Detecting and Modeling People Using Bluetooth

Cameron Devine – Computer Engineering Undergraduate
Nicholas Kirsch – Faculty Advisor – Connectivity Research Center
Electrical and Computer Engineering, University of New Hampshire, Durham, NH 03824

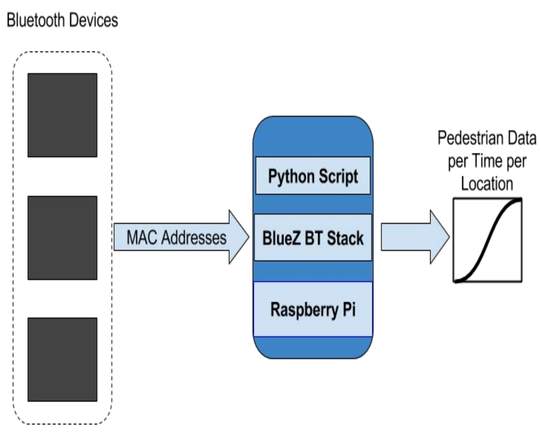
Purpose

- To make transportation more efficient and safe
- Tracking pedestrians vital piece of information to achieve this goal
  - Design better traffic patterns and traffic management
  - Pinpoint highly traveled areas to cleanup for quicker recovery from storms
  - Avoid densely packed areas for quicker commute

Problem

- Current solutions are power heavy and expensive
- Detecting Bluetooth will solve both of these problems while creating another one
  - Not all Bluetooth devices on a person will be active and detectable
- Conduct experiments to create a probability model
  - Correlate devices and actual population
  - Accurately predict devices per person with high confidence

Design



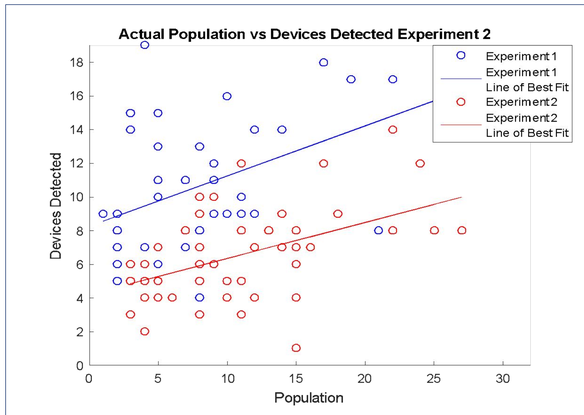
Experiments

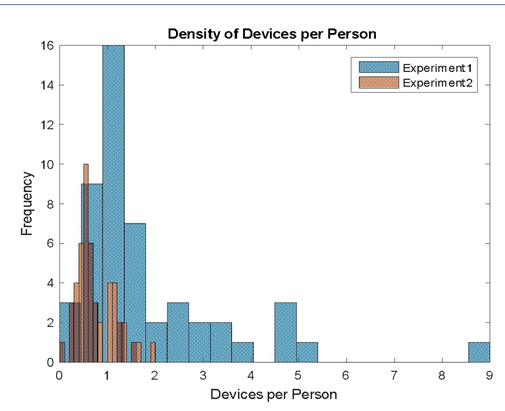
- Conducted in front of Thompson Hall at the intersection of Garrison Ave. and Main St
- Two experiments of 50 samples each
  - Count devices every minute for 30 seconds
  - Keep unique addresses and return the count
  - Compare the devices to the actual amount of people

Experiment Statistics

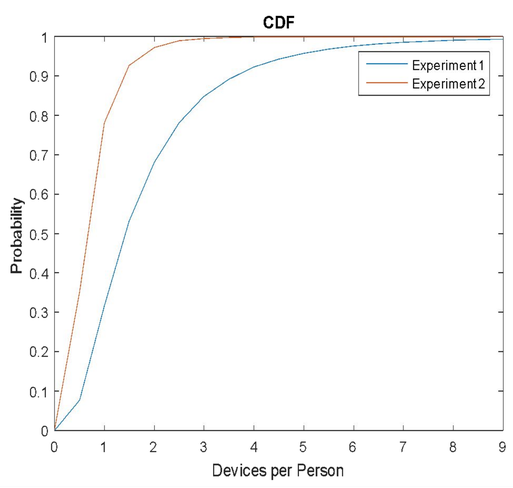
	Devices per Person	
	Experiment 1	Experiment 2
Mean	1.86	0.74
Median	1.22	0.62
Standard Deviation	1.61	0.41
Correlation Coefficient	0.49	0.48

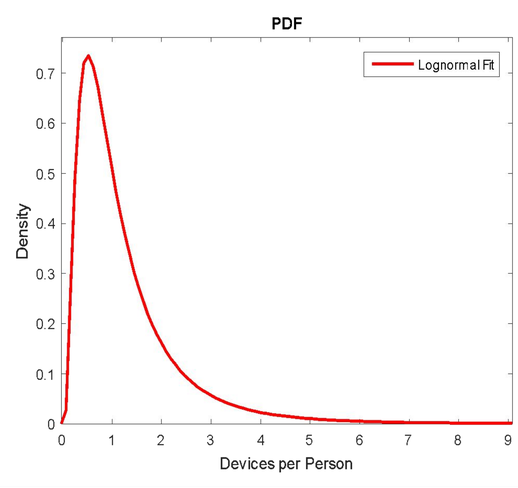
Plotted Data per Experiment





Device Detection Analysis





Results

- A lognormal probability distribution can be used to fit the data
  - Chi 2 Goodness of fit test proves a good fit to use
- One device equals one person around 50% of the time
- 1.5 devices as an upper bound can predict the amount of people around 80% of the time with 90% confidence level
  - More confident prediction than one for one relationship

Conclusions

- Detecting Bluetooth devices can be used to predict the amount of people in an outdoor space
- A strong probability model can make predictions more accurate
- Deployment around a city can now have extended battery life
- Connecting this device to a low powered network would allow information to be collected for analysis of foot traffic in a city

Future Work

- Upgrade to a lower power module that supports Bluetooth
- Use LoRaWAN to connect to a server
- Use this probability distribution to give real time predictions of population to users
- Widescale deployment across Durham

Acknowledgements

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