Phytoplankton Air Systems

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Project Overview

Phytoplankton –> Oxygen (Photosynthesis)

Algae tank placed under a water reservoir that supports the algae's growth environment.

Four sensors are embedded in the system:

- A light sensor to monitor brightness for optimal photosynthesis,
- A proximity sensor to detect nearby human interaction,
- A turbidity sensor to assess the health of the algae culture by analyzing water clarity, and
- An ENS160 sensor, which estimates the ambient carbon dioxide concentration to infer the rate of CO_2 consumption.

The Product

Water reservoir

Carbon dioxide sensor

Phytoplankton solution

Light sensor

Turbidity sensor

Proximity sensor

ENS160

- ENS160 can very efficiently estimate eCO_2 (equivalent carbon dioxide) levels using its metal oxide (MOX) gas sensing array and embedded AI algorithms.

- Unlike basic CO_2 sensors, ENS160 can estimate volatile organic compounds (TVOCs) and eCO_2 in a compact form factor.

SparkFun Breakout Board specs

Sensor Type: ENS160 MOX–based gas sensor

Breakout Board: SparkFun Qwiic ENS160 (I2C)

Key Features:

– Measures eCO_2, TVOC, AQI

–Operating Voltage: 1.8—3.3V

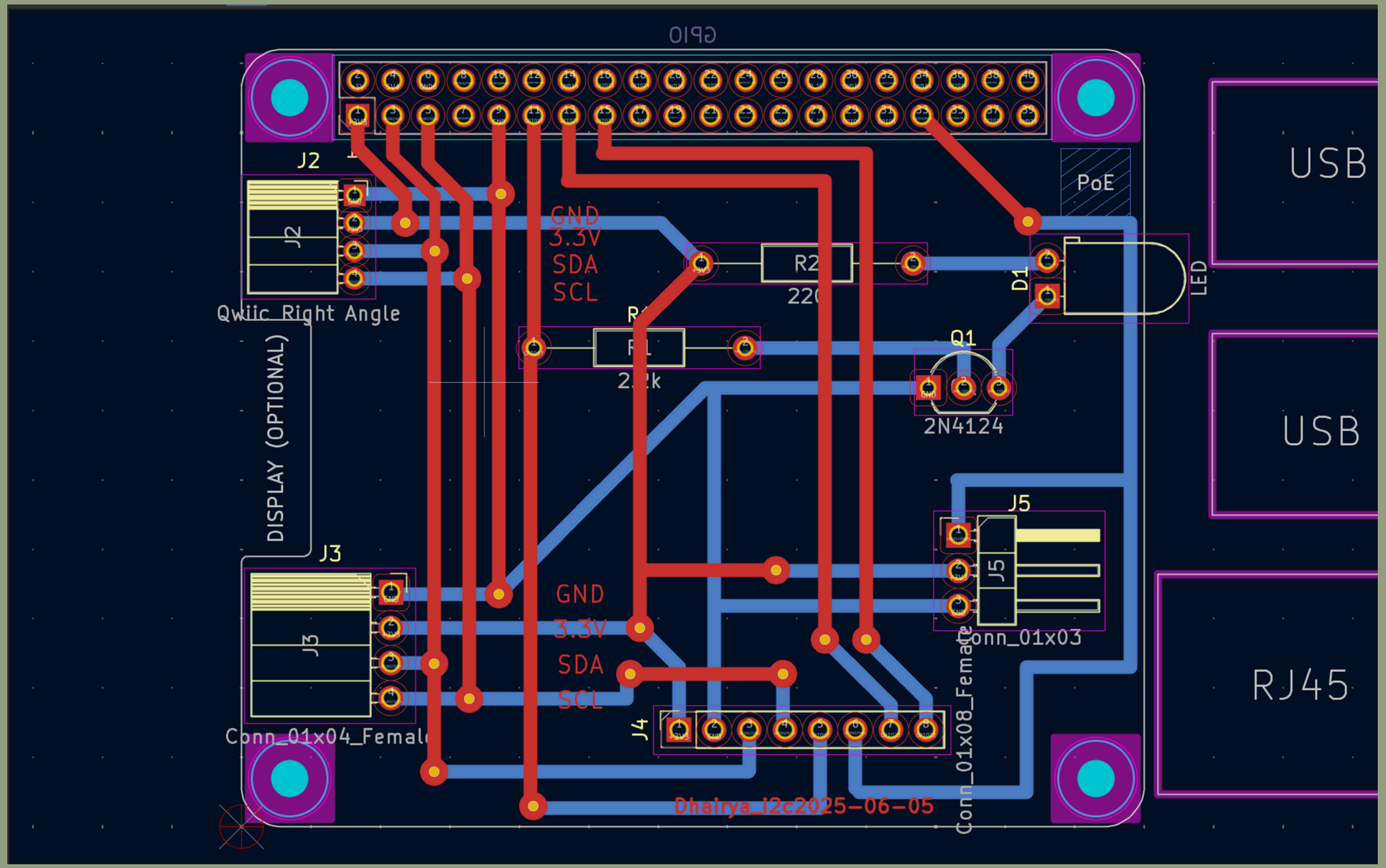
– I²C Address: 0x53

– Communication: I²C (Qwiic–ready), fully supported by Raspberry Pi

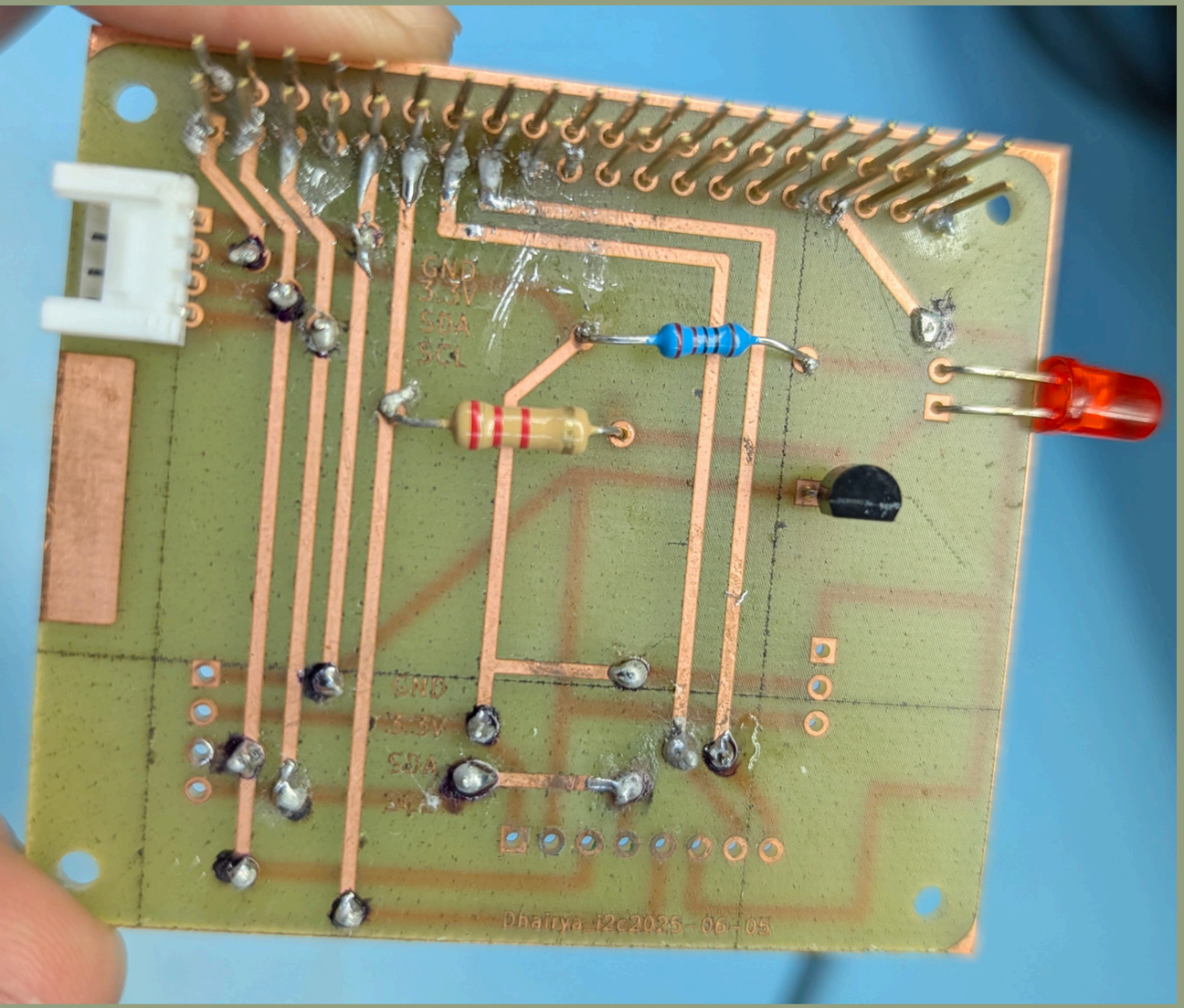
– Warms up ~3 mins

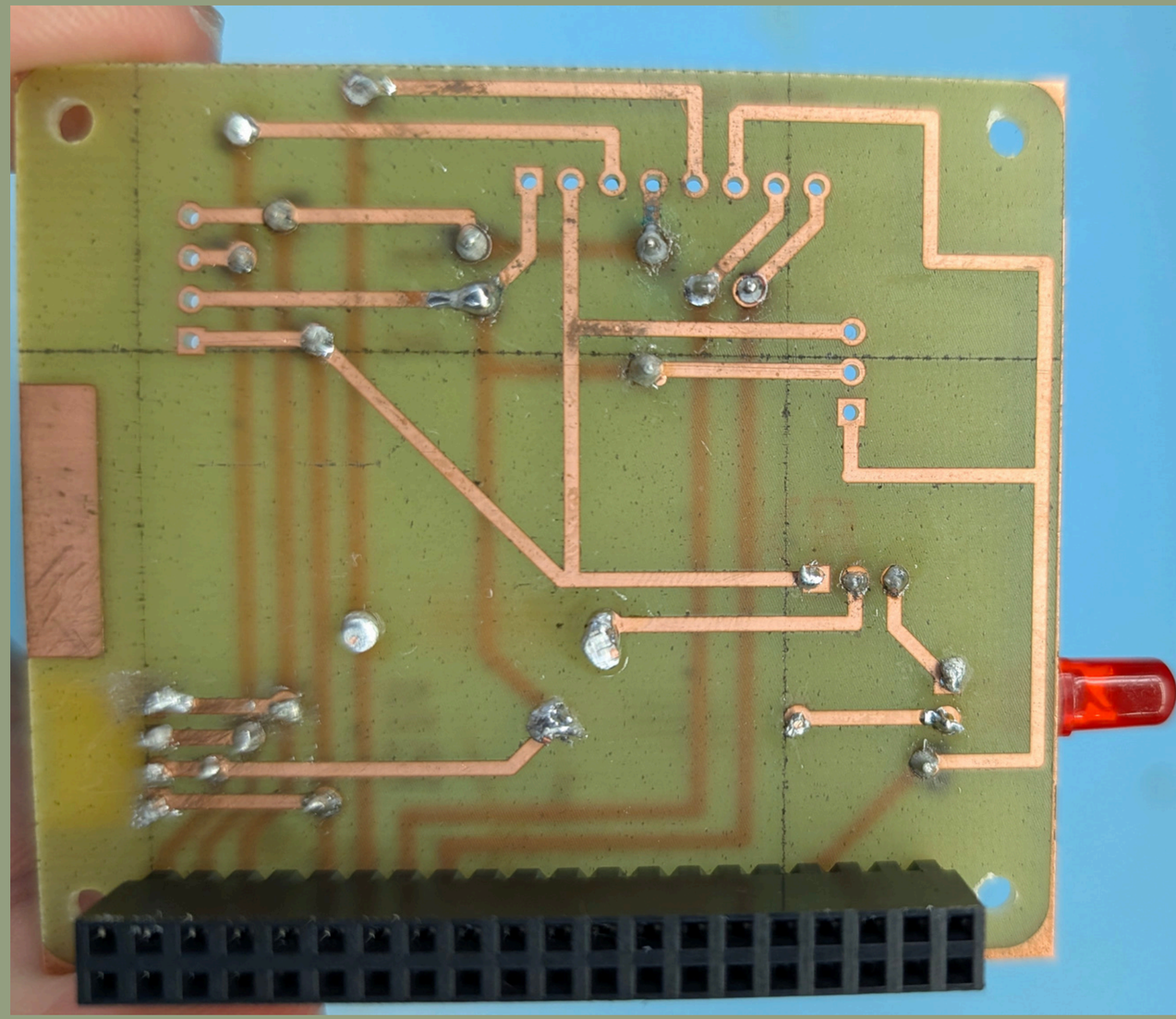
– Speed ~1Hz (I2C allows faster but ENS160 internal update rate is ~1Hz)

Designed PCB

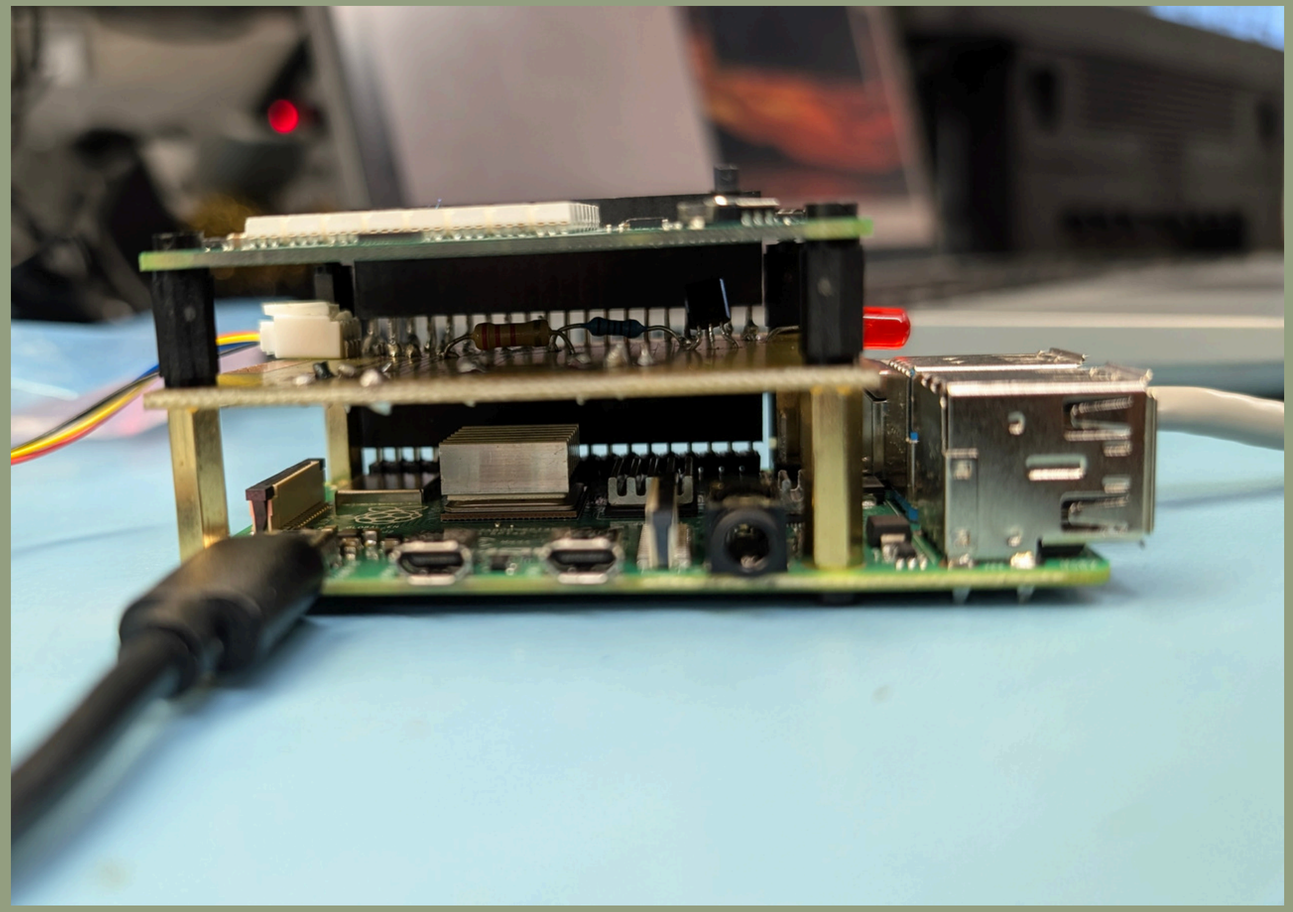


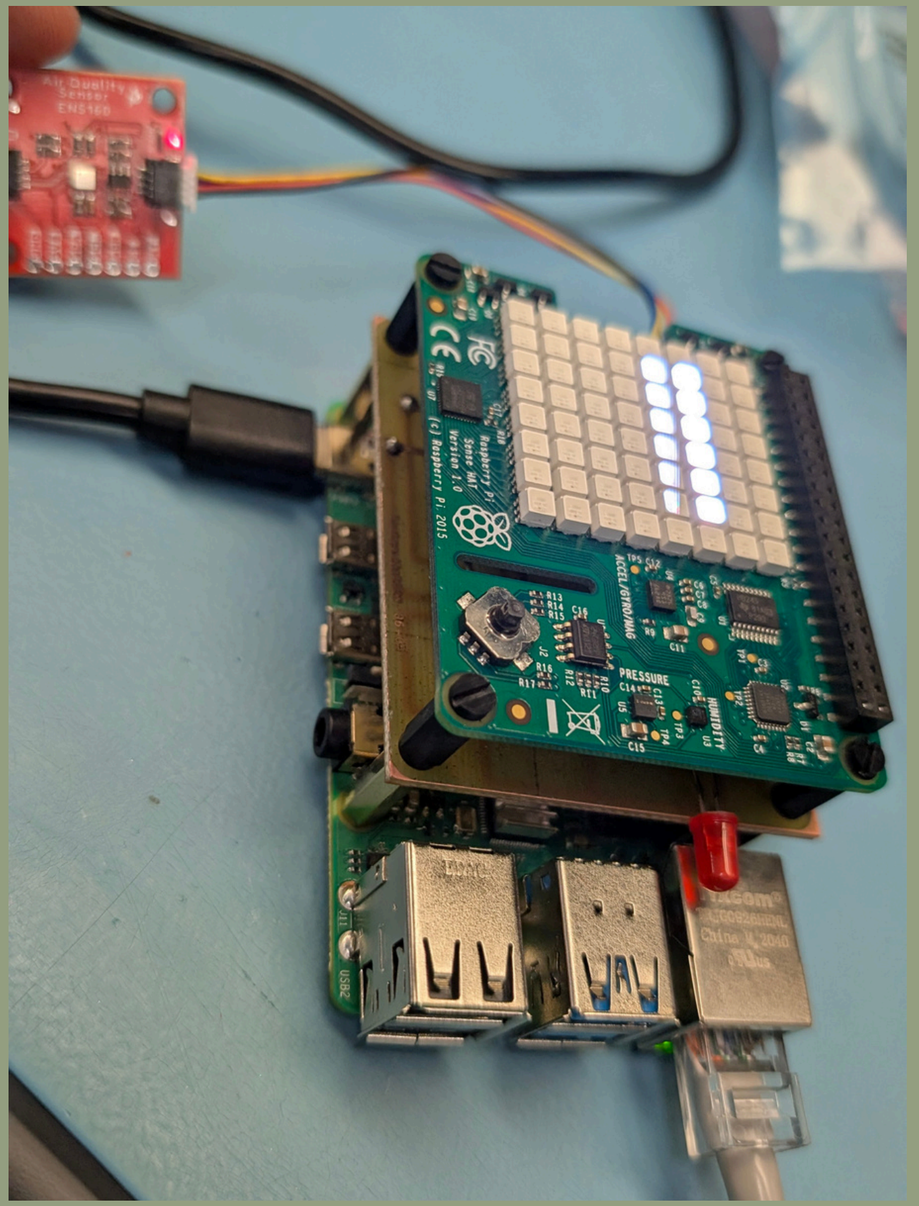
Printed PCB



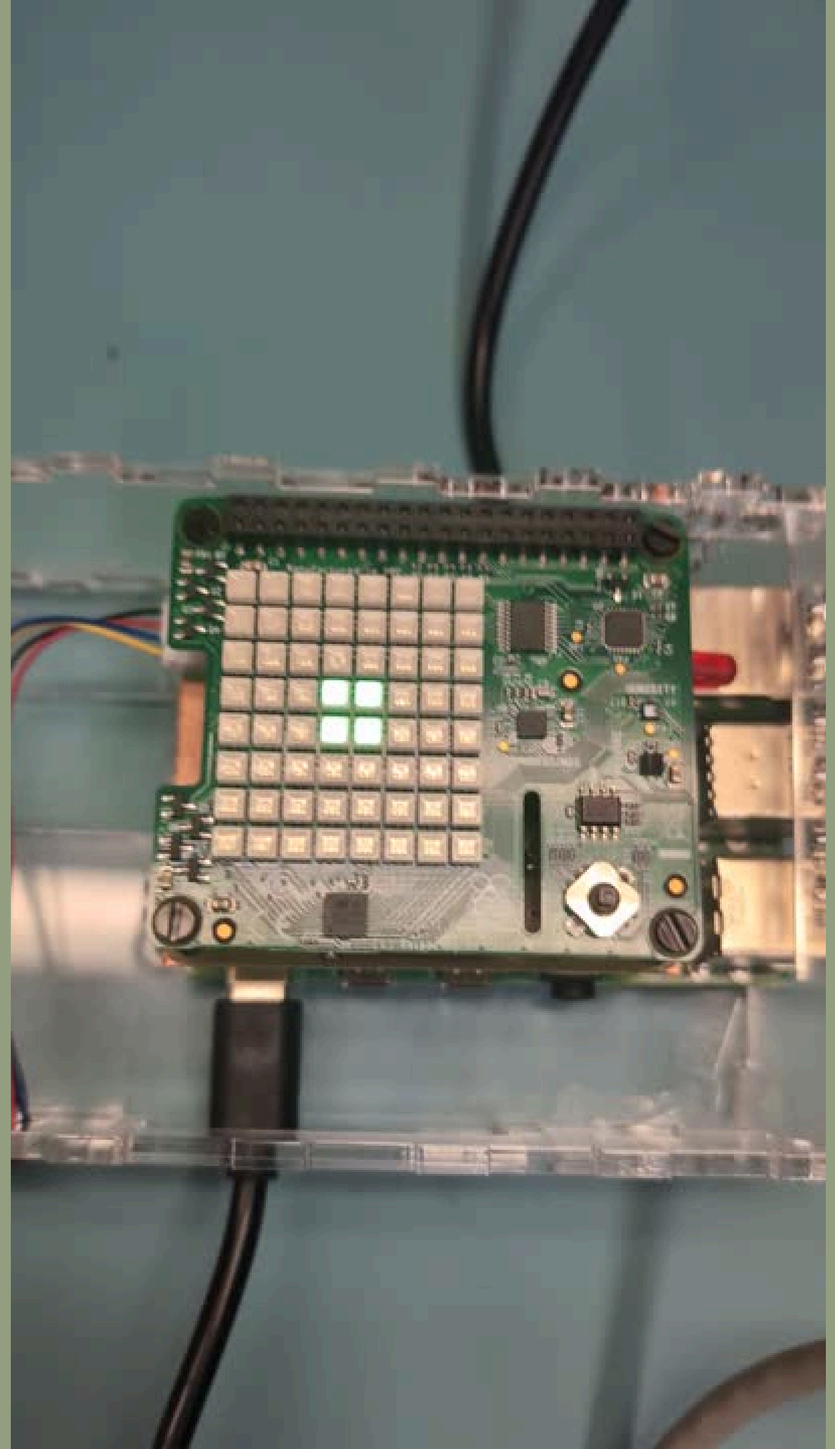


Assembled hardware





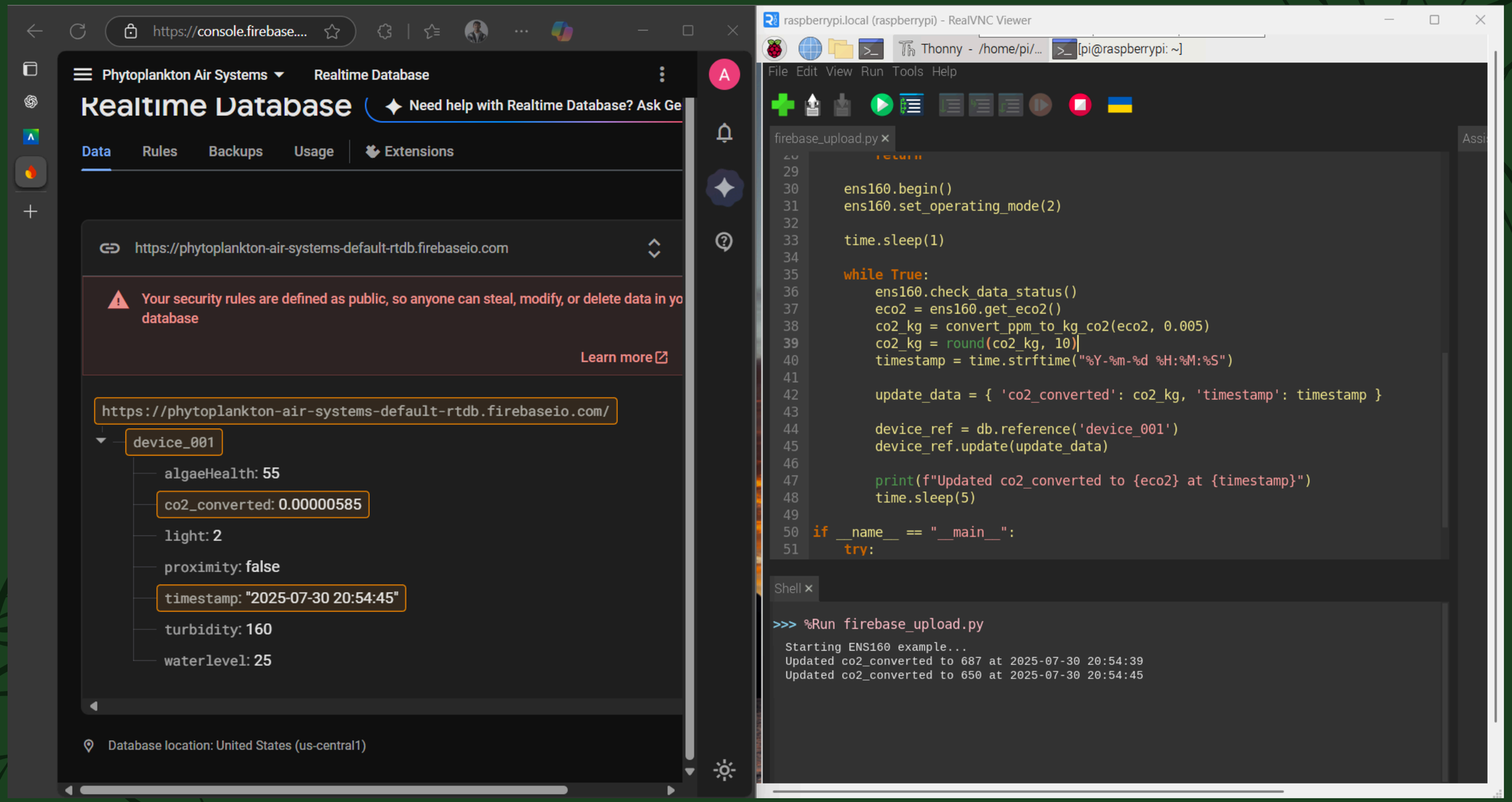
Demo



Code

```
def read_sensor():
    print("Starting ENS160 example...")

    ens160 = qwiic_ens160.QwiicENS160()

    if not ens160.connected:
        print("Sensor not connected. Check your wiring.")
        return

    ens160.begin()
    ens160.set_operating_mode(2)

    time.sleep(1)

    while True:
        ens160.check_data_status()
        eco2 = ens160.get_eco2()
        co2_kg = convert_ppm_to_kg_co2(eco2, 0.005)
        co2_kg = round(co2_kg, 10)
        timestamp = time.strftime("%Y-%m-%d %H:%M:%S")

        update_data = { 'co2_converted': co2_kg, 'timestamp': timestamp }

        device_ref = db.reference('device_001')
        device_ref.update(update_data)

        print(f"Updated co2_converted to {eco2} at {timestamp}")
        time.sleep(5)
```

Sensor updates Firebase values and timestamp



Challenges, solutions, and lessons learned

- Using KiCad, InkScape for the first time
  - Did research
  - Kept patience
- Cold soldering for a few connections – the 40 pin header and the Qwiic connector
  - Resoldered connections nicely and removed the extra cold solder.
  - Checked electrical continuity before moving on to connecting the sensor.
- Sensor light wasn't turning on
  - Connector was loose

Be precise and careful while handling hardware, and ask a lot of questions – to prof, and do your research.

CENG317 Hardware Production Technology

Thank you

Algaerithms Inc.