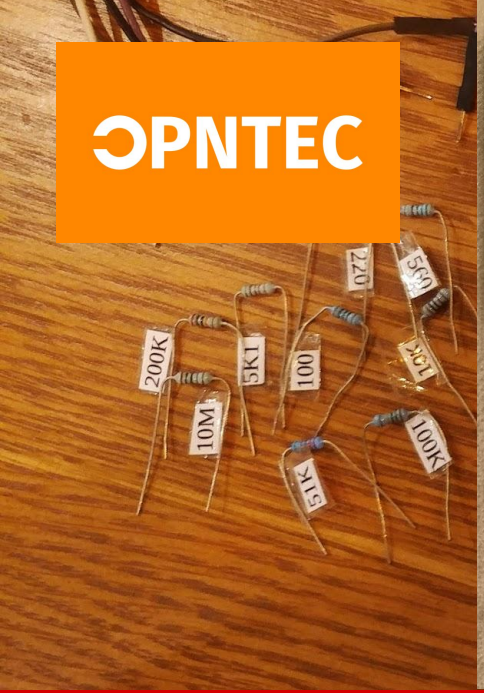
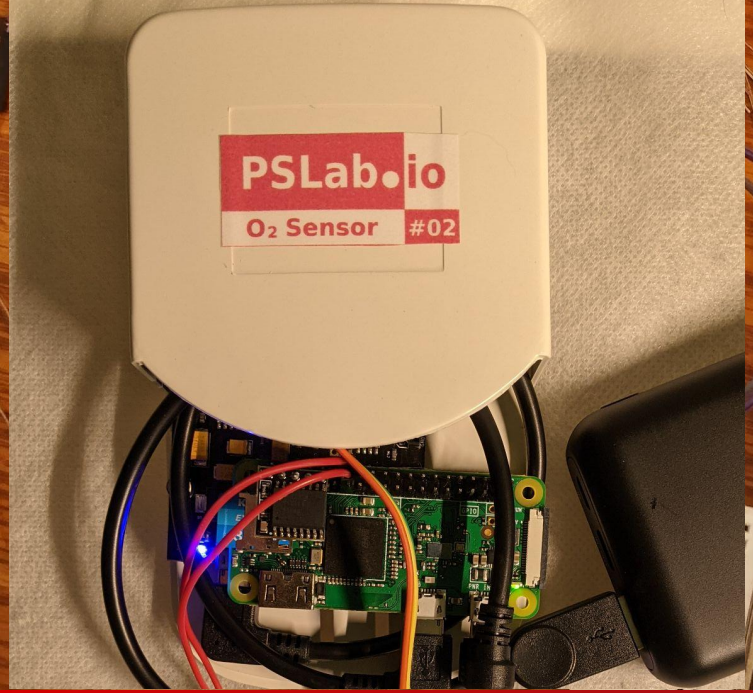
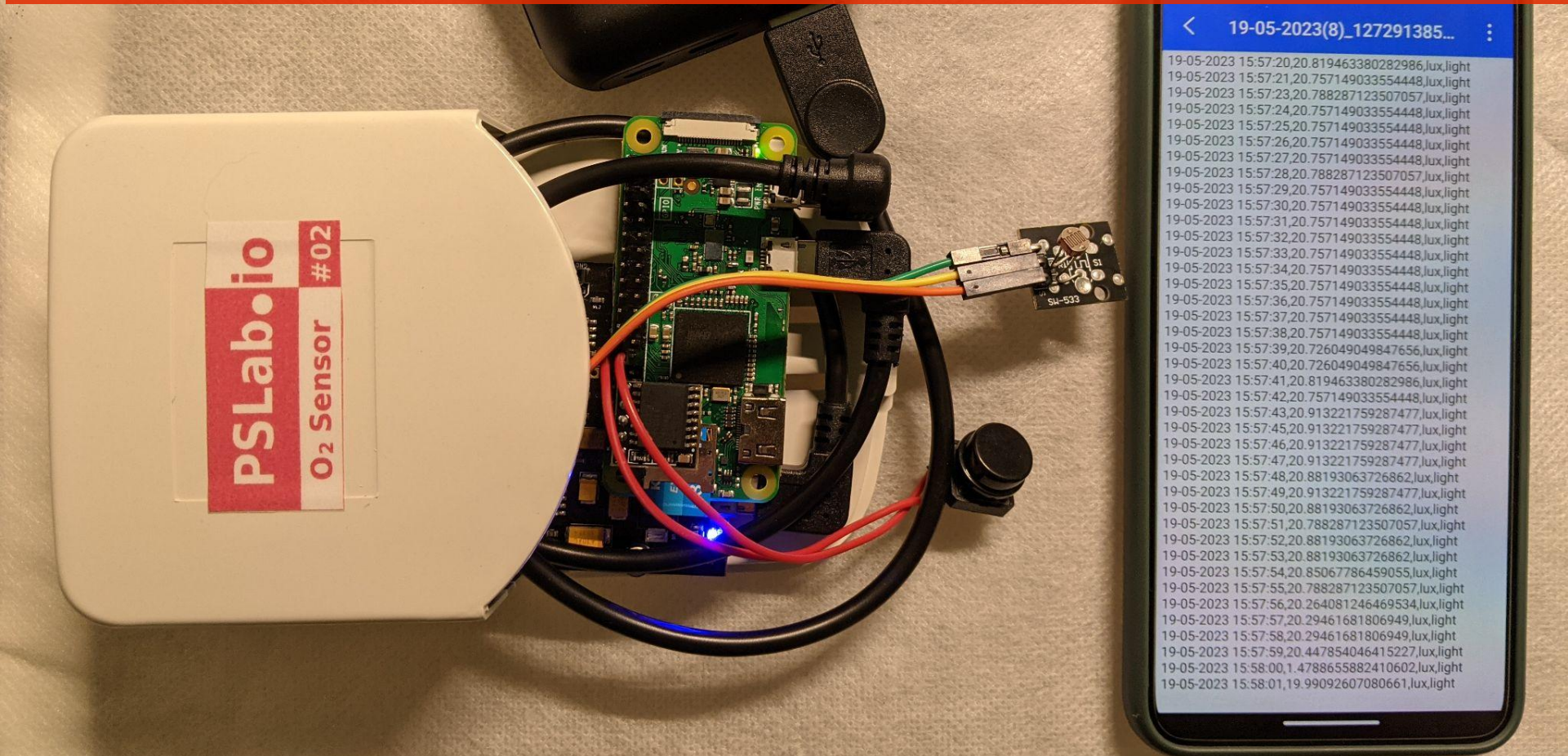


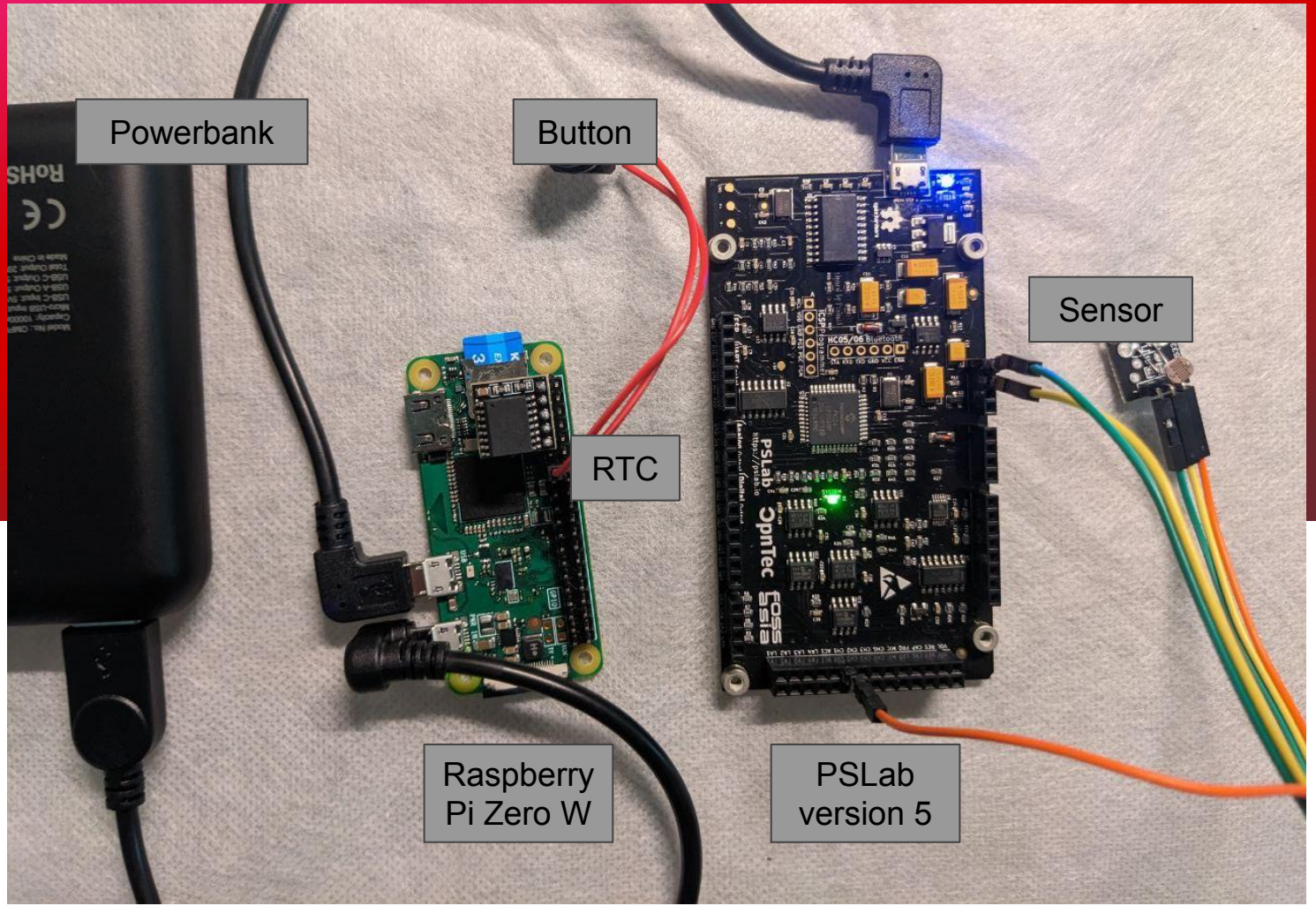


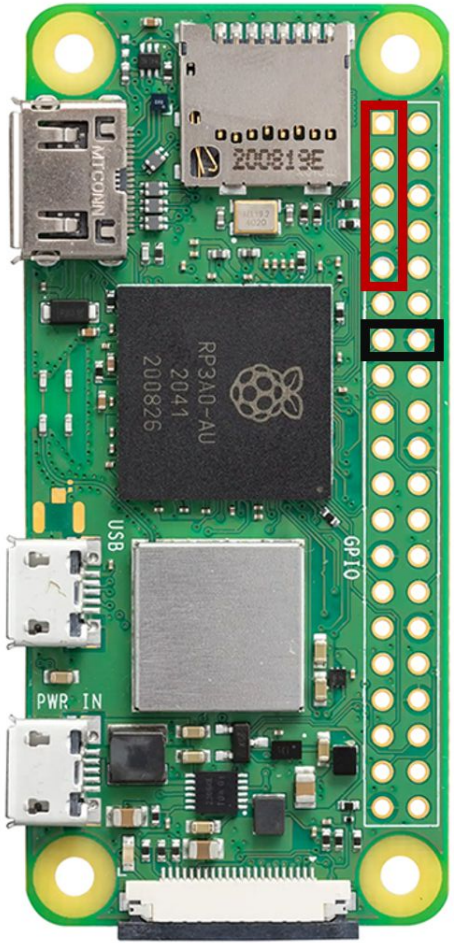
PSLab Sensor Boxes

Rebekka Roßberg, Mario Behling

Let’s make science and knowledge accessible for everyone! From entry level to advanced and industry, create your own scientific sensor boxes and experiments easily.




Powerbank
Button
RTC
Sensor
Raspberry Pi Zero W
PSLab version 5



Additional Hardware

- **Raspberry Pi Zero W**: for permanent data storage on the SD card and hosting of a file server via the integrated Wi-Fi Hotspot
- High Accuracy **Real Time Clock**: for network independent time stamps in the measurement data
- **Button**: for a safe shutdown
- **Powerbank**: for mobile use

1. Measuring Light Intensity

- Measurement in Lux
- Using the **GL5528** photo-resistor
- Embedded within the **KY-018**'s voltage divider circuit
- Value on exponential scale

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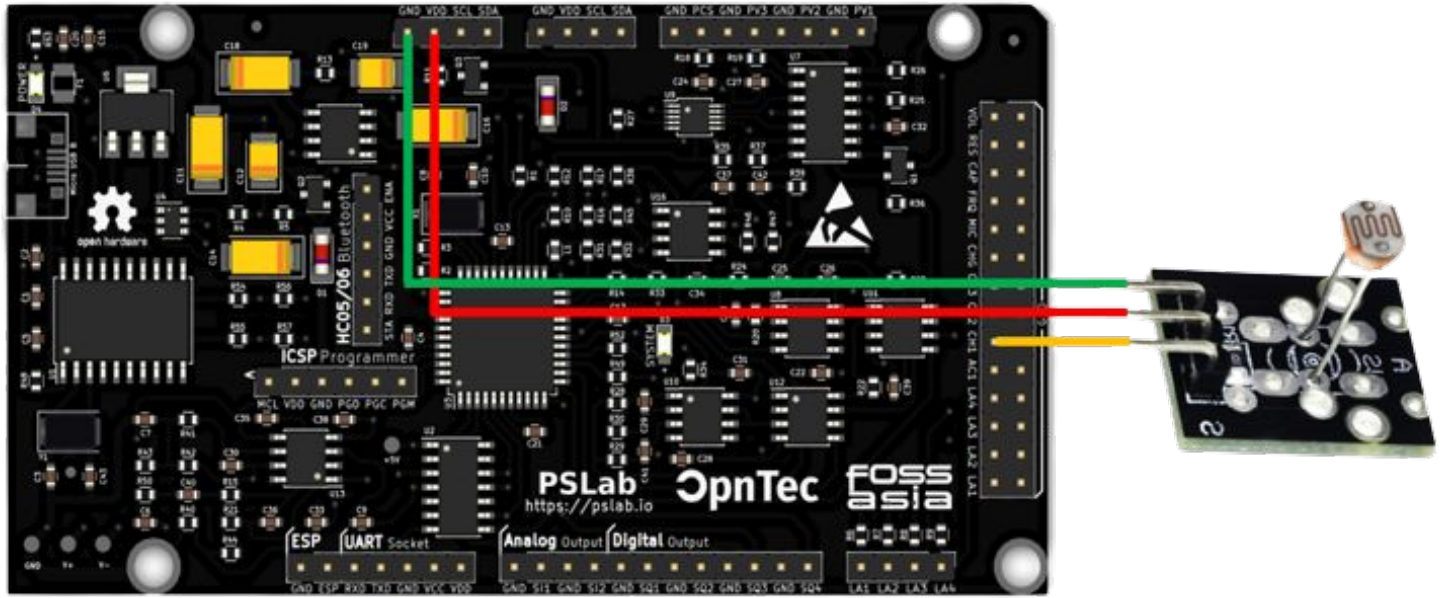
Lux-Meter #01

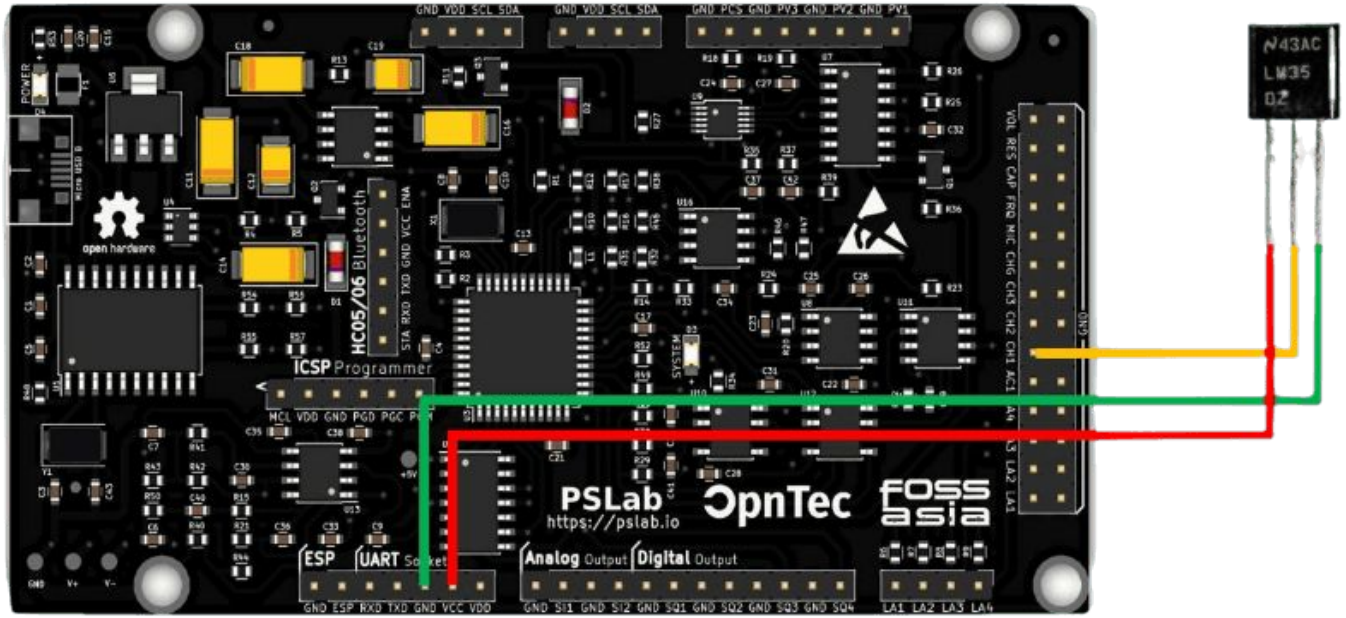
Light Intensity Sensor: GL5528



2. Measuring Temperature

- Using the **LM35** sensor
- Range: -55 °C to 150 °C
- Accuracy: +/- 1 °C

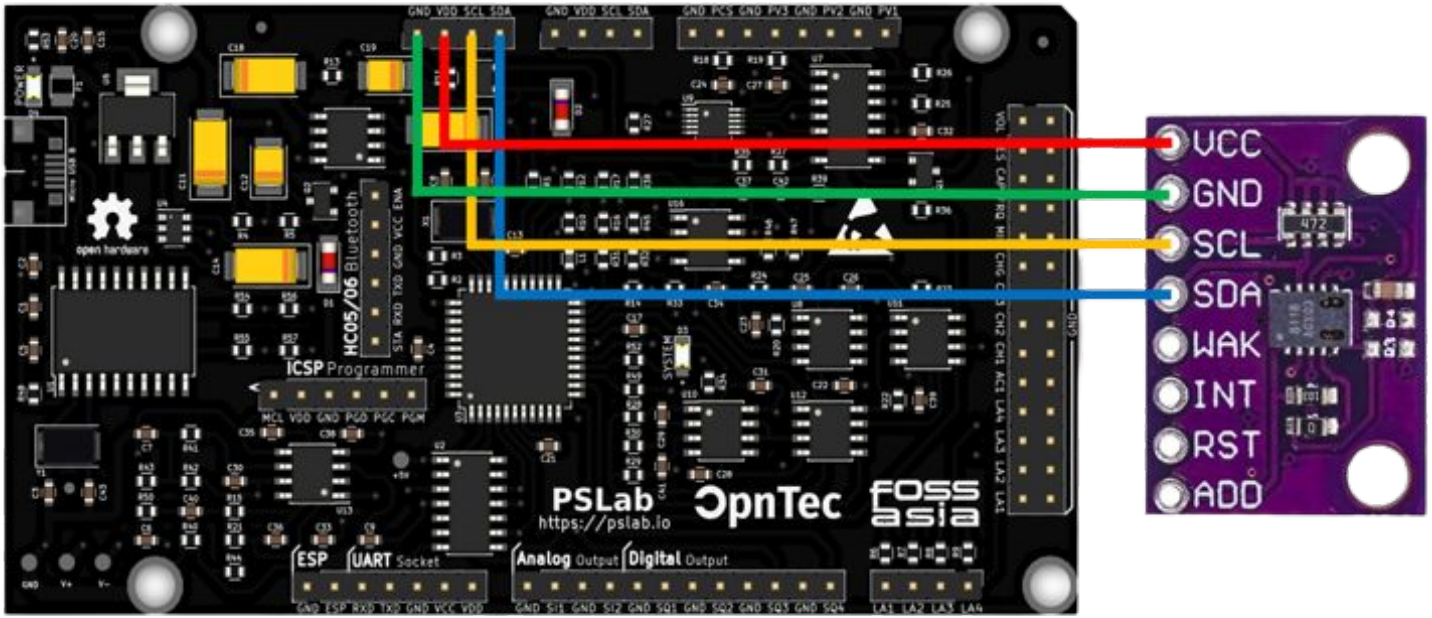
Temperature Sensor: LM35



3. Measuring CO_2

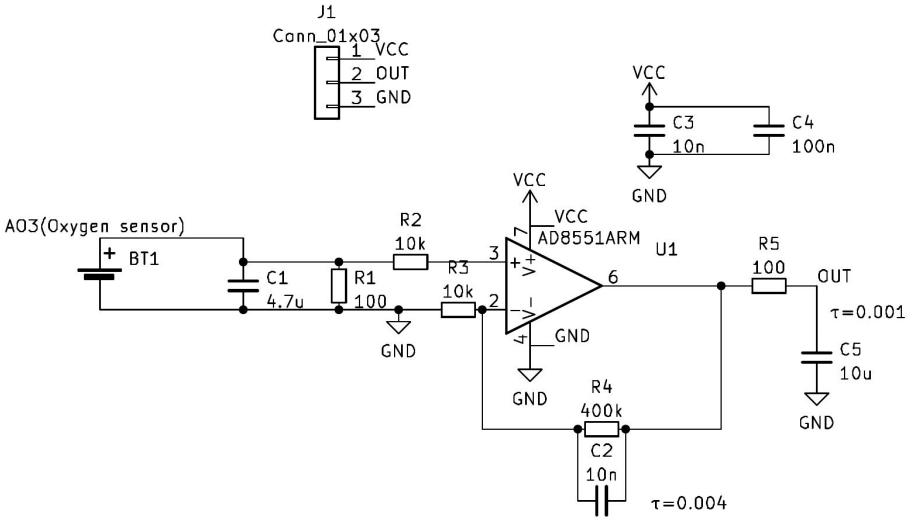
- Measurement in particles per million (ppm)
- Using the **CCS811** sensor for CO_2e quantification:
  - Accurate measurement of green house gases
- Automatic offset of temperature and humidity
- Lower limit of 400ppm CO_2e
- Embedded on the **CJMCU-8118** circuit board
- With custom I²C driver

CO_2 Sensor: CCS811



4. Measuring Oxygen

- Measures the percentage of oxygen in the surrounding air
- Using the **AO-03** sensor
- Embedded in a custom circuit board for signal amplification



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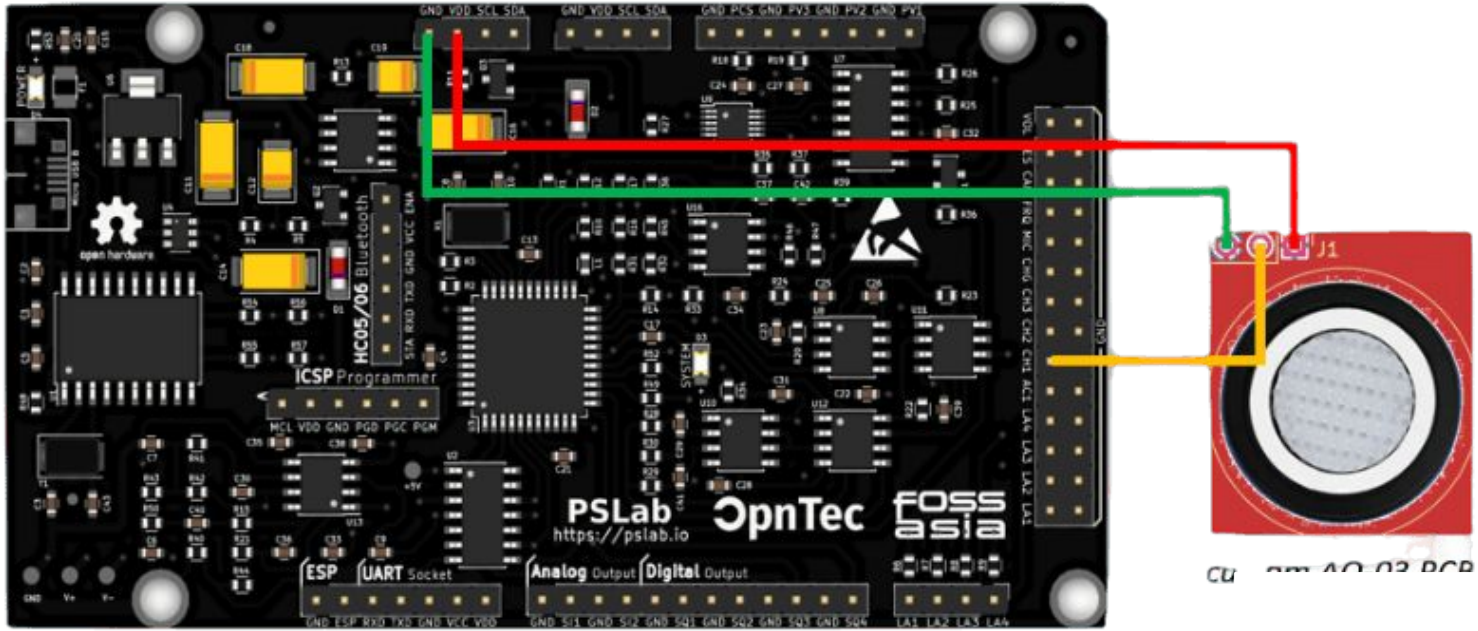
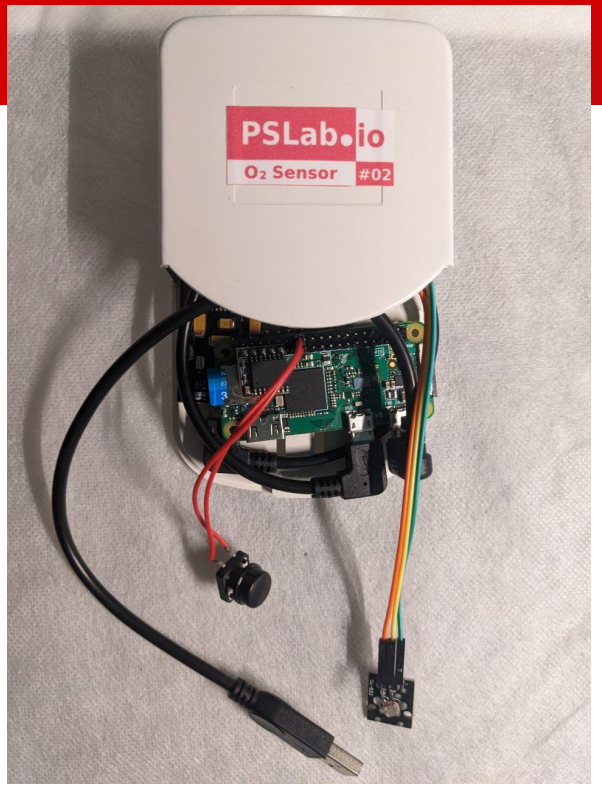
O_2 Sensor #01

Oxygen Sensor: AO-03



Stealth Design for Outdoor Usage



Basic Usage

- Plug Power Source into the PSLab Sensor Box
  - **Measurement starts**
  - Wi-Fi Hotspot for file sharing is opened
- To fetch the measurement data:
  - Connect PC/ phone to the corresponding **Wi-Fi Hotspot**
  - Access **file server**
  - Fetch **CSV** file
- Push button to trigger the safe shutdown

Connecting

- Detailed **manuals** to initialize a connection to the file server can be found in the [GitHub Repository]
- Currently Windows, Mac, Linux, Android, and iPhone are supported there

General Advice

- Wait a minute or two after starting the PSLab sensor box
- Ensure an **active Wi-Fi connection**
- Access the file server “anonymously”
- Choose unique connection names

Linux

- Open the file explorer
- The new device “PSLab” should automatically appear in the network section (else, refresh the page)
- Connect to this device

Windows

- Open the file explorer
- Right click on "This PC" and select "Add Network Address"
- Choose to add a user defined network address and enter "\\10.42.0.1\data" as this address
- Assign a name to this new connection

Mac

- Hit Command+K and look for "Connect to Server"
- Enter "smb://10.42.0.1/data" as the server address and click "Connect"
- Confirm the action be entering your login details

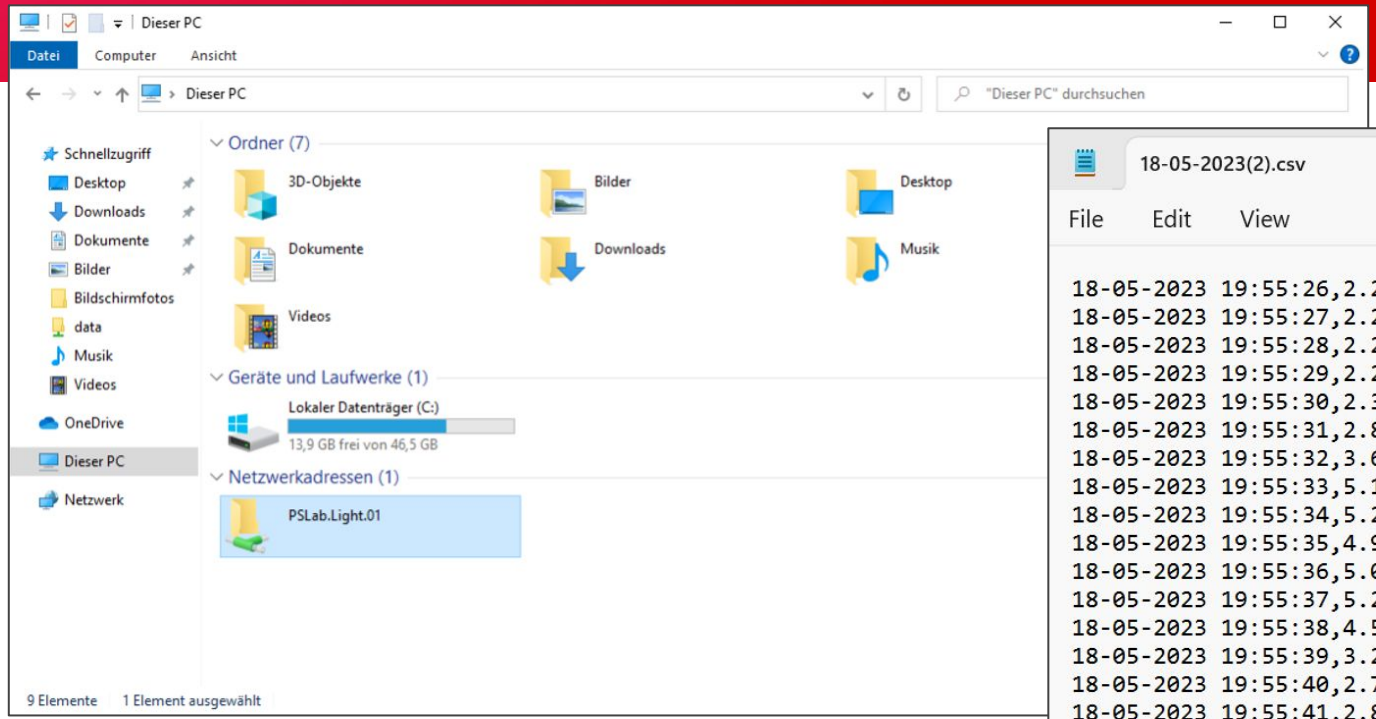
iPhone

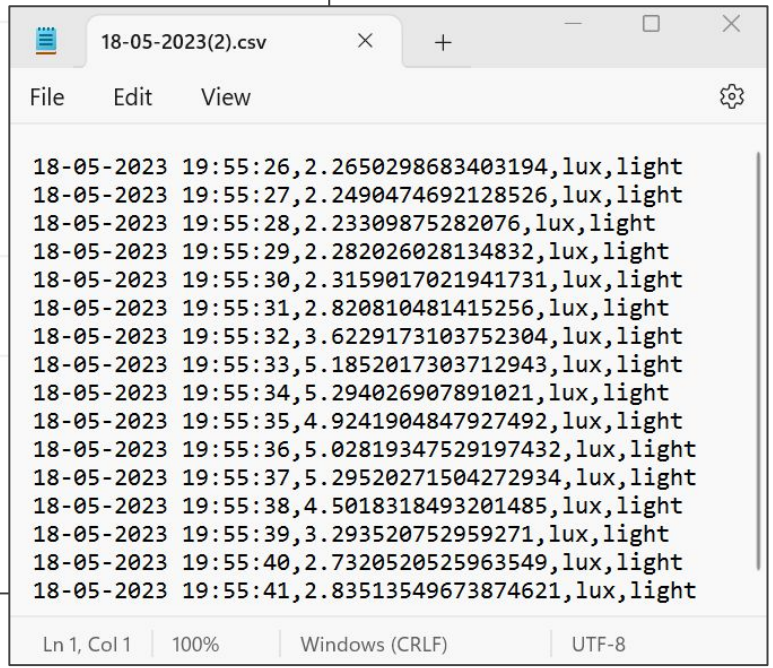
- Open the "Files" app
- Select "Browse" > "Connect to Server"
- Enter "smb://10.42.0.1/data" as the network address and click "Connect"

Android

- Network device support depends on the specific phone type
- In case they are not supported, there are several external applications for this use case available in the Play Store or on F-Droid

Accessing the Data





Up Next: Advanced Projects for Students

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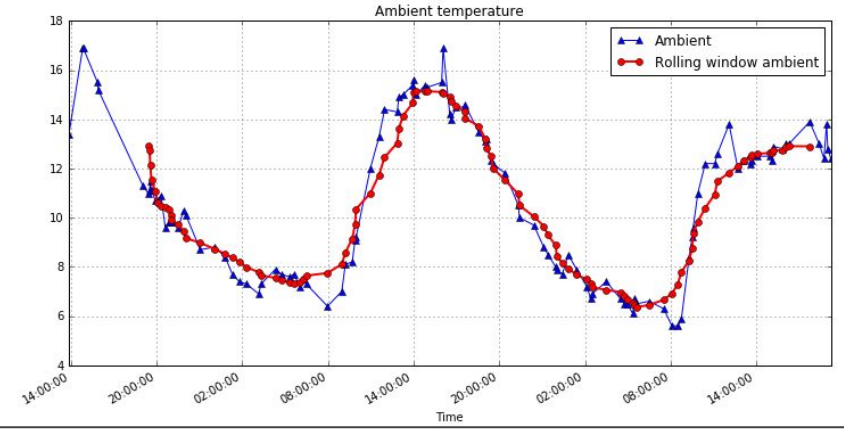
- Accessing the Raspberry Pi operating system
- Manually running the sensor scripts
- Adjusting the **measurement interval**
- Adjusting the **flushing interval**
- Accessing the continuous measurement data stream via an **API**
- Fetching Software Updates from GIT
- Changing the **sensor type**
- … and many more

Experimenting with Python

```
MEASURING_INTERVAL = 1 # in seconds

experiment_options = { # item_name : [function_name, unit]
    "co2"         : [measure_co2, "ppm"],
    "oxygen"      : [measure_oxygen, "%"],
    "light"       : [measure_light_intensity, "
    "temp"        : [measure_temperature, "°C"]
    }
```

```
In [41]: ax = df['T_ambient'].plot(figsize=(12, 6), grid=True, marker='^')
         ax = df['T_ambient'].rolling(window=12, center=True).mean().plot(ax=ax, grid=True, lw=2, c='r', marker='o')
         ax.set_title('Ambient temperature')
         ax.legend(['Ambient', 'Rolling window ambient']);
```



Thank you!

OPNTEC

https://github.com/fossasia/pslab-scripts

Twitter, Github, FB, Linkedin: @pslabio @opntec

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