

# Temperature Data Analysis



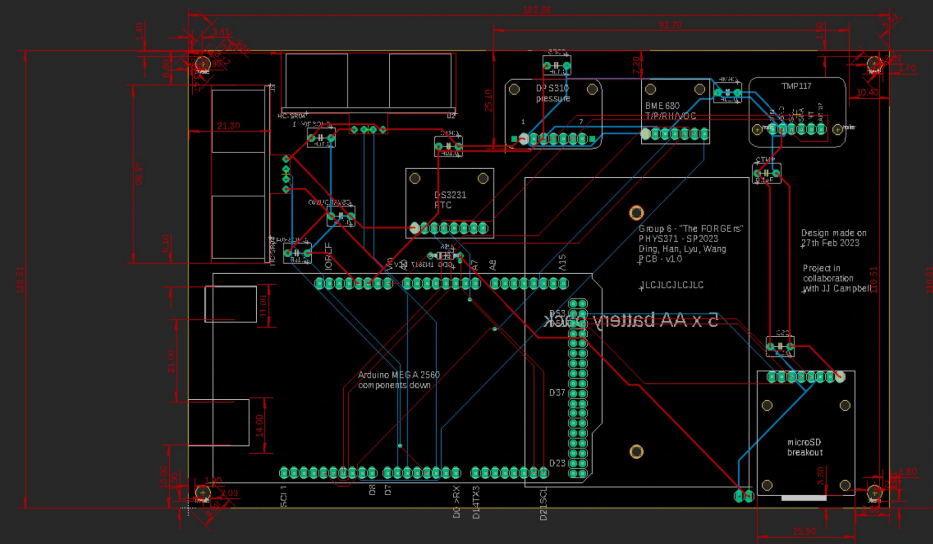
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3/31/2023

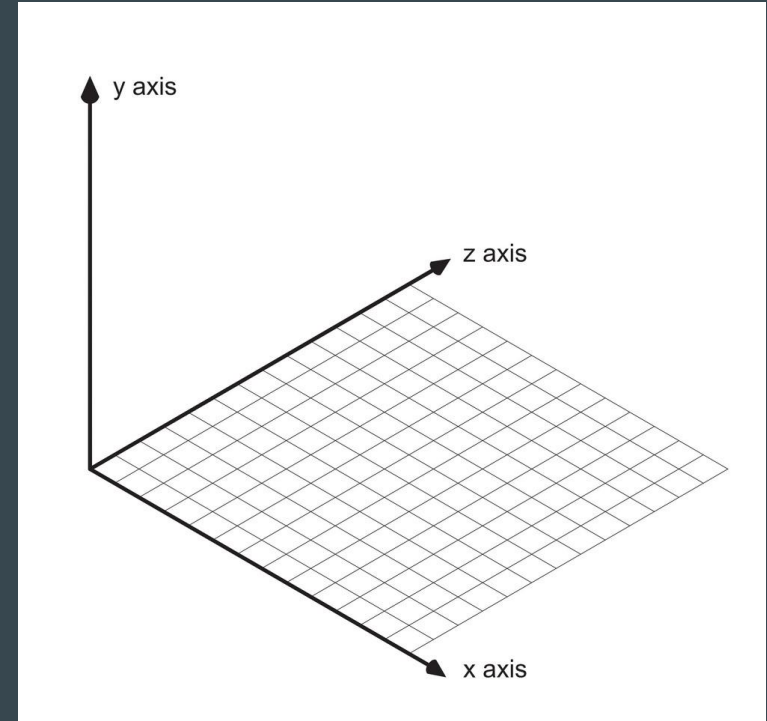
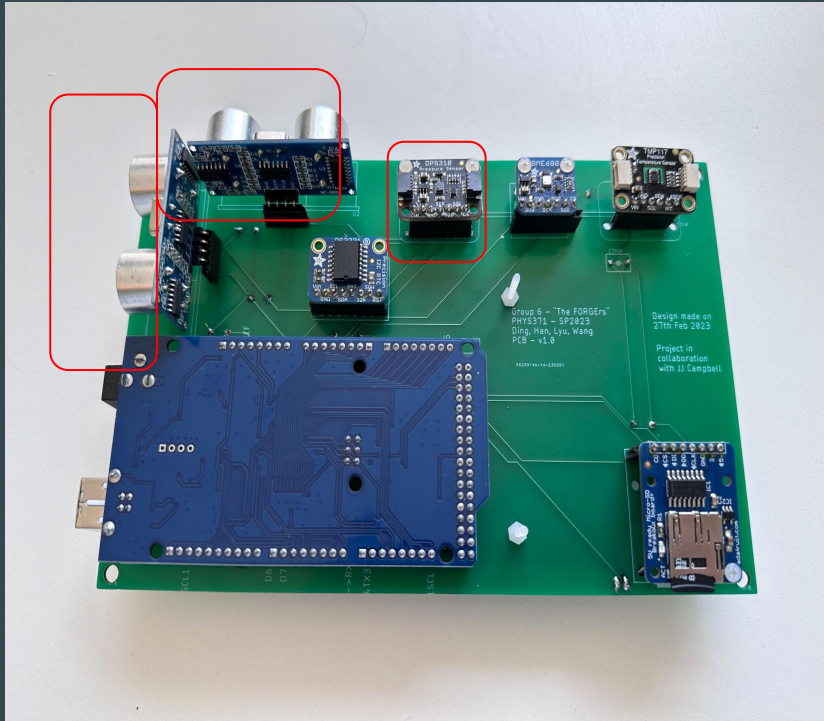
Peter Ding, Charles Wang, Xinying Lyu, Yunlong Han

# Setup

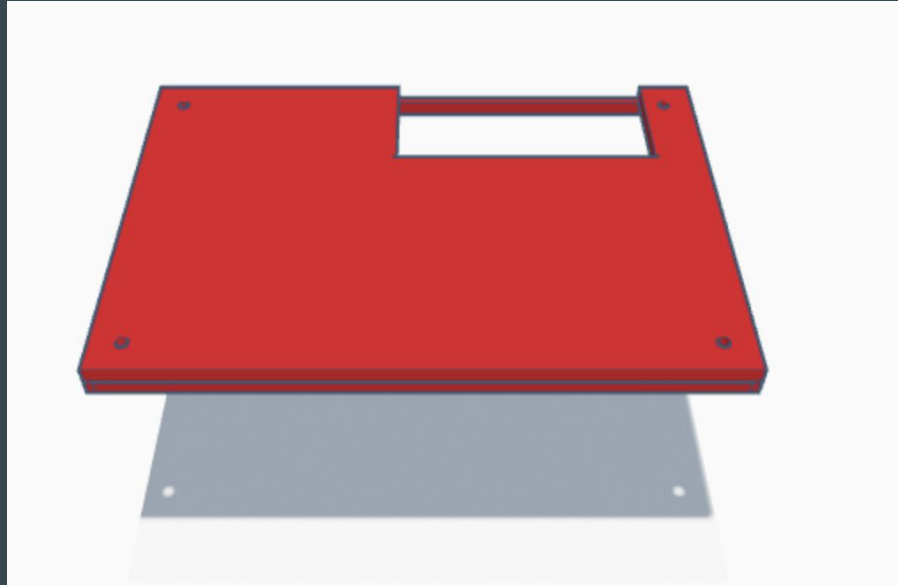
- 3D Printing
- PCB Board Layout



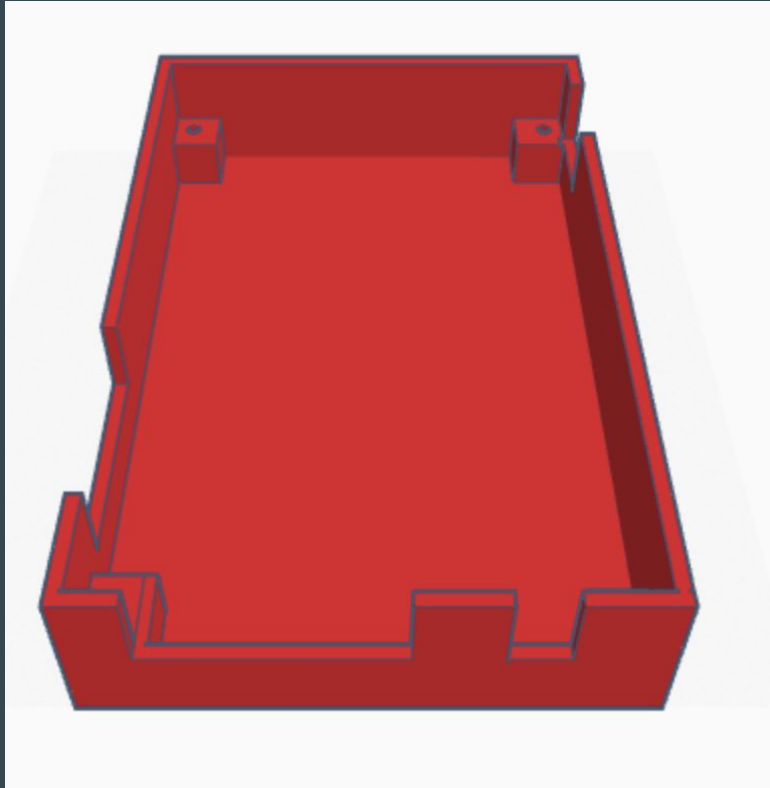
# PCB Design and Reasoning



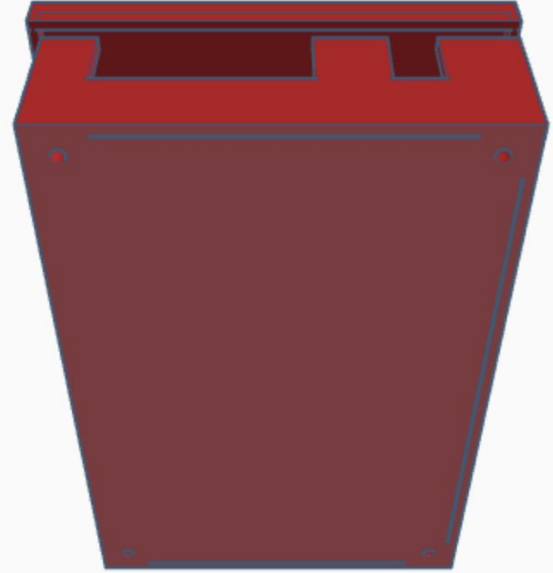
# 3D Printing Cover



# 3D Printing Case



# 3D Printing Case & Cover



# Test Data

- Calibration
- Data Analysis
- Heat Map

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from mpl_toolkits.mplot3d import Axes3D

df = pd.read_csv('all_data_combined.csv')

fig1 = plt.figure()
sns.lineplot(data=df, x='time', y='TMP_cabinet', color='blue', label='Cabinet')
sns.lineplot(data=df, x='time', y='TMP_corner', color='red', label='Corner')
sns.lineplot(data=df, x='time', y='TMP_shelf', color='green', label='Shelf')

ax = plt.subplot()
ax.set_xticks([0, 120, 240, 360, 480, 600, 720, 840, 960])
ax.set_xticklabels(['13:27', '13:45', '14:03', '14:21', '14:39', '14:57', '15:15'])
ax.tick_params(axis='x', labelsize=12)
ax.tick_params(axis='y', labelsize=12)
plt.xlabel('Time', fontsize = 16)
plt.ylabel('Temperature (°C)', fontsize = 14)
plt.title('TMP Temperature vs Time', fontsize = 14)
plt.show()
```

# Calibration of temperature

- Although all sensors are pre-calibrated, there are still some discrepancies in the data acquired by three detectors.
- When we put all three detectors together, the TMP temperature still shows a little difference.
- Therefore, we need to determine how much of the differences between each detector's measurements and use one of the detector as the reference temperature.

Detector #	1	2	3
TMP temperature mean	22.45	22.38	22.81
TMP temperature standard deviation	0.0124	0.118	0.011



# Calibration of Altitude

- The DPS310 altitude measurements exhibit slightly variation within a narrow range of time.
- Every time we initiate a new measurement, we will place the detector on the floor for a period to record the DPS altimeter reading, from which we will calculate the mean. This mean will serve as the reference point for 0 meters.

Detector #	1	2	3
Mean	153.6	151.64	148.55

# Trial Run with 3 sets of sensors

- We positioned our three detectors at the corner of the room, on the shelf, and on the cabinet, respectively.
- Over a 3 hour period
- We will exclude the initial and final few seconds of data, as they may contain unstable results resulting from our handling of the board.

# Location Information

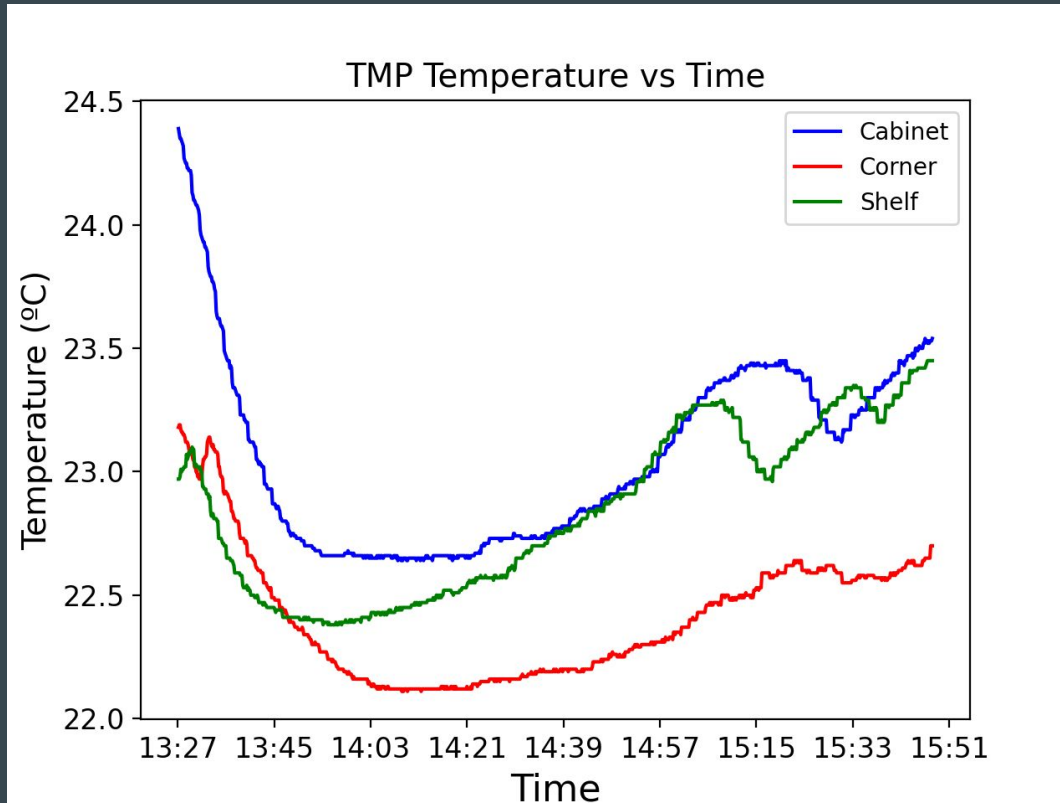
- 3 set of sensors in lab

X_cabinet (cm)	Y_cabinet (cm)	Z_cabinet (m)
389	586	118.29
x_corner	y_corner	z_corner
0	0	121.26
x_shelf	y_shelf	z_shelf
279	396	118.62

3D structure of the lab

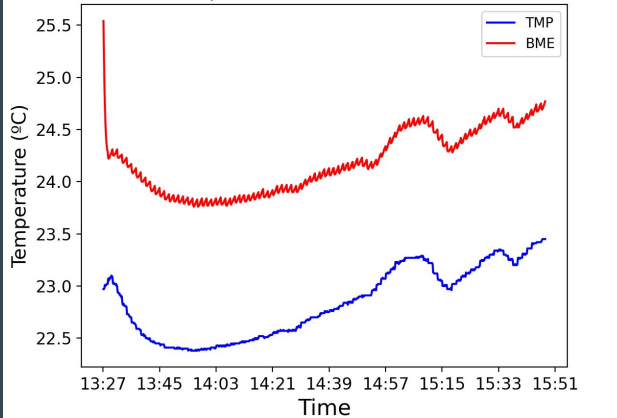


# Visualize temperature change over a period of time

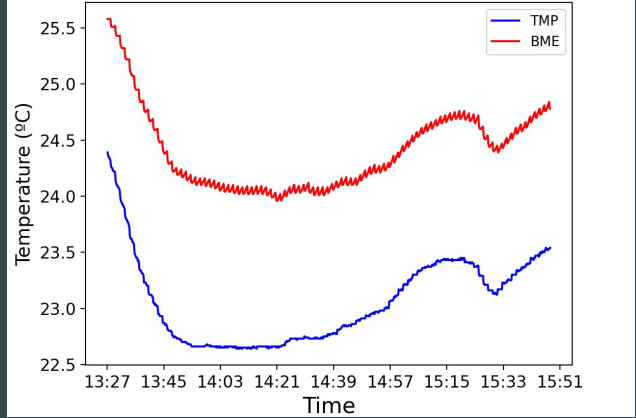


# Temperature change over time

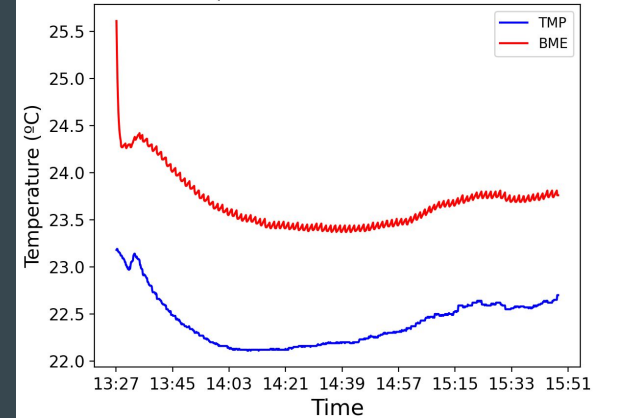
TMP and BME Temperature vs Time for Detector on the Shelf



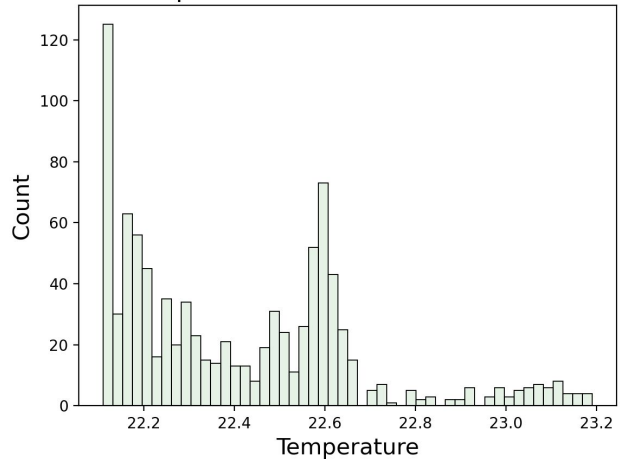
TMP and BME Temperature vs Time for Detector on the Cabinet



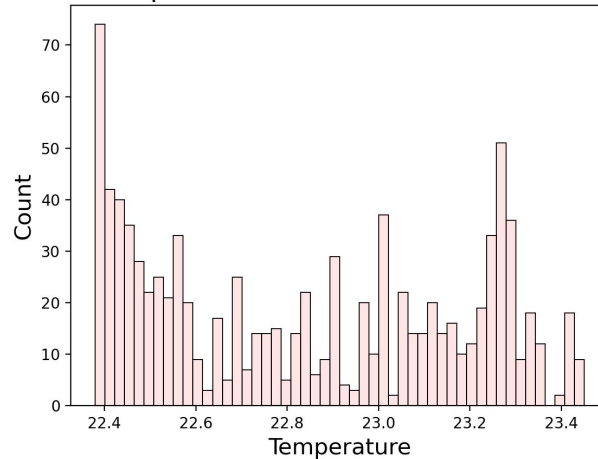
TMP and BME Temperature vs Time for Detector at the Corner



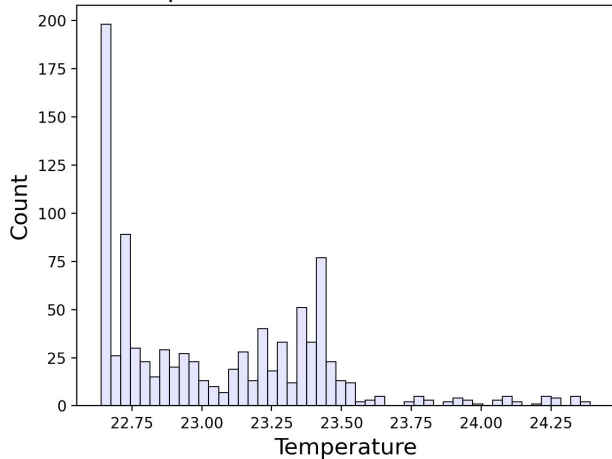
### Temperature Distribution at Corner



### Temperature Distribution on the Shelf

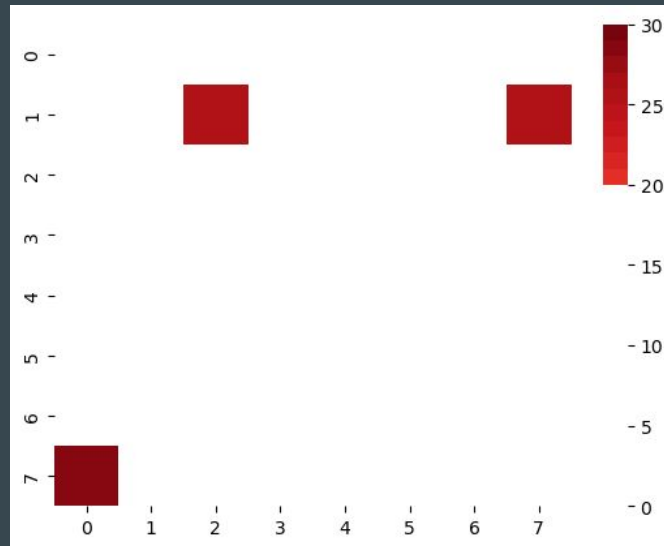


### Temperature Distribution at Cabinet



# Heat Map

- A heat map is generated based on the x, y, and z coordinates of each detector placed inside the laboratory.
- The warmer the color, the higher the temperature



# Next Step

- Problems need to be solved
  - Interactive Heat Map
  - Data Collection
-



# Problems During the Trial Run

Time
3/28/23 13:27:44
3/28/23 13:27:45
3/28/23 13:27:47
3/28/23 13:27:48
3/28/23 13:27:50
3/28/23 13:27:51
3/28/23 13:27:52
3/28/23 13:28:02
3/28/23 13:28:03
3/28/23 13:28:04
3/28/23 13:28:06
3/28/23 13:28:07

- The difference in time intervals causes significant difficulties when visualizing the data.
- We will improve our Arduino code to fix this problem.

# What's Next

- Mapping HeatMap onto the layout of the lab room
- Export the interactive HeatMap from python
- Make test at more locations and measure how does the altitude change affect temperature
- Figure out where roughly in the lab room is better suited for optic fiber experiments by comparing how temperature changes over time

**Thanks!**