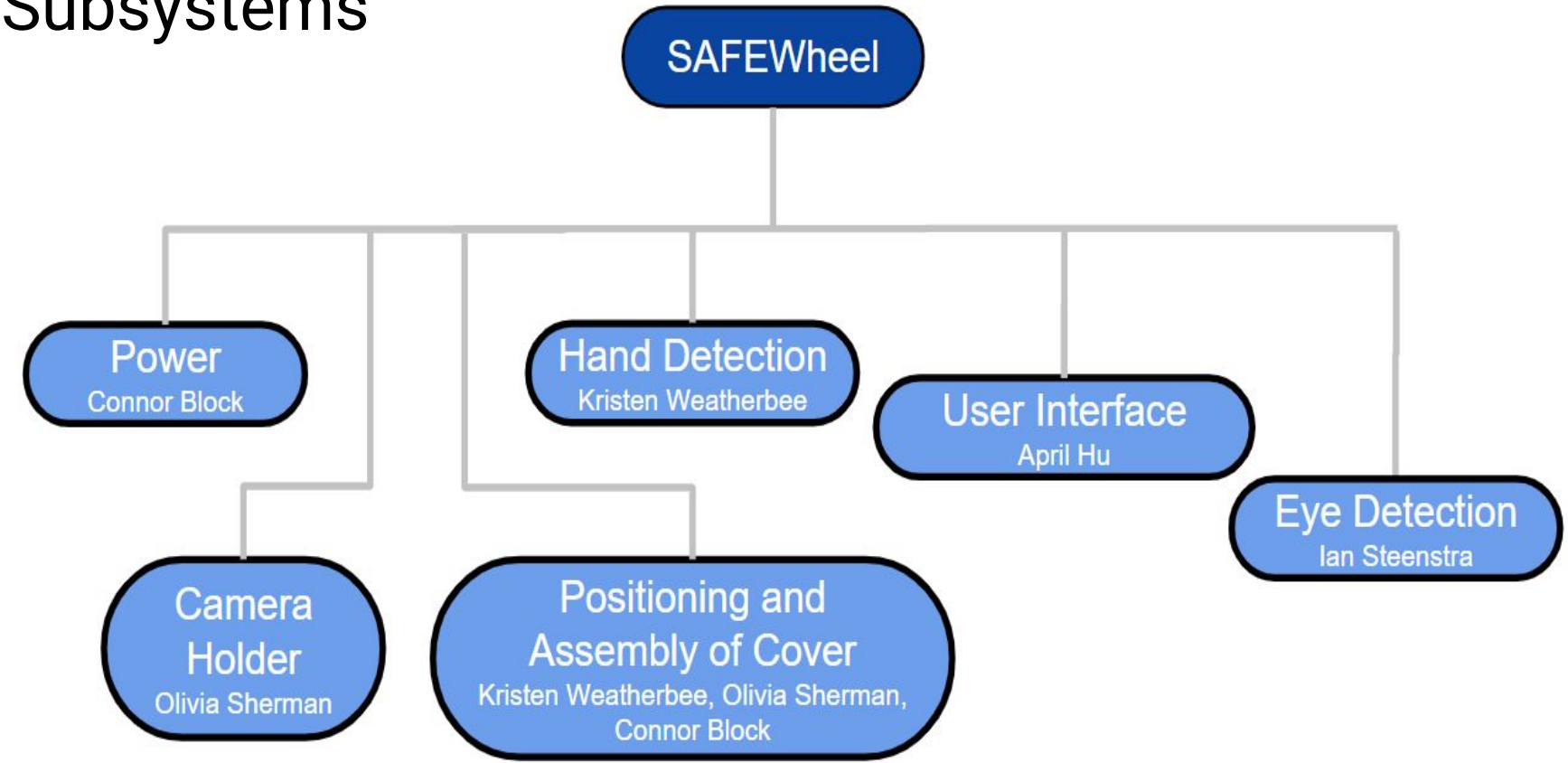
Prioritized Customer Statements

	Customer Statement	Importance (1-5)	Interpreted Need(s)
1	“It can’t get in the way of my child’s ability to drive normally”	5	• Compact System • Clear line of vision • Control of vehicle with the cover on
2	“I don’t want it to fall apart”	4	• Reliable • Durable • High Quality
3	“It needs to work consistently and output data”	5	• Consistent

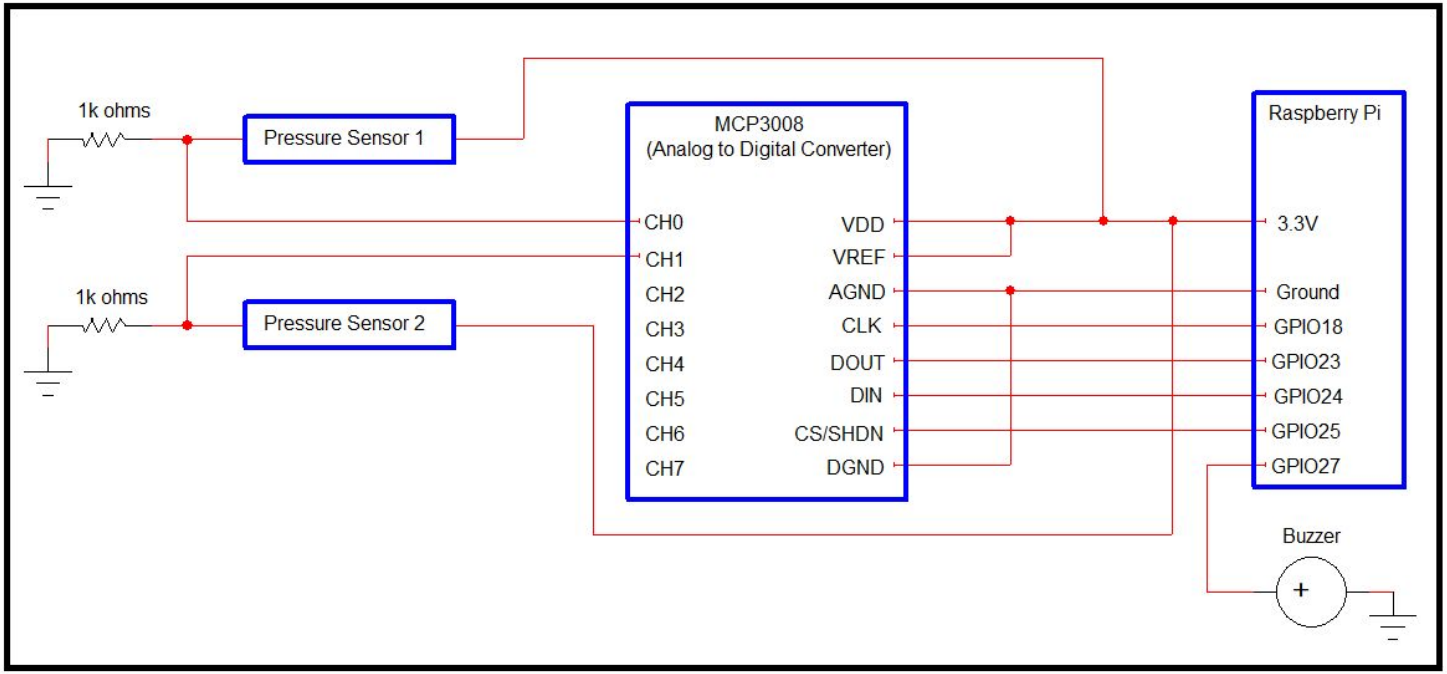
Concept Development and Selection

Structure	Generate Power	Alarm to User	Detect Sleepiness	Detect Hands On/Off Wheel	Data Processing	Data on Website
Steering Wheel Pads	Car's Cigarette Outlet ✔	Sound Alarm (Buzzer) ✔	Takes Video With Camera	Pressure Sensors ✔	Arduino	Time Hands Were On/Off Wheel ✔
Full Steering Wheel Cover ✔	Car Battery	Vibration	Takes Pictures With Camera ✔	Heart Rate	Raspberry Pi ✔	Time Intervals Hands Were On/Off Wheel
Device with Straps for Wheel		LED Lights Flashing	Uses Heart Rate From Hands On Wheel	Buttons	No Microcontroller	If Hands Were Mostly On/Off Wheel With Yes or No
				Temperature		Time Eyes Were Closed/Open ✔

Subsystems

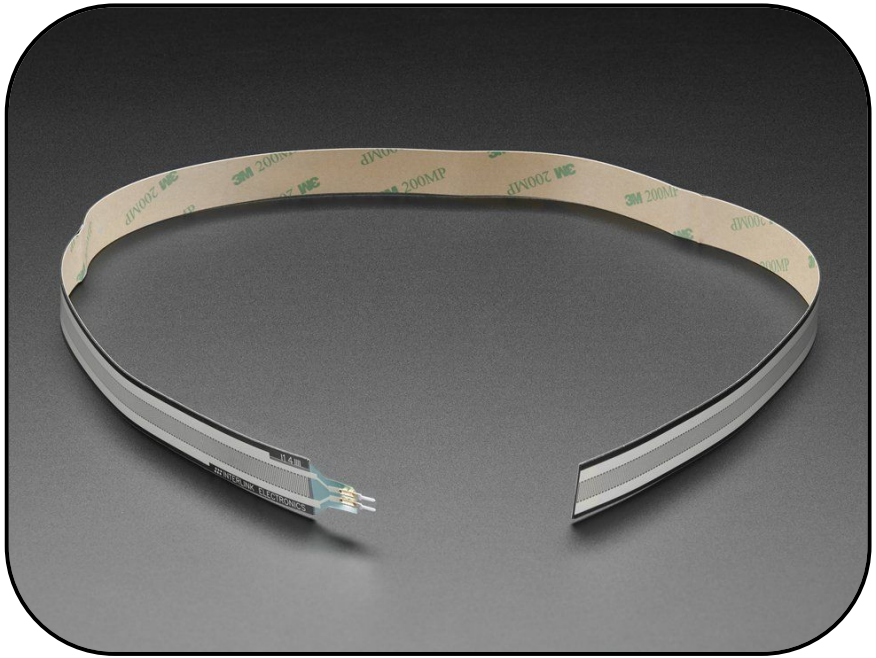

SAFEWheel
Power
Connor Block
Hand Detection
Kristen Weatherbee
User Interface
April Hu
Eye Detection
Ian Steenstra
Camera Holder
Olivia Sherman
Positioning and Assembly of Cover
Kristen Weatherbee, Olivia Sherman, Connor Block

Hand Detection



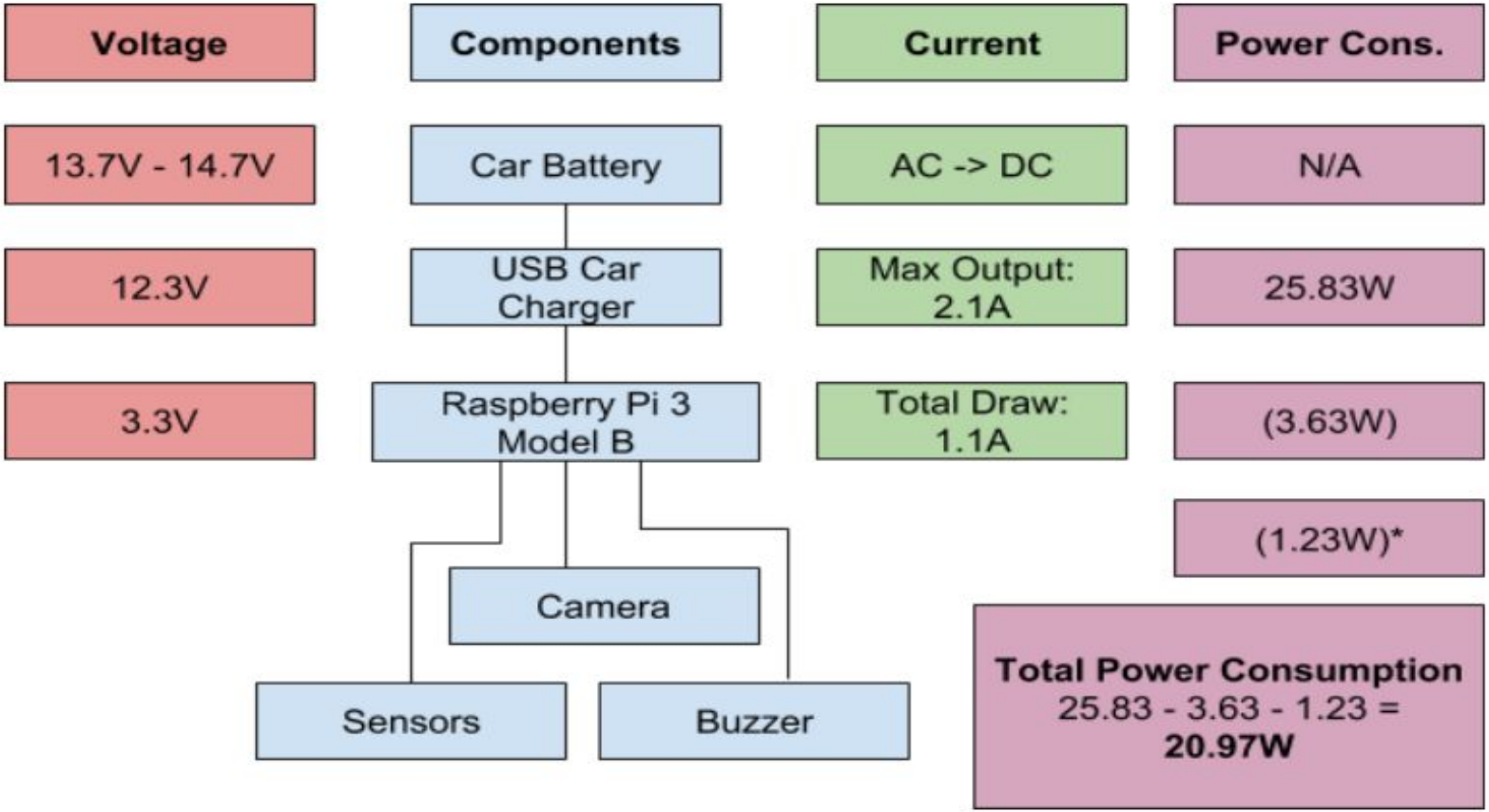
- Analog to Digital Converter
- Pressure Sensors in Voltage Dividers
- Buzzer

Testing Hand Detection



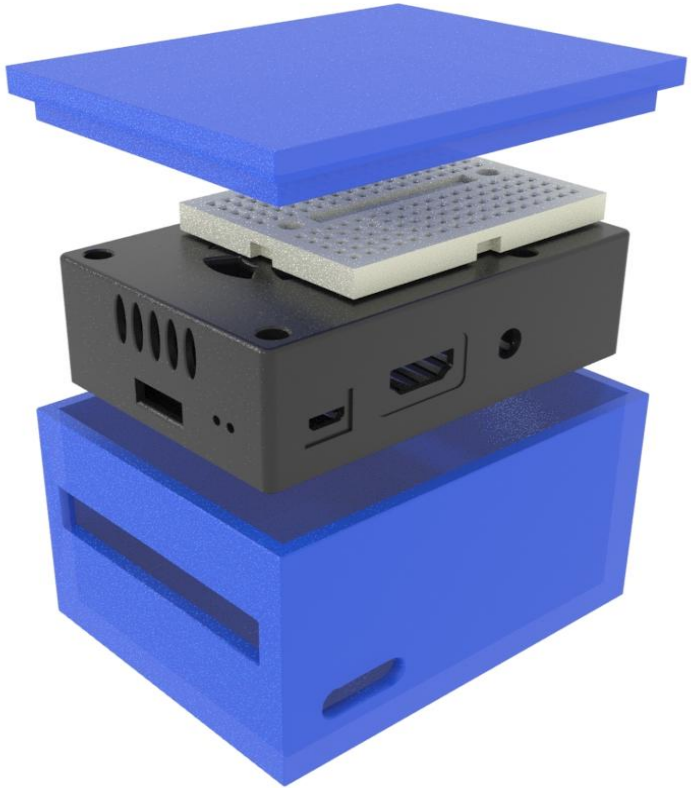
- **Setbacks:**
  - Bought wrong sensors
  - Broken sensor
  - Errors in code
- **Adjustments During Testing:**
  - Calibration
  - +10 Deadband
  - Buzzer delay - 1.2 seconds
- **Final Results:**
  - Buzzer turns off correctly and turns on correctly with a 1.2-second delay

Power


Voltage
Components
Current
Power Cons.
13.7V - 14.7V
Car Battery
AC -> DC
N/A
12.3V
USB Car Charger
Max Output: 2.1A
25.83W
3.3V
Raspberry Pi 3 Model B
Total Draw: 1.1A
(3.63W)
(1.23W)*
Camera
Sensors
Buzzer
Total Power Consumption
25.83 - 3.63 - 1.23 =
20.97W

Positioning & Assembly of Wheel Cover

- **Tasks:**
  - Enclose Raspberry Pi and secure it to vehicle dashboard
  - Attach the sensors to the wheel cover
- **Focus:**
  - Not obstructive
  - Safety
  - Comfort
  - Durability



Testing Positioning & Assembly of Cover

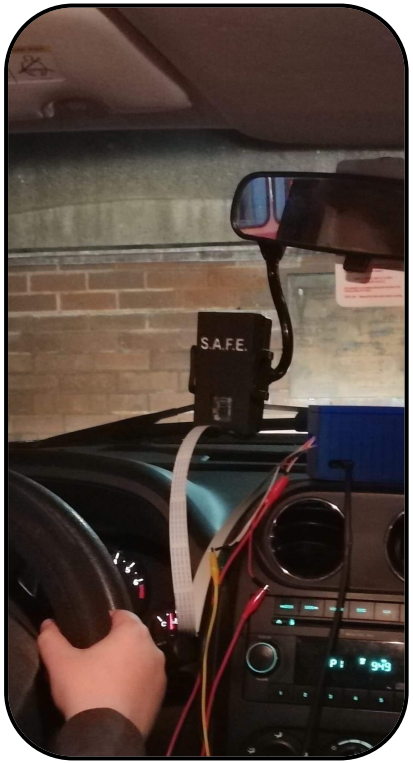
- **Rotation of wheel without slippage**
  - Interpreted Need: Control of Vehicle with the cover on
  - Importance: 5
  - Displacement Test
- **Wiring from Raspberry Pi to Sensors**
  - Run wire along steering column
  - Length of wire calculation:

(540°/360°)2π(d) = Length of Wire

= 70.68” from Raspberry Pi to Wheel

Camera Holder

- Piece was created to hold the micro camera
- Camera holder was secured by the windshield attachment
- Positioned above dashboard according to target customer specifications
  - Not in line of vision
  - Not a distracting color

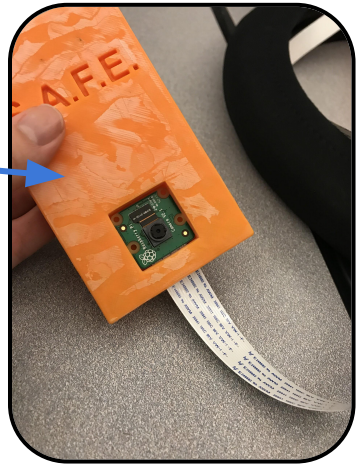


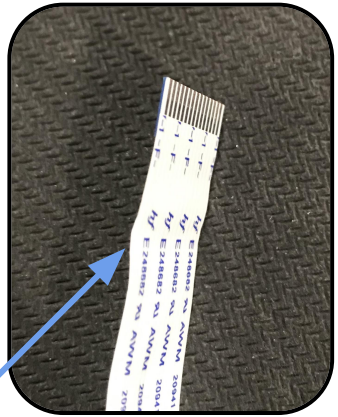
Testing Camera Holder

Ran into three problems:

1	**Printer Error**	• Plastic would not stick to the base • Error repeated three times • Fourth print try base stuck
2	**Dimensional Error**	• Camera was more rectangular than square • Used acetone to make piece malleable • Able to bend the piece to fit the camera into the square
3	**Wire Connectivity**	• Wire was too flimsy to insert easily • Had to manipulate with hands to insert

Acetone soaked





Ripple in wire

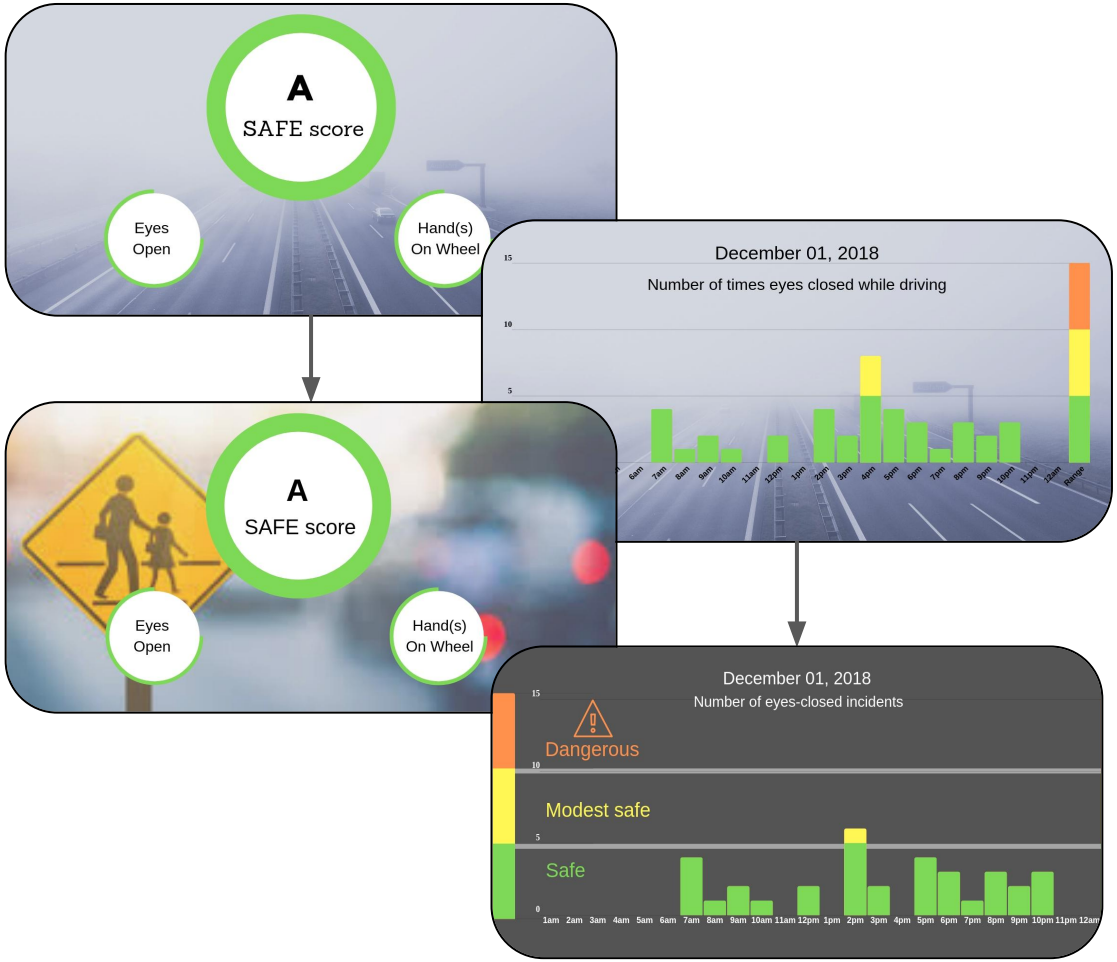
User Interface

Goals:

- Clear data ✓
- Simple to use ✓

  (No manual needed)
- Visually appealing ✓
- Time grid ✓
- Data calculation

  (translated into grades)



Testing UI

- Basic graphic of the user interface which uses sample data
- Constant improvements (with feedback from the survey)

	Parents	Adults	Teens
Ranking Q1	**3.80**	**3.86**	**3.89**
Ranking Q2	**4.40**	**3.97**	**4.39**
Ranking Q3	**4.00**	**4.24**	**4.61**

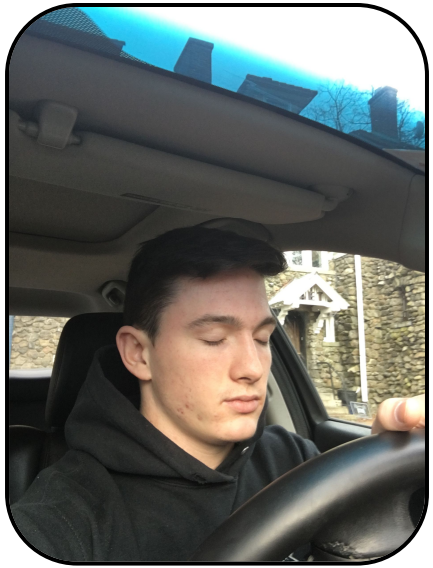
How visually appealing do you find the homepage? *

	1	2	3	4	5	
Not Appealing at all	○	○	○	○	○	Very Appealing

What changes would you make to the homepage to make it more visually appealing?

Eye Detection

- **Classification Algorithm**
  - Google AutoML Vision
  - 500 images of closed & open-eyed faces
  - 55% to 98% average precision
- **Buzzer**
- **Software Backend**
  - Python
  - RPI WiFi
  - Picamera library



Closed: 97.1% ✅
Open: 2.9%

Closed: 0.8%
Open: 99.2% ✅

Testing Eye Detection

- **Image Variations**
  - Car
  - Blurry
  - Lighting
  - Glasses
  - Face Position
- **Online Testing**
  - Google AutoML Vision
  - Model Evaluation & Information
- **Camera Testing**
  - Lower Quality Camera
  - Circuitry & Wireless Connection

OPEN

CLOSED

Team Dynamic

Group Cohesiveness

- Some meetings occurred at our respective Greek houses
- Attended social events together
- Similar mindsets

Time Management

Our group is very involved with extracurriculars:

- Greek Life
- Chem Demo Team
- RPI Wrestling

Constantly updating a schedule on our shared drive that made it simple to plan the next meetings

Defined Roles

- Subsystem Leaders
- Treasurer: Connor
- Scribes: Olivia & Kristen

MBTI Breakdown

The Commander
Connor

The Mediator
Olivia

The Debater
Kristen

The Campaigner
Ian

The Virtuoso
April

Lessons Learned

- Always plan extra time for possible errors/failures along the process.
  - Ex. Bought wrong sensors, broke a sensor, etc.
- Assign leadership roles early to prevent confusion and establish accountability.
  - Ex. Defined roles are listed above
- Simplify design ideas to allow for an obtainable project given the time constraint.
  - Ex. Did not use an accelerometer, used a simpler website, etc.

Future Plans

Expand Market

- Truck driving companies
- Car insurance companies

Enhance Visuals on Website Upgrade UI/UX

- Organize by years, months, days
- Percentages
- Grade/Score

Add to Functionality of Wheel Cover

- Add accelerometer to detect turning
- Use the parent's voice

Further Develop Google AutoML Vision Precision

- Add variance to photos
- Use better camera

Summary

Major Technical Accomplishments

- Use of Machine Learning
- Google Cloud Services
- FlashForge Creator Pro 3D Printer
- Analog to Digital Conversion with Raspberry Pi

Team Accomplishments

- Team bonding
- High level of accountability
- Committed to success of group

For Next Time:

- Scale down project
- Hold more meetings
- More collaboration among subsystems

Questions?

Sources

https://www.adafruit.com/product/1071

https://www.health.ny.gov/prevention/injury_prevention/children/fact_sheets/teens_15-19_years/drowsy_driving_16-19_years.htm

https://www.rand.org/blog/2018/03/teens-are-driving-drowsy-every-day-and-thats-dangerous.html

https://www.raspberrypi.org/documentation/faqs/

https://docs.microsoft.com/en-us/windows/desktop/appuistart/the-process

https://www.16personalities.com/

Concept Matrices

SOURCE OF POWER	Concepts	
Selection Critera	Cigarette Outlet	Car Battery
Cost	1	1
Difficulty of Implementation	1	-1
Creativity	0	0
Efficiency	1	1
Weight	0	0
Size	0	0
Practical	1	-1
Aesthetic	-1	1
Safety	1	1
Durability with Average Use	1	1
Sum of +1's	6	5
Sum of 0's	0	0
Su, of -1's	-1	-2
Net Score	5	3
Rank	1	2
Continue?	**Y**	**N**

FUNCTIONS ON WHEEL	Concepts	
Selection Critera	Volume Control	Pressure Sensors
Cost	-1	1
Difficulty of Implementation	-1	1
Creativity	1	1
Efficiency	1	1
Practical	1	1
Aesthetic	1	1
Safety	1	1
Durability with Average Use	1	1
Sum of +1's	6	8
Sum of 0's	0	0
Su, of -1's	-2	0
Net Score	4	8
Rank	2	1
Continue?	**N**	**Y**

CAMERA CAPABILITIES	Concepts		
Selection Critera	Emotion	Eye Openness	Pupil Dialation
Cost	1	1	1
Difficulty of Implementation	1	1	-1
Creativity	1	1	1
Efficiency	1	1	1
Priority for Completion	-1	1	-1
Practical	1	1	1
Sum of +1's	5	6	4
Sum of 0's	0	0	0
Su, of -1's	-1	0	-2
Net Score	4	6	2
Rank	2	1	3
Continue?	**N**	**Y**	**N**

The presentation is to be approximately 15 minutes with 5 minutes for Q & A. I suggest that you have one student serve in a **moderator** role to help direct the questions to the appropriate person.

Your presentation should not just rehash your demonstration but instead should discuss how the **design choices you made (or failed to make) affected your outcome and the deliverables**. Discuss the design or production **obstacles** you encountered and how you **attempted to overcome** these issues and to what extent you were **successful or not**. Don't be afraid to discuss both **what went wrong as well as what went right**. This class is about learning the design process not about building the perfect prototype. Good presentations will demonstrate this with **candor and honesty.**

Do not forget to cover **teamwork and professional development** issues in your presentation. Generally this should be around **10 – 15% of your presentation** depending upon the impact of team development issues on your particular team. Remember to revisit and discuss PD1 content material such as the **MBTI**, your team contract and the Thomas Kilman **Conflict modes**. Ask yourself, "How did this material prove useful/insightful or fail to be internalized and used by your team". **Do not simply restate your group's MBTA profile**. Analyze and synthesize your team's performance through the lens of "the tools" we provided you with.

Remember that your presentations should have a **degree of genuineness** and should say something with conviction about your project, your team and what you as a group learned from this experience. If you are bored after practicing it with one another, I assure you we will be bored after hearing it.

Don't forget to include strong **visuals** in your presentation such as photos, diagrams or video. A picture can be worth a thousand words.

I strongly suggest having a **clear conclusion that features a review of the "lessons learned"** and how you would improve your product or performance in the future. Avoid banal generalities such as "if we only had more time", instead discuss **how you would plan or operate differently** to create or **use time more affectively.**

Good luck and don't forget to review the Team Project Final Presentation Rubric on LMS.

Lastly, on the day of your presentation please **submit two hard copy** of your presentation to Instructors prior to giving presentation. Failure to do so will result in the loss of one point on your team's presentation grade. (**6 slides per page** to conserve trees).

Rubric

Engineering Project

- Problem Identification
- Prioritized ~~**Customer Needs**~~
- Requirements / Performance Specifications
- Value Proposition / Alternative System Concept
- Test / Analysis

Public Speaking

- Intro / Conclusion
- Verbal (volume, tone, pace, fillers)
- Non-Verbal (gestures, posture, eye contact)
- Effectiveness/Professionalism
- **Team Presence** (change slides for one another, **unified** business-casual attire, etc.)
- Q&A

Documentation

- Consistent/Flows
- Logical/Accurate
- Professional (no typos, has proper citations)
- Supports / contributes to the message
- Uses communication tools such as diagrams/figures, sketches, models

Excellent

Solution & approach demonstrate the total use of the engineering design process.

20

Professionally presented the material in a clear, accurate and concise manner without distracting mannerisms. Was able to clearly and accurately respond to questions.

30

Presentation material was always clear and concise. There were no **spelling / grammar errors**. Information was well formatted and always flowed smoothly and in a logical manner. Numerous ~~**diagrams / figures**~~ were appropriately used to illustrate the text.

30

Teamwork

- Shared procedures & protocols
- Shared responsibilities for team's success or failure
- Not afraid to ask each other for help
- Shared understanding of goals & objectives
- Have a fun & productive time
- Fully accept each other's strengths & weaknesses
- Able to work through group problems
- Express criticism of others constructively
- Often share pertinent & appropriate information with each other to ensure effective and communication and overall success
- Consistency between members & their messages
- Appears as a cohesive unit & provides a consistent message throughout the presentation

Overall Quality

- Attention to Detail
- Workmanship
- Attitude
- Equal Member Contributions

Team members demonstrated, integrated, evaluated, and assessed their performance utilizing all of the tools discussed throughout the semester (i.e., **MBTI**, Conflict Resolution, Giving & Receiving Feedback, etc.), while also including additional tools that they researched regarding team development and leadership skills.

10

Clearly demonstrates effort in terms of **attention to detail**, performance, and **workmanship**.

10