Bike Navigation Assistant

Final Presentation

Group 48

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Project Introduction

- On-bike peripheral that improves ease of navigation
- Communicates with mobile application
- Features include
  - LEDs and buzzer to indicate upcoming turn
  - Ultrasonic sensor and blinkers for improved safety
  - Speedometer

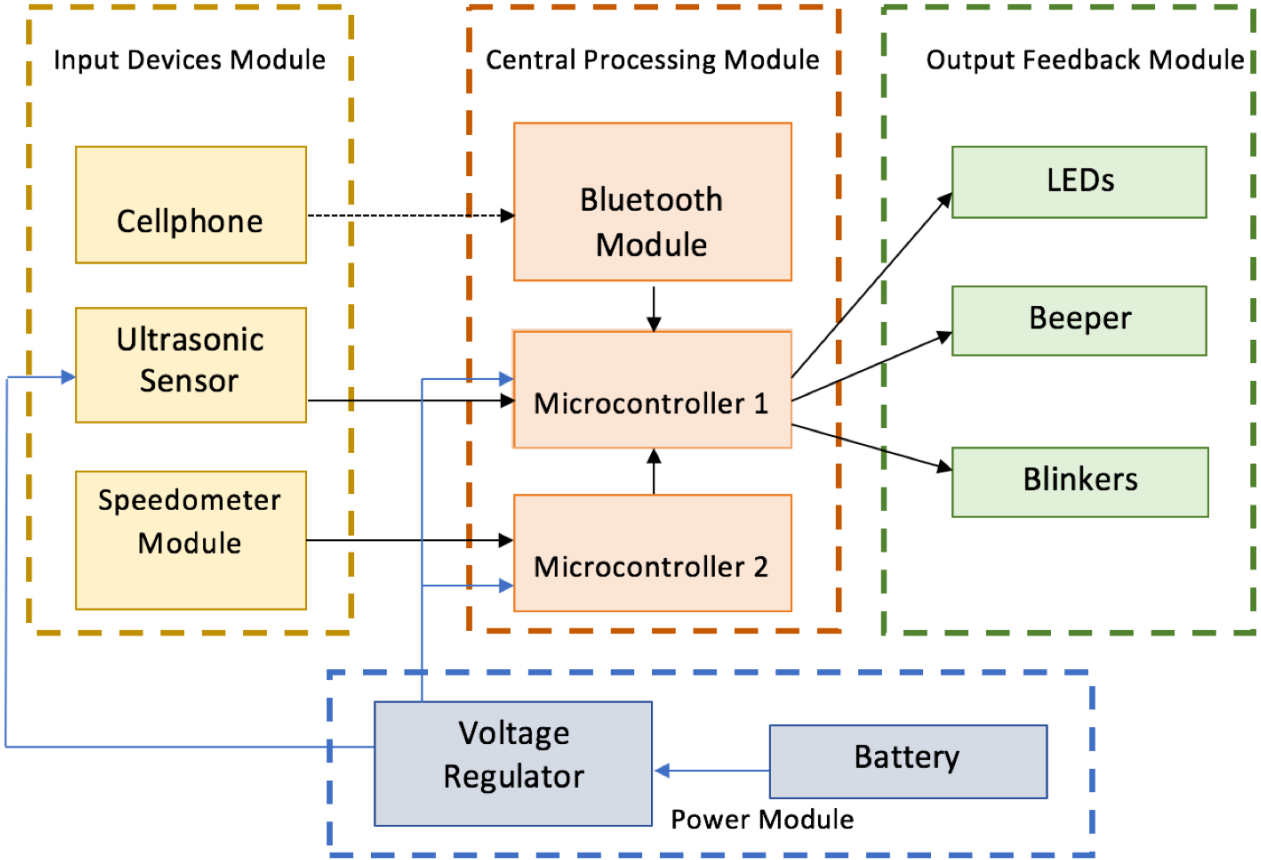
Objective

- Lack of directional knowledge in new location
- Reduce car use
- Increase short term bike rental
- Bike safety growing concern:
  - 1000 bike-related deaths
  - 0.5M injuries

Physical Design

1. Microcontroller, Buzzer, Bluetooth Module and Power Supply
2. LEDs
3. Ultrasonic Sensor
4. Indicators/Blinkers
5. Reed Switch and Magnet

Block Diagram



Mobile Application

Connect to Bluetooth device

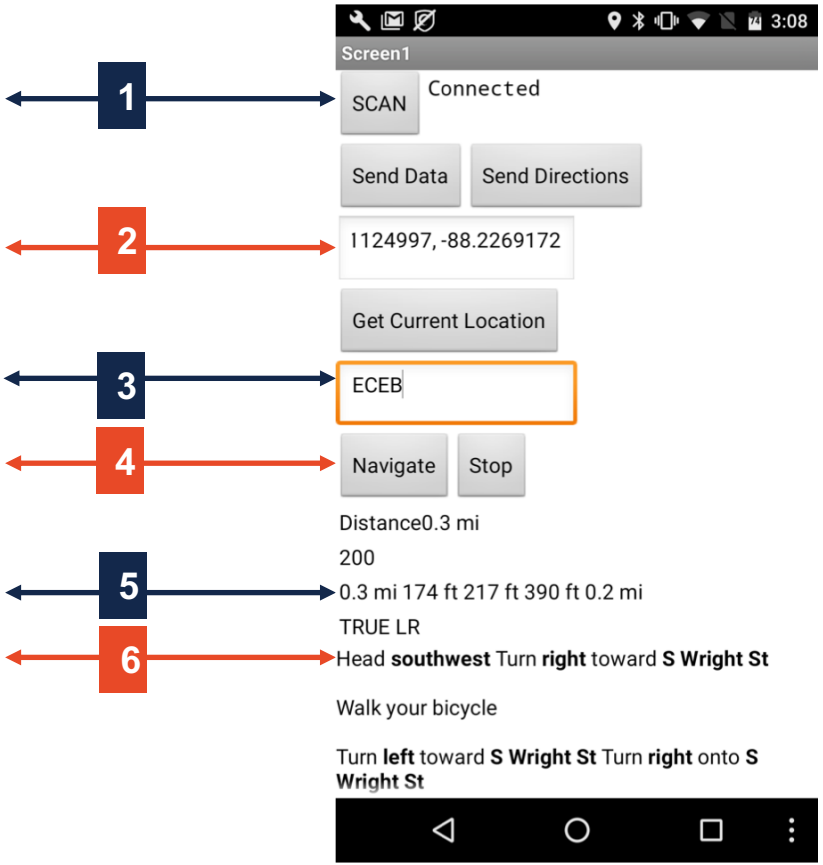
Current Location every 2 seconds

Enter Destination

Call Google Maps API
Send data to Bluetooth module

Distances

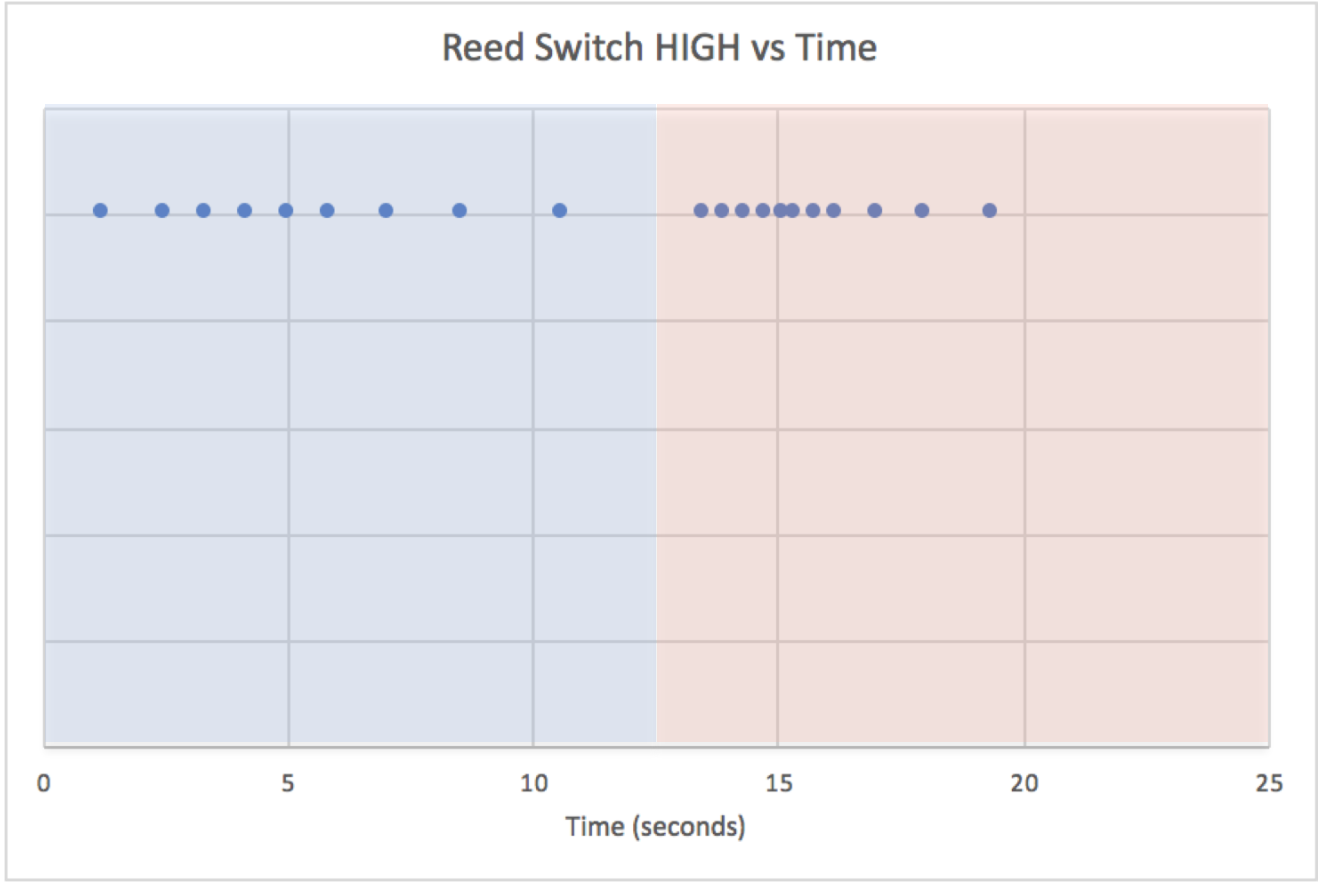
Directions



Speedometer

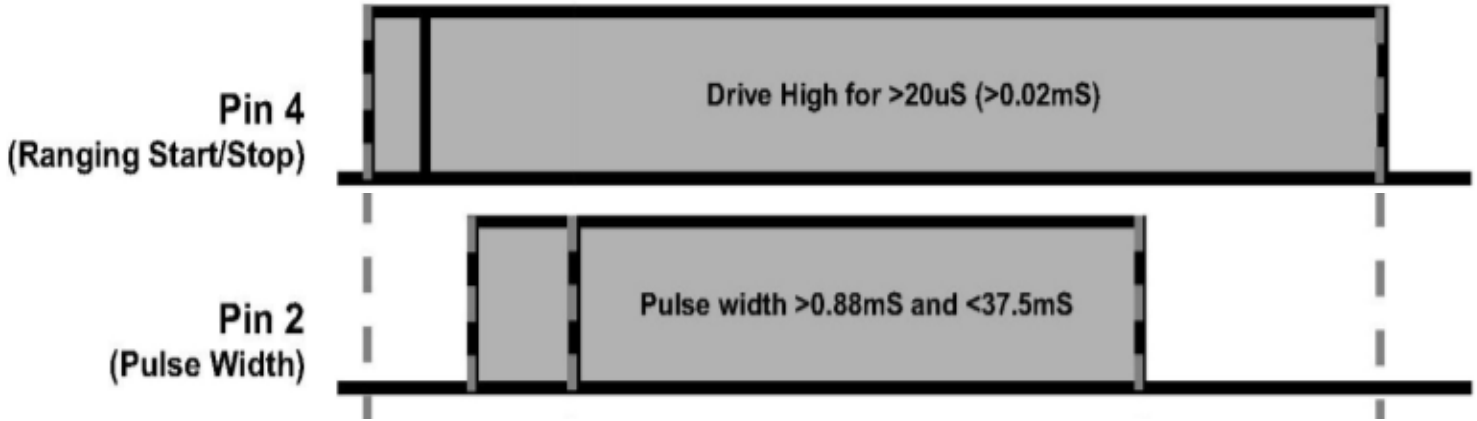
- Reed Switch on bike fork
- Magnet on spoke
- Microcontroller reads HIGH when switch is closed by magnet
- Speed calculated using diameter and time between two revolutions

Speedometer R&V

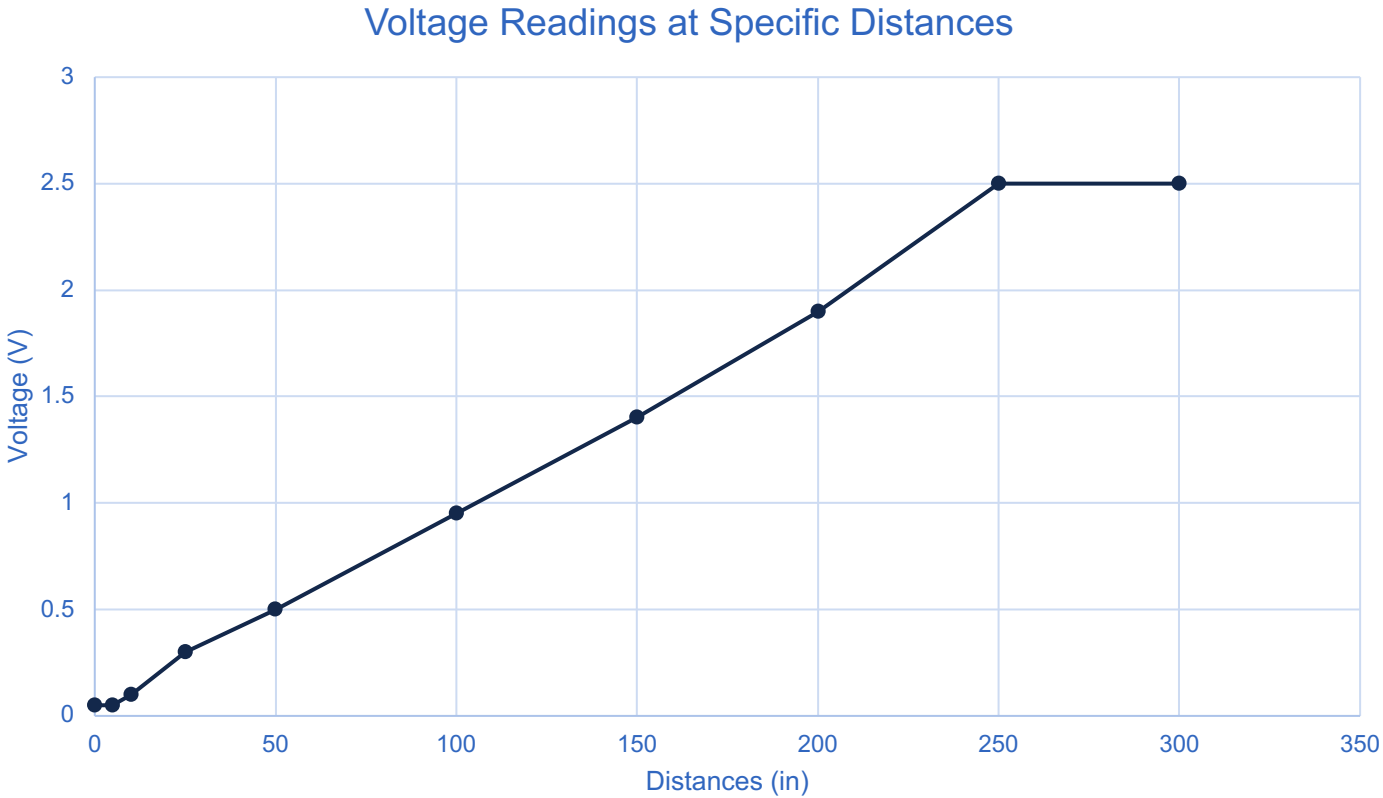


Ultrasonic Sensor - Max Sonar EZ2

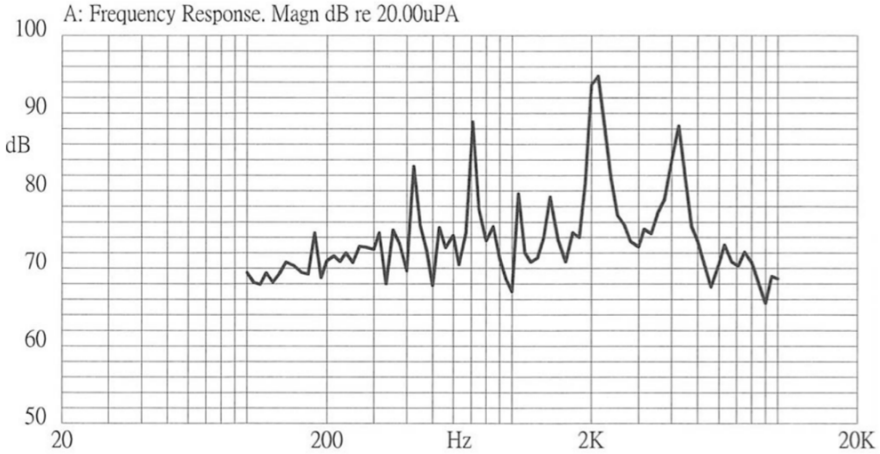
- Operating range of 15 cm to 645 cm
- Pulse Width to calculate distance
- Obtains readings by pulling trig(RX) pin high



Ultrasonic Sensor R&V



Beeper - CEM-1203(42)

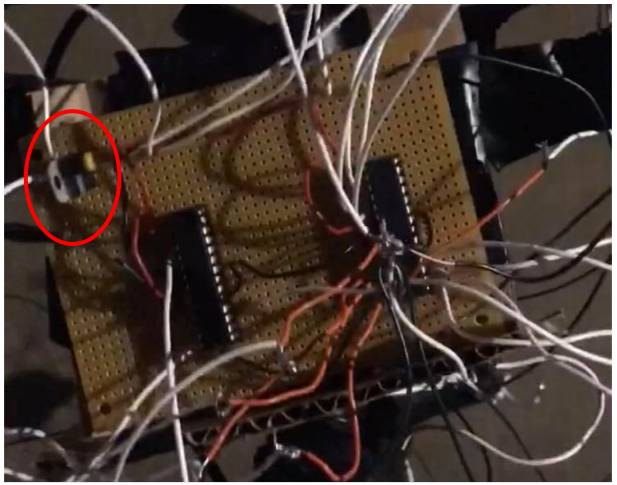


Frequency Response Curve

- Beeper to notify user
- Varying frequencies based on distance
- Continuous beep if alerted by ultrasonic sensor

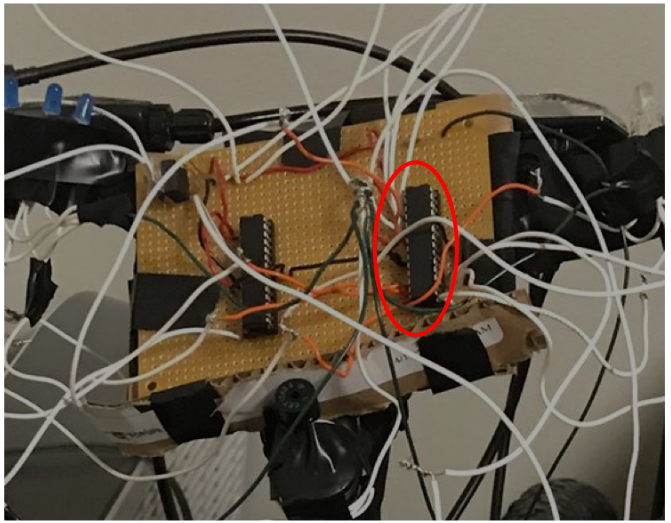
Power Supply (Voltage Regulator)

- Outputs 5V regardless of input voltage
- Powers microcontrollers and ultrasonic sensor



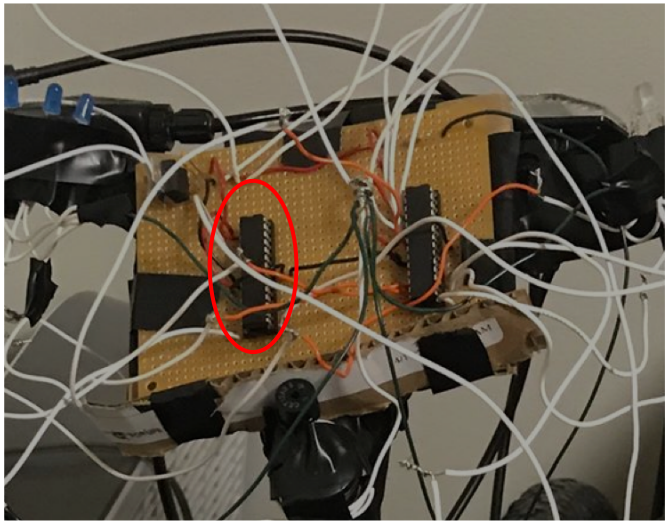
Primary Microcontroller

- Receives data from application and speedometer microcontroller
- Calculates distance traveled (from speedometer data)
- Sends signals to LEDs and buzzer
- Communicates with ultrasonic sensor

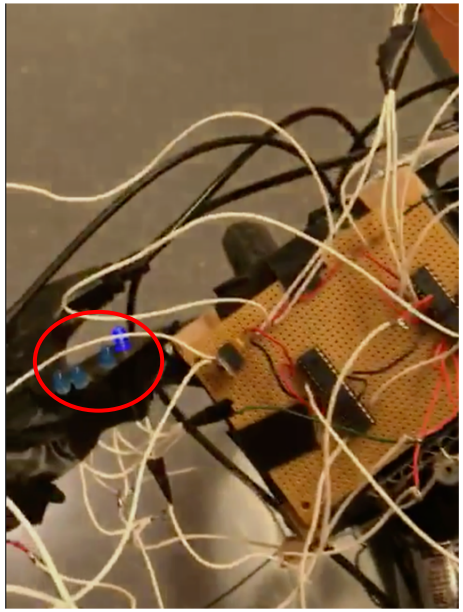


Secondary Microcontroller

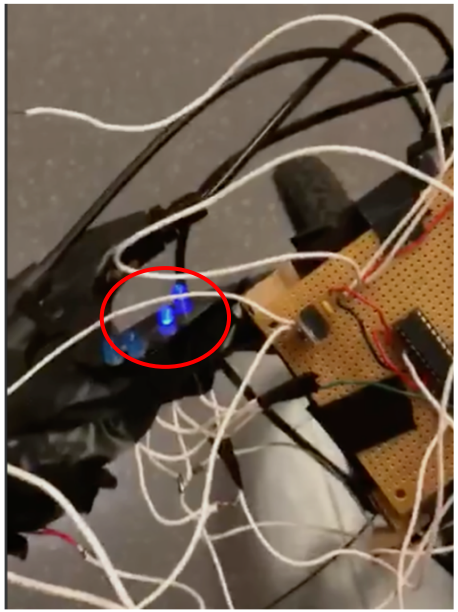
- Calculates speed
- Send revolution count to primary microcontroller via I2C protocol
- Control logic for blinkers



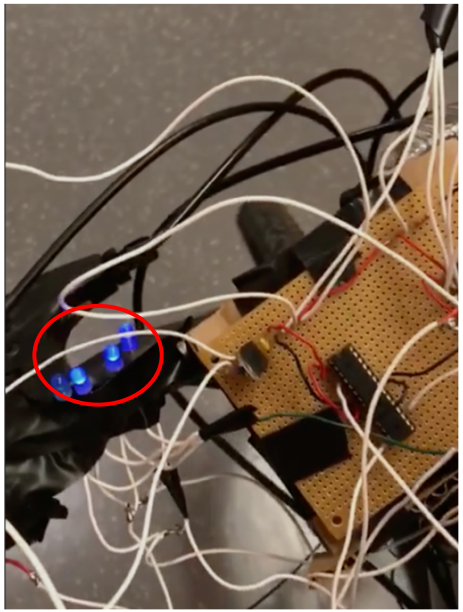
Lab Test (Left Turn)



Distance: 44 m

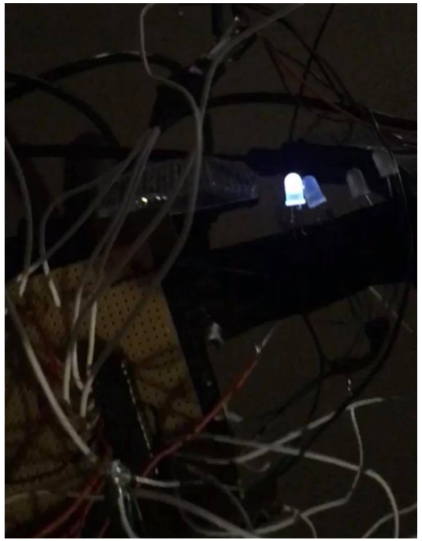


Distance: 35 m

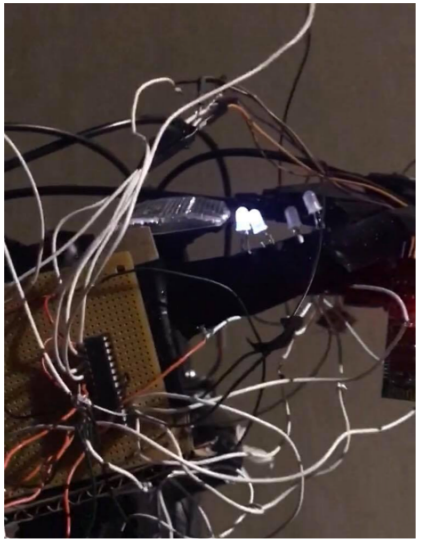


Distance: 21 m

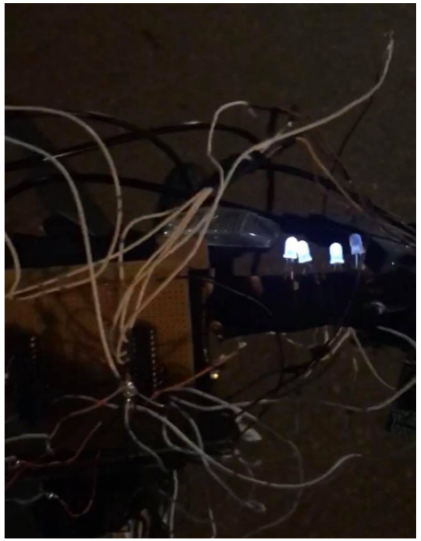
Road Test (Right Turn)



Distance: 42 m



Distance: 37 m



Distance: 24 m

Latency

- Application to Bluetooth Communication: 2 ± 0.260 seconds
- Google Maps Directions API: 0.031 seconds (median)
- LEDs insignificant
- Beeper: insignificant

Total Latency: 2 ± 0.291 seconds

Challenges

- PCB design
- GPS signal strength
- Bulky circuit and wiring
- Delicate components
- Sensitivity of ultrasonic sensor

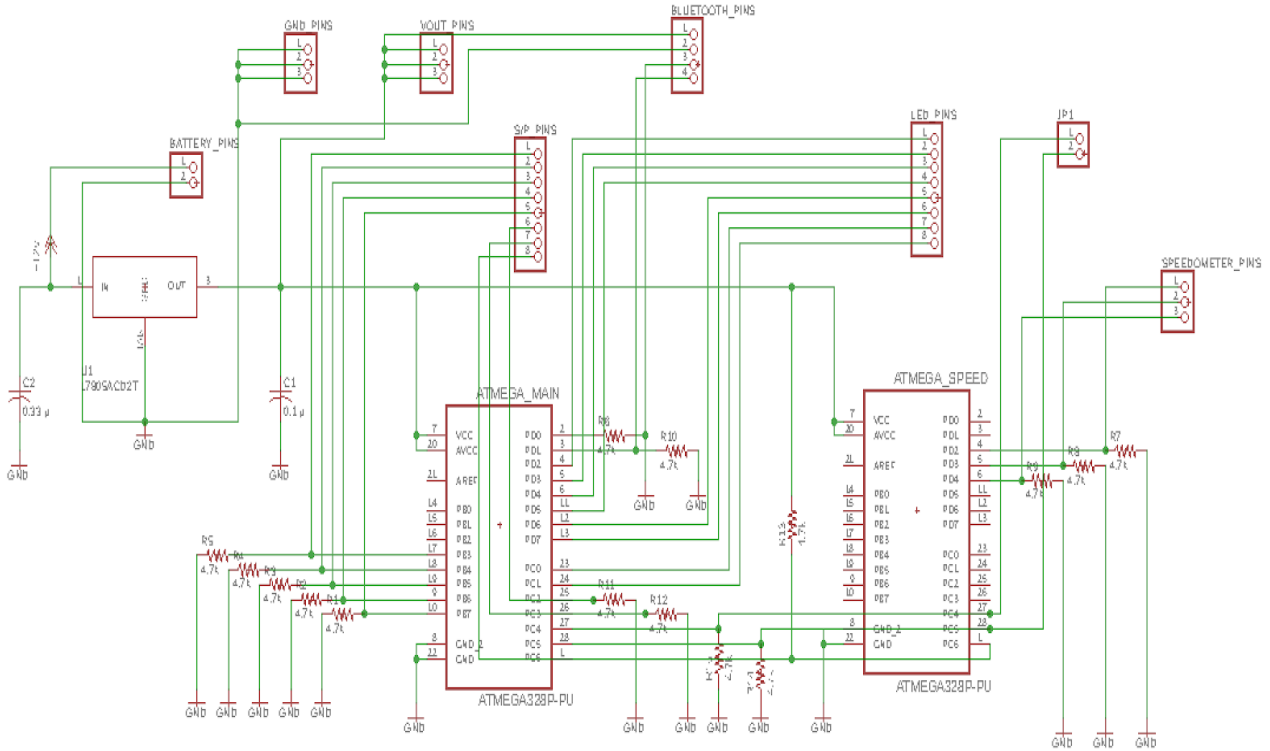
Next Steps

- Develop compact circuit
- Partner with bike sharing services
- Partner with bike manufacturing companies
- Sell as standalone mountable product

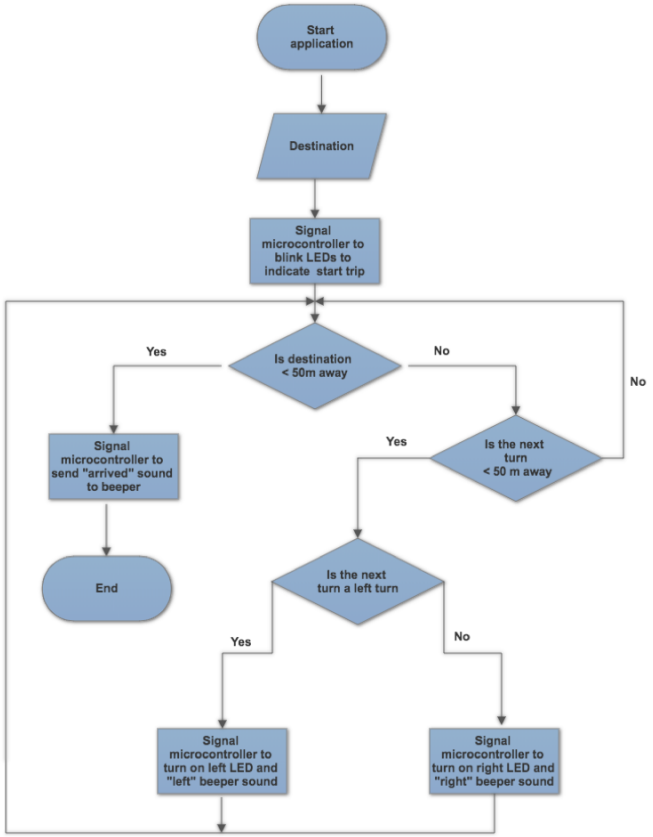
Thank You!

Appendix

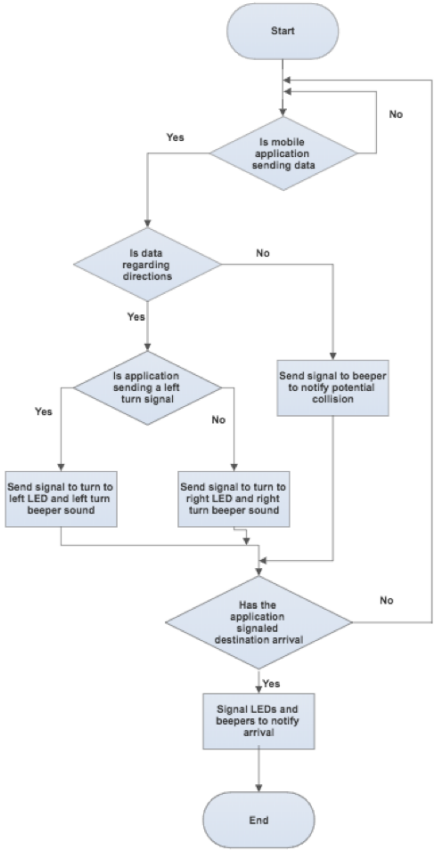
Project Circuit Schematic



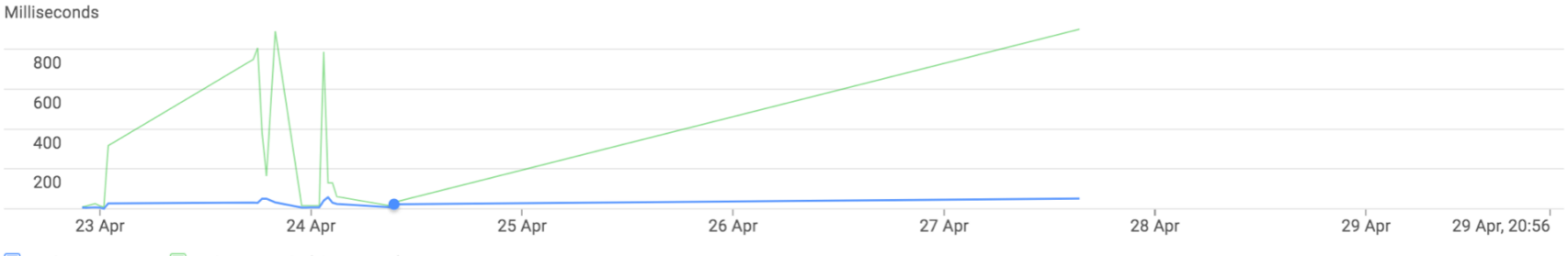
Application Flowchart



Microcontroller Logic



Google Maps Directions API Latency



Latencies	Latency, median	98th percentile (slowest 2%)
	31 ms	295 ms