GROUP 23 VOICE CONTROLLED RC

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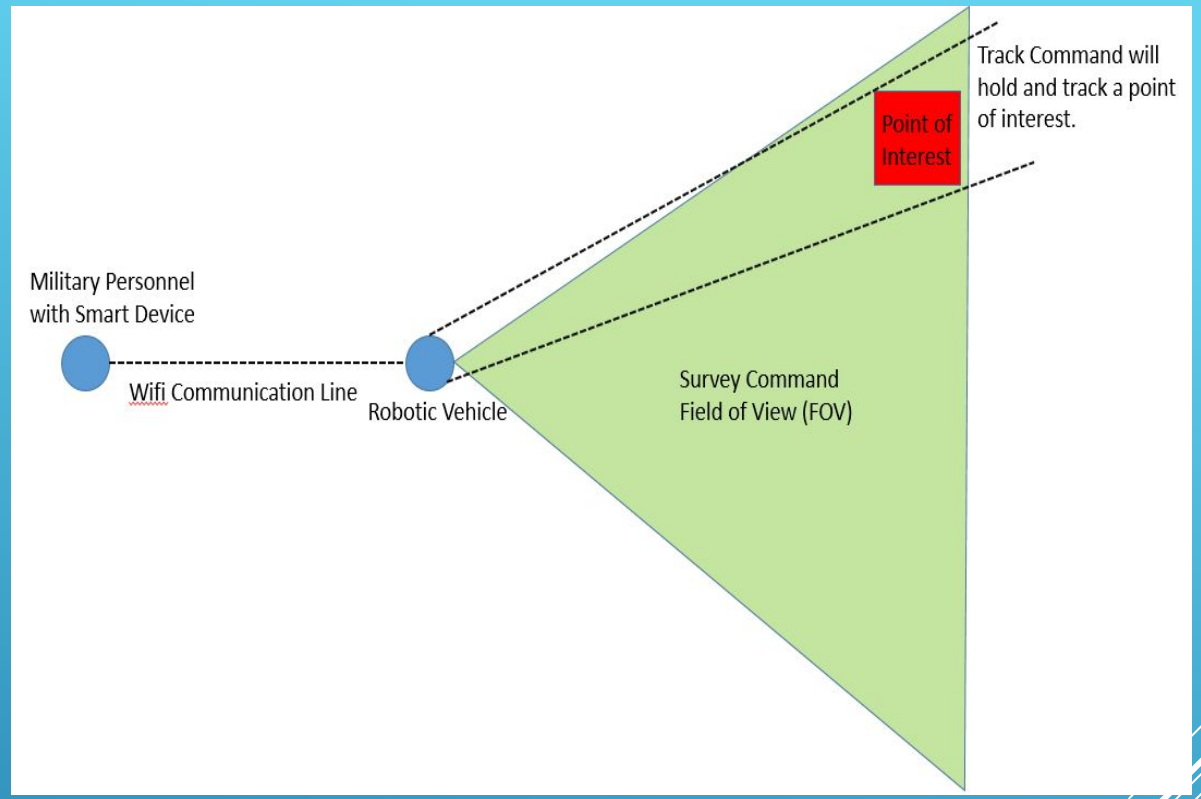
Introduction

- Autonomous tracking vehicle
- Commands:
  - Survey
  - Find
  - Stop
  - Track
- Commanded through android app



Goals & Motivation

- Create new design that addresses problems in existing products
  - Portability
  - Simplicity
  - Usability
- Make ground surveillance safer and more effective

Specification Summary

- robotic vehicle:
  - be no larger than 2’/2’/2’ (L/W/H)
  - accept functional commands over Wi-Fi
  - have a maximum range of at least 25ft
  - The robotic vehicle shall be able to scan a 120-degree area in front of itself.
  - hold a track on a POI for at least 30 seconds.
  - Use collision detection
  - The robotic vehicle shall have a cost of no more than $450
  - The robotic vehicle shall utilize a camera for basic vision

Existing Systems

- Throwbot XT vehicle made by ReconRobotics
- California Institute of Technology vehicle
  - Similar function to our design
  - Large size and weight, portability issues

TEAM MEMBER ROLES

Ryan Hromada: EE role- PCB design, component interfacing, electronics testing

Adam Baumgartner: EE role- PCB design, servo control and interface, vehicle assembly

Austin King: CpE role- Software design and testing

Kevin Plaza: CpE role- Software design and testing

HARDWARE OVERVIEW

Attiny & I2C

Sensor Array

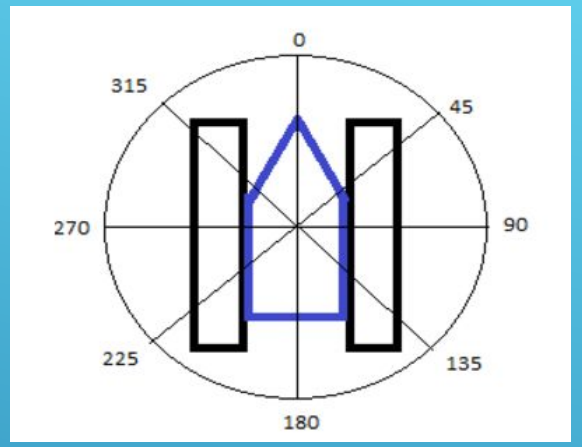
Accelerometer

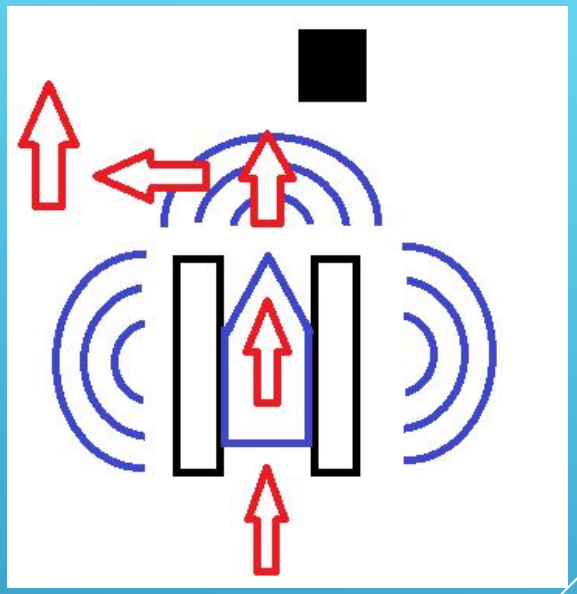
Encoders

Camera & Bluetooth

Movement

SENSOR ARRAY



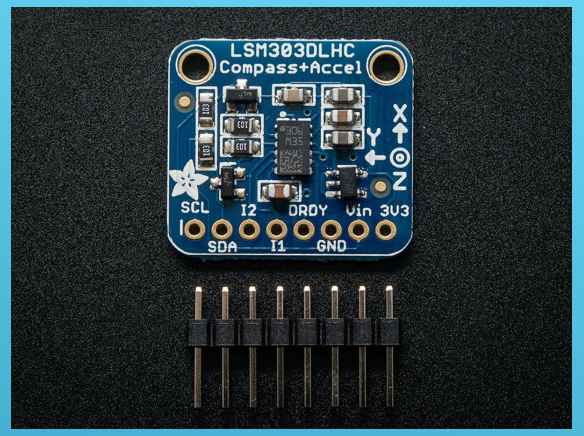


- How will the vehicle movement work?
- How can the device know what's in front of it?
- How does the device know where it's been?
- How does the device know what a left turn is?

Ultrasonic Sensor Array

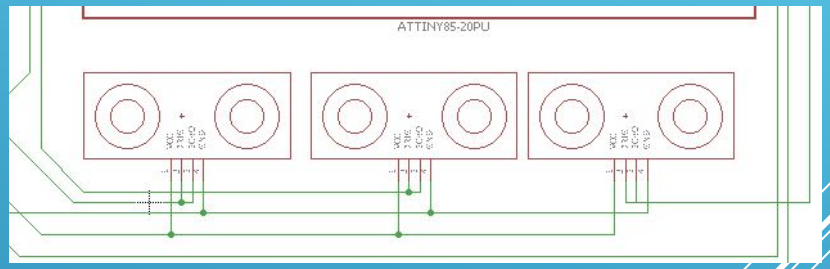
- Inexpensive components
- Low voltage tolerance
  - Difficult to interface with Raspberry Pi
- Range of up to 3 meters
  - Effective range of 1 meter
  - Not clean data
- Can combine trigger and echo pins to make an array

Accelerometer, Camera, Bluetooth



- Utilizes built in Bluetooth and wifi functionality
  - allows for easy programming and communications
- High enough image resolution for image detection
  - Plug and play; 1080p; 8 megapixel
- Small form factor accelerometer
  - i2c, magnetometer
  - flexible voltage input

Communications to the Microcontroller



- How will the sensor array communicate with the micro controller?
- What voltage limitations are there?
- Reduce the number of GPIO ports used
  - 2 x ultrasonic sensor, 1 x rotary encoder, 5 x servo driver, 2 x magnetometer, Power and Ground,
  - 14 minimum GPIO pins

Inter-integrated Circuit (i2c)

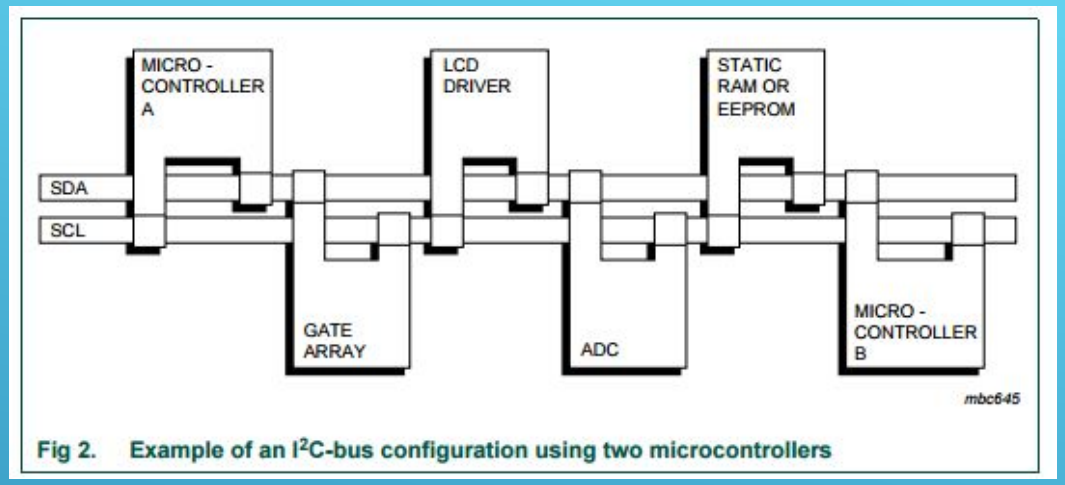
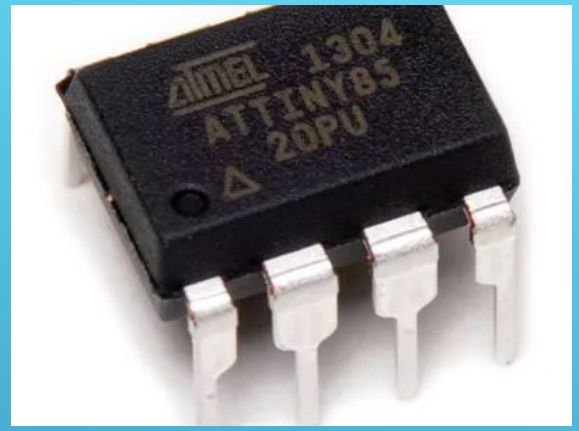


Fig 2. Example of an I²C-bus configuration using two microcontrollers

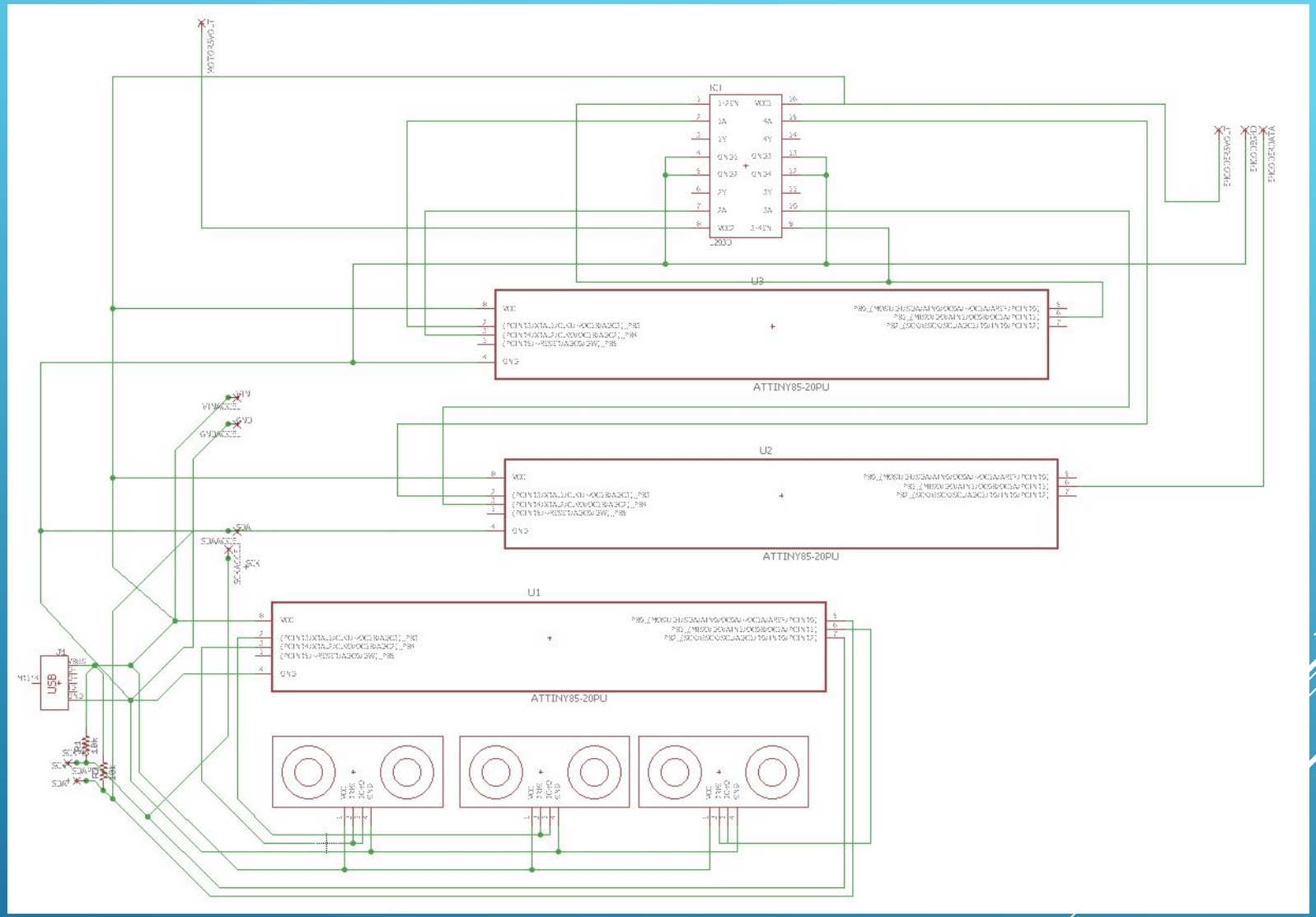
- Unique address for each component
- Serial based communications
- Industry standard in many microelectronics
- Reduces the communication lines by sharing the same bus
  - 2 minimum GPIO Pins

ATTINY85 & I2C



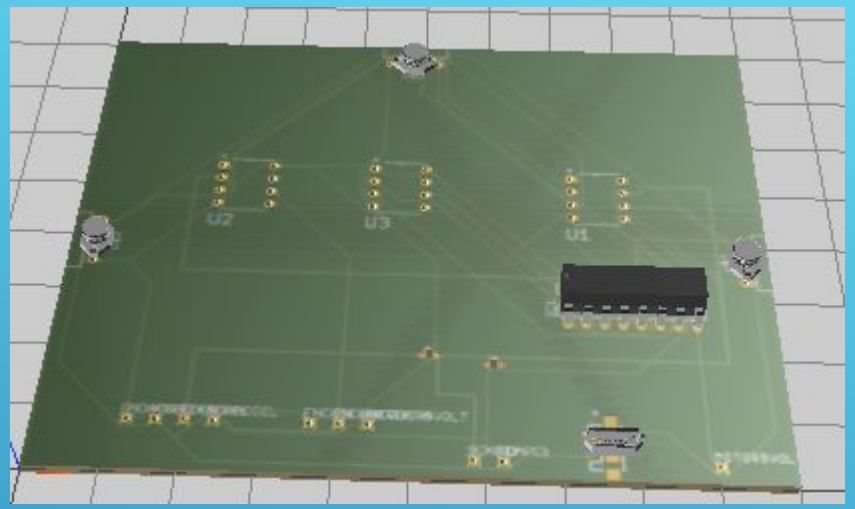
- Low Power Consumption
  - 300 Microamps
  - Large operation voltage
- 6 programmable pins
  - 2 x I2C Lines
  - 3 ADC lines
  - 1 Reset line multi use line
- Slave-Master Ability for offloading code

Schematic



- Integrates all sensors and controllers on to one PCB
- i2c contains all communications between PCB and Raspberry Pi

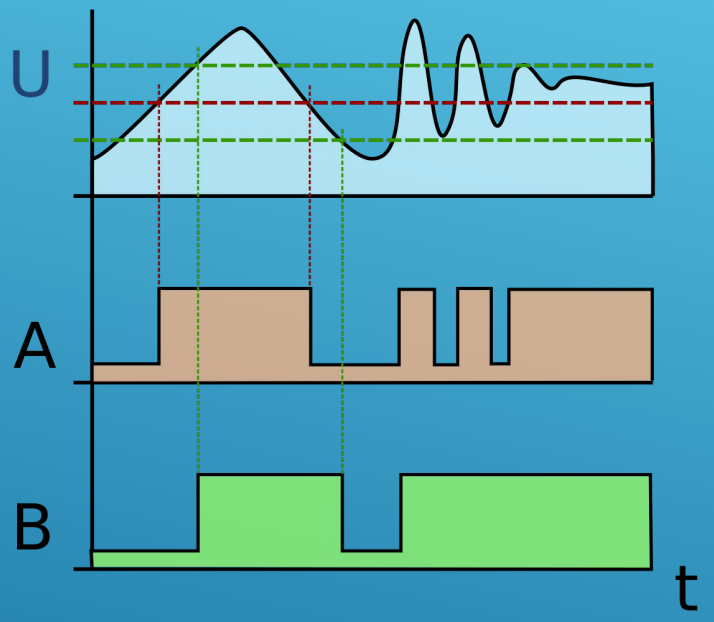
Schematic

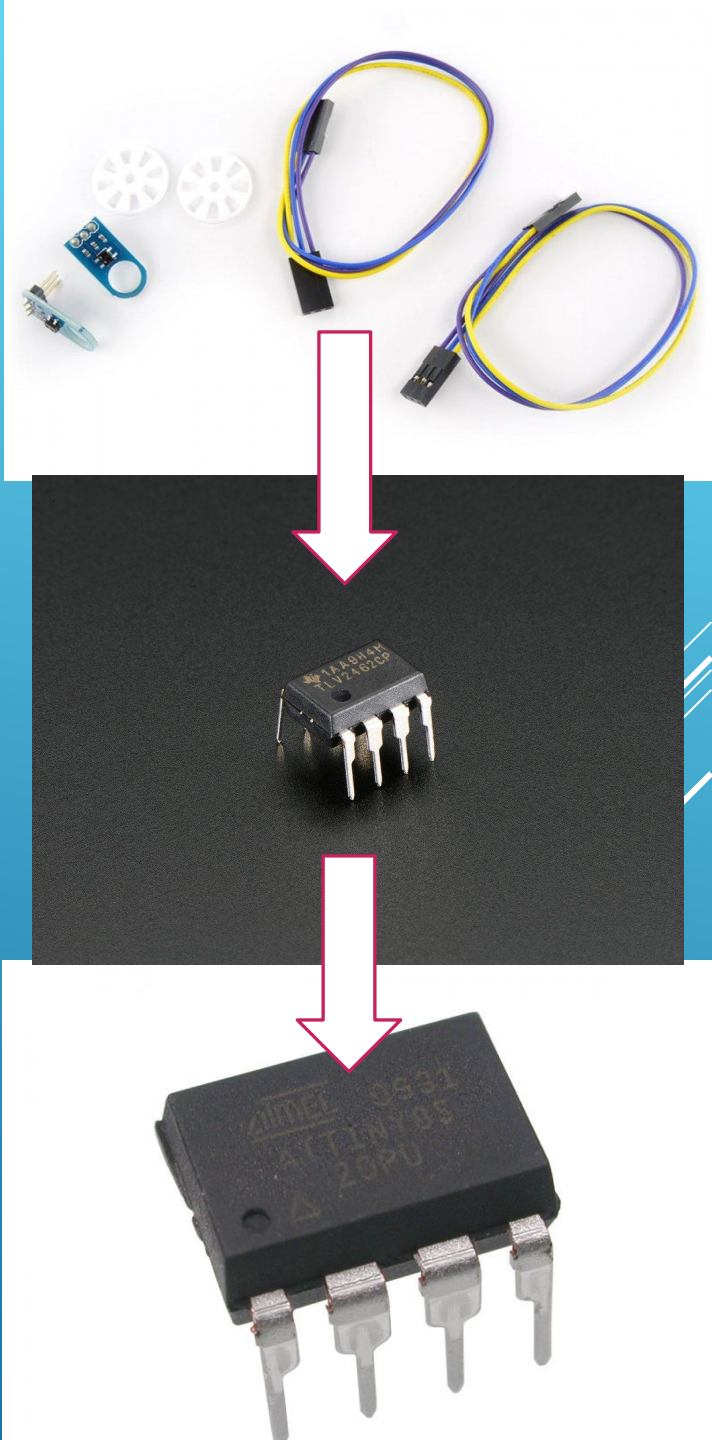


- Known Issues
  - Accelerometer is on a breakout board
  - Possible noise from the servo's interfering with communications
- Re-Design efforts
  - Include separate power supply for servo's
  - Custom Accelerometer PCB board
  - Mounting hardware to match Robot Chassis
  - Remove jumper wires

ENCODERS

- Analog Rotary Encoders
  - Output High (3.5V-4V); Low (2.5V-3V)
- Schmitt Trigger
- ATtiny85
  - Analog To Digital Conversion
  - Communication

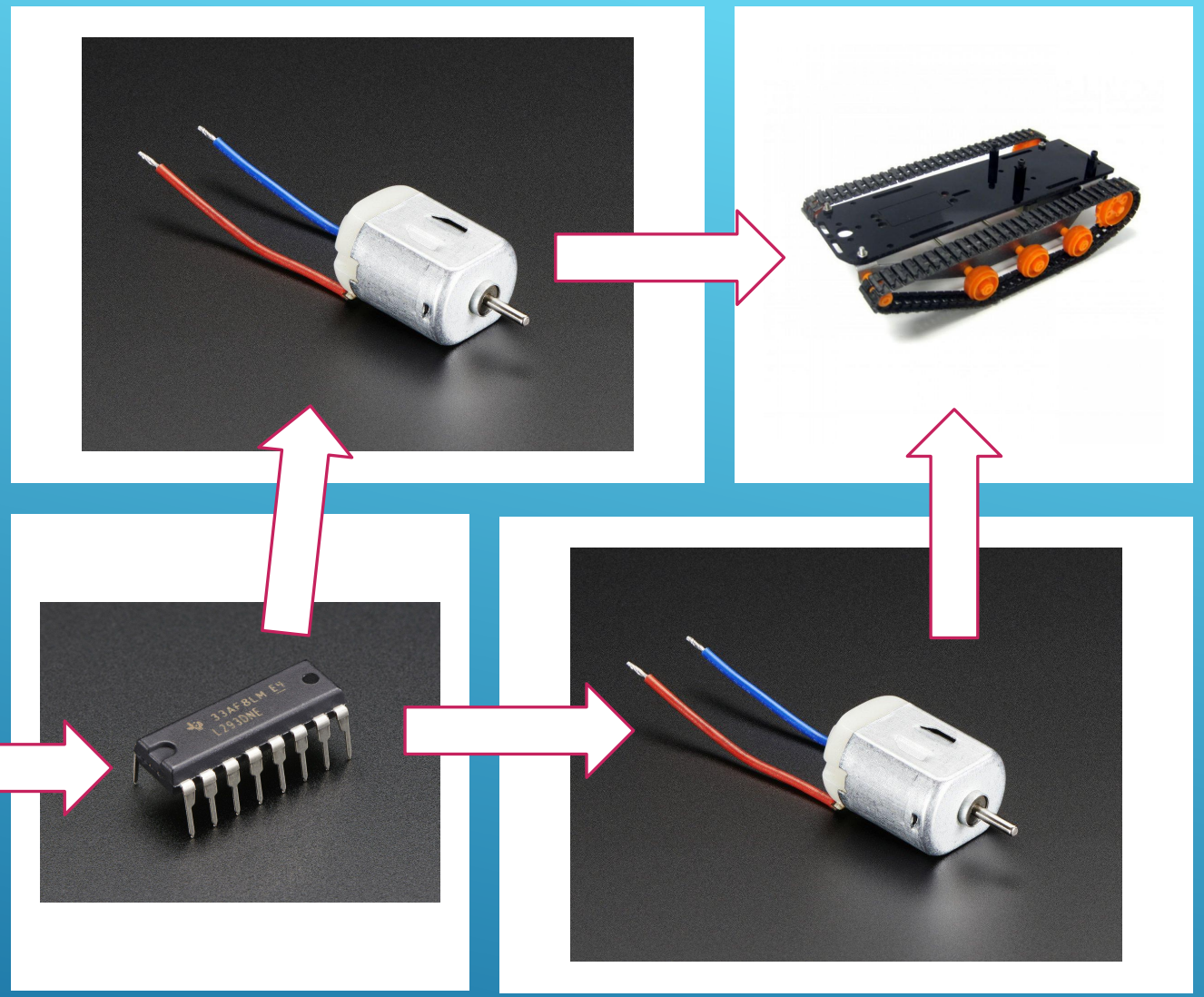




MOVEMENT

- L293D Motor Driver
- Brushed DC Motors- 130 Size

  Noisy; Current Requirements
- Tracked Robot Chassis



PROGRAMMING OVERVIEW

App Design

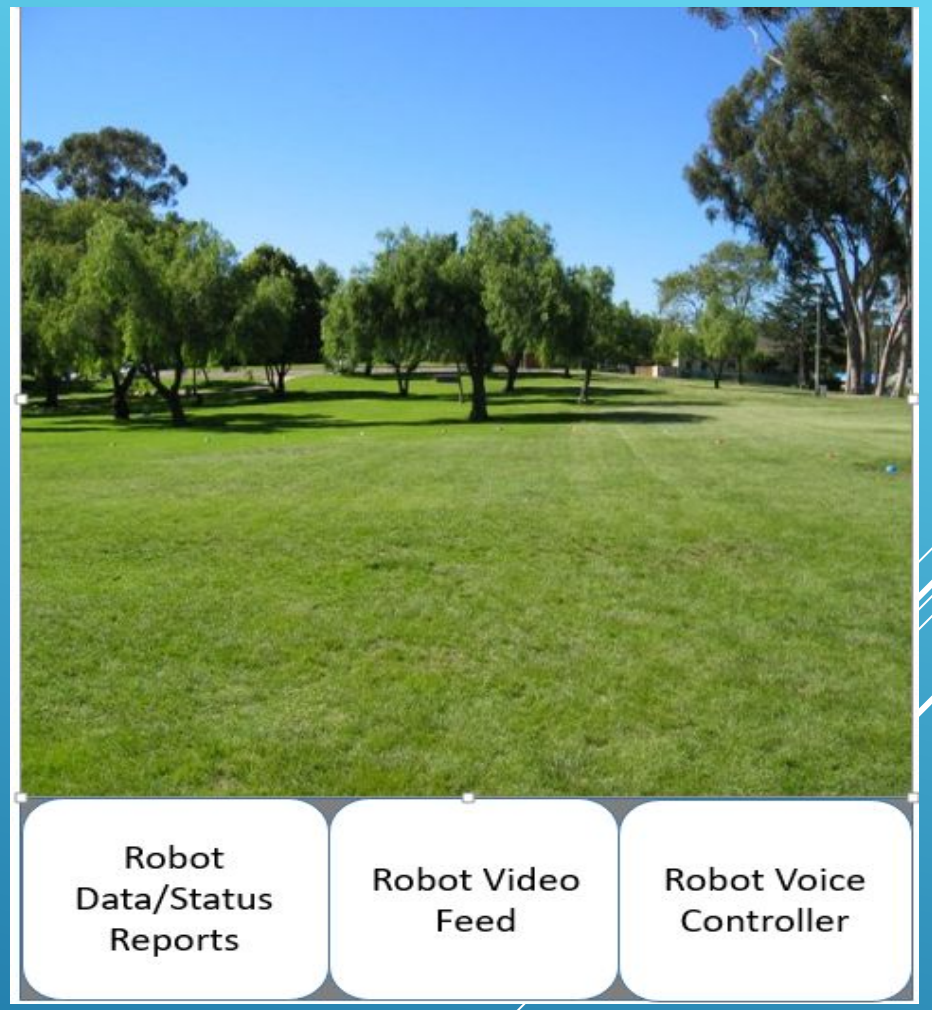
Voice Commands

Computer Vison

Collision Detection

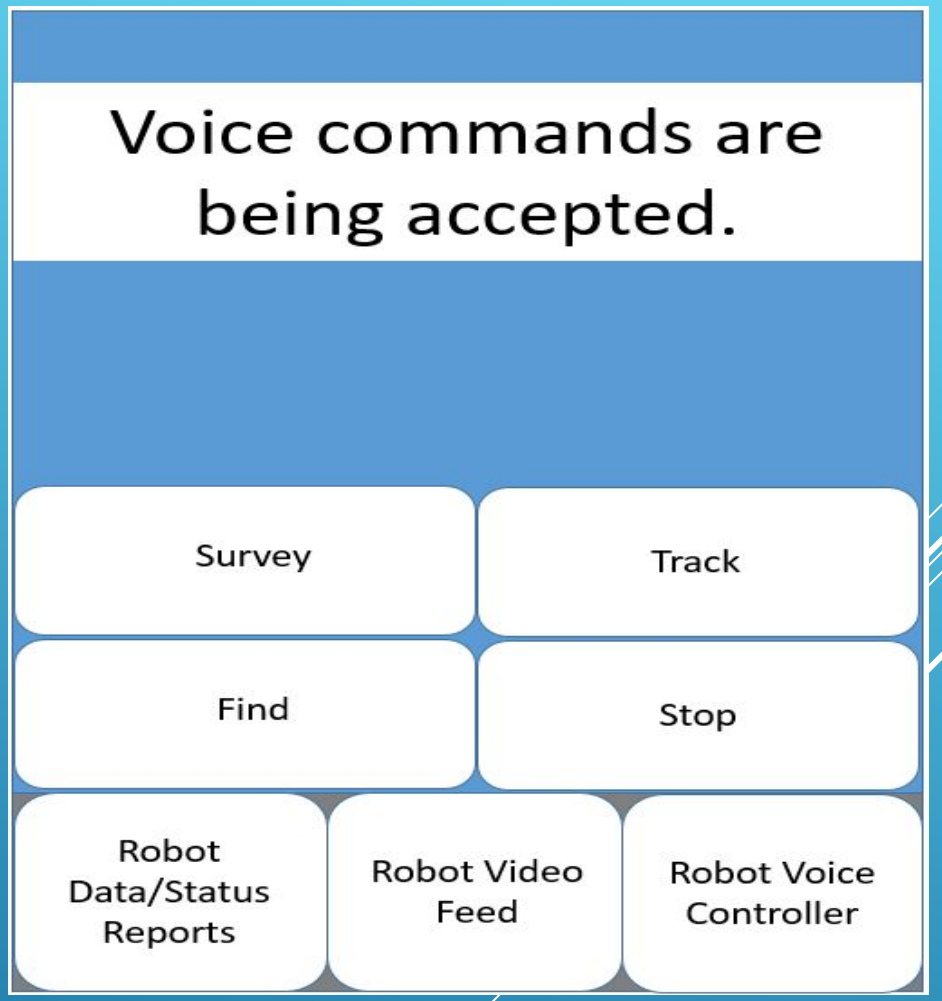
Android Application

- Phone app using android studio
- Connecting to Raspberry Pi via WiFi
- Video is sent to phone via the app



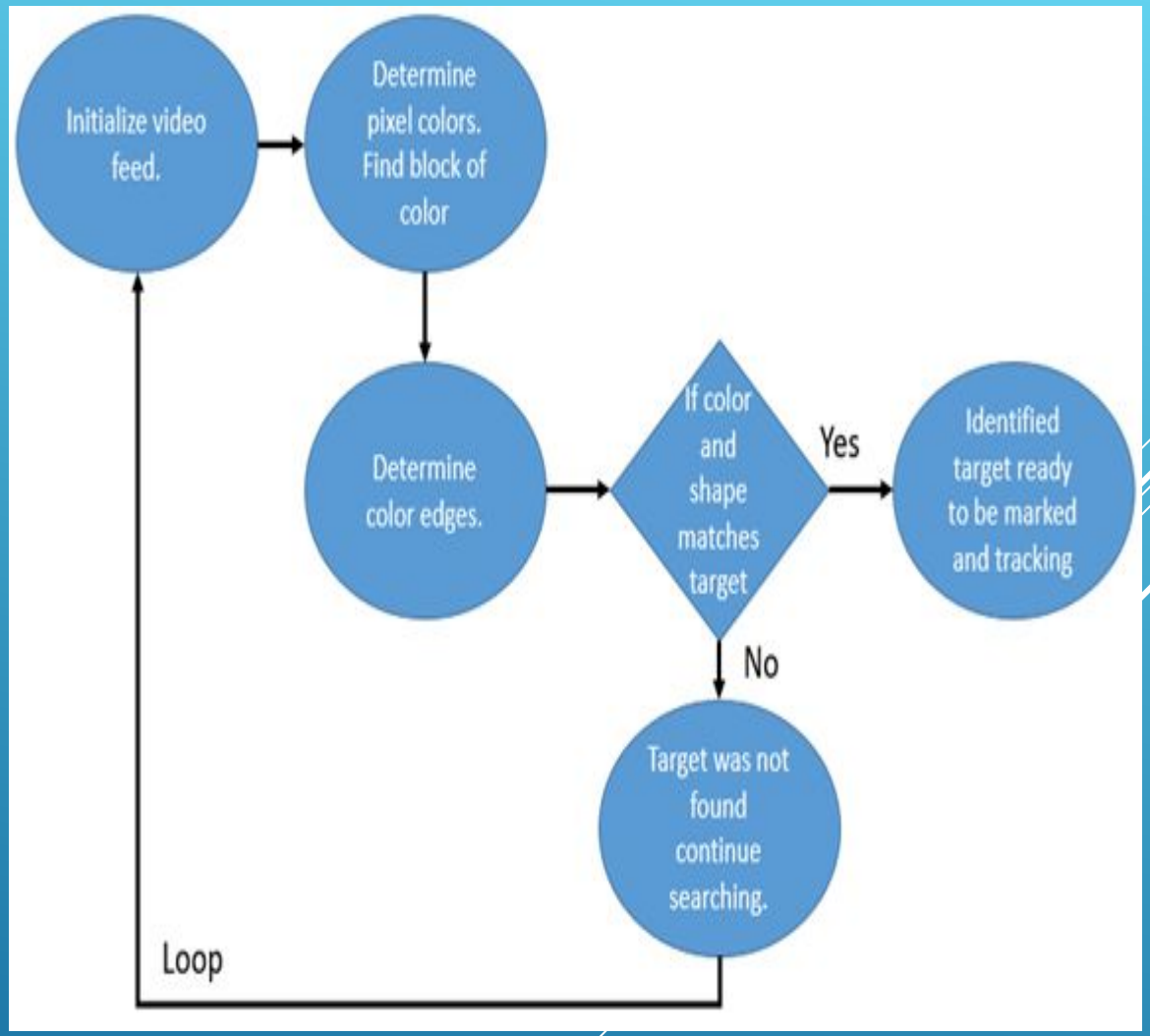
VOICE COMMANDS

- Commands accepted through device
  Cordova Plugins will be used be voice and video
- App will select mode based on voice command
- Command will be sent to vehicle from app



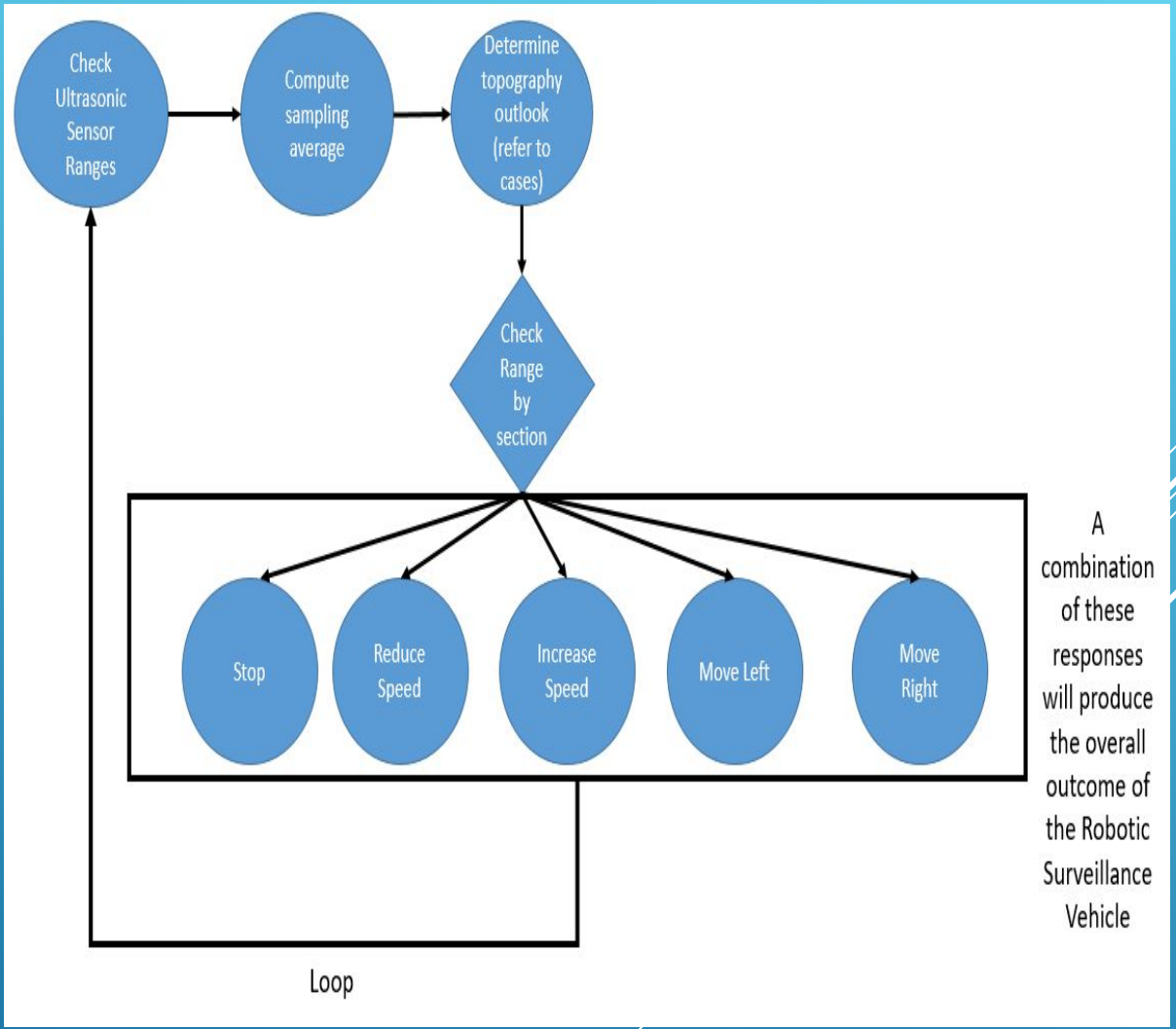
COMPUTER VISION

- Camera on vehicle records images in front of vehicle
- Computer vision software will use camera images to find or track a specified target
  - Once target is detected, software will alert the user and track
- SimpleCV library used with Python language to program the computer vision



COLLISION DETECTION

- Uses sonar sensor array
- Sensors feed distance values to ATtinys, Raspberry Pi pings for distance within threshold (~ 3-100cm)
- Current distance and rate of change of the distance will be used to determine logic controls
  - Motor controls based on determinations will be done using servo controller.



CONCLUSION

Budget

House of Quality

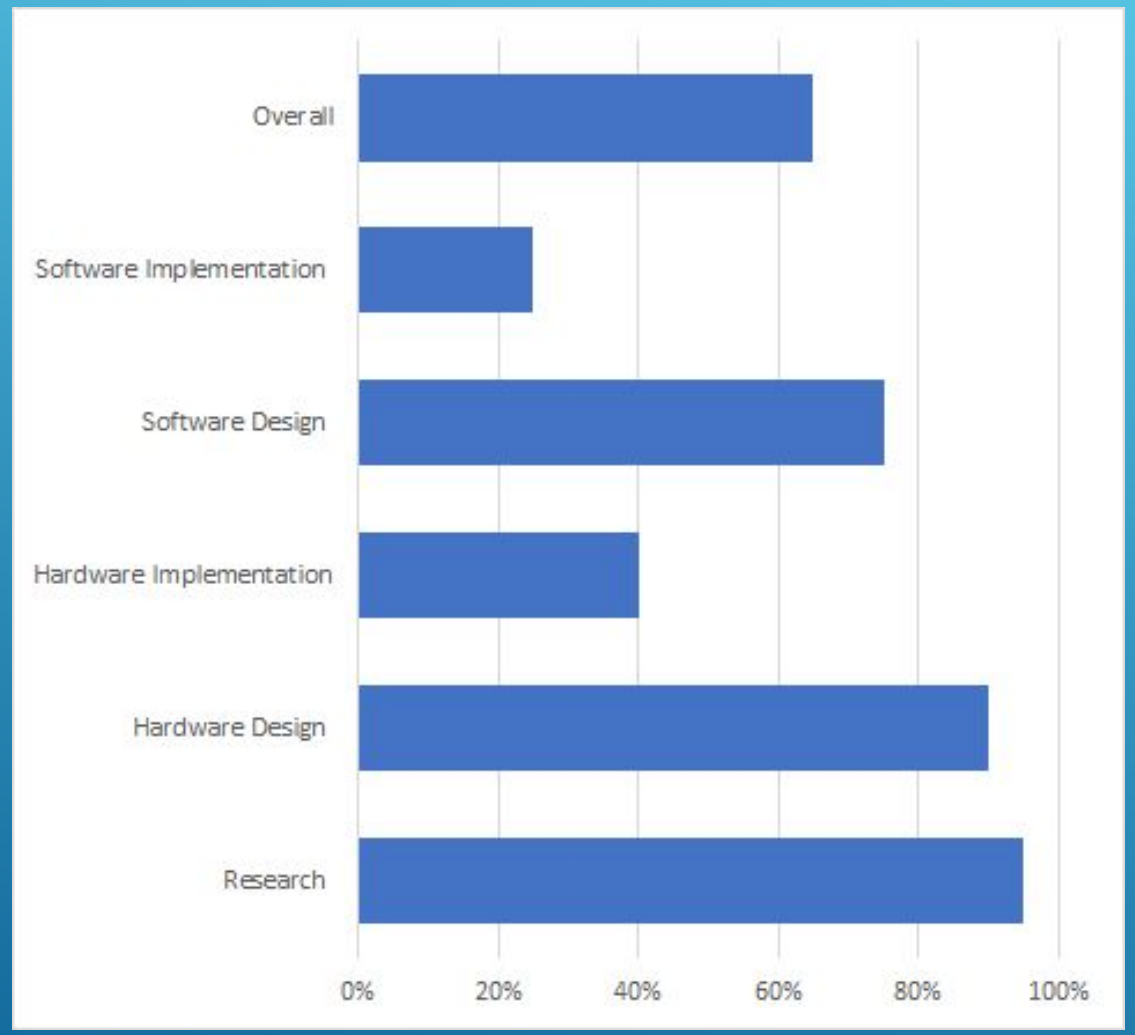
Design Progress

BUDGET

Part	Cost			
	Low	High	Qty	Average Total Cost
PCB	$50.00	$100.00	1	$75.00
GPS Chip	$20.00	$30.00	1	$25.00
Wifi Chip	$4.00	$20.00	1	$12.00
RF or Bluetooth Transmitter/Reciever	$5.00	$20.00	1	$12.50
Robotic Vehicle Kit	$20.00	$300.00	1	$160.00
Battery	$10.00	$20.00	2	$30.00
microphone	$2.00	$10.00	1	$6.00
Transformer	$10.00	$20.00	1	$15.00
Microcontroller	$40.00	$80.00	1	$60.00
Ultrasonic Sensors	$3.00	$30.00	3	$49.50
Camera	$25.00	$40.00	1	$32.50
Digital Compass	$3.00	$25.00	1	$14.00
Totals	$192.00	$695.00		$491.50

HOUSE OF QUALITY

			Marketing				Targets
			Cost	*Accuate*	*Intuitive*	*Portable*	
			-	+	+	+	
Engineering	*Dimensions*	-	↓	-	-	↑↑	24''/24''/24'' (L/W/H)
	Wifi Enabled	+	↓	↑	↑	↑	≤ 1Kg
	Voice Control	+	↓↓	↑	↑↑	↑	Accurate voice commands
	Battery Operated	+	↓	-	-	↑	>2 Hours
	Range	+	↓	-	-	-	150 ft
	Response Time	-	↓	↑	-	-	≤ 3s
	Collision Detection	+	↓	↑↑	-	-	Avoid collisions causing loss of track or damage to the vehicle
	Cost	-	↓	-	↓	↓↓	≤ $350



DESIGN PROGRESS