What's That Smell?

Detecting Air Quality with Python, Raspberry Pi, and Redis

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(AP Photo/ Eric Risberg)

Covered in this talk:

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

Sad Introductory Stats for 2020 Wildfires in the United States West Coast:

- **10,274,679** acres of land burned
- **58,258** individual fires
- **176** acres average per fire
- **13,887** buildings destroyed
- Financial loss of **19.884 billion** dollars
- **1,200 to 3,000** excess deaths from exposure to wildfire smoke

Sad Introductory Stats for 2020 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
- 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**

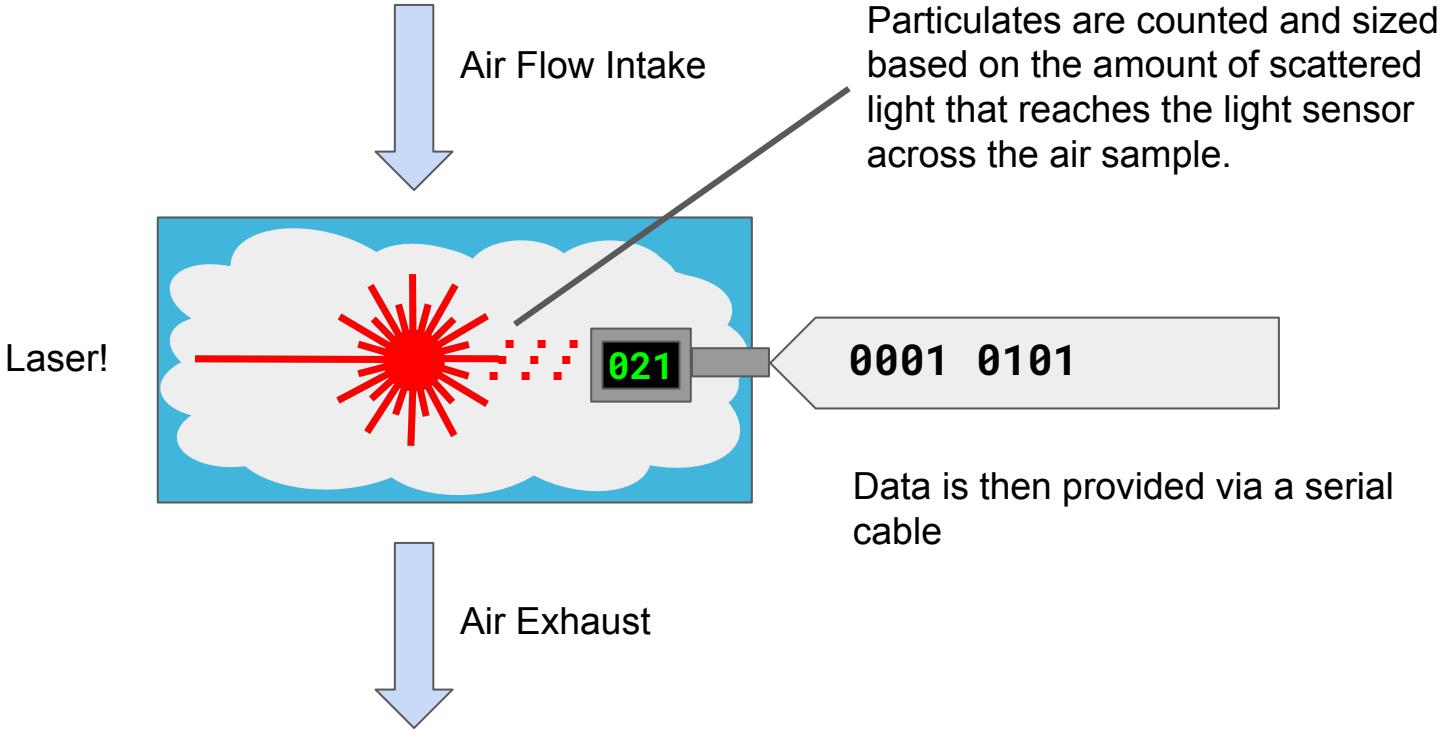
Wildfire Smoke - How we measure it

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

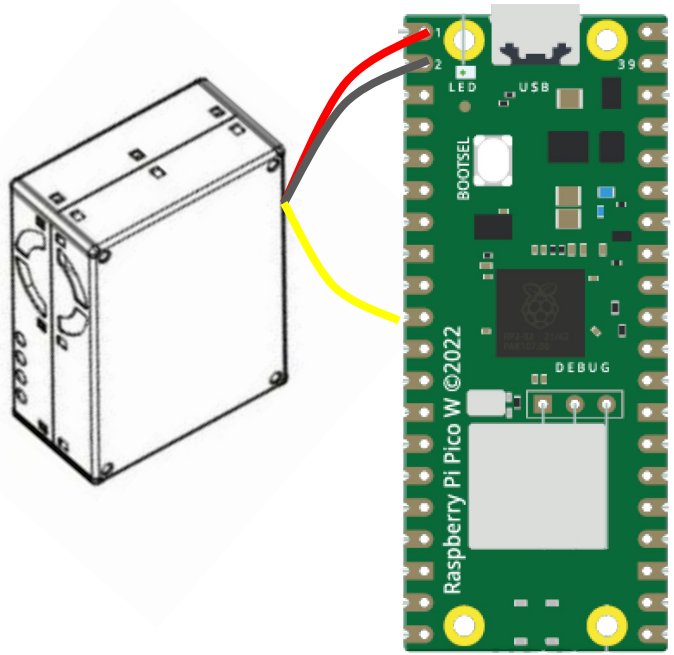
Wildfire Smoke - How do we measure it

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

- NoSQL Database
- Runs on RAM, not on hard drives
- Exists on all major cloud providers
- Stores key/value pairs
  - Strings/Numbers
  - Lists/Sets/Sorted Sets
  - TimeSeries
  - JSON / Query
  - Streams

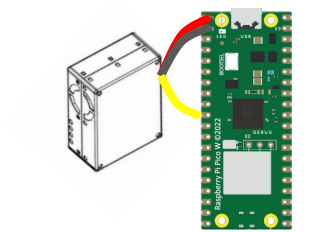
Pi Pico W Code - Tasks

- 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

Pi Pico W Code

Let's see some code!

Overview - What's going on?



"office"

```
target:'office'
PM2.5: 4
AQI: 16
temp: 67.75
```

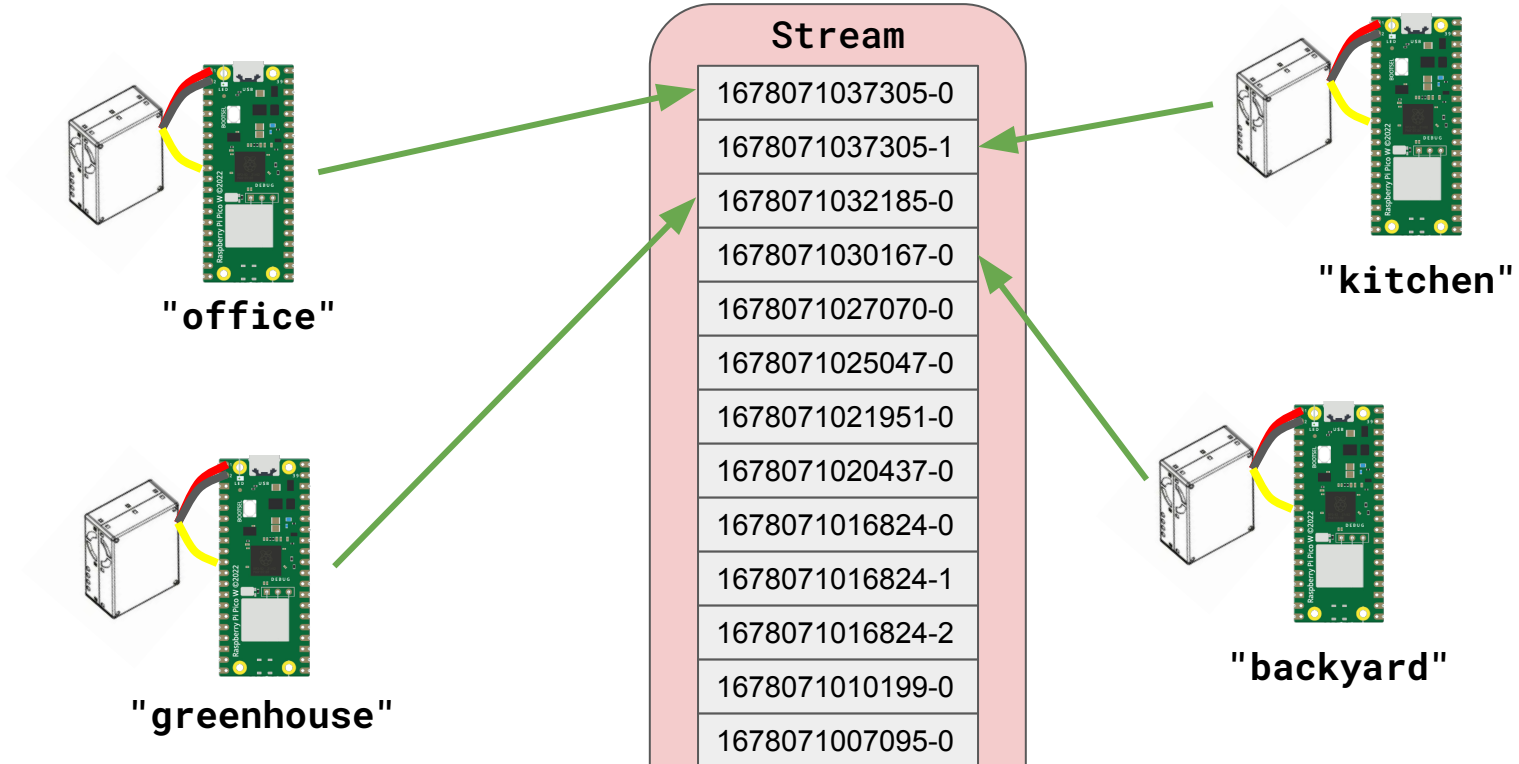
Stream

1678071037305-0
1678071035287-0
1678071032185-0
1678071030167-0
1678071027070-0
1678071025047-0
1678071020437-0
1678071016824-0
1678071016824-1
1678071016824-2
1678071010199-0
1678071007095-0
1678071005081-0

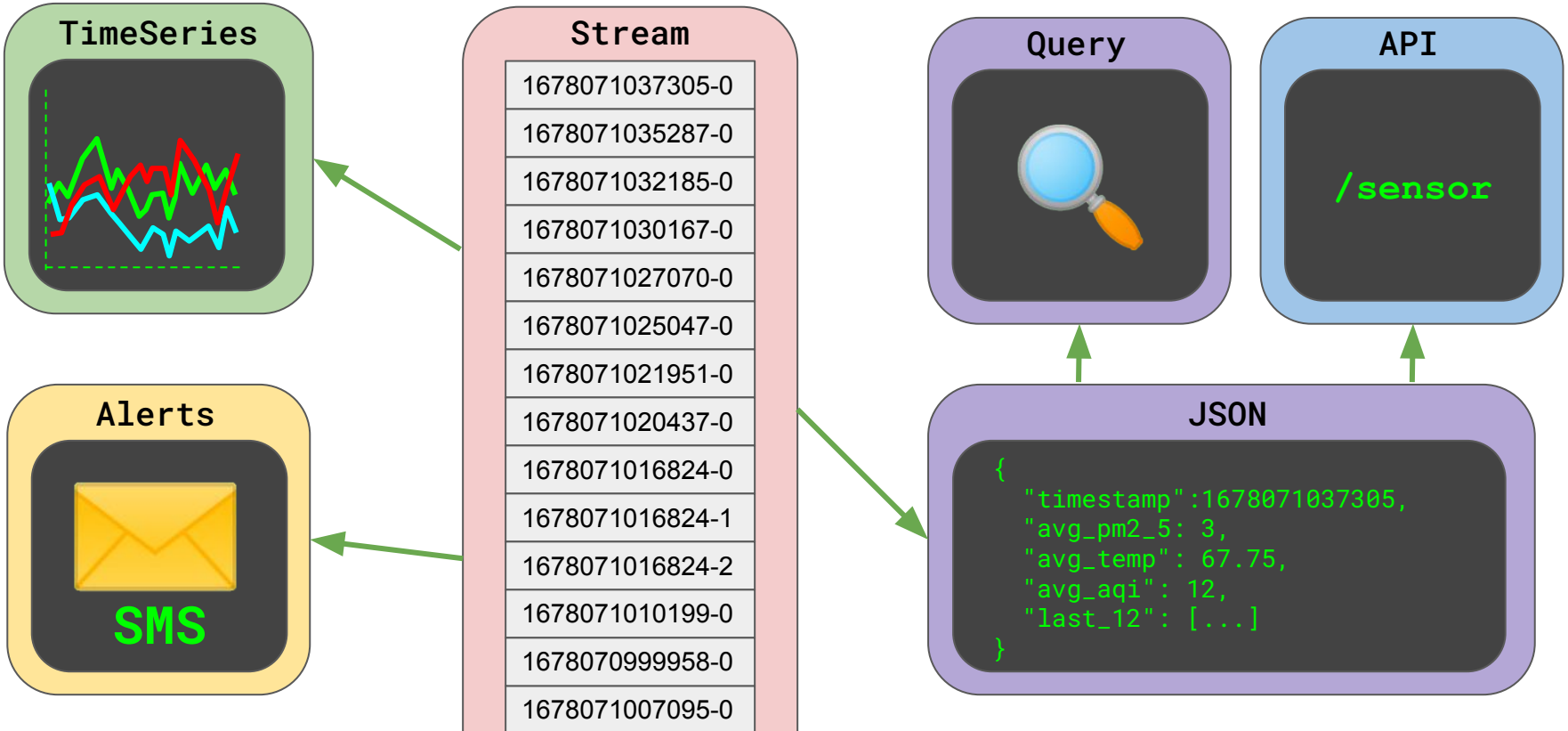
Newest

Oldest

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 - Viewing a TimeSeries in Grafana

Consumers - Creating/Updating JSON documents

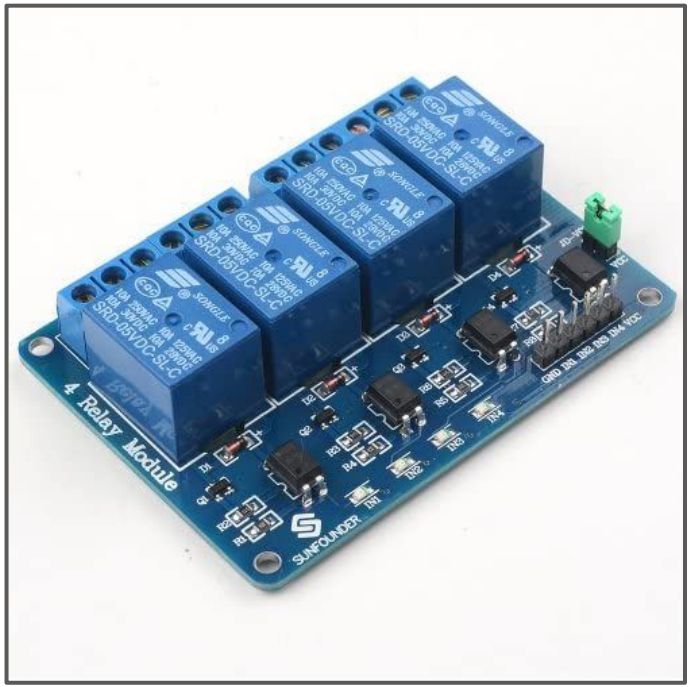
Let's see some code!

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



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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(AP Photo/ Eric Risberg)