Dorm Environ Lab

Urban Informatics II Final Report

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The "Dorm Environ Lab" is a project focuses on human behavior and its influence on the micro environment in buildings and cities.

Introduction

Initial project

The initial project was a city-scale project, which was planned to be carried out in Starlight Park and expanded to other parks in New York City. The idea of that project is to find out the relationship between micro environment and human behavior by monitoring human activities and environmental indices.

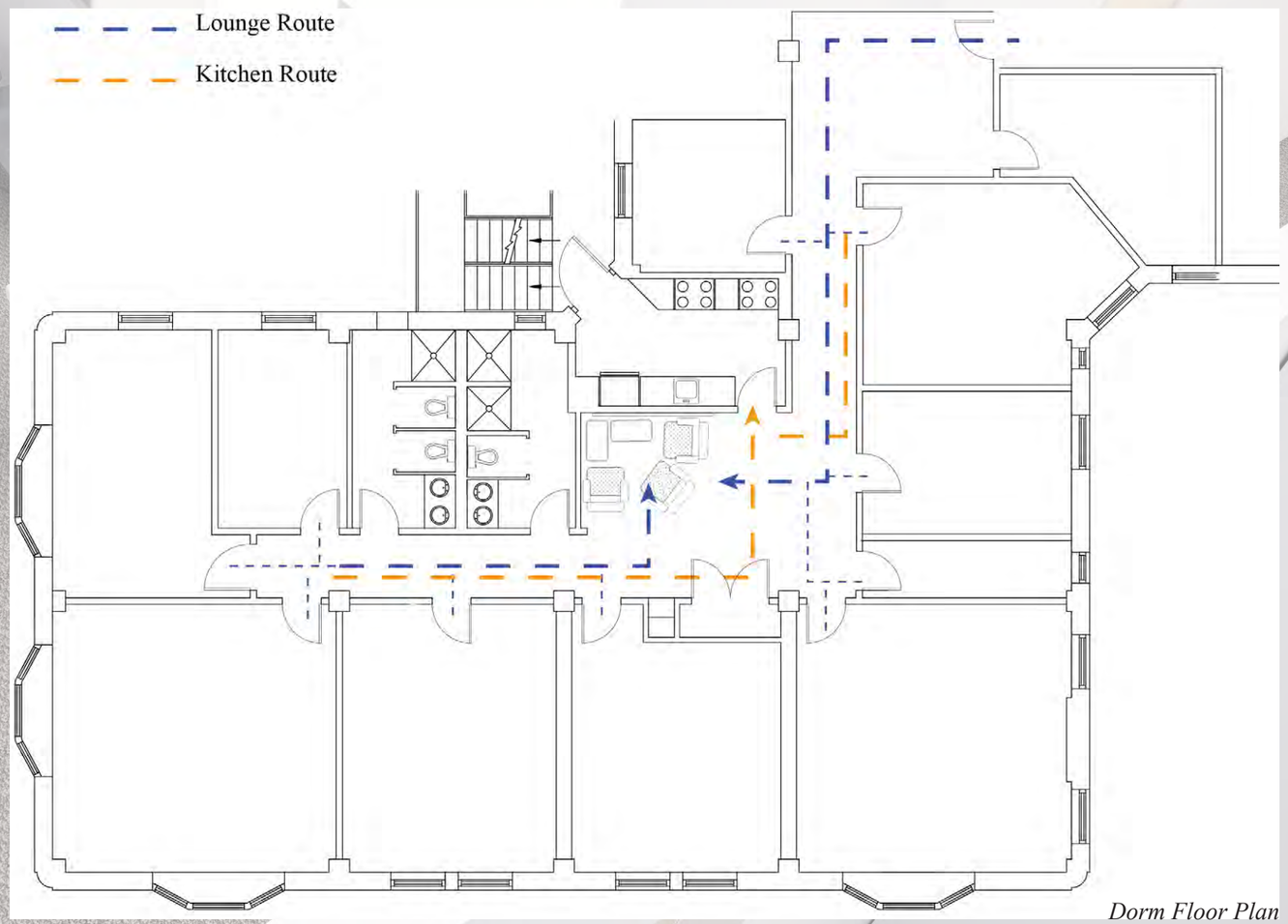
Introduction

Current project

Because of the outbreak, the scale of the project was switched into a dorm of the student apartment building. In the current project, sensors are used to collect people's activity data and the environmental data. By analyzing these data, we can find the correlation between human behavior and the indoor micro-environment.

Local Interactions

In this project, two types of data are required. One is human activities, another is environmental data.



Dorm Floor Plan

Technologies Used

3D Model & VR

A digital model of the indoor space is created and rendered in Enscape. It can be combined with VR tools, which can help the audience to understand the space better when they can’t physically enter the place.

Technologies Used

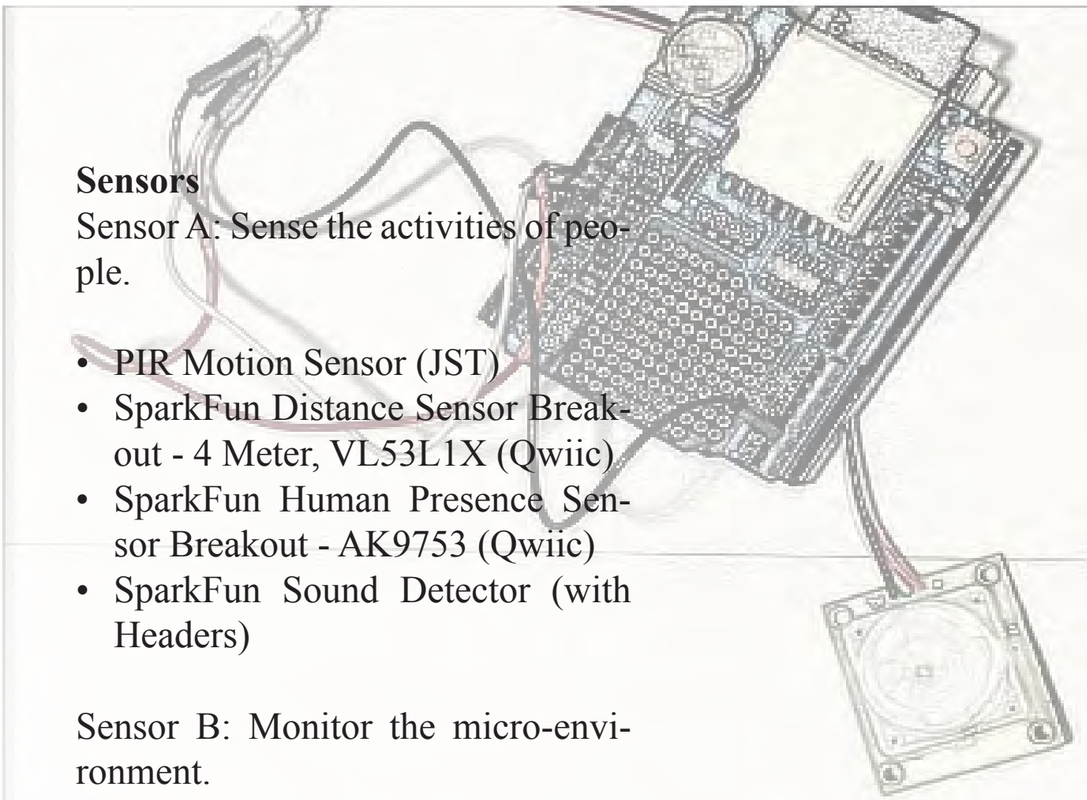
Sensors

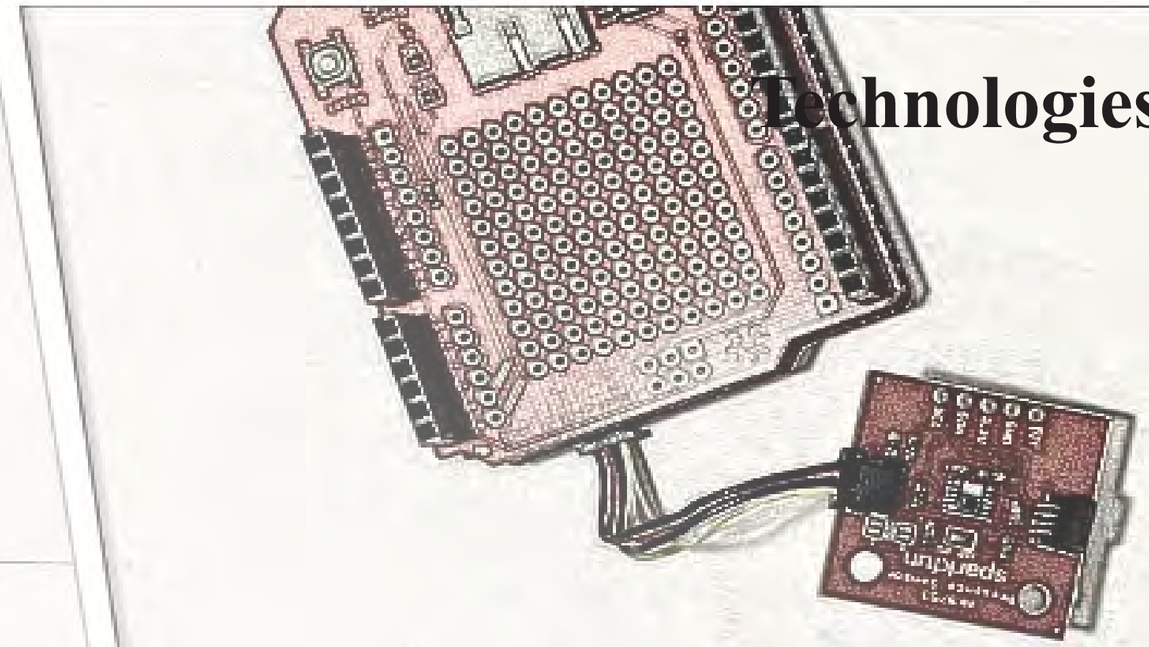
Sensor A: Sense the activities of people.

- PIR Motion Sensor (JST)
- SparkFun Distance Sensor Breakout - 4 Meter, VL53L1X (Qwiic)
- SparkFun Human Presence Sensor Breakout - AK9753 (Qwiic)
- SparkFun Sound Detector (with Headers)

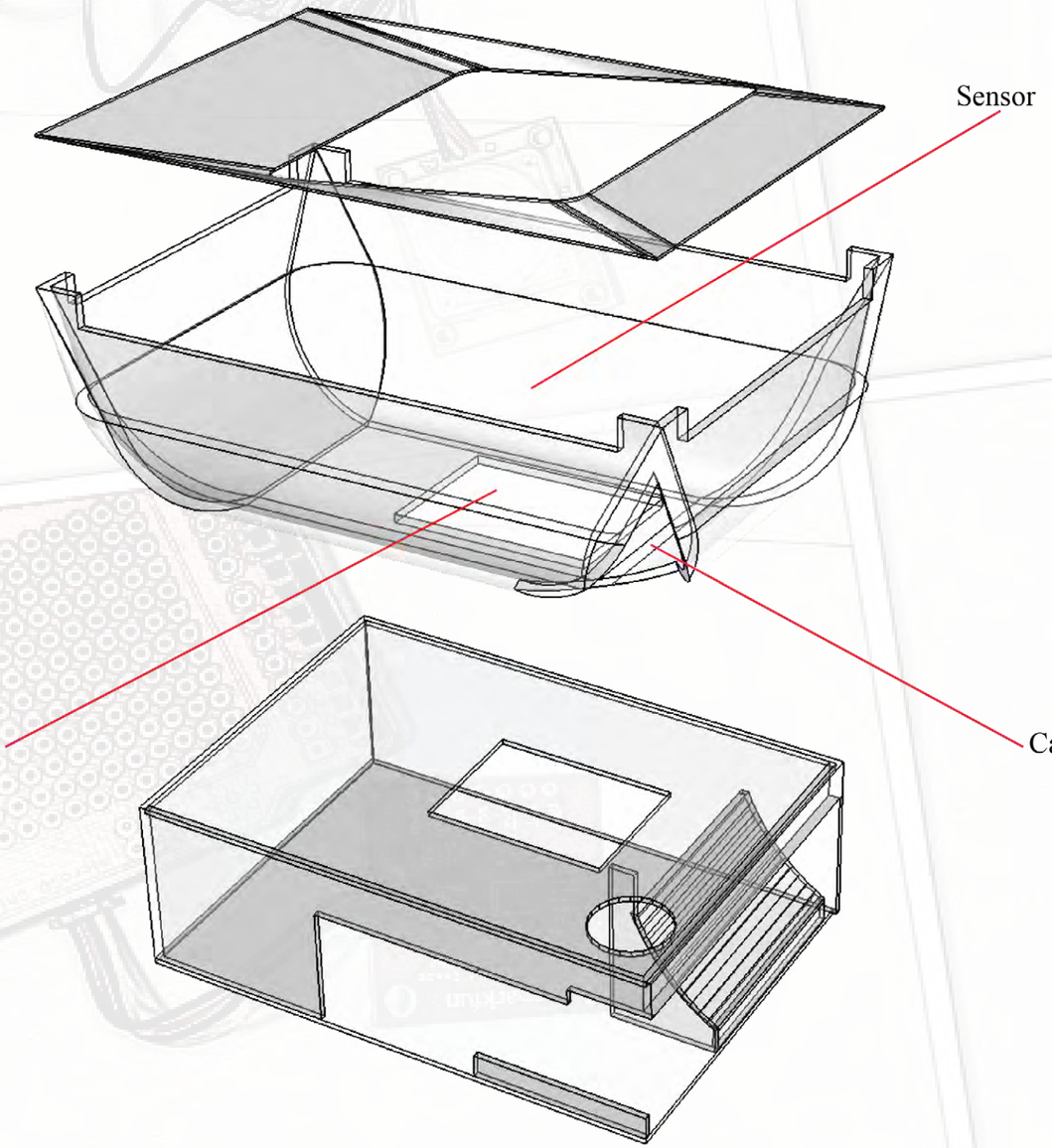
Sensor B: Monitor the micro-environment.

- SparkFun Atmospheric Sensor Breakout - BME280 (Qwiic)
- SparkFun Air Quality Breakout - CCS811
- SparkFun Ambient Light Sensor - VEML6030 (Qwiic)



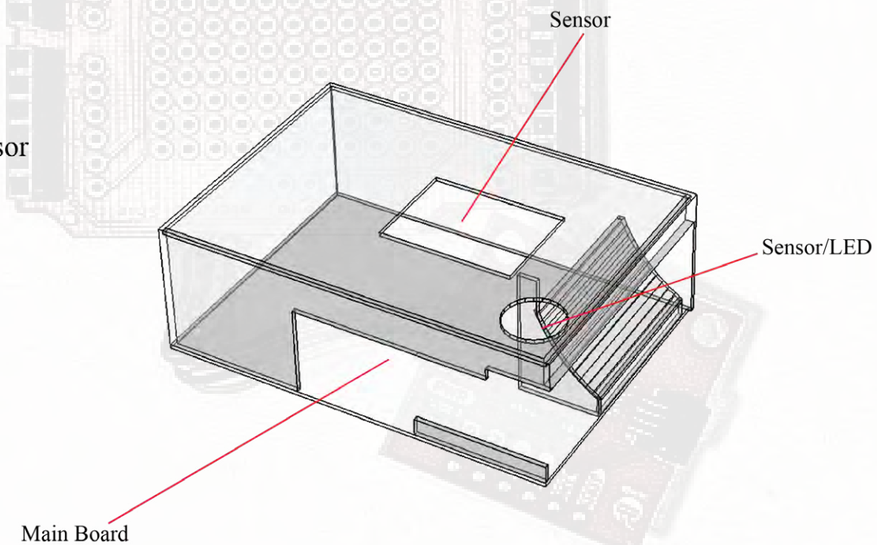


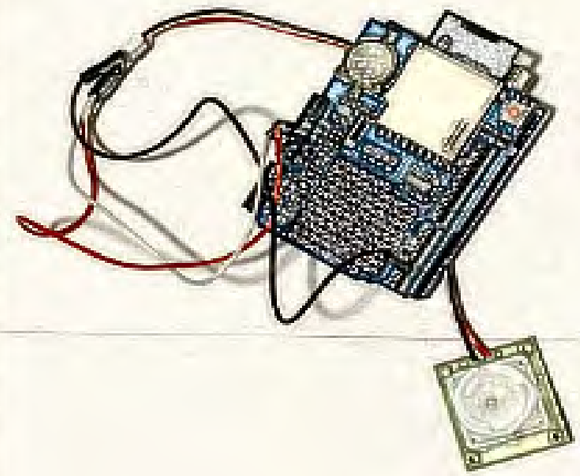
Technologies Used

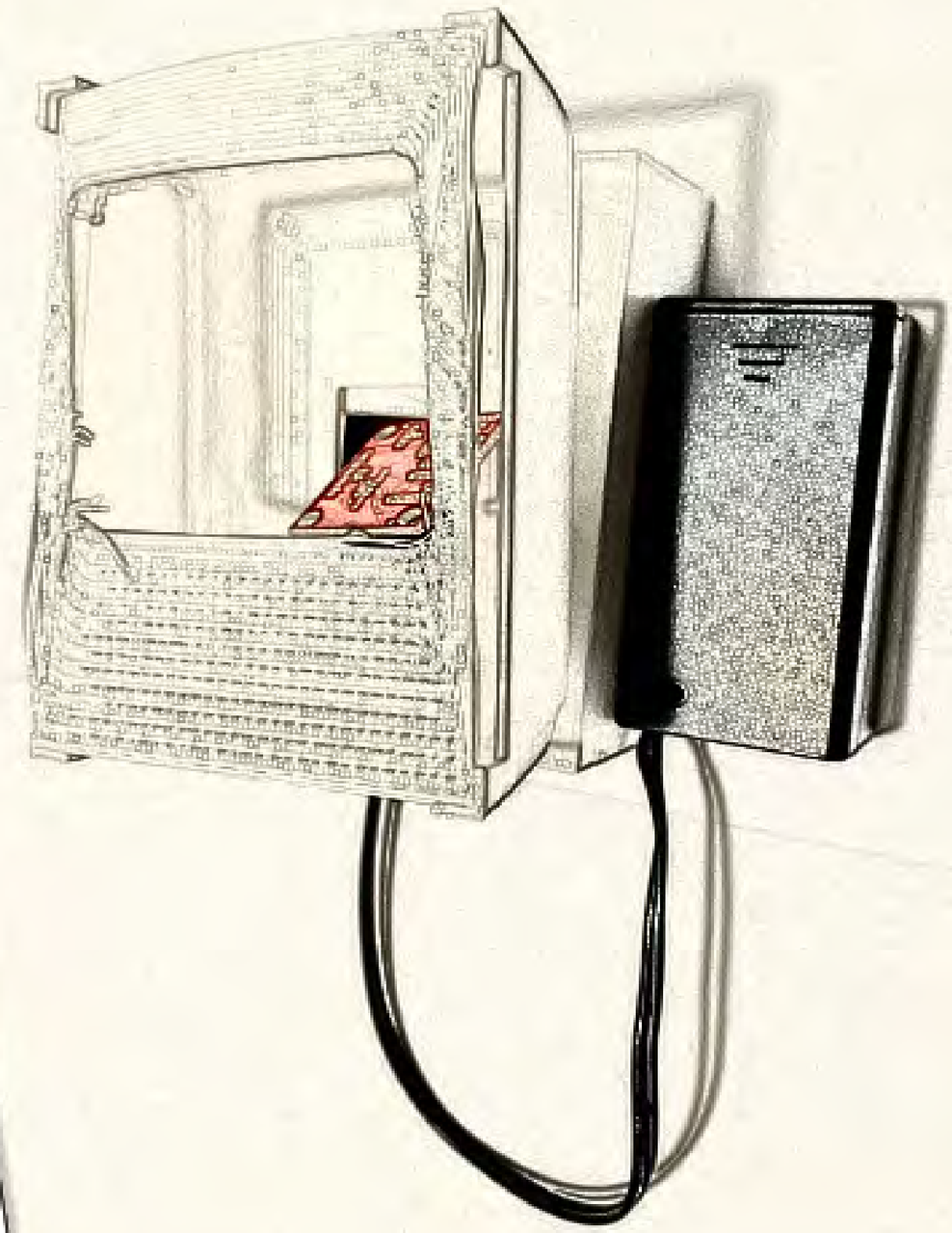


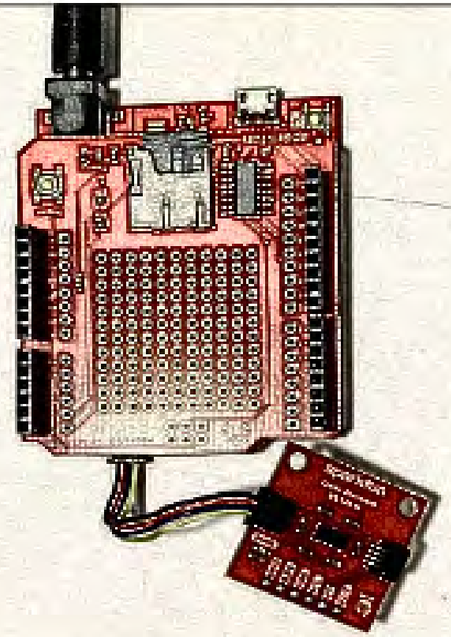
Sensor Design

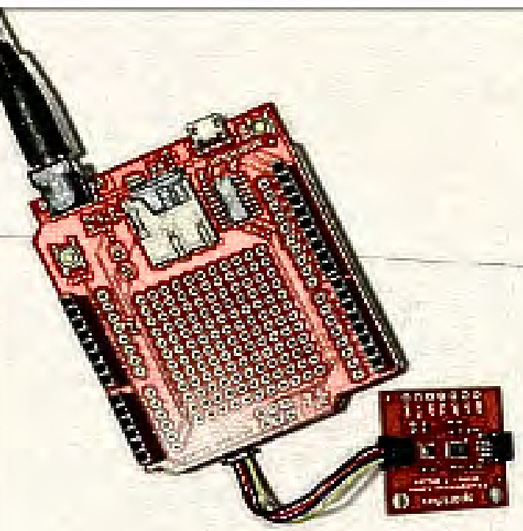
The prototype of the sensor holder is from a previous architecture design. The shape is modified and then 3D printed. The holder can protect and hide the sensor.

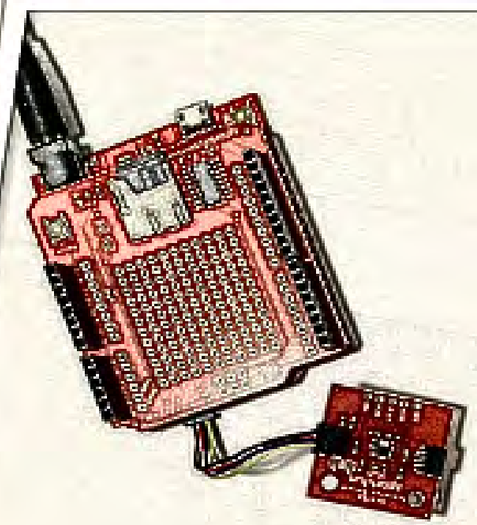












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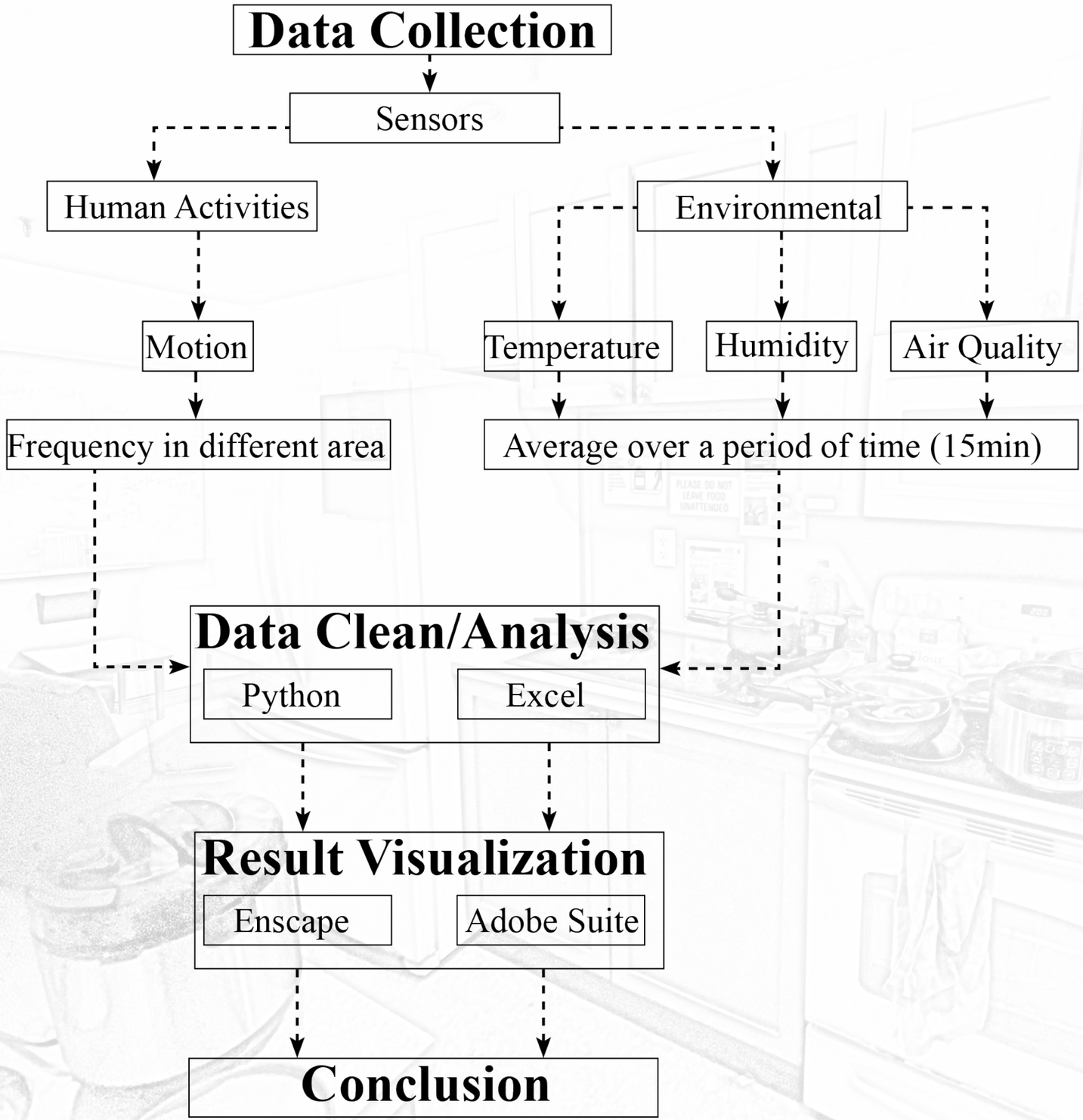
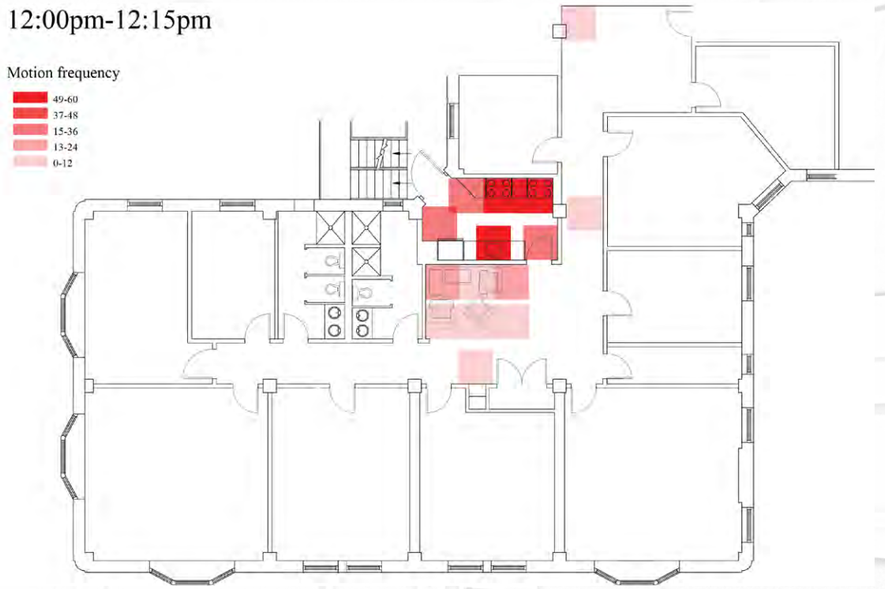
Methodology

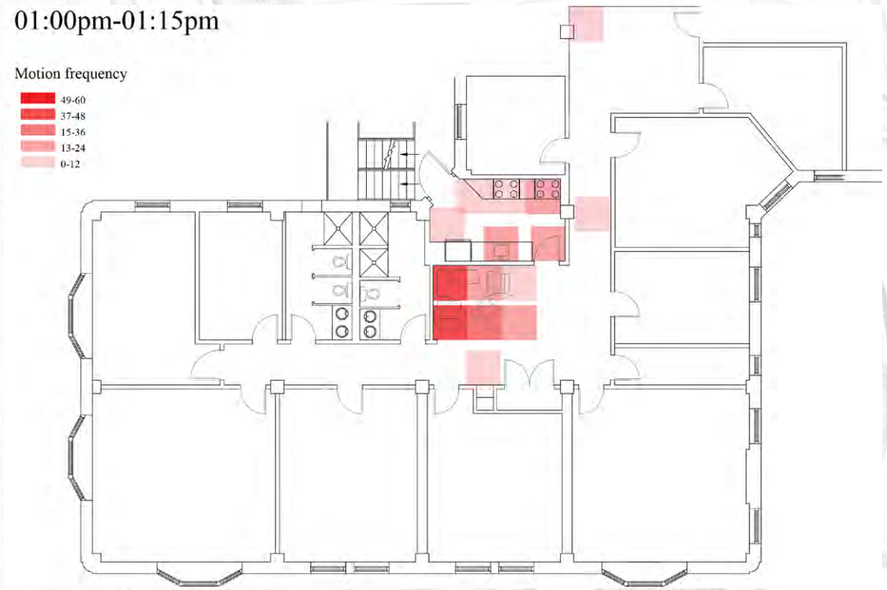


Analysis and Visualization



Motion Data

The motion data is used as an index of human activities. The motion sensors combined with the human sensors and distance sensors are put in different areas and detect people's movement. The frequency of detection is every 15 seconds. Then count the total number of motions detected every 15 minutes. The darker the red color, the higher the frequency.

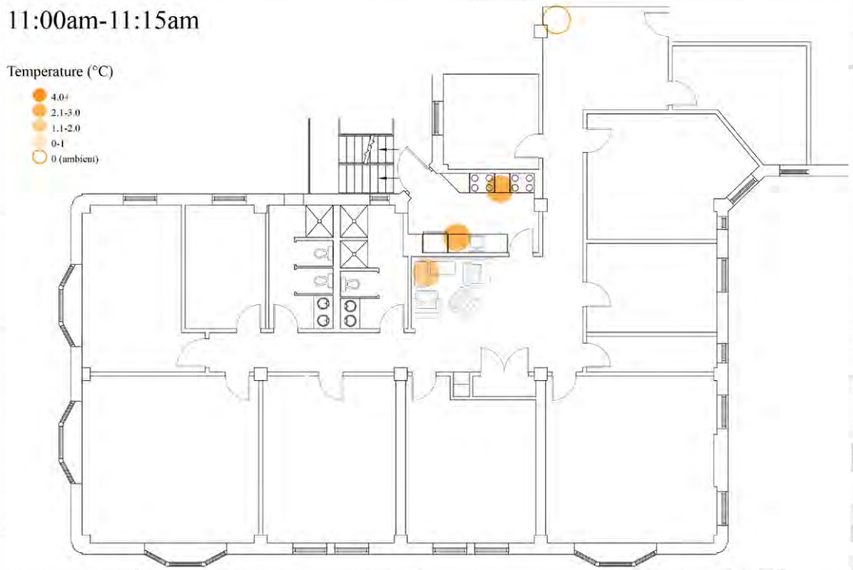


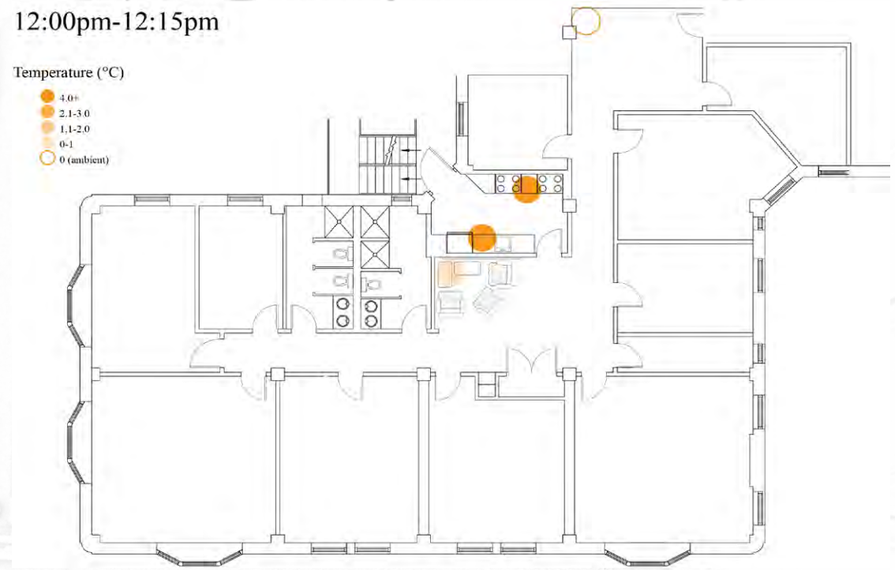
Motion Data Examples

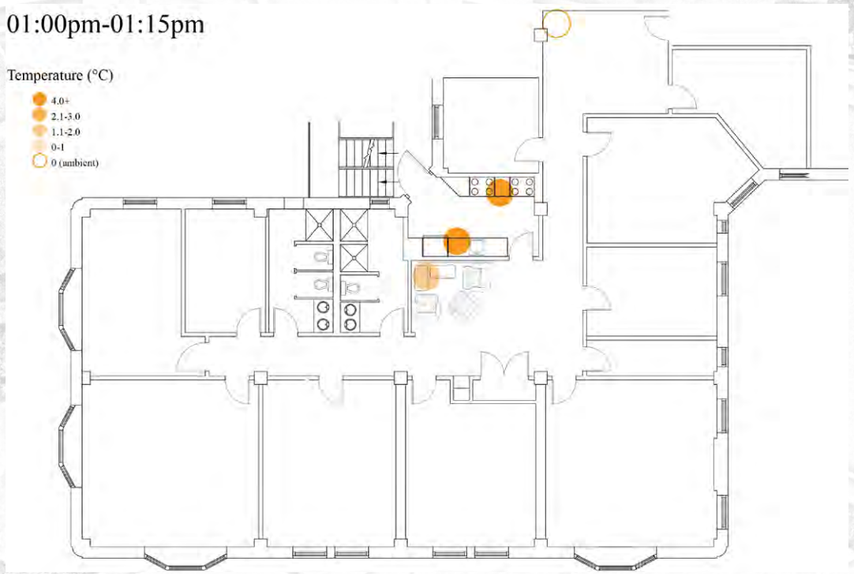
Analysis and Visualization

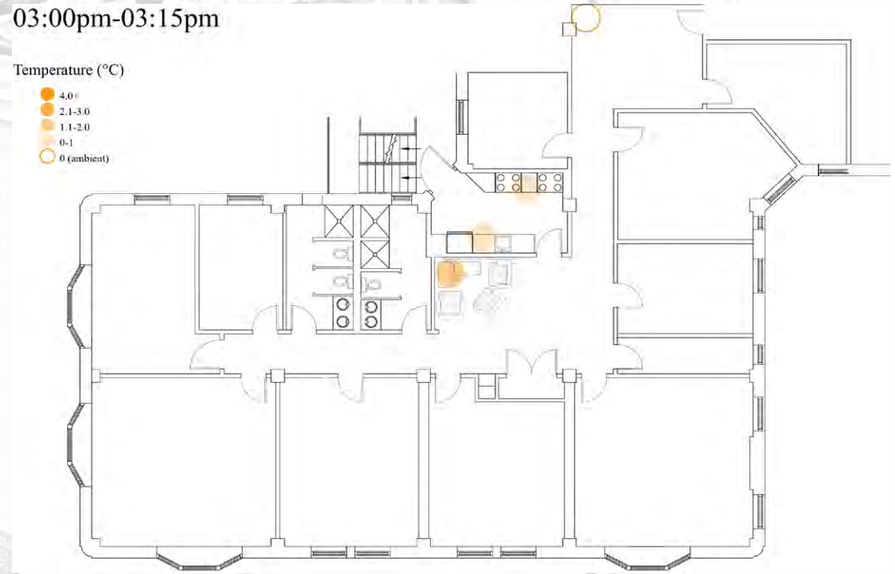
Temperature Data

The temperature sensor detects every 3 minute. Then calculate the average value of the 5 records in 15 minutes. The data from the sensor at the end of the corridor is used as a standard for the ambient temperature. Compared the data in the studied area with the ambient temperature. The darker the color, the more the temperature is higher than the ambient temperature.



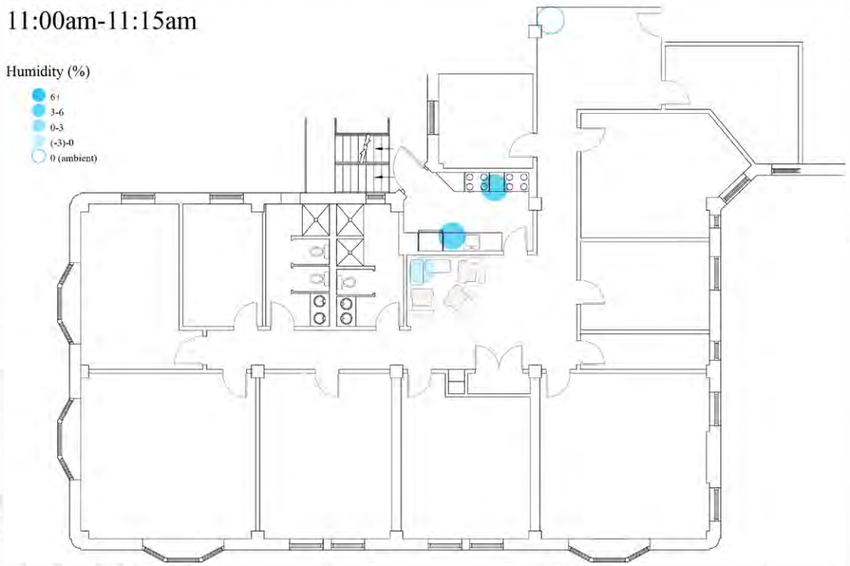


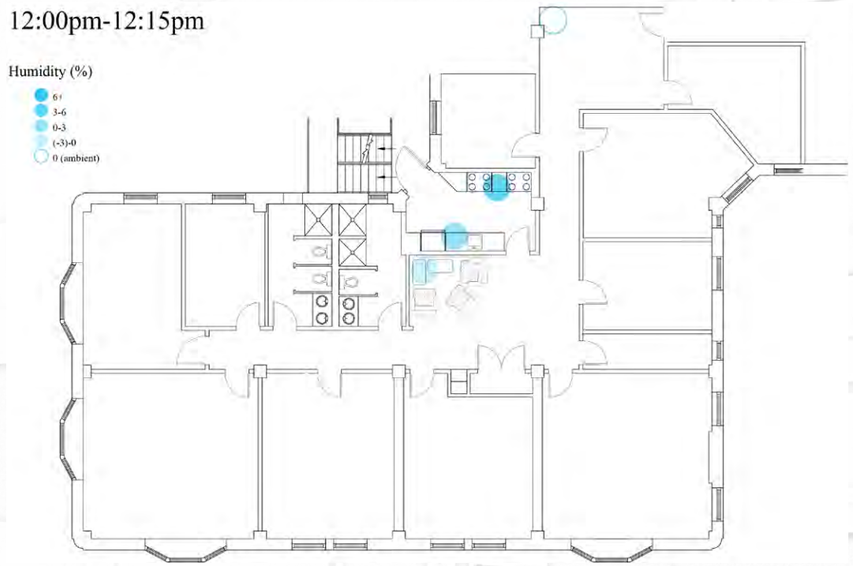


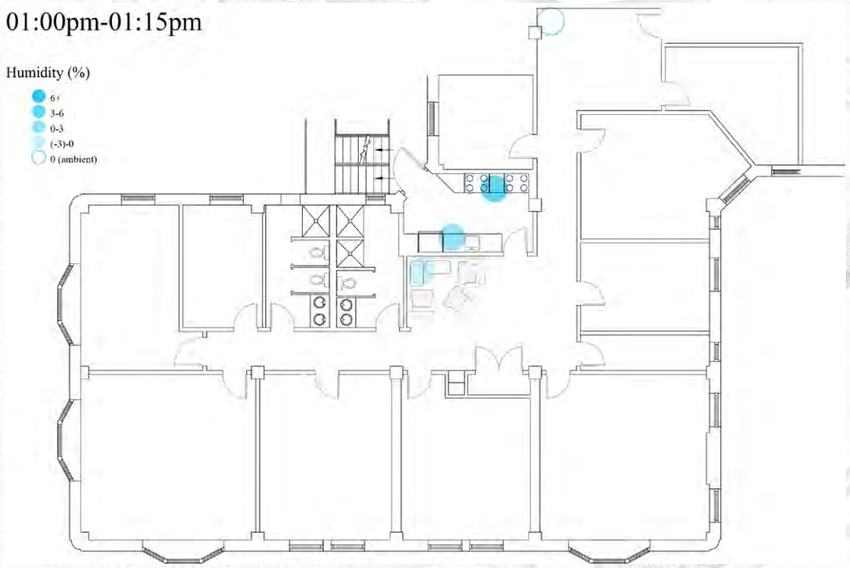


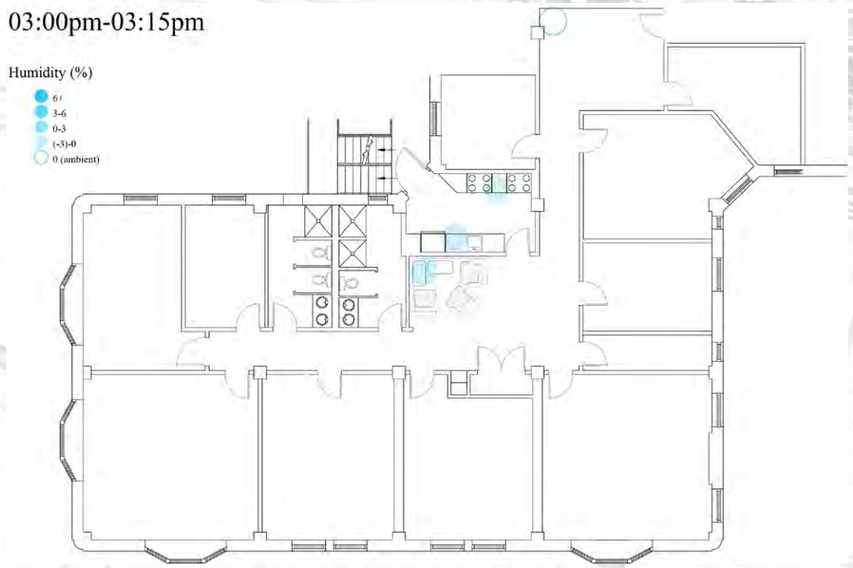
Temperature Data Examples

Analysis and Visualization









Humidity Data

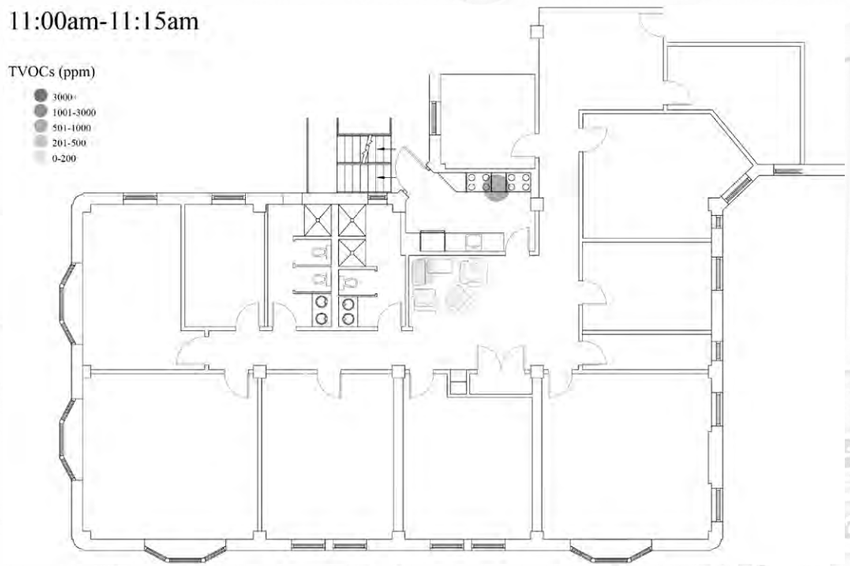
The humidity sensor detects every 3 minute. Then calculate the average value of the 5 records in 15 minutes. The data from the sensor at the end of the corridor is used as a standard for the ambient humidity. Compared the data in the studied area with the ambient humidity. The darker the color, the more the humidity is higher than the ambient humidity.

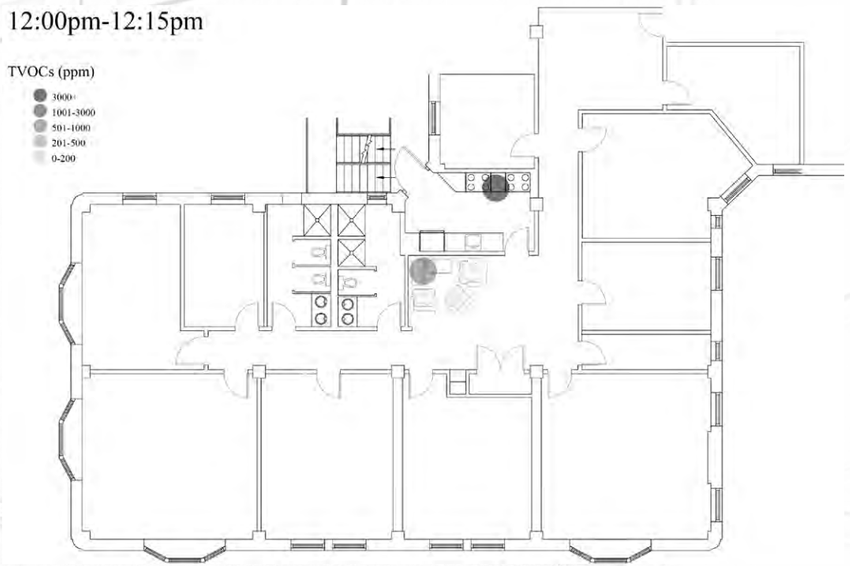
Humidity Data Examples

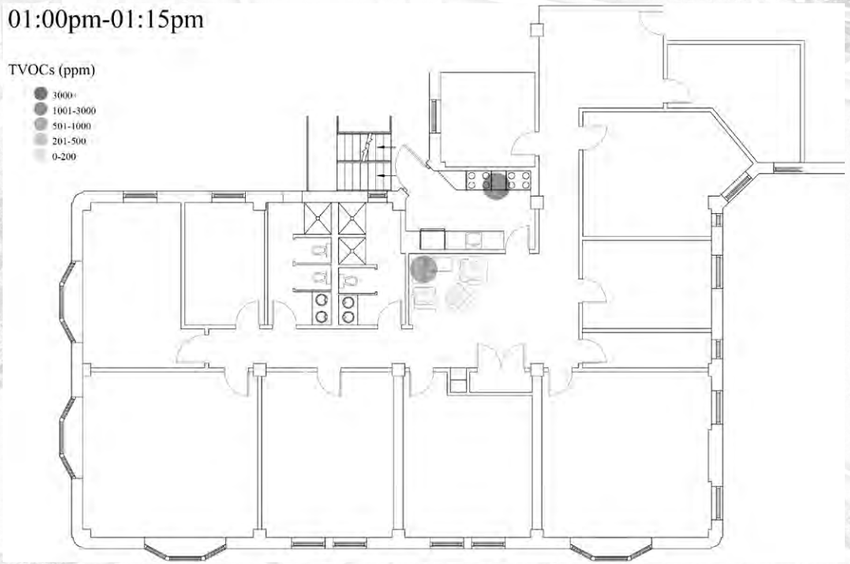
Analysis and Visualization

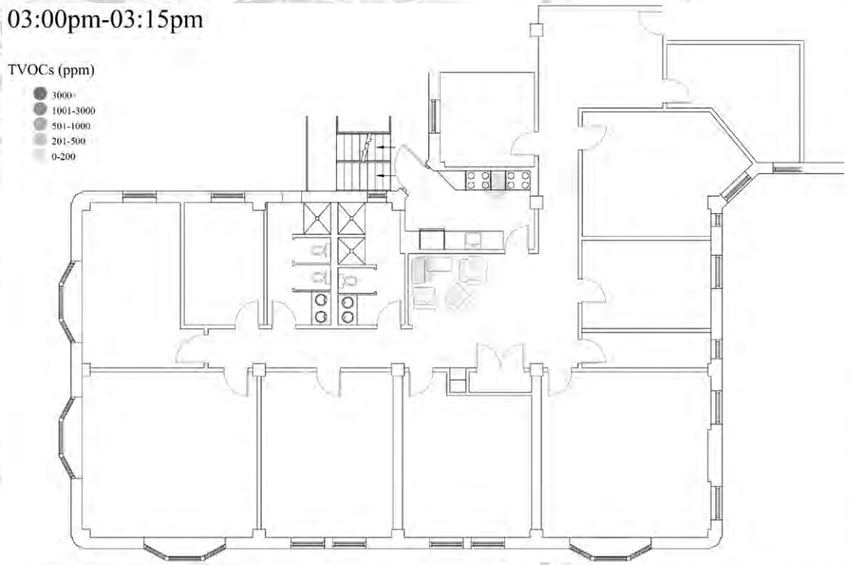
Air Quality Data

The Volatile Organic Compounds is used as the index for air quality. The air quality sensor detects every 3 minute. Then calculate the average value of the 5 records in 15 minutes. The darker the color, the higher the TVOCs concentration.



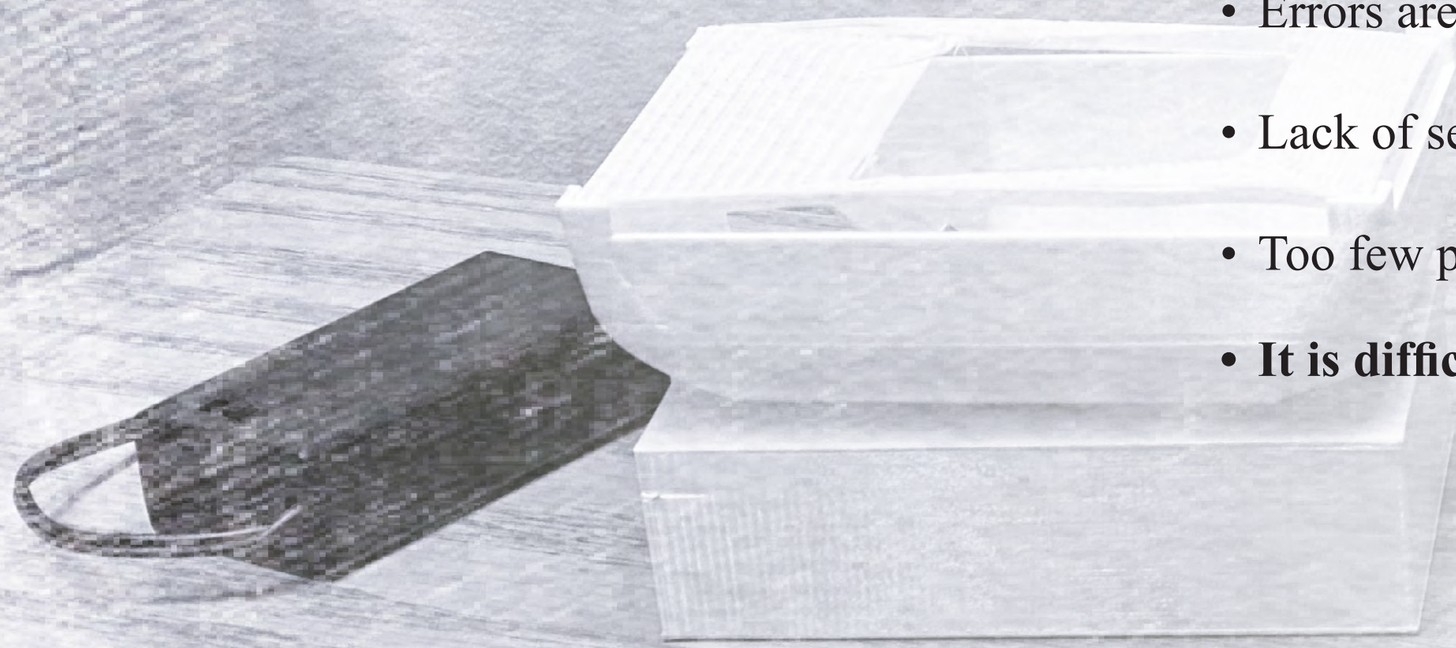






Air Quality Data Examples

Limitations & Difficulties



- Monitoring time is too short
- Errors are hard to avoid
- Lack of sensors
- Too few participants
- **It is difficult to draw a very rigorous conclusion.**

Conclusion

Activities & Microenvironment

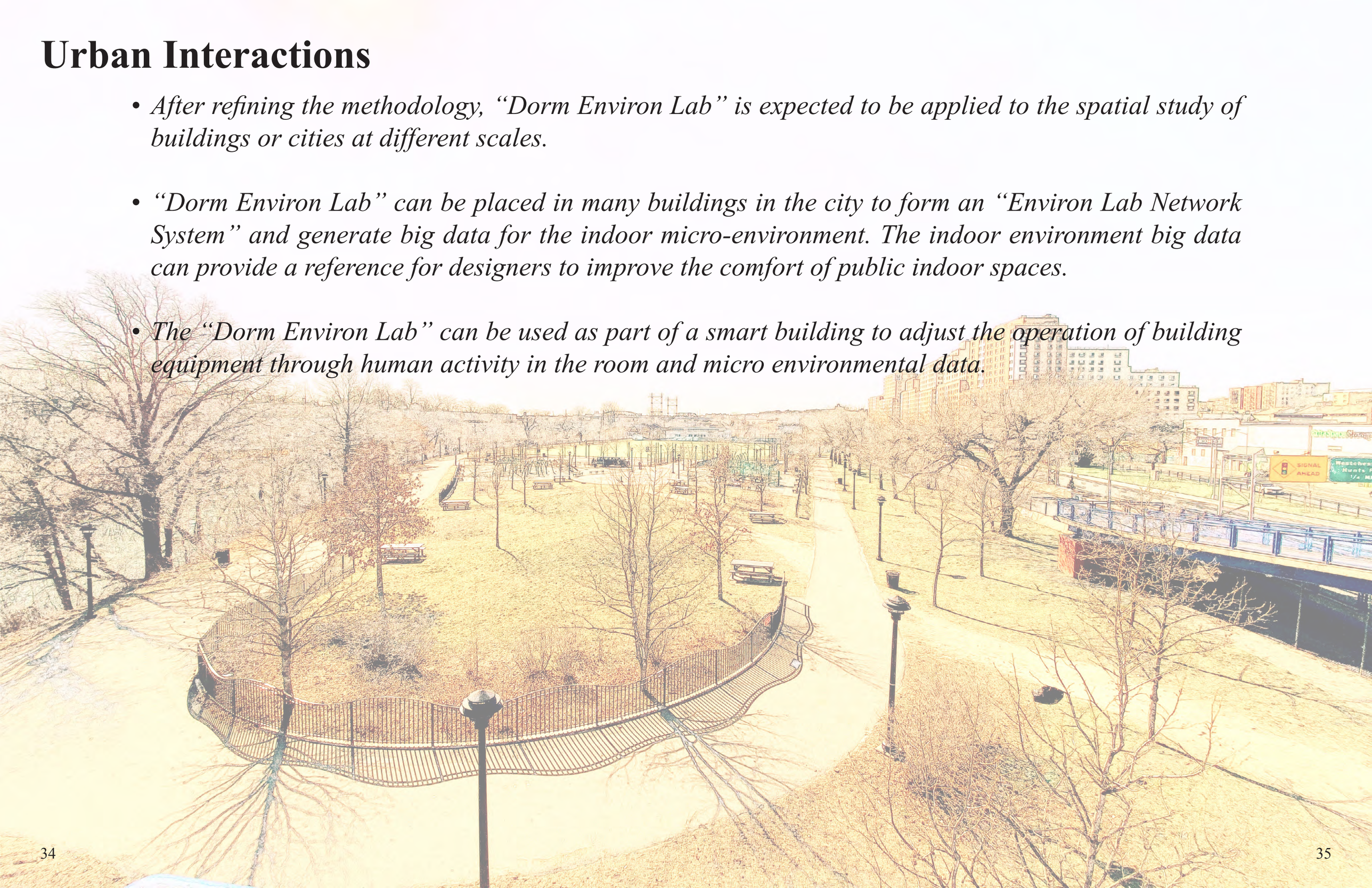
- Within a certain number of people, human activities (study, talk…) will not have a significant impact on temperature/humidity.
- Cooking in the kitchen, especially when using the stove, will significantly increase the temperature and humidity, and the VOCs concentration will increase sharply.
- Even when the exhaust fan is turned on, the VOCs produced by cooking will still have a significant impact on other spaces.
- When people use food just cooked from the kitchen in the lounge, the temperature of the lounge will rise, and the concentration of VOCs will also increase.
- After cooking, it takes about an hour to reduce the VOCs concentration to normal levels.

Human behavior

- During the outbreak, the residents in the dorm are trying to reduce the time spent in the same space.

Urban Interactions

- *After refining the methodology, "Dorm Environ Lab" is expected to be applied to the spatial study of buildings or cities at different scales.*

- *"Dorm Environ Lab" can be placed in many buildings in the city to form an "Environ Lab Network System" and generate big data for the indoor micro-environment. The indoor environment big data can provide a reference for designers to improve the comfort of public indoor spaces.*

- *The "Dorm Environ Lab" can be used as part of a smart building to adjust the operation of building equipment through human activity in the room and micro environmental data.*