

Illumvmnt

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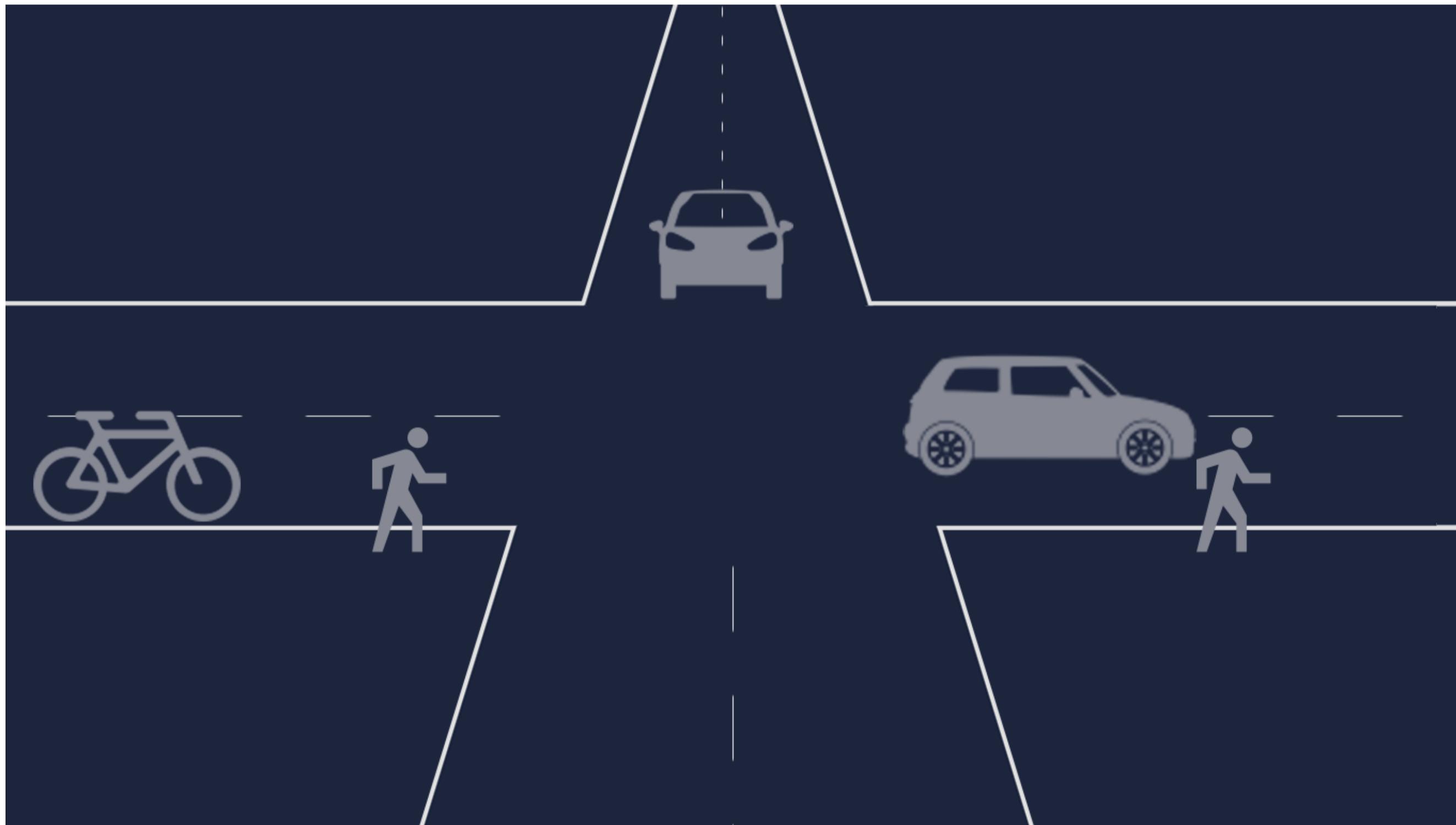
THE CITY OF EDINBURGH COUNCIL



THE UNIVERSITY
of EDINBURGH

IoT Challenge Stream- Mobilization

Introduce a new way to track and improve mobilization of vehicles, bicycles, and people using smart technology.



Initial Research

What technology already exists?

- 1) Monitoring traffic congestion using smart phone congestion¹
- 2) Street lights that detect approaching cyclists, CCTV cameras that identify unusual activity, and bus stops that count²
- 3) Google Maps
 - Visualizes congestion using red, yellow, and clear areas
 - Provides alternate routes to take
 - Provides data on driving, public transit, and walking times
- 4) Smart Lighting
 - Automatic lights that detect movement

¹<https://www.linkedin.com/pulse/smart-city-iot-applications-traffic-congestion-phone-curtis>

²<https://www.theguardian.com/public-leaders-network/2015/mar/31/internet-of-things-revolutionise-council-services>

Questions Asked

- 1) How can we use IoT to reduce traffic congestion?
- 2) **How do we measure the difference between a car, a bicycle, and a person? (i.e. speed, temperature, shape, etc.)**
 - a) Consider that a car stuck going slower in traffic, could be mistaken for a person walking.
- 3) **Is there a way to use existing technology, i.e. smart lights, to alert users to different kinds of movement?**
- 4) Is it possible to nudge existing patterns of movement through positive or negative reinforcement?
- 5) Do you want people in space knowing that you are collecting data about their mobility habits?
- 6) Will the solution differ between night and day?



Target



Bicyclists



Vehiclists

Personas

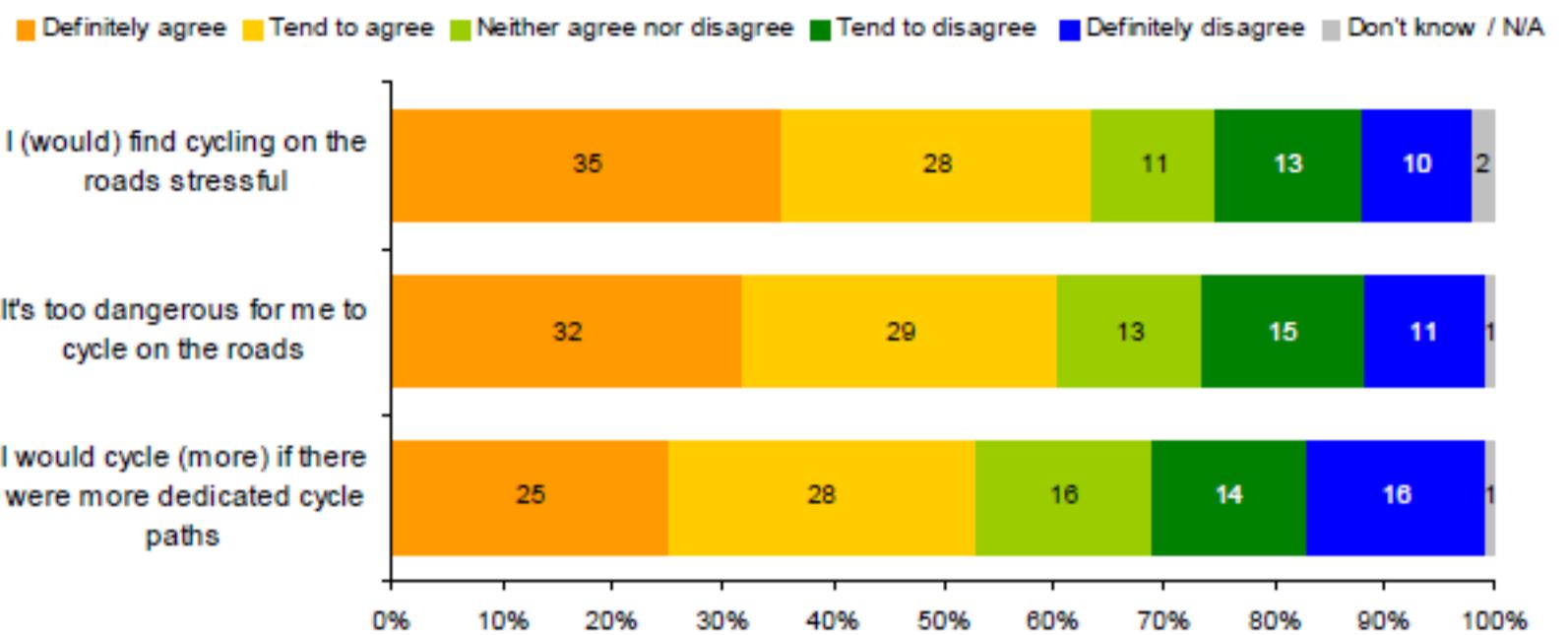
User Research

An overwhelming amount of evidence gathered through research indicates that **bicyclists feel unsafe on the roads.**

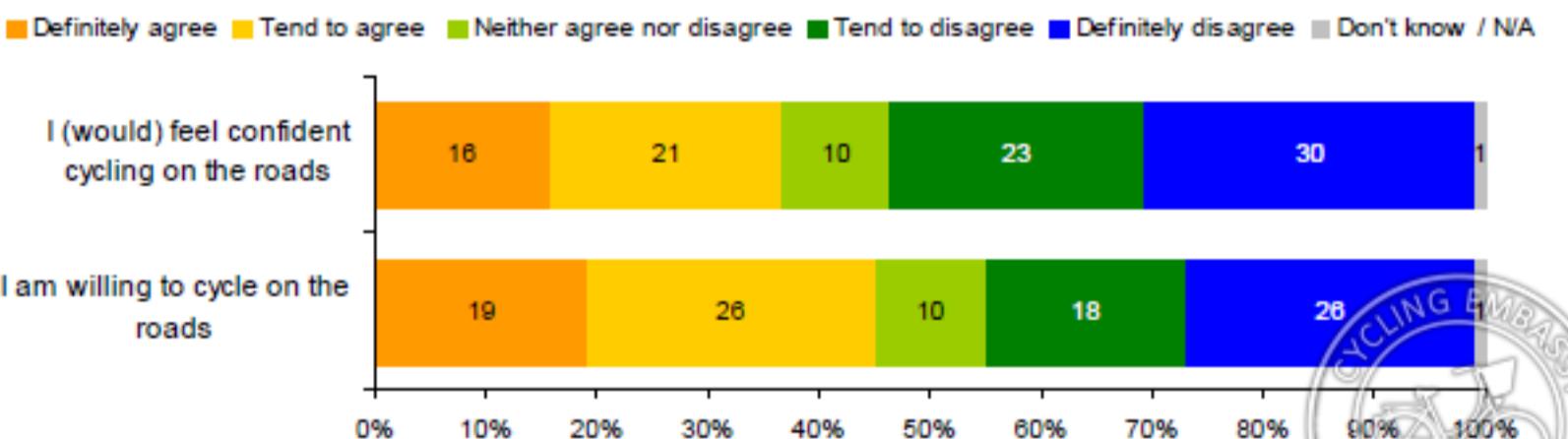
“... the main barrier to cycling in this country [United Kingdom] is the perception that our roads are too dangerous and uncomfortable, largely due to high volumes and high speeds of motor traffic.”¹

Figure 5.1. Attitudes towards cycling and safety

(i) Negatively phrased statements



(ii) Positively phrased statements



Base: All who can ride a bicycle / do not find it impossible due to disability or health problem (3,155)

¹<https://www.cycling-embassy.org.uk/wiki/barriers-cycling>

Cont.

According to a study done on the correlation between reduced street lighting at night and health¹,

*“changes which reduce lighting, particularly ‘switch off’ and part-night lighting in urban areas, have attracted considerable public and media concern, centring on crime, fear of crime, perceptions of safety, and road safety.”*²

¹Green, Judith et al. “Reduced Street Lighting at Night and Health: A Rapid Appraisal of Public Views in England and Wales.” *Health & Place* 34 (2015): 171–180. PMC. Web. 24 Feb. 2017.

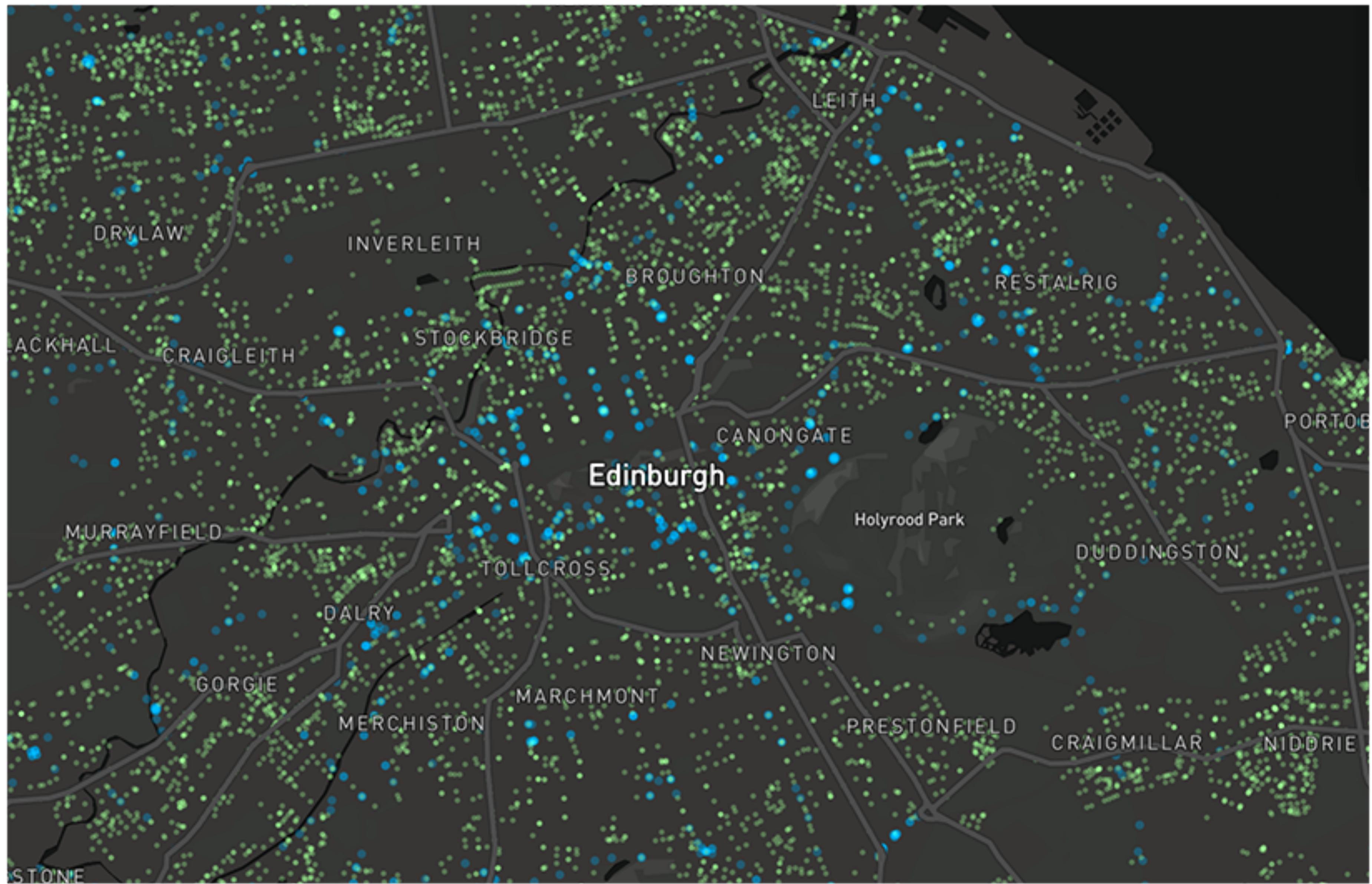
²<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4509526/>

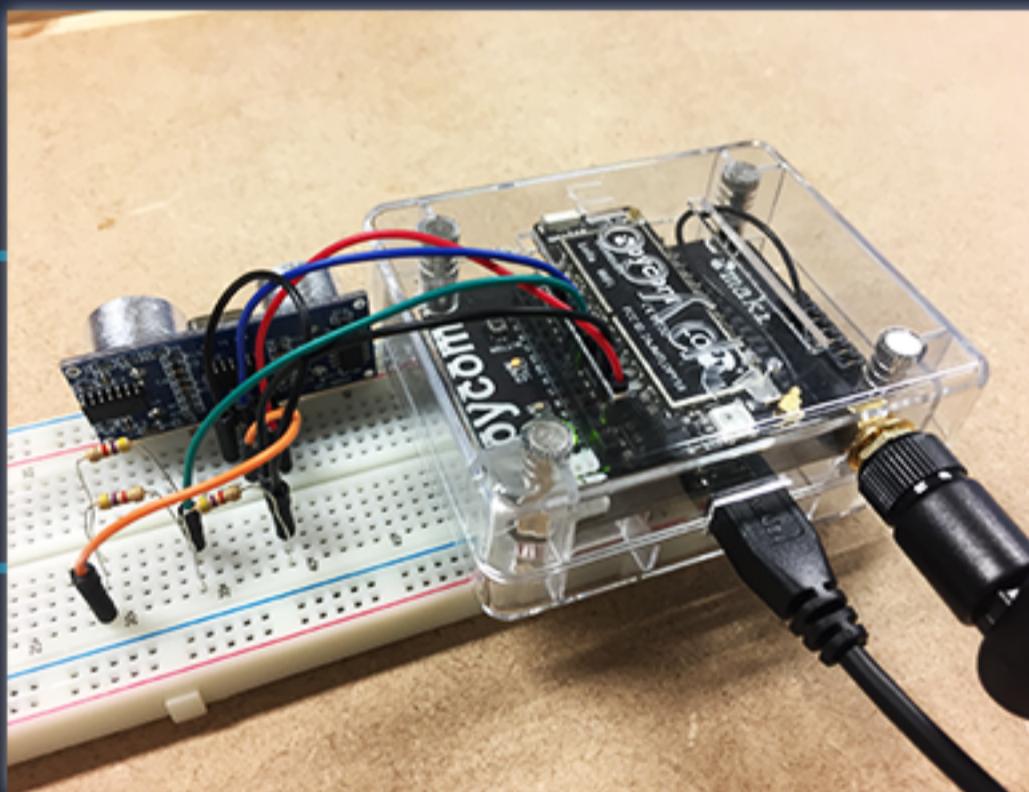
Our Goal

We have decided to focus our attention on making the roads safer at night for bicyclists and pedestrians by using smart technology to generate paths of light through motion detection.

The lights will not only help bicyclists and pedestrians will be able to see more clearly, but also inform car drivers about the presence of them.

We aim to work with the city to provide a solution that is in line with their efforts to remain energy efficient. Our lighting solution is optimal because of its ability to work only in the presence of pedestrians and bicyclists, reducing the need for permanent illumination.

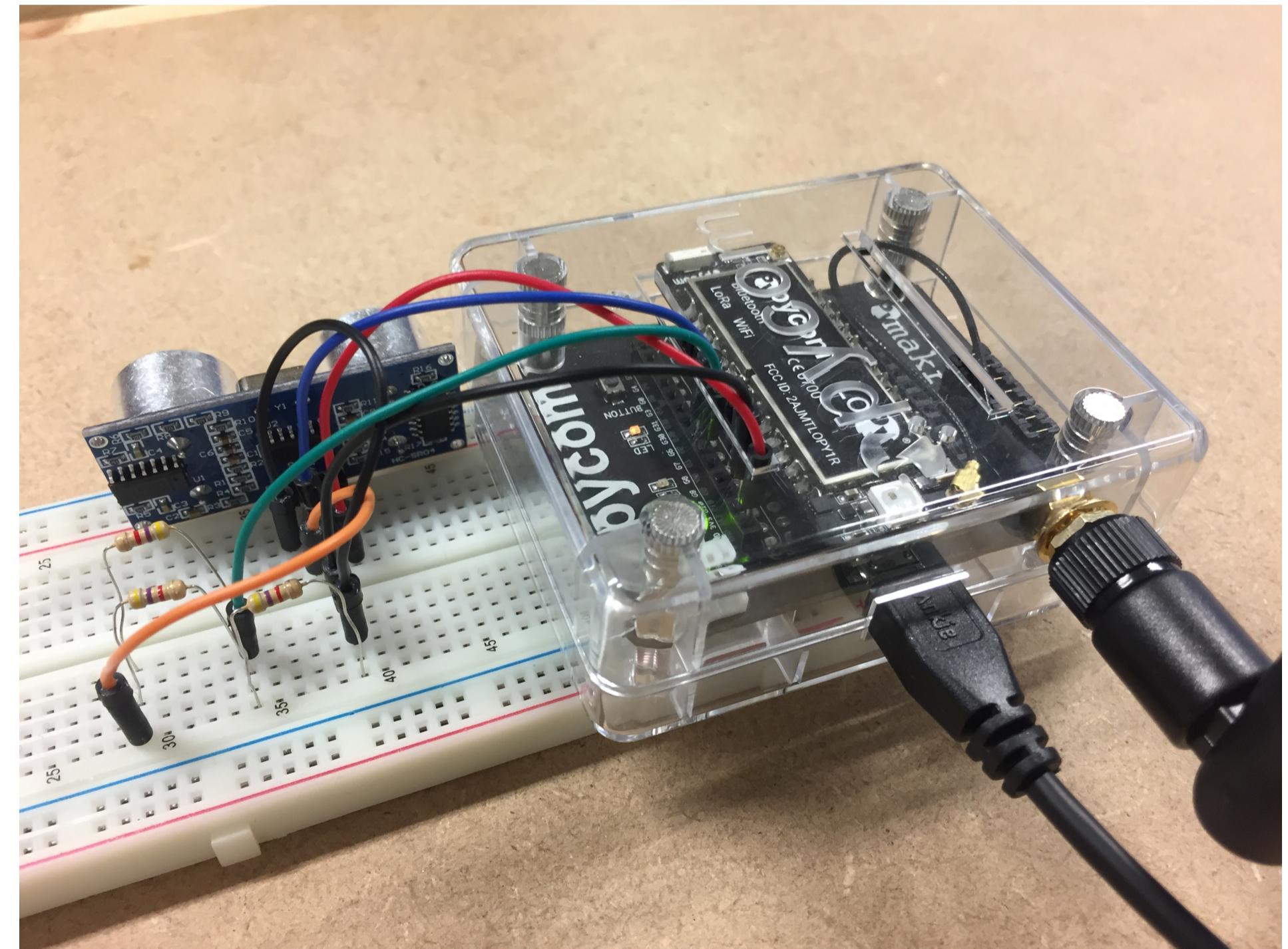




Each box signifies one of the sensors which will be placed a specified distance apart.

Ultrasonic Distance Sensor

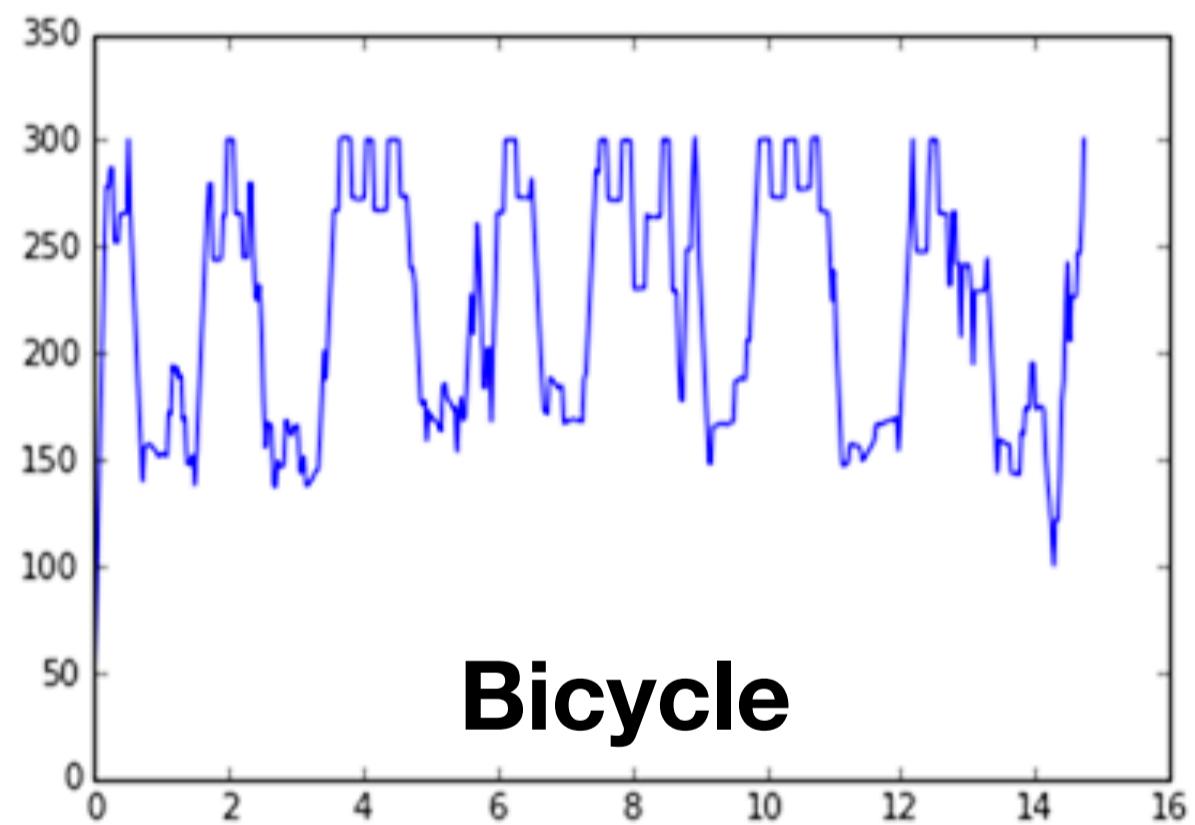
- Our intention is to use this sensor to distinguish between bicyclists and pedestrians on the road.
- If you look at a bicyclist and a person from a profile view they will appear different; **the sensor is also able to detect this difference in shape.**
- Ideally, we would like to use higher frequency sensors in order to measure differences more accurately.



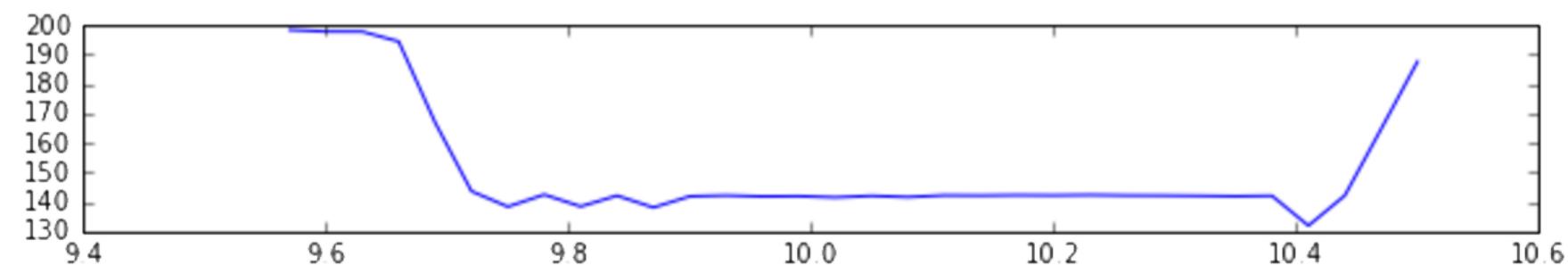
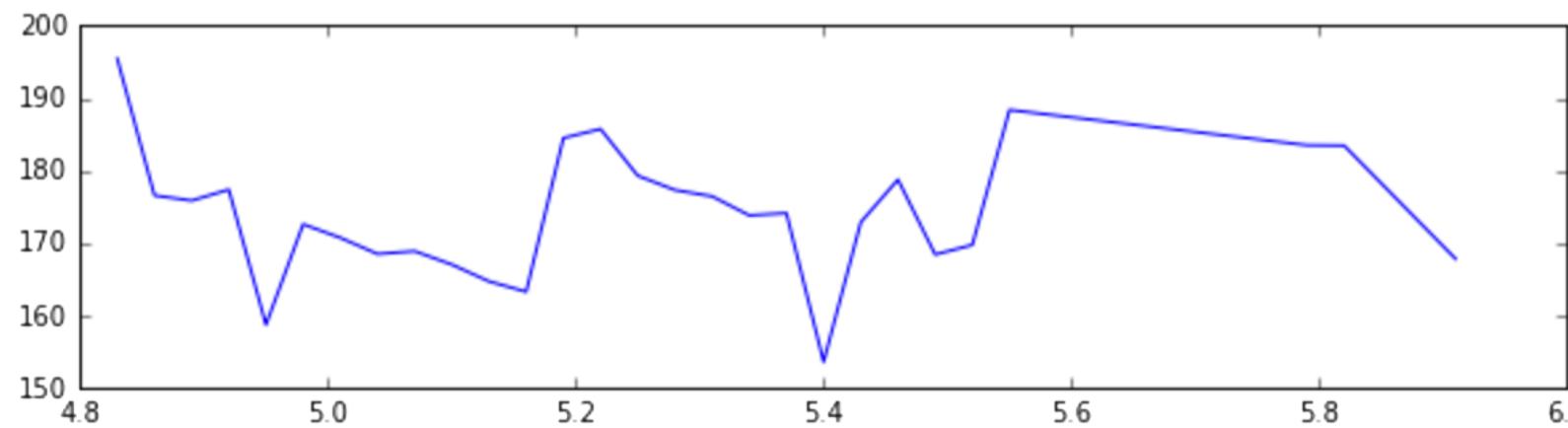
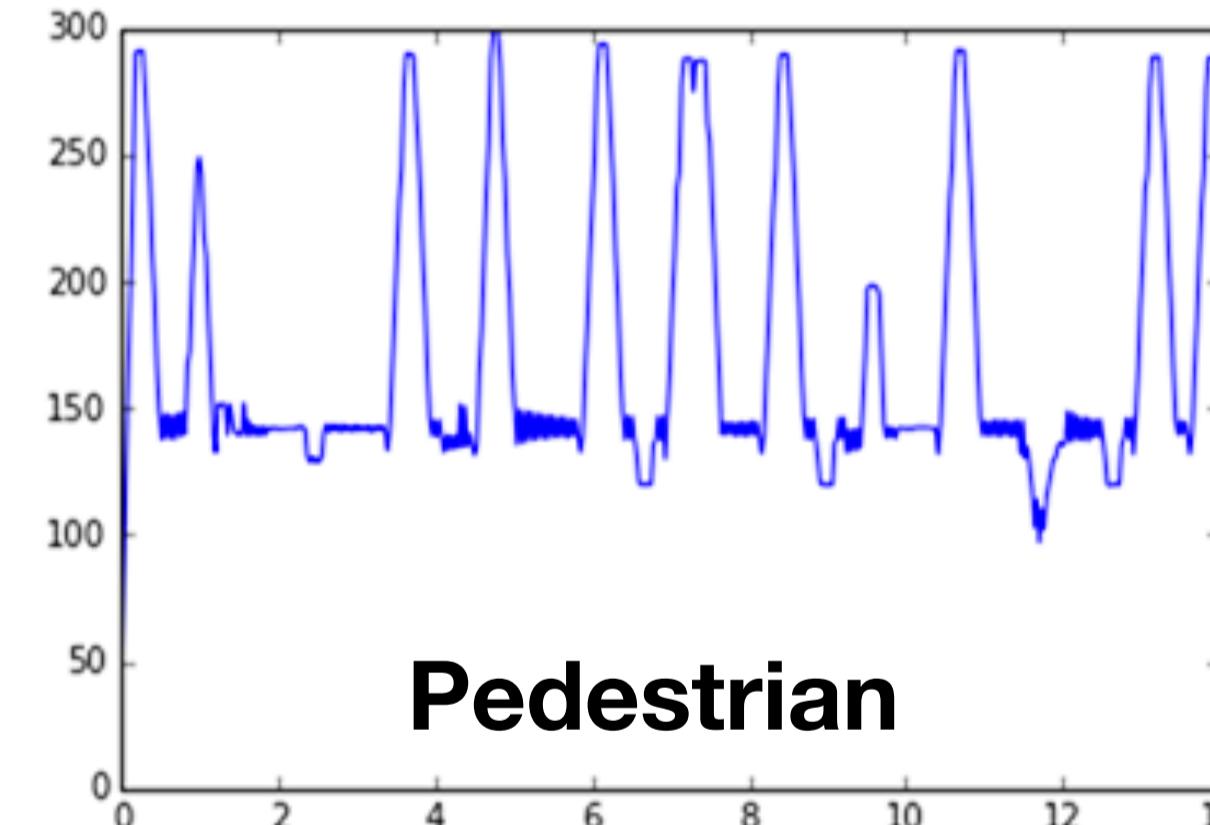
Data Collection

<https://github.com/ondrejbohdal/iot-challenge-flow>

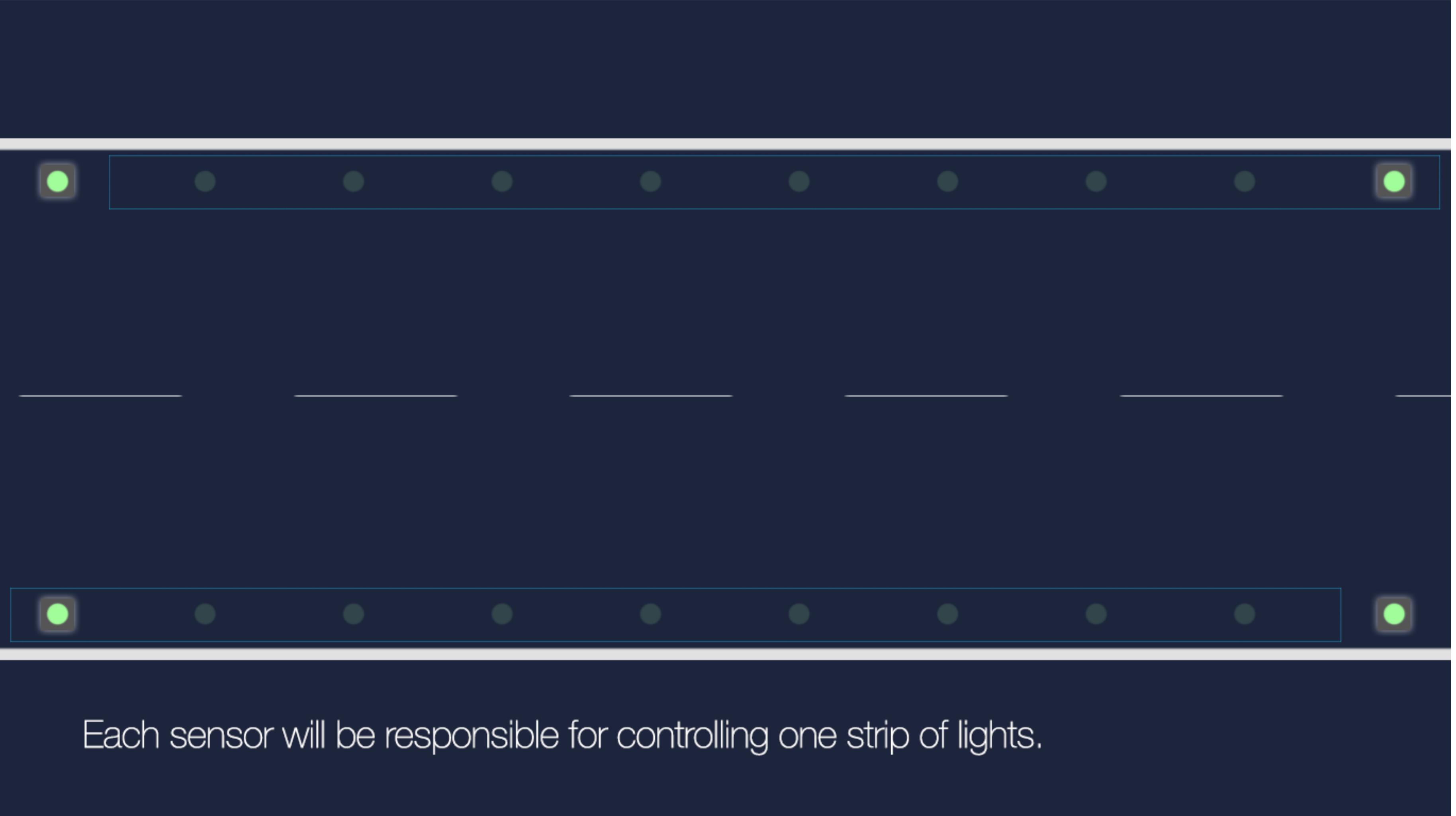
- We measure the distance of the object in front of the sensor over time using an ultrasonic distance sensor. We repeat the measurement every 0.03 seconds. Based on how the distance varies over time, we decide if it is a bike or a person.



vs.



Demo Time



Each sensor will be responsible for controlling one strip of lights.



As part of an effort to conserve energy throughout the city, the lights on the street will remain primarily off until a passing movement is detected.



> > > > > > >



The lights will be signalled to turn on gradually based on the distinguishing profile and speed of either a bicyclist or pedestrian. A new path will light the user's journey.

Current

- Realtime Python distance measurement
 - Noise filters
 - Noise cutoff
- Offline analysis
 - Kmeans clusters
 - Variance classification

Potential for More

- This project would benefit from the use of additional sensors.
 - Infrared sensor
 - Weight sensor
 - Digital signal processor
- Realtime X-means clustering
- Classification
 - Decision trees
 - Neural networks
 - Additional data on the profiles of bicyclists/ pedestrians

Thank you!