

What's That Smell?

Detecting Air Quality with
Python, Raspberry Pi, and
Redis

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CODE

Covered today:

- Motivation for this project
- How air quality is determined
- How to measure airborne particulate matter
- Creating the hardware sensor device
- Parsing the raw data
- Visualizing the data
- Extensibility and utility of data

Sad Introductory Stats for 2023 Wildfires in the United States West Coast:

- 2,540,000 acres of land burned
- 48,681 individual fires
- 176 acres average per fire
- 13,887 buildings destroyed
- Western US wildfires destroyed 246% more homes and buildings over the past decade

Sad Introductory Stats for 202X Wildfires in the United States West Coast:

- We learned about fire tornadoes



Wildfire Smoke – How does it affect us?

- Eye and respiratory tract irritation
- Reduced lung function
- Bronchitis
- Exacerbation of Asthma and Heart Failure
- Overall Premature death

Wildfire Smoke – How we measure it

- **PM 2.5: Particulate Matter 2.5 micrometers and smaller**
- **Small enough to pass through to the deepest part of the lungs and into the bloodstream**
- **AQI (Air Quality Index): a computed value based on PM 2.5 to convey health risks**

Wildfire Smoke – How we measure it

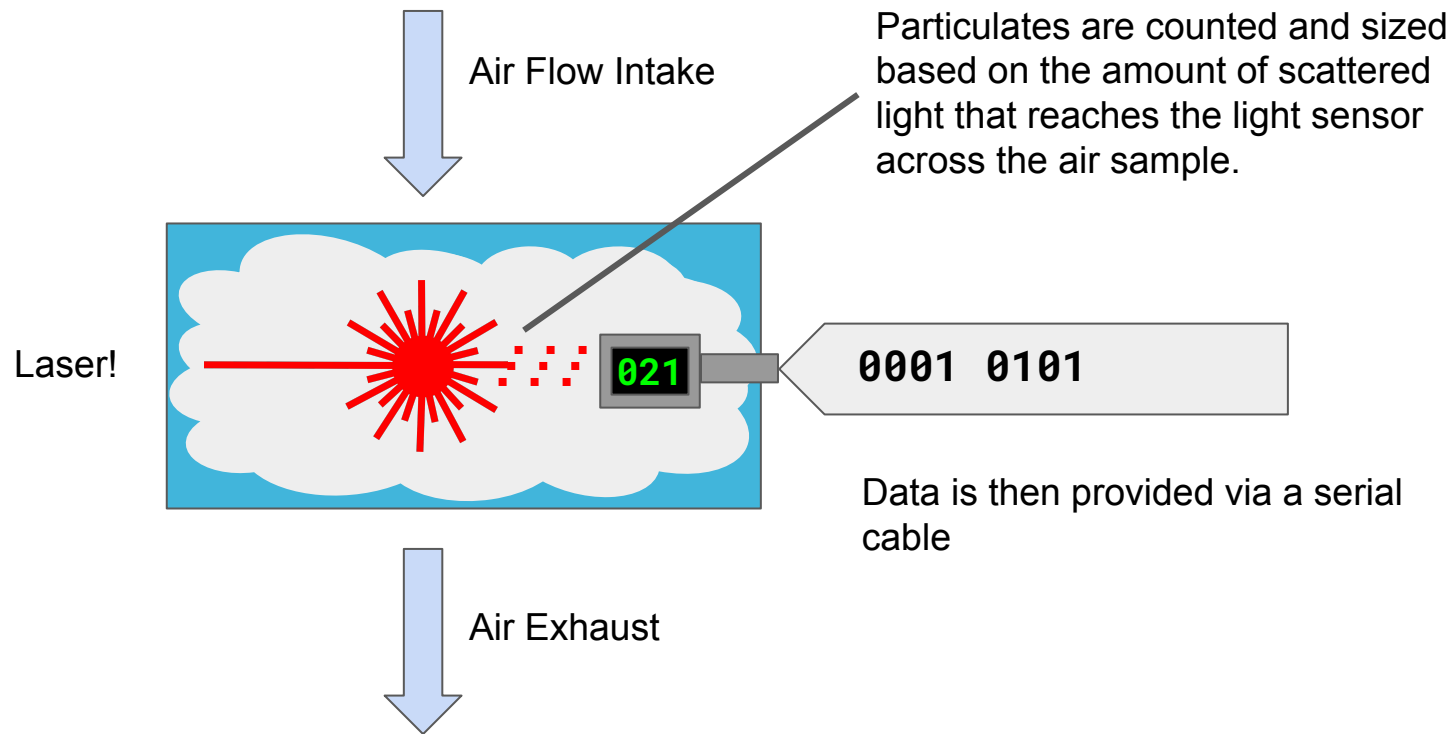
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk
51 - 100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101-150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151-200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects
201-300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.
300+	Hazardous	Health alert: everyone may experience more serious health effects

Wildfire Smoke - How do we measure it

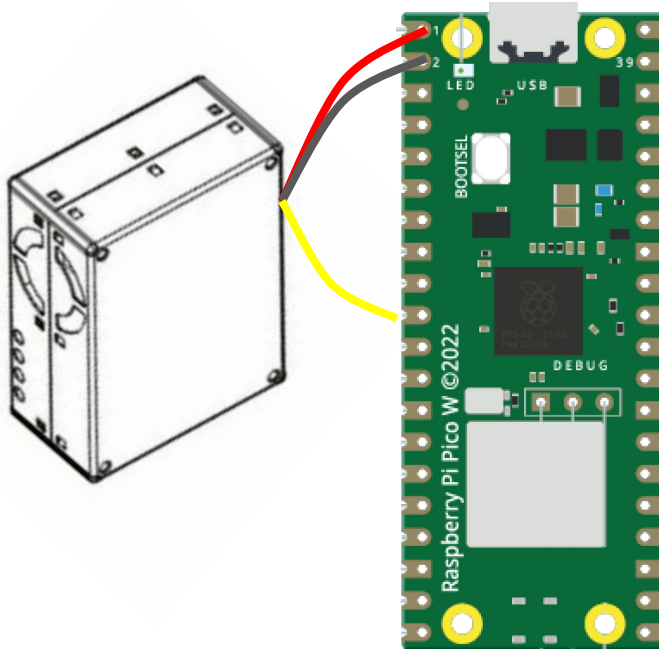


Plantower PMS 5003 Particulate Matter Sensor

Wildfire Smoke - Plantower PMS5003 breakdown



The Raspberry Pi Pico



- Capable of running Micropython
- Wireless capabilities
- Dual-core ARM processor,
- 264 kB of SRAM
- 2MB of on-board flash memory
- Only \$6.00 (USD)

Redis



- Stores key/value pairs
 - **Strings/Numbers**
 - Lists/Sets/Sorted Sets
 - **TimeSeries**
 - JSON / Query
 - **Streams**

Pi Pico W Code – Tasks

- Send a liveliness pulse every five minutes
- Sample the air every five seconds
 - Convert PM2.5 to AQI
- Send PM2.5, AQI, and temperature to a Redis Stream

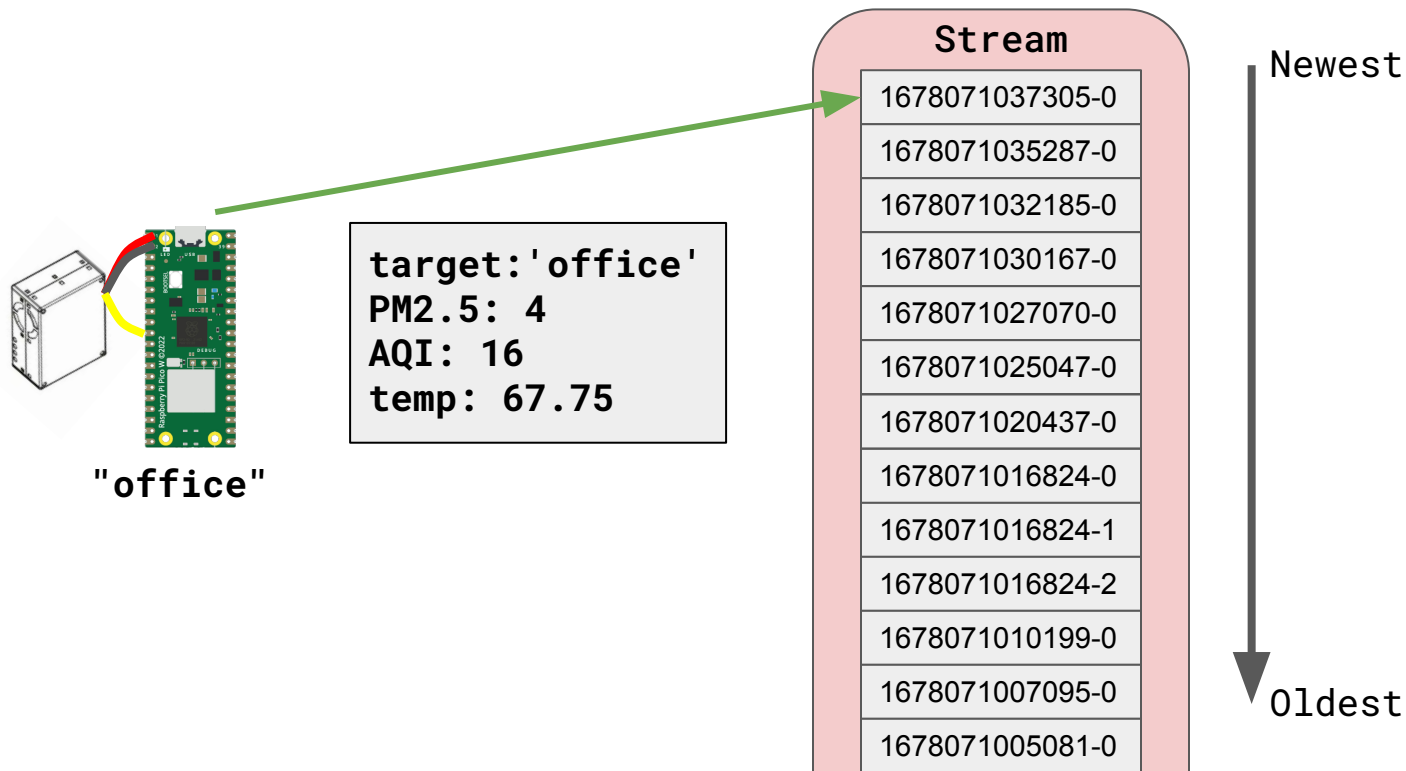
Python Microservices - Tasks

- **Insert PM2.5, AQI, and temperature into individual timeseries per sensor unit**
- **Trigger SMS when air quality threshold is met**
- **Provide an API to Grafana for visualization**

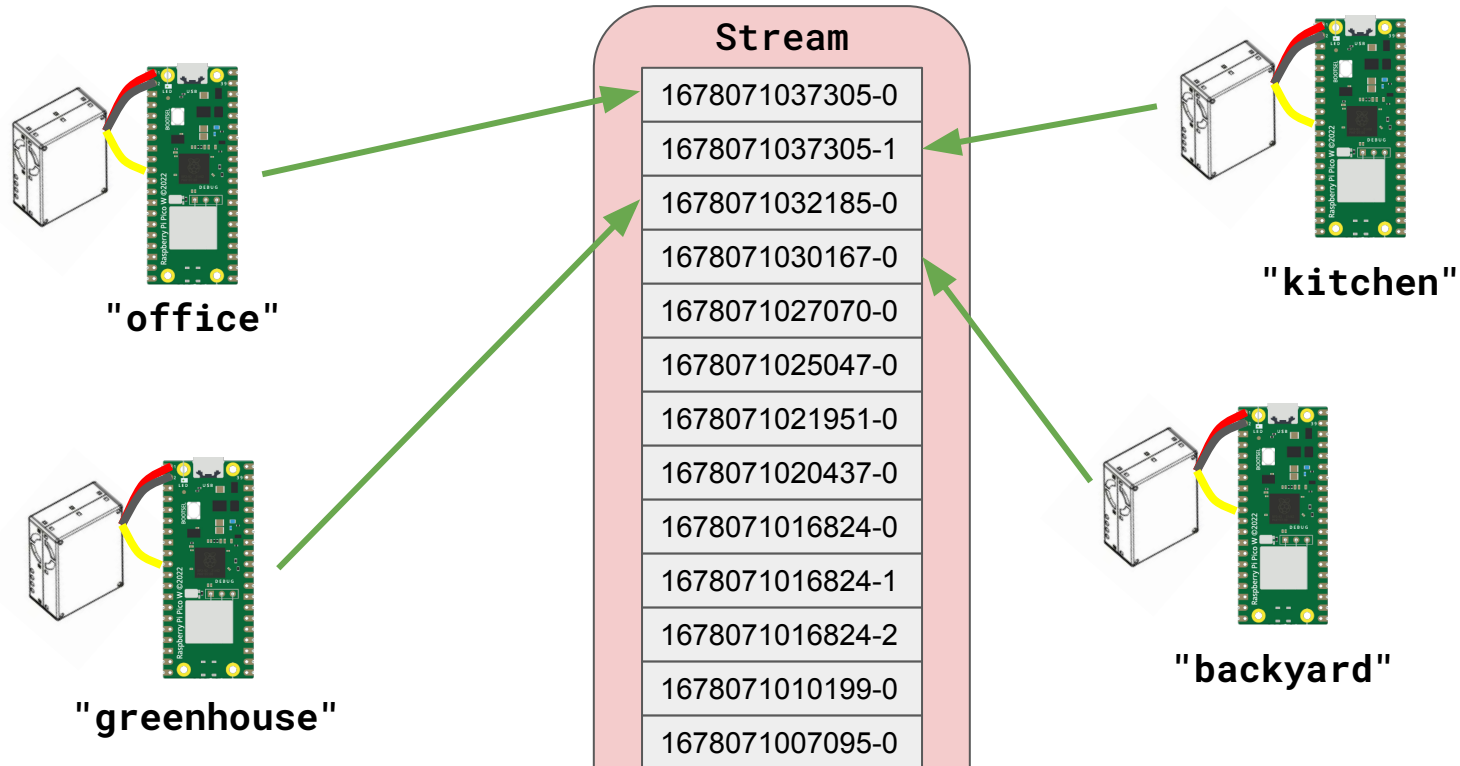
Pi Pico W Code

Let's see some code!

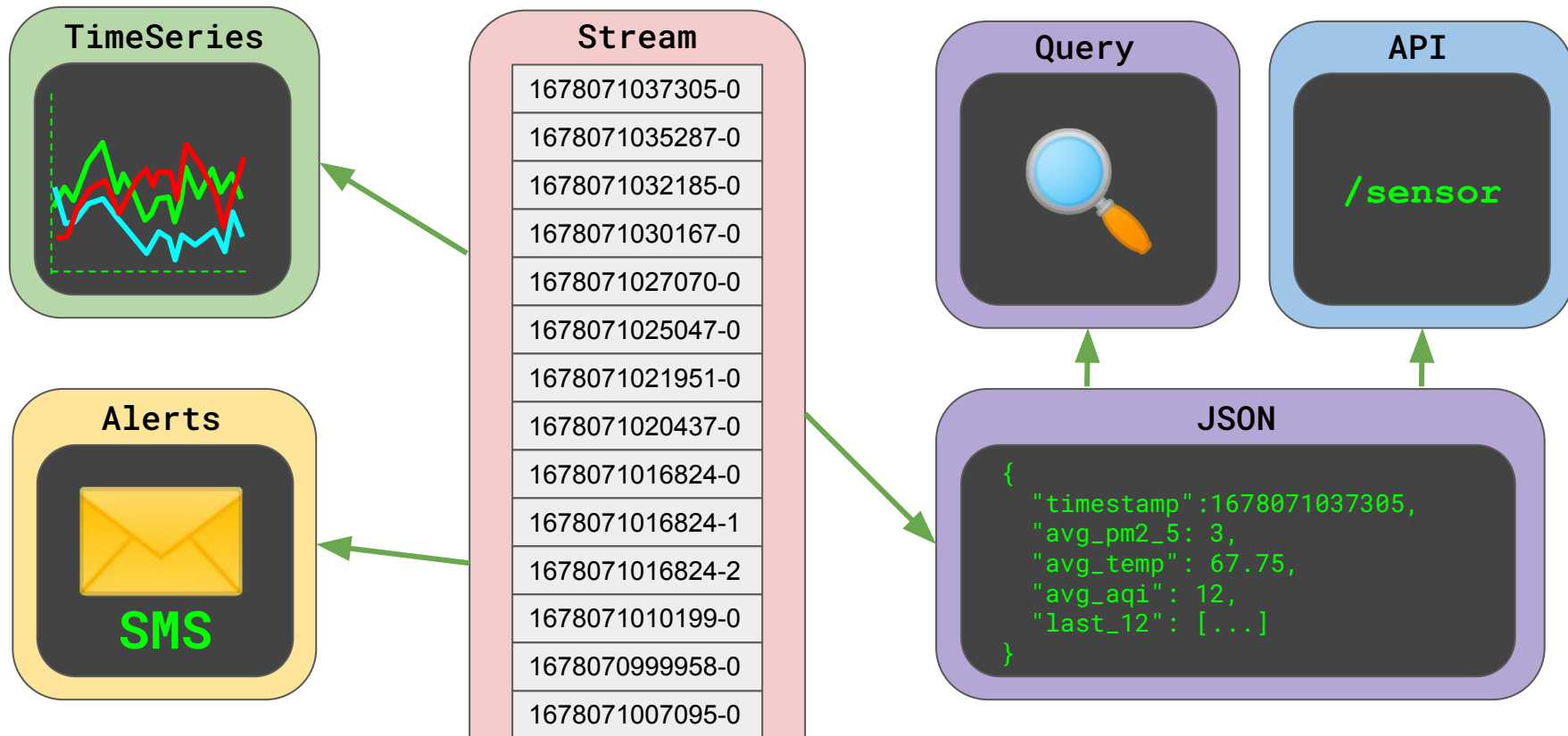
Overview - What's going on?



Producers - Let's scale out!



Consumers - Making the data work



Consumers - Creating a TimeSeries

Let's see some code!

Consumers - Sending the data to Grafana

Let's see some code!

Consumers - Creating/Updating JSON documents

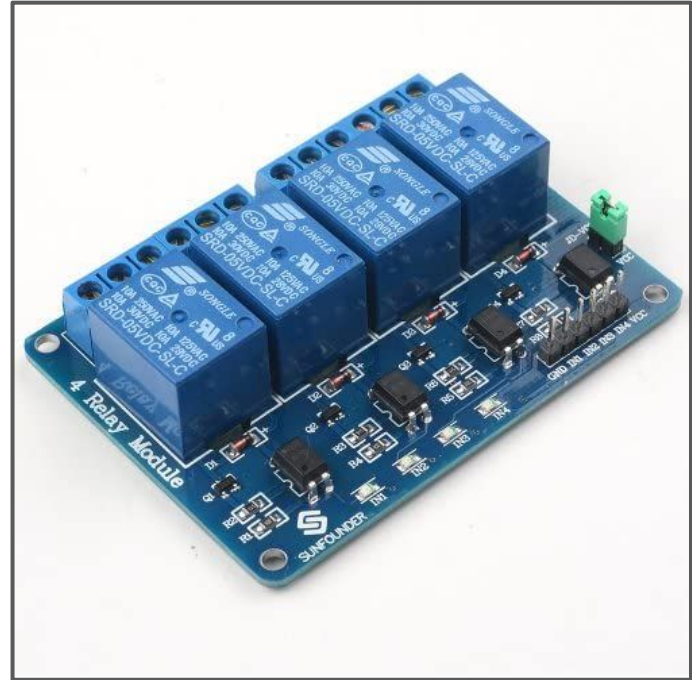
Let's see some code!

Bonus SMS notifications!

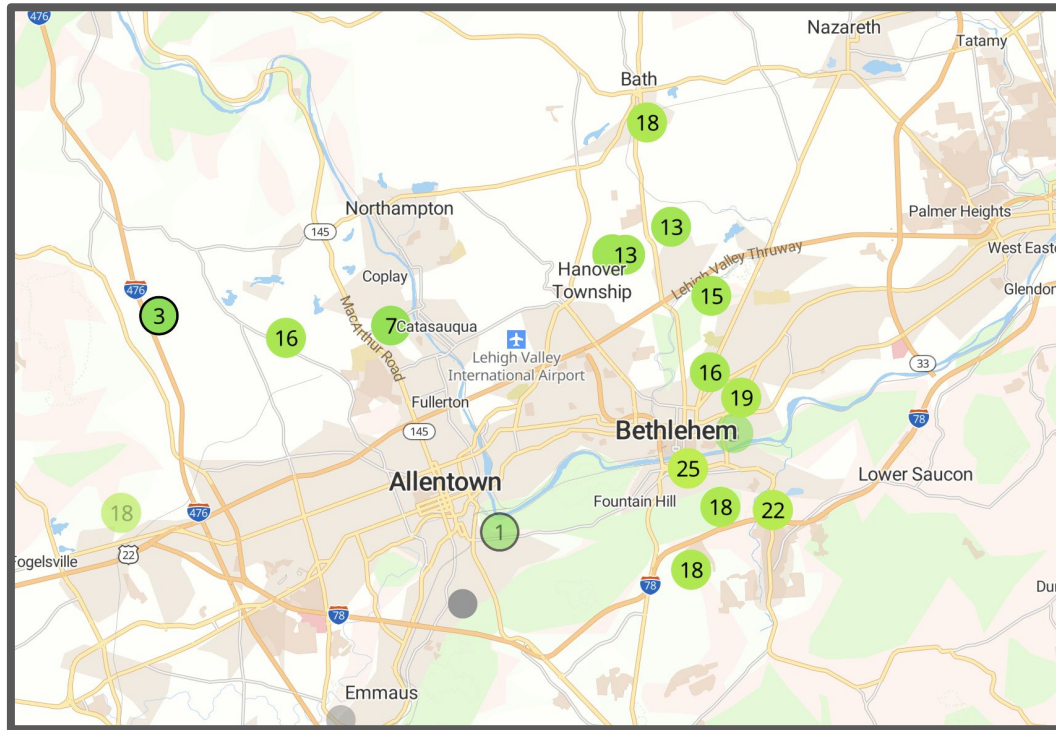
Let's see some code!

What else can you do with this data?

- Trigger an electric relay to activate a fan, air purifier, window opener, or HVAC system.
- Share outdoor locations with crowdsourced AQI maps, such as PurpleAir.
- Send notifications to Alexa to alert rooms of high AQI values
- Email notifications
- Create a heat map of a building of changing AQI values
- Create a predictive model of air dispersal/ventilation



Shoutout to PurpleAir!



<https://map.purpleair.com/>

Learn more about this project

Github repository:

- Pico W code
- Consumer services code
- API code
- Instructions on assembling your own unit
- .STL files for printing the box at home
- Data sources of statistics



<https://github.com/redis-developer/redis-aqi-monitor.git>

Learn more about Redis

Redis:

<https://redis.com>

Redis University:

<https://university.redis.com>

Youtube:

<https://youtube.com/redis>

Discord

<https://discord.gg/redis>



Thank you!



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