CROWDSENSING: A MOBILE NOSE

{ Eric Berquist, Kevin Oktavian, Jacky Wang}
ENTREPRENEURIAL CAPSTONE, DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITY OF WASHINGTON

Crowd Sensing

INTRODUCTION

It is difficult to measure pollution level across a large environment. In regions such as the Pacific Northwest, there are only a few towers that are capable of measuring levels of various pollutants. Moreover, these towers are typically large and expensive to construct.

Crowdsensing is a mobile platform for air quality measurement that uses an array of low cost sensors in combination with a server and a mobile phone to produce accurate, geo-tagged pollution information, aggregate from the users. The platform is composed of three main parts: a multi-sensor device, a mobile app and a server.

MULTI-SENSOR DEVICE

The device is composed of three main parts:

- Sensors
- PIC Microcontroller
- The main PCB board that holds all parts together and allows for communication via Bluetooth and Wi-Fi modules

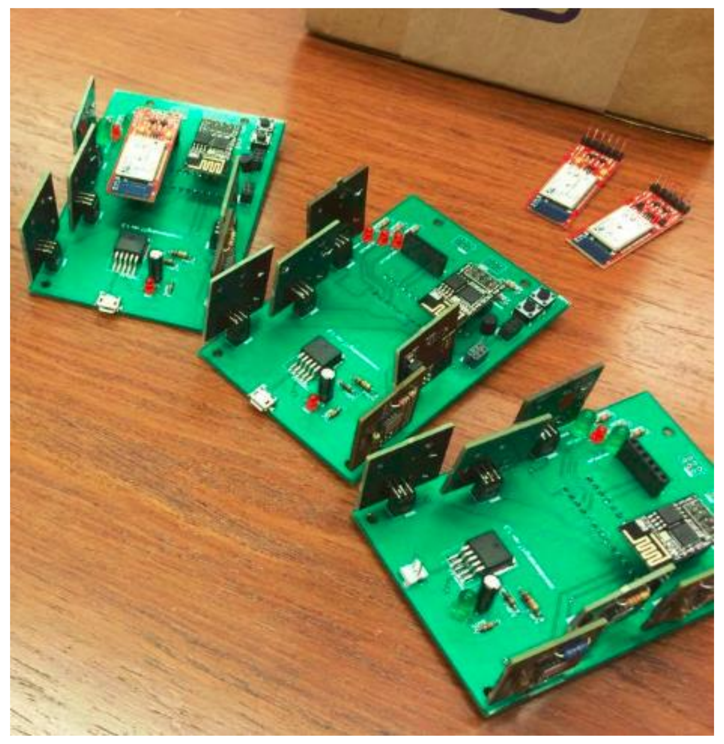

Figure 1: Multi-sensor Platform with PIC

SENSOR MODULES

Several modular sensors were created. Each module is an inch by inch printed circuit board (PCB) with a mounted metal oxide sensor. The sensors are:

- Temperature & Humidity sensor
- Ozone sensor
- Carbon Monoxide sensor
- Nitrogen Dioxide sensor
- Ammonia sensor

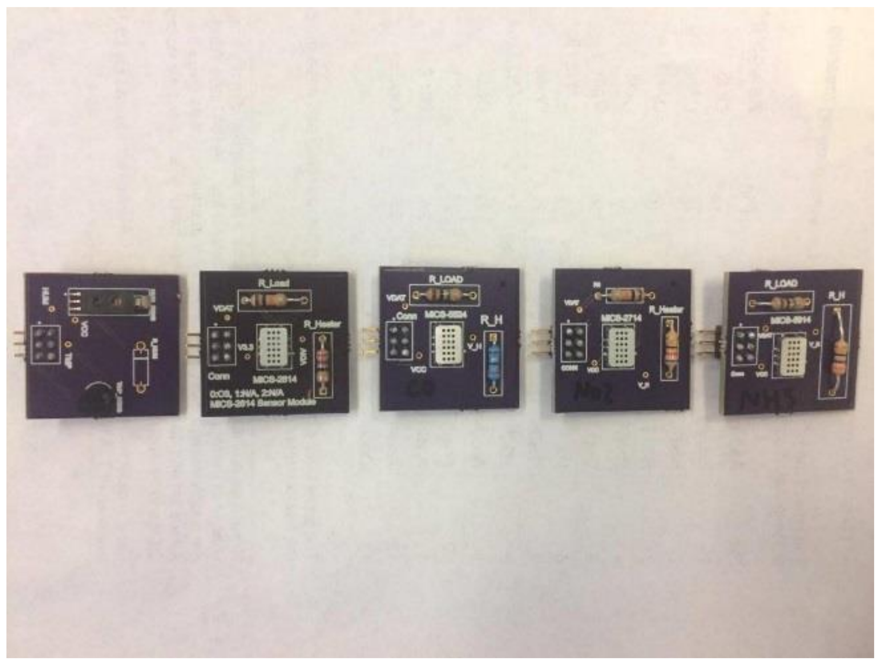

Figure 2: Five Sensor Modules

MOBILE APP

- Built in Xcode environment with Swift
- TCP protocol
- BLE connection to device
- GPS Information

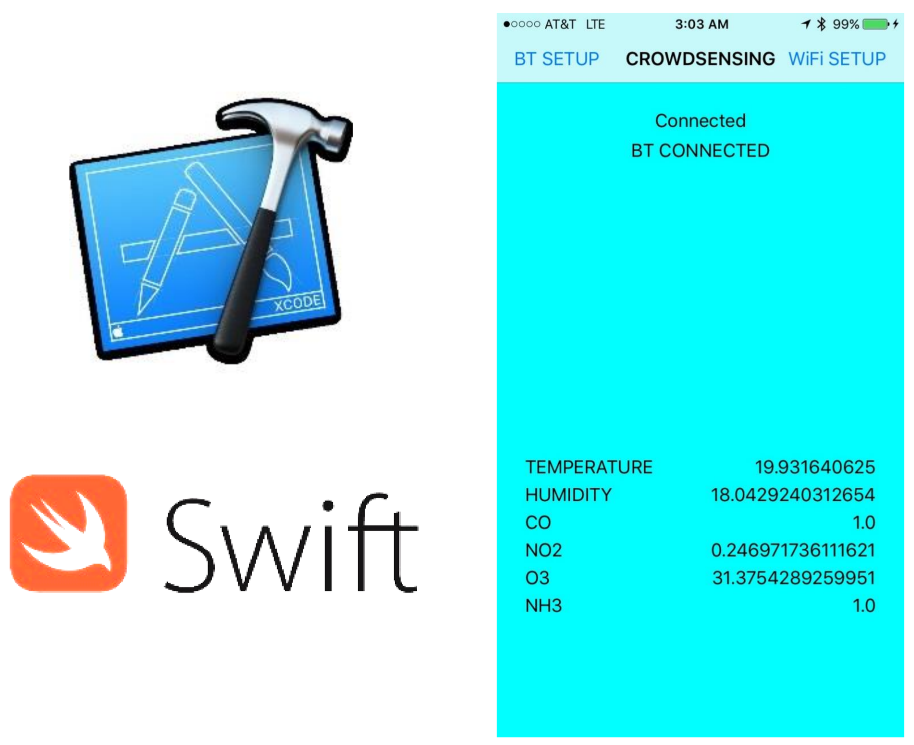

Figure 3: Screenshot of the App

BACKEND SERVER

- Socket server, TCP protocol
- SQLite database
- Live data display

python™

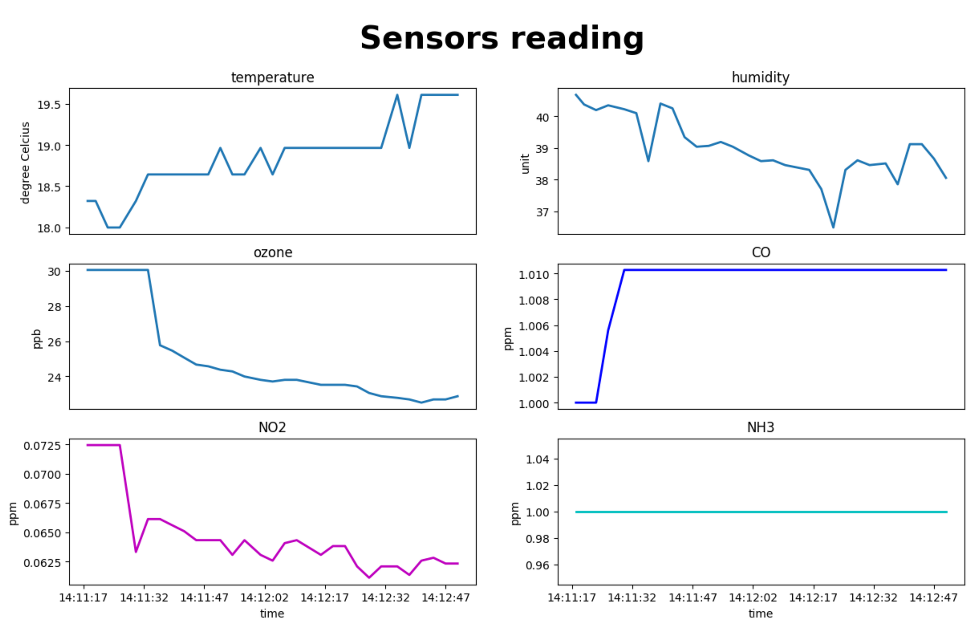

Figure 4: Live Data Display

NEURAL NETWORK

The neural network is trained to recognize four different kinds of chemicals: Ozone, Carbon Monoxide, Nitrogen Dioxide and Ammonia. Figure 5 and 6 show the correlation of input gas to the target gases.

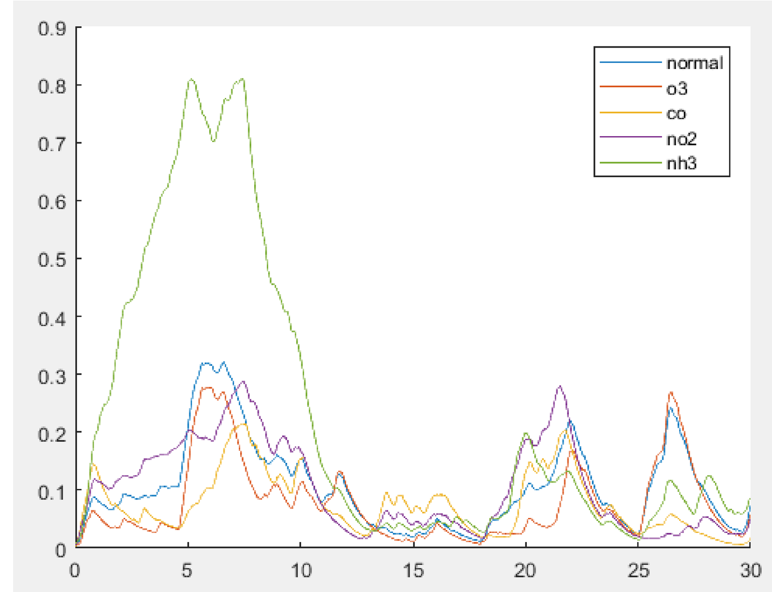

Figure 5: Detection of Ammonia

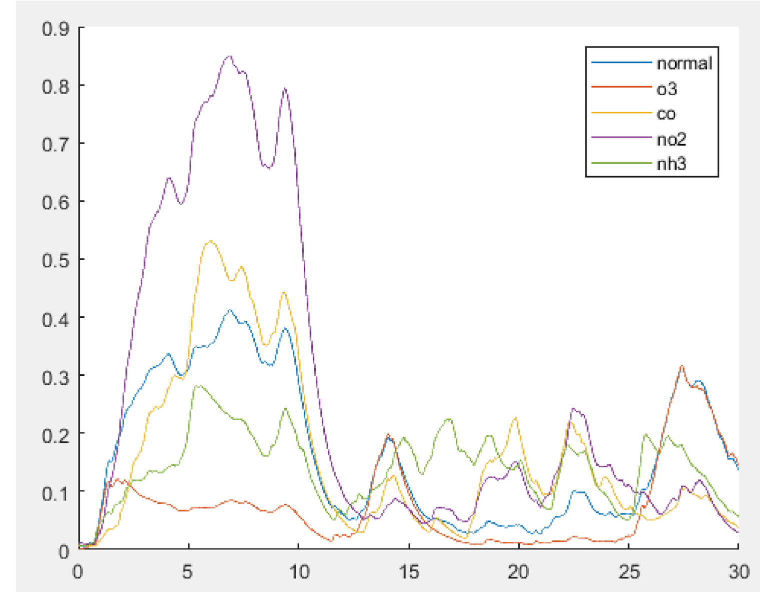

Figure 6: Detection of Nitrogen Dioxide

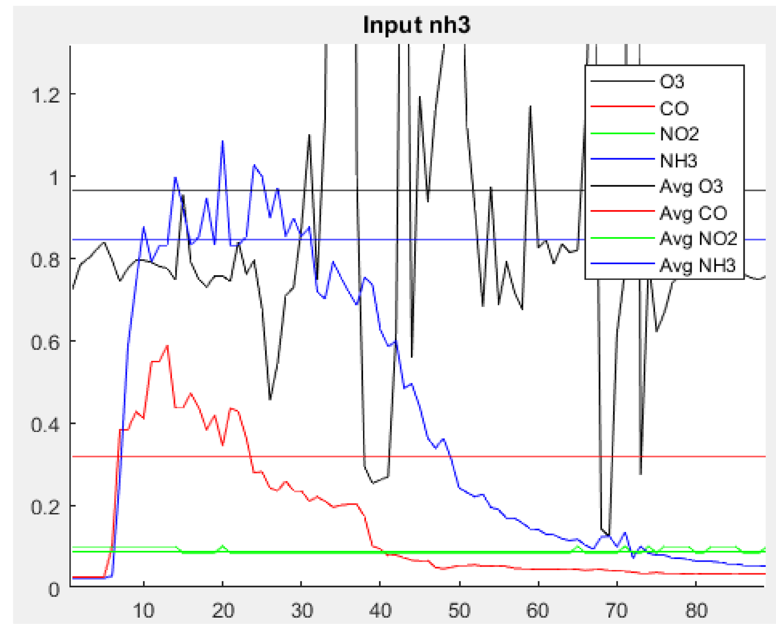

Figure 7: Sensor Reaction to Ammonia

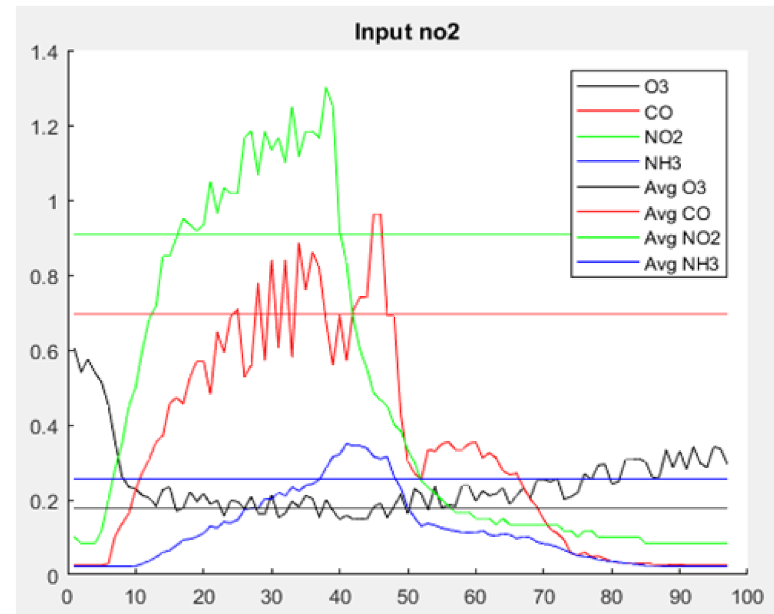

Figure 8: Sensor Reaction to Nitrogen Dioxide

INDOOR TEST RESULTS

Performing device measurements, variation in different gases could be observed under different room conditions.

Location	Ozone (ppb)	CO (ppm)	NO2 (ppb)	NH3 (ppm)
EE Lab	20	1	0.05	1
EEB Atrium	22	1	0.07	1
Restroom	20	1.017	0.07	1
C5 Parking	25	1.5	0.05	1
Bagley Hall	22	1	0.06	1

Figure 9: Indoor Test Results (gas)

- CO concentration is higher in the parking lot
- NO2 concentration is higher in restroom

OUTDOOR TEST RESULTS

Performing single device measurements, variation in CO and NO2 could be observed under different environmental conditions.

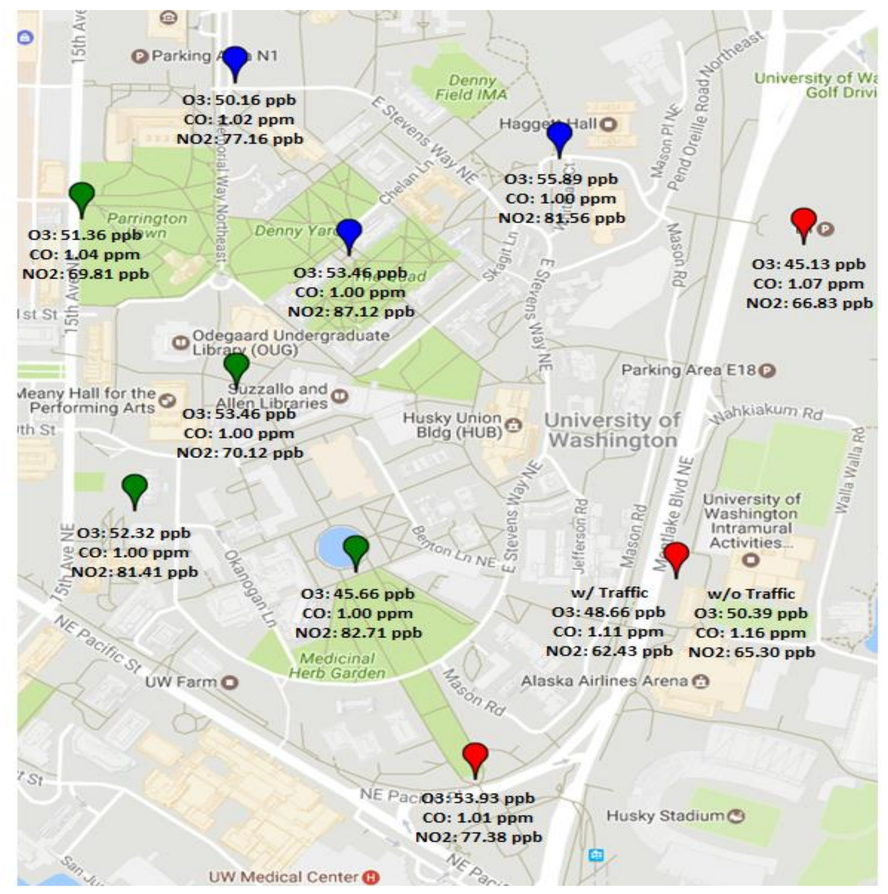

Figure 10: Outdoor Test Results

- CO concentration is higher near roads
- NO2 concentration is higher in tree-line path

ACKNOWLEDGEMENTS

Prof. Eli Shlizerman, UW EE
Prof. Jeff Riffell, UW Biology

FUTURE DEVELOPMENT

- Train neural network to recognize more patterns
- AQI conversion and heat map
- Integrate neural network to the server
- Install solar panels for multi-sensor
- Collect pollution data at different altitudes with UAVs

CONTACT INFORMATION

Eric Berquist: eberq@uw.edu
Kevin Oktavian: kevoo11@uw.edu
Jacky Wang: tingyu7@uw.edu