Crowd Sensing

Crowd Sensing aims to create a mobile sensor device for dynamic measurements of environmental air using commercially available products.

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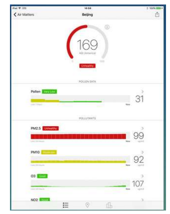
Introduction

- There is a lack of affordable mobile devices able to monitor air pollutants in real-time.
- These devices can potentially detect dangerous chemicals in the air, an ever increasing concern in urban settings.
- Combined with data analytic applications, an integrated IoT system can be created to seamlessly provide instantaneous warnings or provide continuous air quality data for better analysis and decision making.

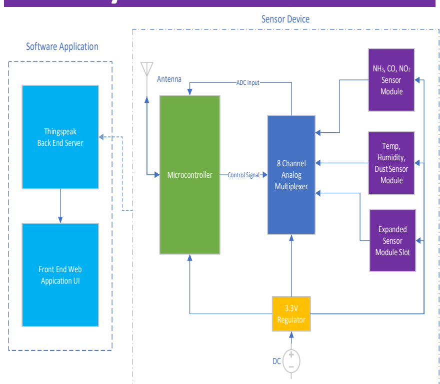


There are existing mobile applications that provide air quality data, but they rely on static sensors. Providing mobile sensors that can be situationally deployed would increase data quality and accuracy.

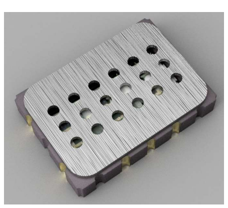
Design Considerations

- Low current consumption: ~500 mA.
- Light and portable: <10X10X3 cm.
- Low cost: <$100 in parts.
- Allow for real time data transmission and processing.
- Initial detection of the following gases: CO, NO2, NH3, and Air Particulates.
- Allow for other gas detection modules.

System Structure



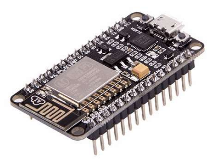
Hardware



Sensor: MiCs 6814

- 3 in 1 Sensor: Reducing Gases, Oxidizing Gases, and NH3.
- Metal Oxide Variable Resistor – outputs different levels of electrical resistance based on gas concentration.
- Detects CO: 1-1000 ppm
  NO2: .05-10 ppm
  NH3: 1-500 ppm
  and other gases.

Hardware (continued)



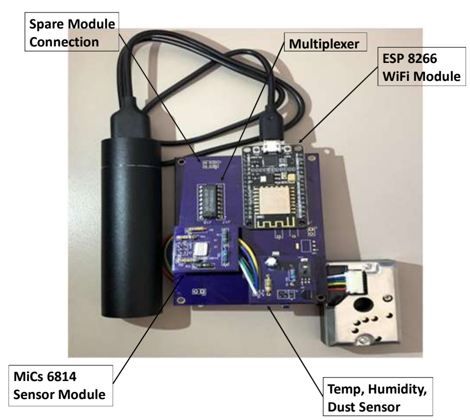
MCU/WiFi:
ESP8266 NodeMCU

- Open source.
- Widely manufactured.
- Arduino compatible.
- Capable processor.
- Low cost.

Other Hardware and Components

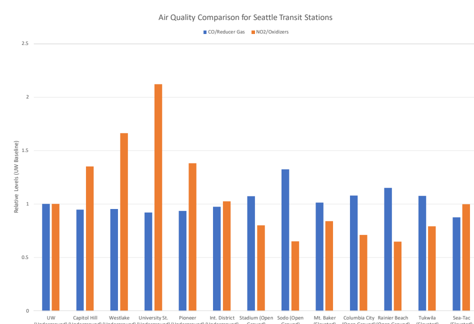
- Multiplexer: ON Semiconductor MC14051B.
- Dust Sensor: SHARP GP2Y1010AU0F.
- Temperature Sensor: Analog Device TMP37FT9Z.
- Humidity sensor: Honeywell HIH-5030-001.
- Power supply: Anker 3350 mAh Battery.
- Generic Resistors and Capacitors.
- Customized Printed Circuit Boards (PCB).
- GPS Logger Android application.
- Thingspeak.com commercial web application.

Prototype



Demonstration of Concept

Not all Seattle Light Rail Stations are the same.

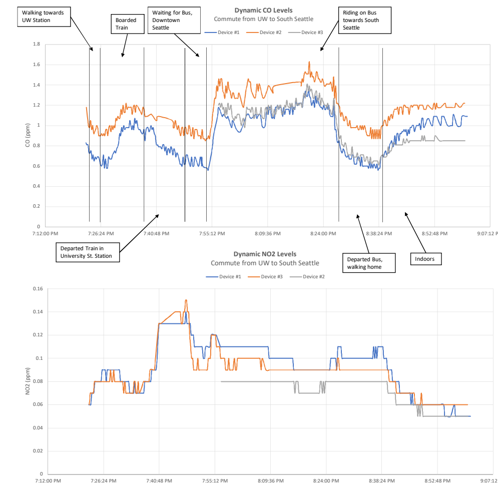


- Three sensor devices were carried across various Light Rail Stations in Seattle for monitoring.
- Air quality data was recorded by the sensor and transmitted to thingspeak.com.
- Relative gas concentration values were averaged across all three device over a period of several minutes with the UW Station serving as the base reference.
- Results showed that underground stations centering around downtown have abnormally high levels of NO2, with the University St. Station having the highest levels, more than 2X the concentration at the UW station.
- CO levels were roughly the same across the stations, with the exception of the SoDo Station, which showed ~1.3X the base level.

NYC Times Square is observed to have 4X greater CO levels than Olympic National Park.

	CO (ppm)
Times Square	3.9
Olympic National Park	<1

Dynamic response of air quality levels during everyday commute.



- Gas concentration measured while commuting from UW to South Seattle via Seattle Light Rail and Transit Bus.
- Results show CO levels increase while in train and bus, NO2 levels lower indoors.

Further Improvements

- Optimized integrated hardware circuit to include better power distribution and space efficiency.
- Improve MiCs-6814 circuitry for better performance.
- More precise calibration needed for detection accuracy.
- Find and incorporate newer/better gas sensor technology, including an Ozone sensor.
- Integrated GPS module.
- Fully integrated IoT system with feedback control.
- Develop mobile application for better data presentation.

References

- SGX SENSORTECH MICS-6814 Datasheet.
- NodeMCU Documentation.
- Air Quality Image from Air Matters Mobile App.

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