

Bringing ideas to life with IoT

Visualizing noise pollution

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A little about me

- Full-stack development for 8 years
- Outdoor lover
- Weekend audio engineer
- Father and husband



Where we're going

- What is IoT, anyways?
- Why noise?
- High-level project walkthrough
- Tech deep dive
- So, what were the results? *Demo time!*
- What does this mean for you?



What is IoT?



A thing with internet!

What is noise pollution?

"any unwanted or disturbing sound

that **affects the health and well-being**

of humans and other organisms."

- National Geographic



What is noise pollution?

“...To be precise, noise becomes **harmful** **when it exceeds 75 decibels** (dB) and is painful above 120 dB...noise levels [should] be kept below 65 dB during the day and indicates that restful **sleep is impossible** with nighttime ambient noise levels **in excess of 30 dB.**”

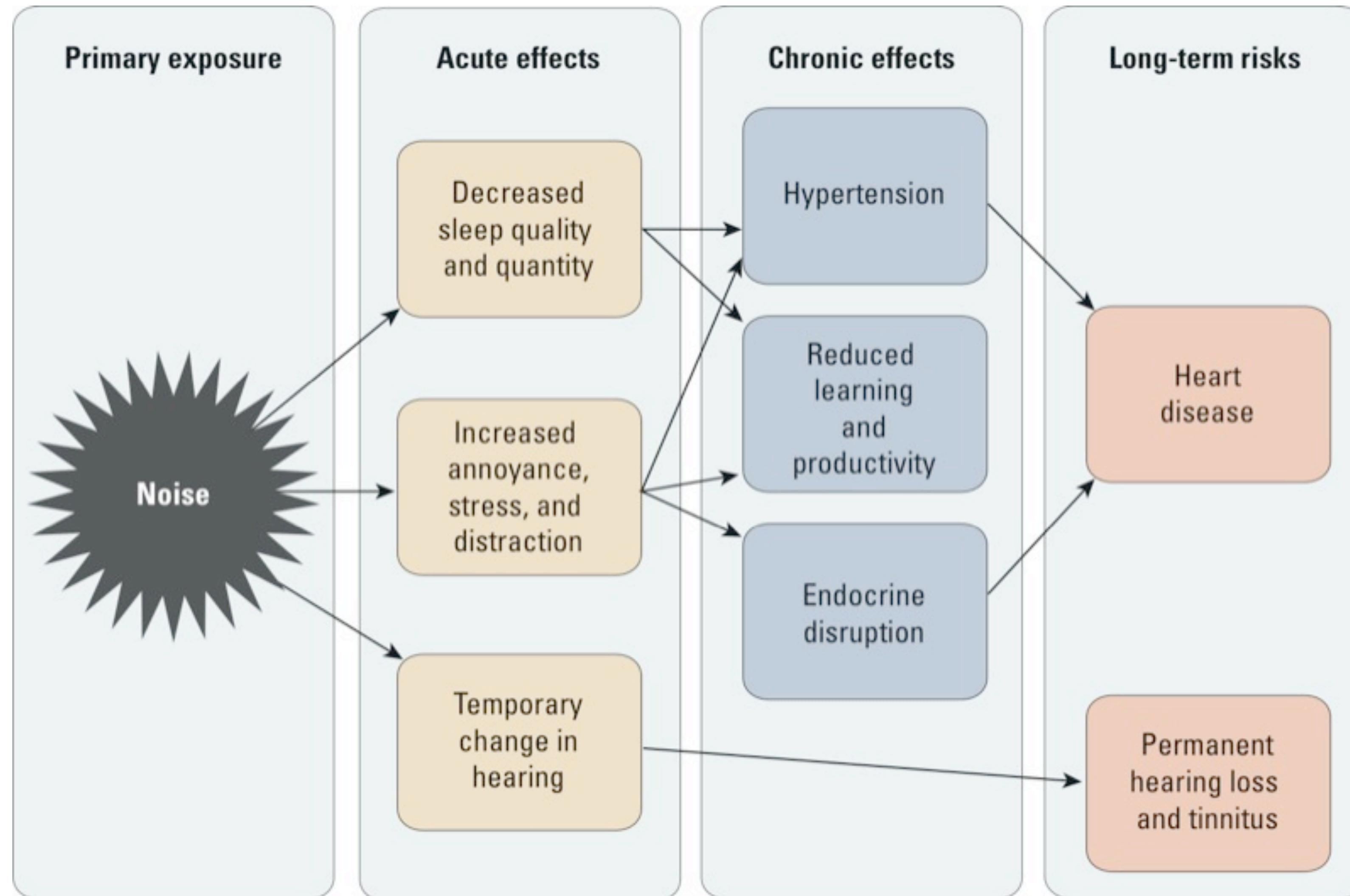
Source: iberdrola.com



Sources include:



Why is it a big deal?



Source: nih.gov

Figure 11. Key impacts of exposure to unhealthy noise levels, based on END thresholds, in the EU in 2017



*Disability adjusted life years

Source: [EEA \(2022c\)](#).

So, what is a decibel anyways?

Logarithmic unit to measure sound



80dbA

10x the intensity



90dbA

How loud is too loud?

Source: hearinghealthfoundation.org

NOISE LEVELS

Sounds at or below 70 dB are safe.



Leaves
rustling /
Whisper

20
30

Ticking
watch

Background
music

30
50
60

Average
room
noise

Average
office
noise

70

Sounds above 70 dB are harmful.

Landscaping
equipment
(from inside
a house)

75

Inside an
airplane /
Electric
vacuum

City traffic
(from inside
a car) / Noisy
restaurant

80

Hairdryer

85

Approaching
subway train /
Car horn at
16 feet / Pro
sports games

Food processor
/ DJ'd school
dance / Crowing
rooster

95
100

Nightclubs
and bars /
Gas-powered
leaf blower /
Ice cream
truck

Motorcycle /
Automatic
hand dryer

100

Approaching
subway train /
Car horn at
16 feet / Pro
sports games

Trombone /
Dog barking
in ear / Ice
cream truck

105
110

Nightclubs
and bars /
Gas-powered
leaf blower /
Ice cream
truck

Jack-
hammer

110
120

Rock or
pop concert /
Siren

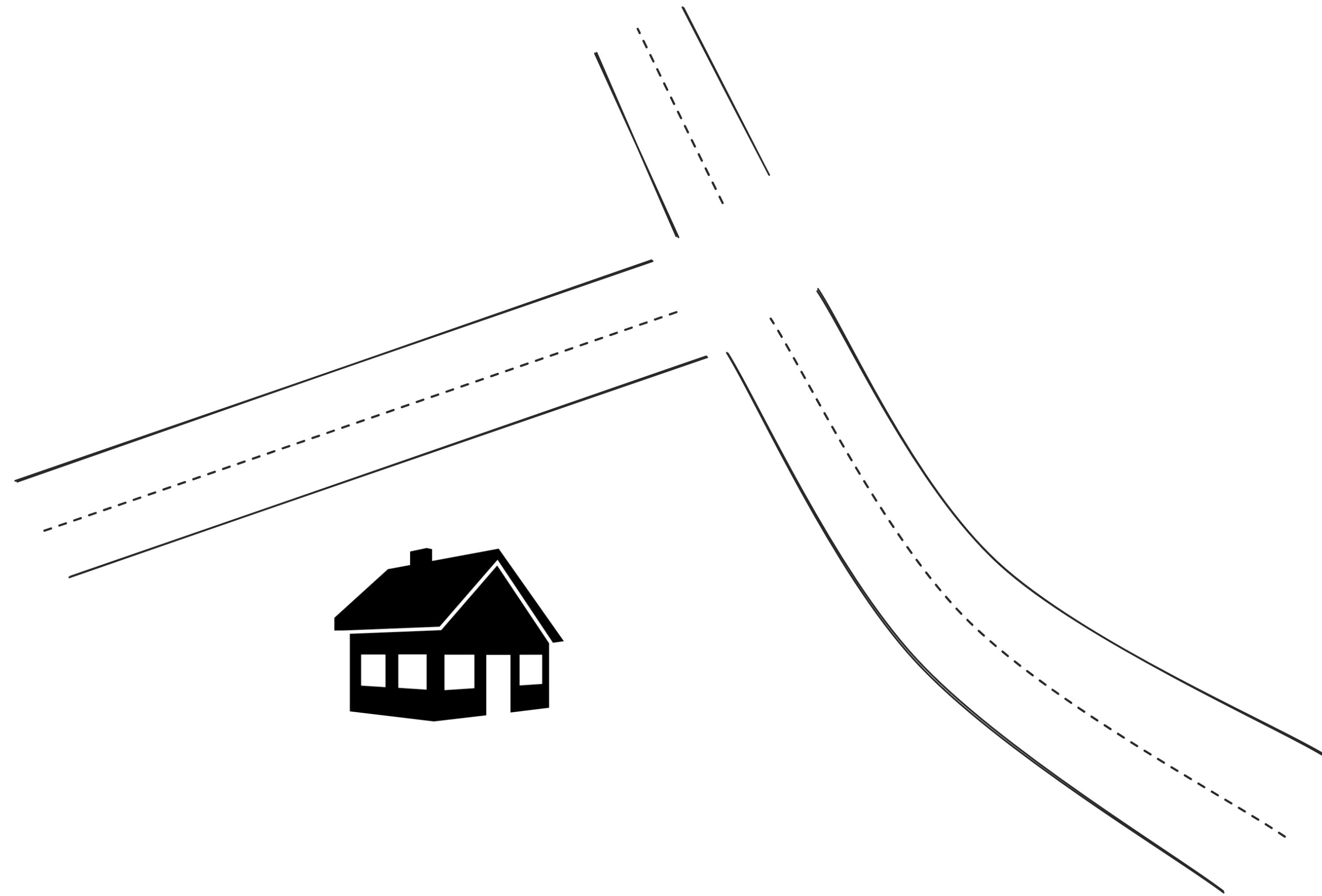
Gunshot

135

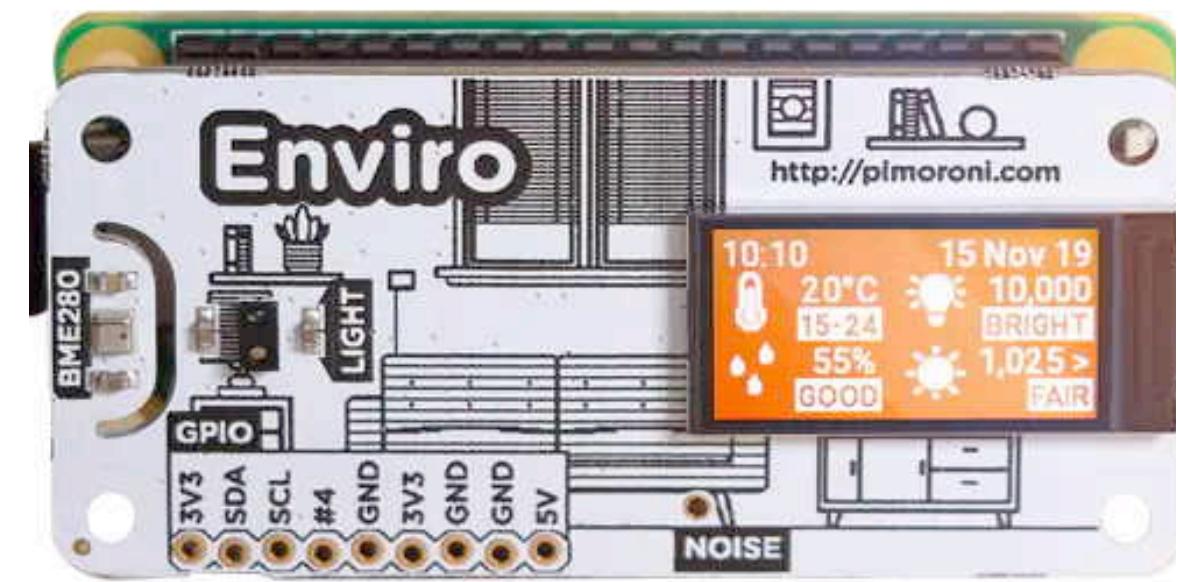
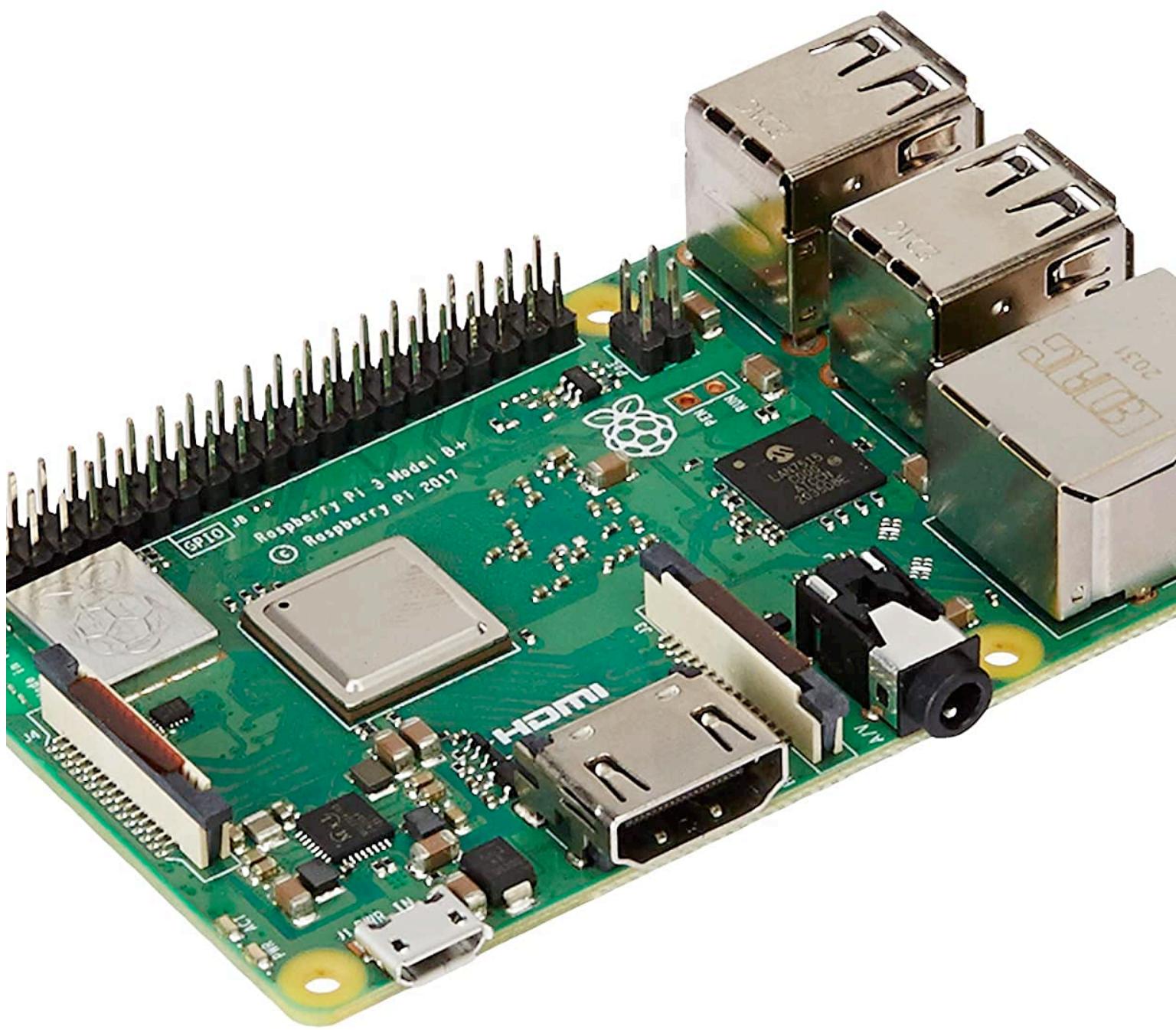
Jet engine
from 100
yards

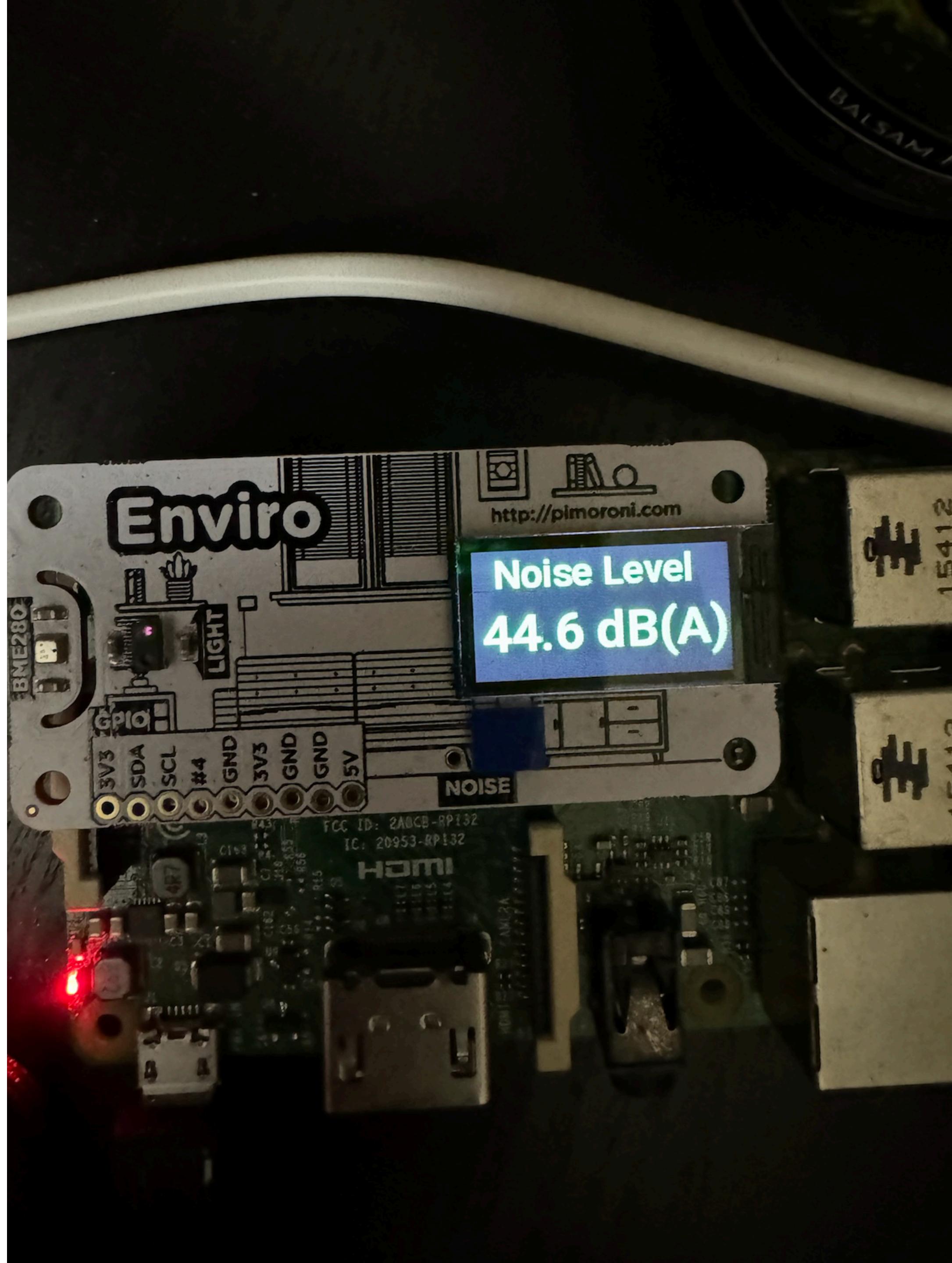
140

Ok, so why did I choose noise?



The project: hardware



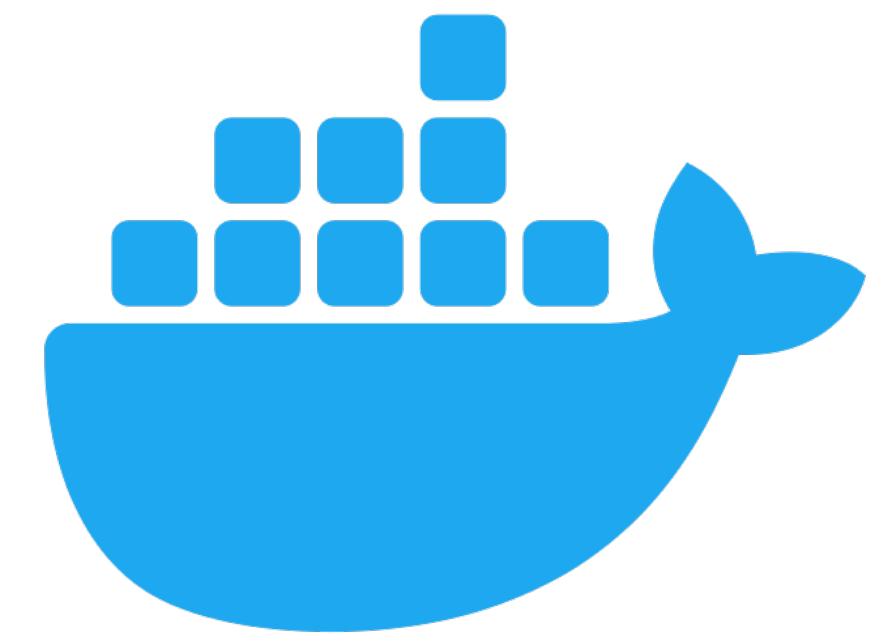




PIMORONI

LTD  EST.
2012

The project: software



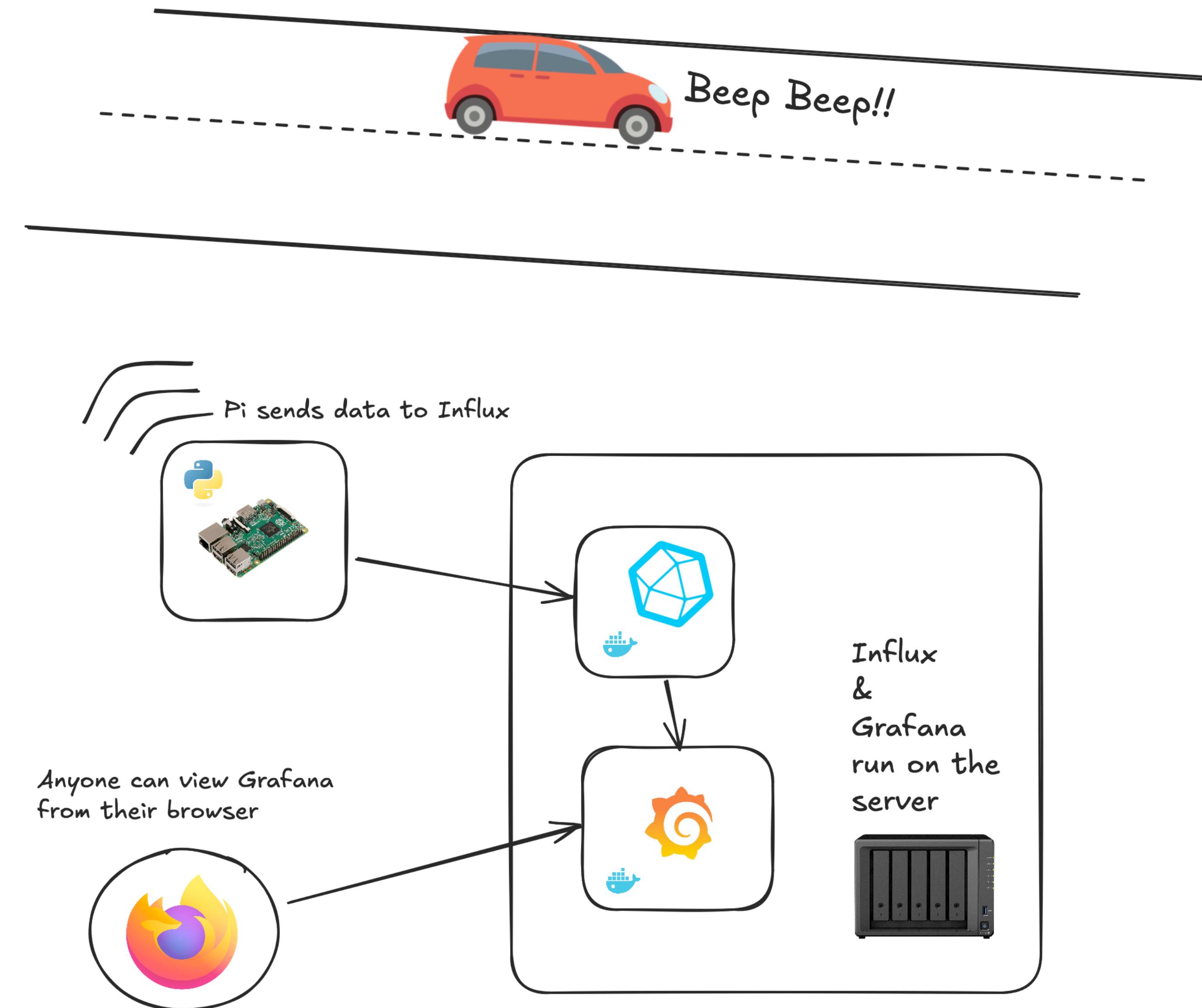
Python

InfluxDB

Grafana

Docker

Bringing it all together



Tech Details

The script

```
● ● ●  
1 self.stream = sounddevice.InputStream  
2 (  
3     samplerate=self.sample_rate,  
4     channels=1,  
5     blocksize = 12000,  
6     device = "dmic_sv",  
7     callback=self.process_frames  
8 )  
9  
10
```

Initialize the stream from the mic

Source: github.com/roscoe81

The script



```
1 weighted_rms = np.sqrt(np.mean(np.square(weighted_recording)))
2                     spl_ratio = weighted_rms/self.spl_ref_level
3                     if spl_ratio > 0:
4                         spl = 20*math.log10(spl_ratio)
```

Get the Root Mean Square
(single value that represents level of energy across a range)

The script

```
1 spl_ratio = weighted_rms/self.spl_ref_level  
2 spl = 20*math.log10(spl_ratio)  
3 self.log_db_to_influx(round(spl, 1))
```

Get sound pressure ratio and scale to decibels

The script

Send the data to InfluxDB

```
1  def log_db_to_influx(self, db_reading):
2      """Logging decibel readings to influx DB"""
3
4      bucket = os.environ['BUCKET']
5      org =os.environ['ORG']
6      token = os.environ['API_TOKEN']
7      url=os.environ['SERVER_ADDRESS']
8
9      client = influxdb_client.InfluxDBClient(
10          url=url,
11          token=token,
12          org=org
13      )
14
15      write_api = client.write_api(write_options=SYNCHRONOUS)
16
17      p = influxdb_client
18          .Point("environment")
19              .tag("location", "home")
20                  .field("dbA", db_reading)
21      write_api.write(bucket=bucket, org=org, record=p)eturn go(f, seed, [])
22 }
```

The Data

- High volume
- Timestamped
- Denormalized

Graph ▾ CUSTOMIZE Local ▾ SAVE AS

table	_measurement	_field	_value	_start	_stop	_time	location
	mean	group	no group	group	group	no group	group
		string	double	dateTime:RFC3339	dateTime:RFC3339	dateTime:RFC3339	string
0	environment	dbA	45.791472172352	2024-12-14T14:11:16.086Z	2025-01-13T14:11:16.086Z	2024-12-14T15:00:00.000Z	Central College
0	environment	dbA	45.70964337700152	2024-12-14T14:11:16.086Z	2025-01-13T14:11:16.086Z	2024-12-14T16:00:00.000Z	Central College
0	environment	dbA	45.27512745812084	2024-12-14T14:11:16.086Z	2025-01-13T14:11:16.086Z	2024-12-14T17:00:00.000Z	Central College
0	environment	dbA	44.65949598246903	2024-12-14T14:11:16.086Z	2025-01-13T14:11:16.086Z	2024-12-14T18:00:00.000Z	Central College
0	environment	dbA	43.95994925697717	2024-12-14T14:11:16.086Z	2025-01-13T14:11:16.086Z	2024-12-14T19:00:00.000Z	Central College
0	environment	dbA	44.26110505270801	2024-12-14T14:11:16.086Z	2025-01-13T14:11:16.086Z	2024-12-14T20:00:00.000Z	Central College

InfluxDB

- Time-series database
- Multi data source
- Expressive data
- Client libraries
- Integrations like Grafana
- Community support

The screenshot shows the InfluxDB Data Explorer interface. On the left is a dark sidebar with various icons: a globe, a blue square with a white 'c', an upward arrow, a left arrow, a pencil, a grid, a calendar, a bell, and a gear. The main area has a header with 'Data Explorer' and tabs for 'Graph' and 'CUSTOMIZE'. Below is a 'Query 1' input field and a '+' button. A 'FROM' section contains a search bar with 'Search for a bucket' placeholder and a list of buckets: 'environmental', 'environmental-downsampled', and 'read_noise' (which is highlighted in blue). The bottom right corner says 'No tag keys found'.

InfluxDB - the how

- Install via Docker compose
- Create a bucket
- Generate an API key
- Install the Influx Python library
- Send readings to the bucket
- Open source offering

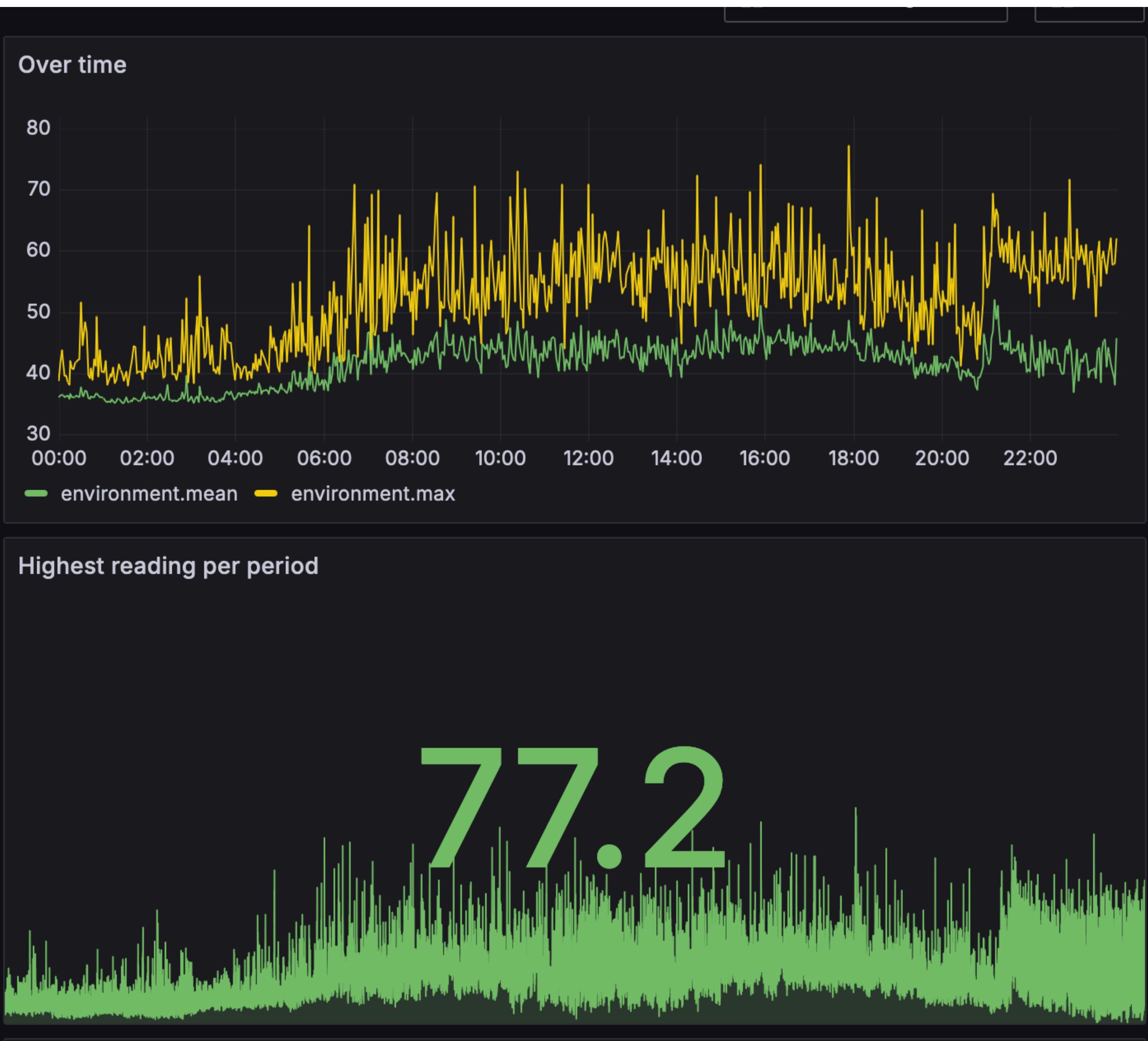
```
version: '3'

services:
  influxdb:
    image: influxdb:2.6-alpine
    env_file:
      - influx2.env
    volumes:
      # Mount for influxdb data directory and configuration
      - influxdbv2:/var/lib/influxdb2:rw
    ports:
      - "8086:8086"
  telegraf:
    image: telegraf:1.25-alpine
    depends_on:
      - influxdb
    volumes:
      # Mount for telegraf config
      - ${PWD}/telegraf/mytelegraf.conf:/etc/telegraf/telegraf.conf:ro
    env_file:
      - influx2.env

  volumes:
    influxdbv2:
```

Why Grafana

- Easy to use
- Built for observability and metrics
- Datavis library
- Open source

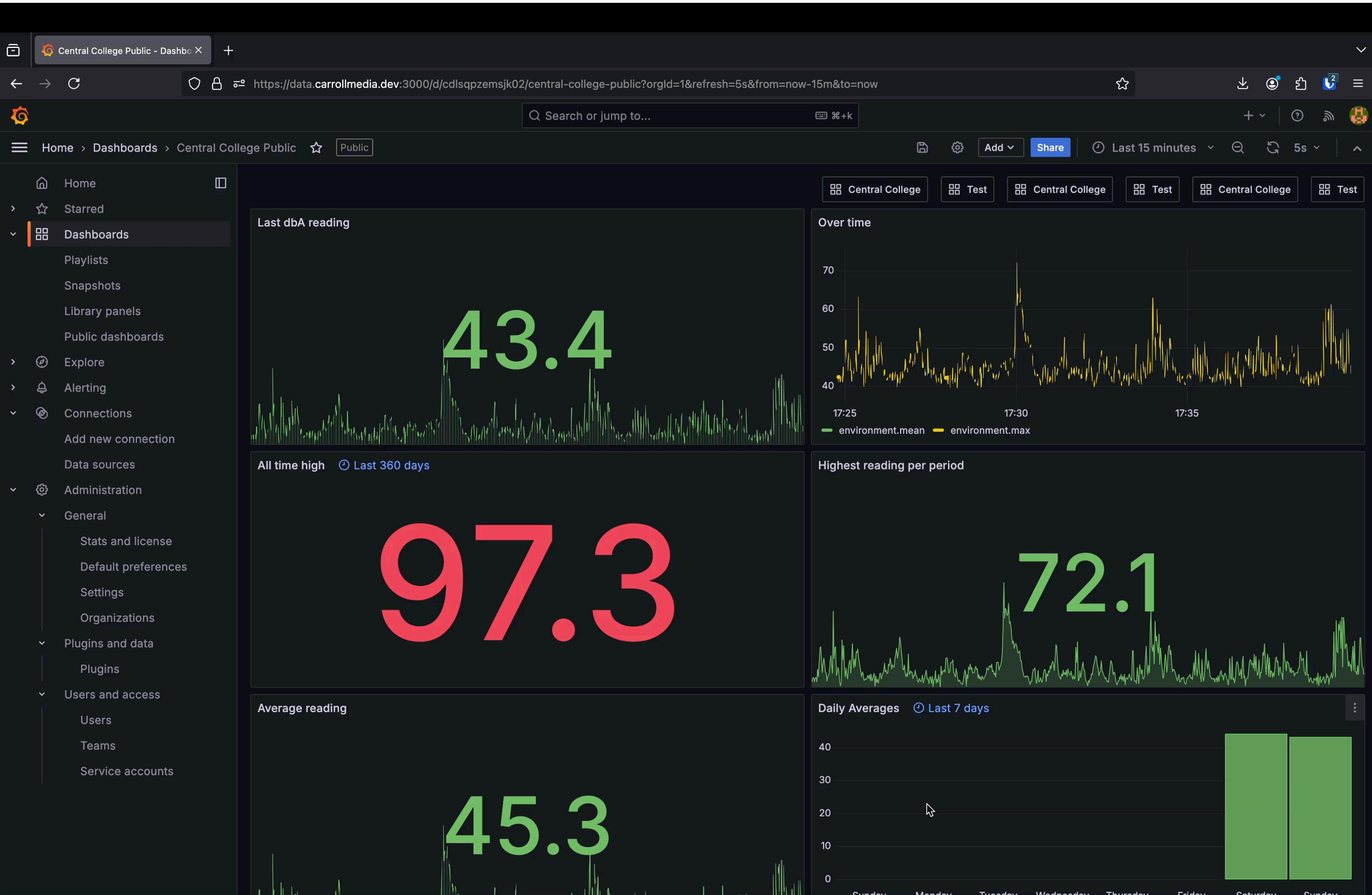


Grafana - the how

- Install via Docker compose
- Configure InfluxDB connector
- Create a dashboard
- Build fun charts!

```
version: '3'
services:
  grafana:
    image: grafana/grafana-oss
    user: grafana:grafana_group
    container_name: grafana
    restart: unless-stopped
    environment:
      - GF_SERVER_ROOT_URL=http://data.carrollmedia.dev/
      - GF_SERVER_HTTP_ADDR=
      - GF_SERVER_HTTP_PORT=3000
      - GF_SERVER_DOMAIN=carrollmedia.dev
      - GF_SERVER_CERT_KEY=/var/lib/certs/grafana.key
      - GF_SERVER_CERT_FILE=/var/lib/certs/grafana.crt
      - GF_SERVER_ENFORCE_DOMAIN=False
      - GF_SERVER_PROTOCOL=https
    ports:
      - '3000:3000'
    volumes:
      - grafana-storage:/var/lib/grafana
      - $PWD:/var/lib/certs
volumes:
  grafana-storage: {}
```

The results



What's next?

- Deploy to additional sites
- Build an action plan/proposal
- Train a model
 - Weather/noise correlation
 - Time/noise correlation
- ID noise type/source



What can you do?

- UV/air quality correlation
- Wildlife tracker/metrics
- Monitor PH in water supply
- Track garden soil moisture
 - Plant growth correlation



Keys to success

- Stay curious
- Pace yourself
- Be patient
- Start small



Questions?



<https://carrollmedia.dev/decibel-meter>

Appendix

What is a decibel? - <https://www.animations.physics.unsw.edu.au/jw/dB.htm#log>

NIH on noise pollution - <https://PMC3915267/>

Decibel scale - <https://hearinghealthfoundation.org/keeplistening/decibels>

Visual guide to noise pollution - <https://www.iberdrola.com/sustainability/what-is-noise-pollution-causes-effects-solutions>

EU study - <https://www.eea.europa.eu/publications/zero-pollution/health/noise-pollution>

EU study additional info - <https://www.eea.europa.eu/en/analysis/maps-and-charts/additional-information-on-health-impacts>

Original dbA conversion code - https://github.com/roscoe81/northcliff_spl_monitor