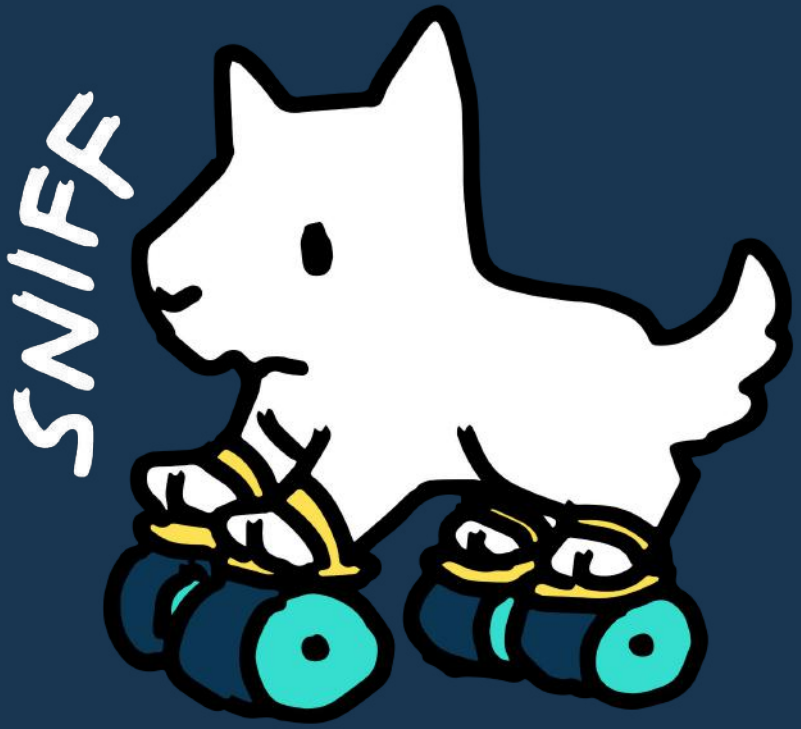
sniff
pittsburgh

Design Presentation

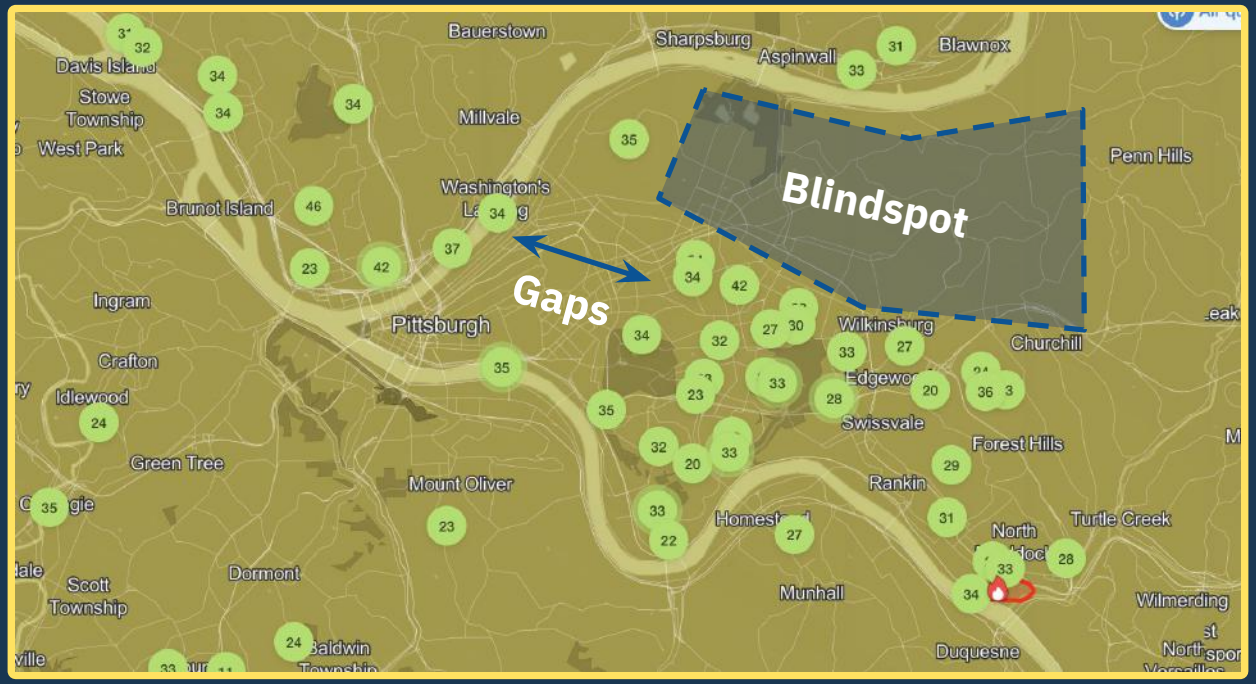
John Alacce, Stella In, **Jaehyun Lim**

- Portable air quality monitoring device on POGOH bikes
- Fills in gaps in coverage in Pittsburgh Air Quality Maps



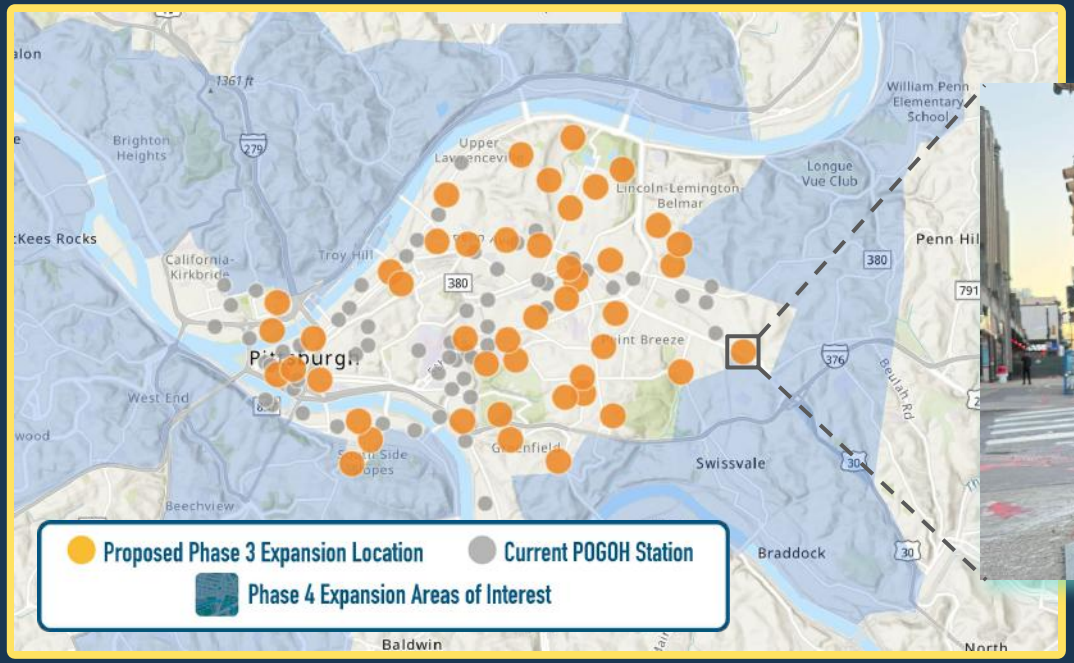
logo by **stella in**

Problem: Air Quality Blind Spots

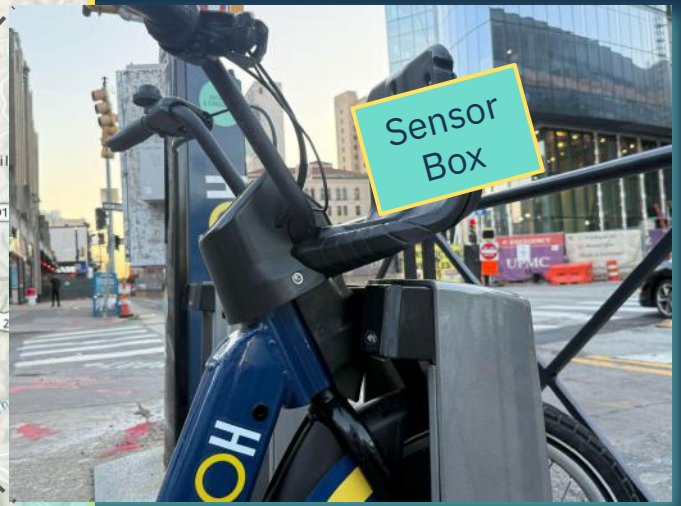


1. Gaps between stations 2. Large swaths of blind spots

Solution: Massively Mobile Air Quality Sensors

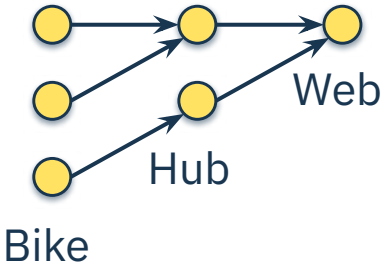


POGOH Website



📸: Stella In

POGOH Bike Network



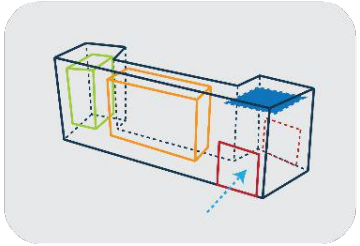
sniff
Station Hub

sniff
Sensor Box

All images from POGOH Website

Introducing

sniff visor



3D Model

Air quality suite lives in a cavity regulated by dams.

Accelero-meter & GPS

I2C

UART

Battery

5V

GPIO

Raspberry Pi 4

GPIO

I2C

LoRa Node

I2C

Antenna

PWM

Servo

Air Quality Sensors

Dam Door

Visor goes in front of the basket, so basket remains usable.

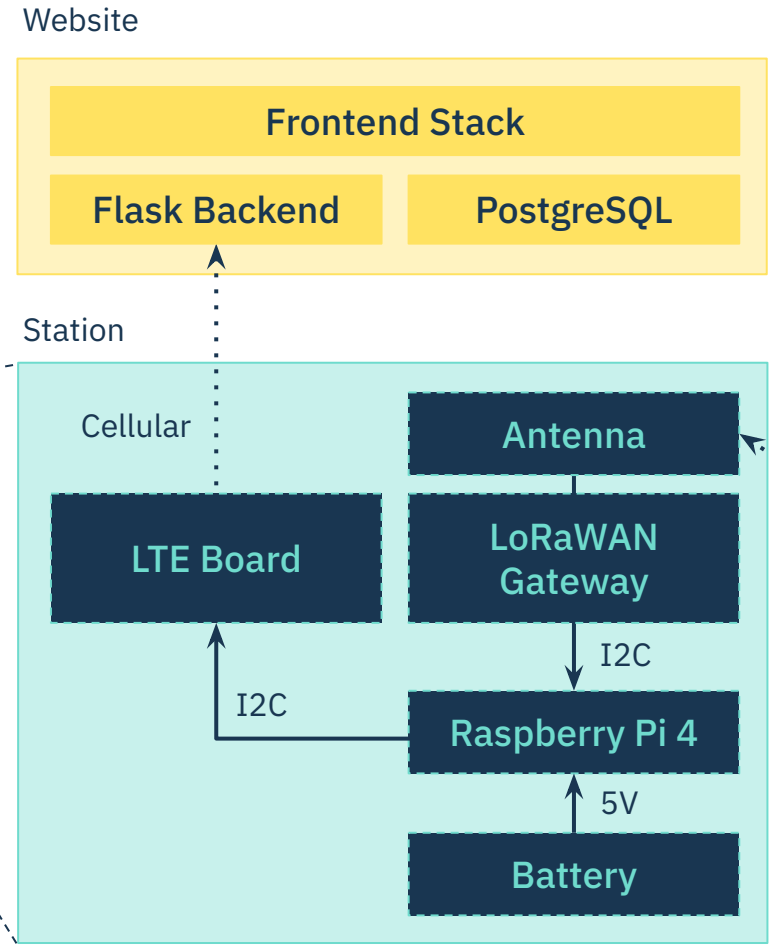
Bike lights are unobstructed.

Mesh blocks outside debris

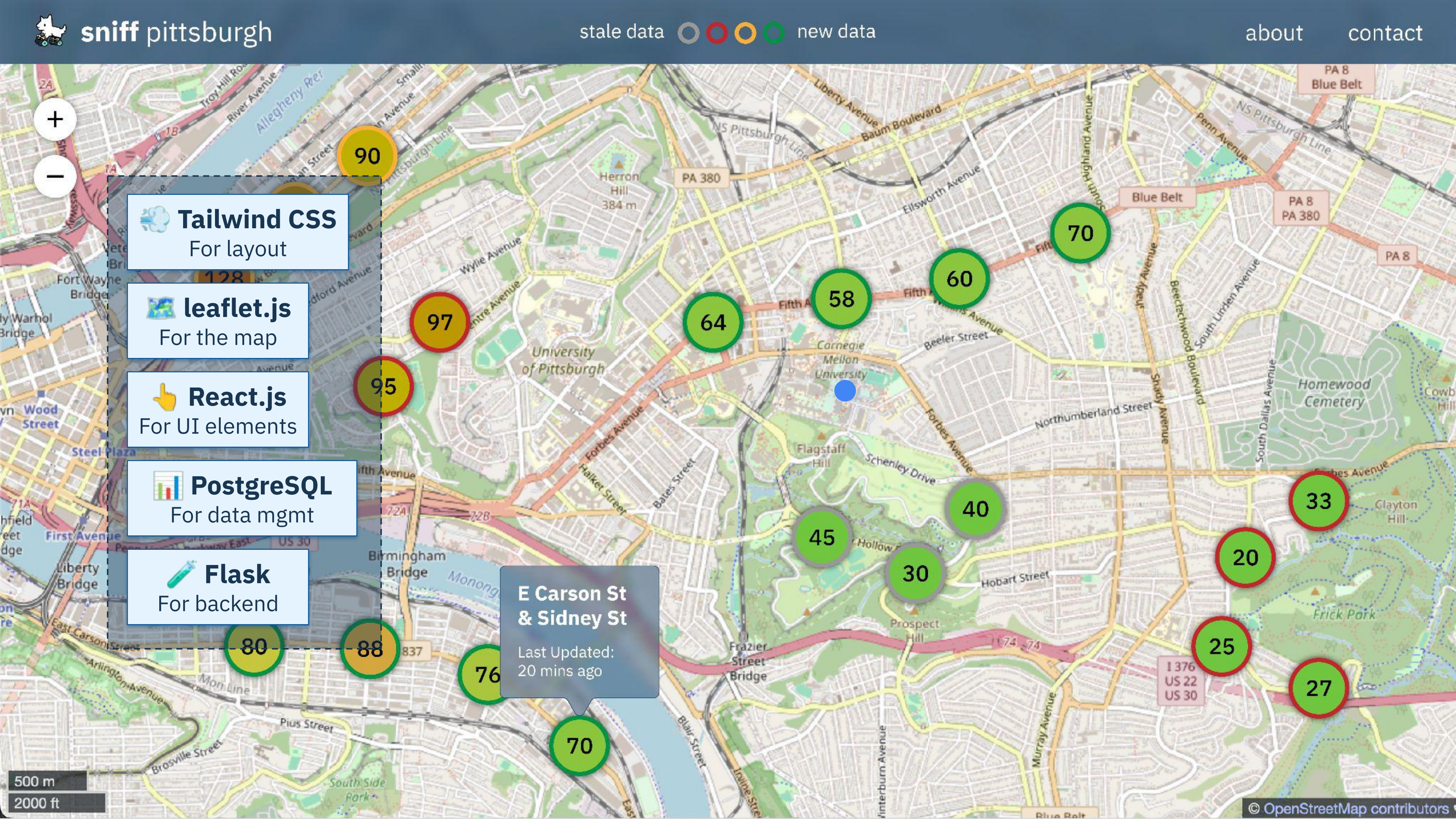
Air intake from front, exhaust from rear.

sniff station

POGOH Bike Station



Bike with Visor


sniff pittsburgh
stale data
new data
about
contact
+
−
Tailwind CSS
For layout
leaflet.js
For the map
React.js
For UI elements
PostgreSQL
For data mgmt
Flask
For backend
E Carson St
& Sidney St
Last Updated:
20 mins ago
90
97
95
80
88
76
70
64
58
60
70
40
45
30
33
20
25
27
500 m
2000 ft
© OpenStreetMap contributors

Quantitative User Requirements

Use Case	Quantitative Requirements	
Accurate up to 20mph	Box can withstand road vibrations and debris for **20 min** at **20 mph**.	AQ measurement not influenced by wind speed up to **20 mph.**
1 hour min operation	Battery must be big enough to sustain **1 hour** of operation.	
Easy web operation	User should spend no more than **20s** to interpret air quality data.	Website should update within **30s** of data upload from station hub.
No interaction required	Box should withstand **10,000** dam actuations before maintenance.	Box accumulates max **100 ml** of water with **1.5”/hr** of rain.

Test, **Verification**, and **Validation**

Requirement	Test Method	Test Outputs and Risk
Road Vibrations and Debris	Ride bike with sniff visor on for **3 hours** cumulative at **20 mph max** speed. Test multiple times on most popular POGOH rides.	✅ Undamaged sensor housing ✅ No debris in air cavity Damaged visor → Reinforce housing
1 hour min operation	Ride bike continuously for **20 minute** increments with data collection enabled. Return bike to station for data upload **3 times**. Total operation time 1 hr.	✅ Continuous operation Early shut off → Bigger battery

Test, **Verification**, and **Validation**

Requirement	Test Method	Test Outputs and Risk
Easy web operation	Recruit users with **no prior knowledge** of Sniff website. Ask them to interpret the data points on the website. Time how long it takes for comprehension.	✅ Comprehension under 20s User confused → get feedback
Ruggedness	Actuate dam continuously for **10,000 cycles**. Run Visor under shower water for **20 minutes**.	✅ Working dam operation ✅ Less than 100ml water inside Damaged sensors → Test only dam

Implementation Plan

Hardware

Off-the-Shelf

- All sensors
- Raspberry Pi
- Battery
- Wires

In-House

- Sniff Visor and Station design and build
- Air dam design, build, and operation

Software

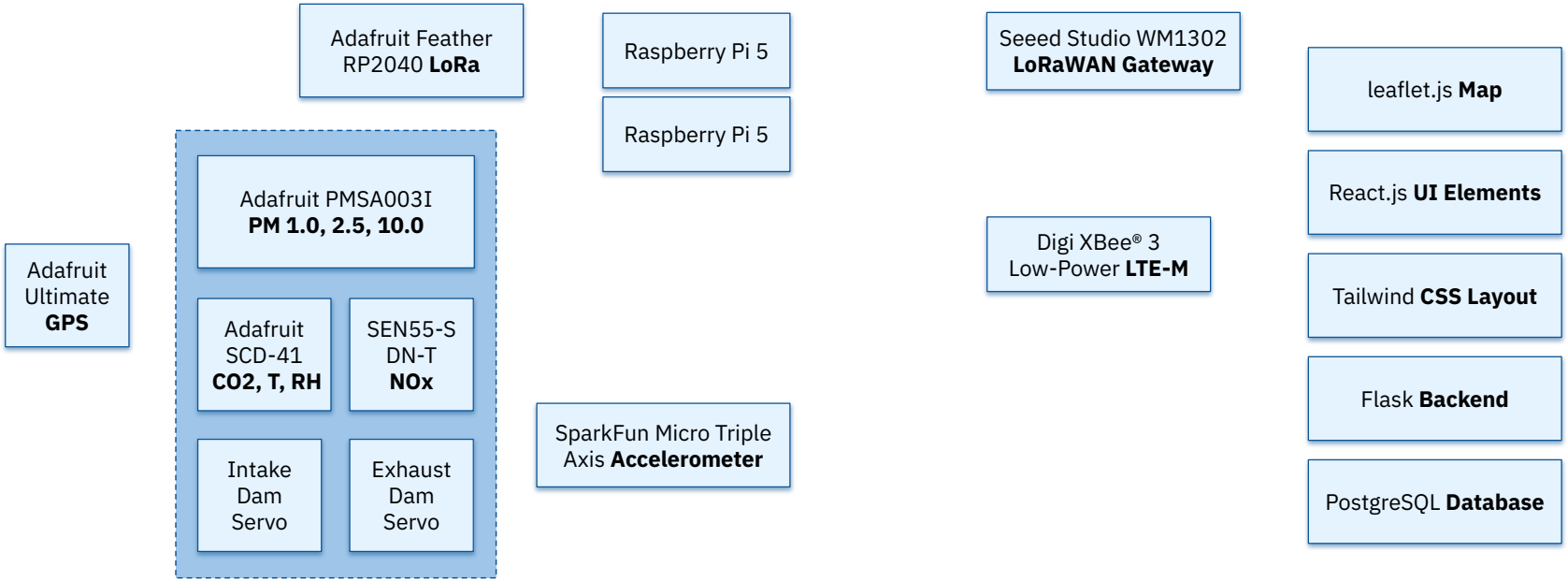
Off-the-Shelf

- Flask
- PostgreSQL
- Tailwind CSS
- React.js
- LoRaWAN Protocol
- Python libraries for I2C, Serial, Cellular

In-House

- Data aggregation logic
- Air sample capture logic

Project Management


Adafruit Feather RP2040 **LoRa**
Raspberry Pi 5
Raspberry Pi 5
Seeed Studio WM1302 **LoRaWAN Gateway**
leaflet.js **Map**
Adafruit PMSA003I **PM 1.0, 2.5, 10.0**
Adafruit Ultimate **GPS**
Digi XBee® 3 Low-Power **LTE-M**
React.js **UI Elements**
Adafruit SCD-41 **CO2, T, RH**
SEN55-S DN-T **NOx**
Tailwind **CSS Layout**
Intake Dam Servo
Exhaust Dam Servo
SparkFun Micro Triple Axis **Accelerometer**
Flask **Backend**
PostgreSQL **Database**