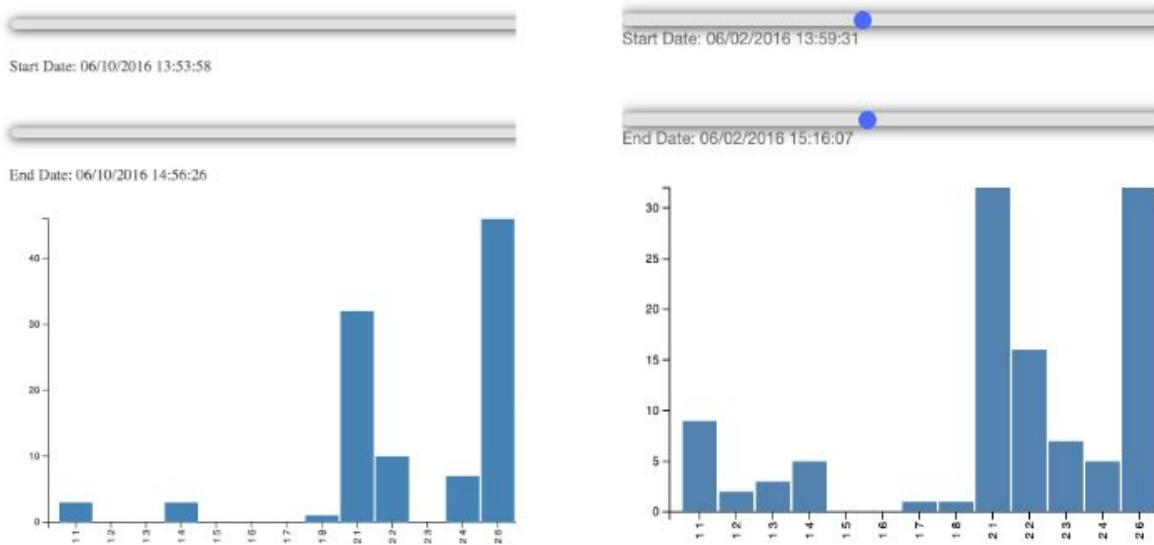


## Term Project

Beket Bayemirov, Alibi Yeslambek

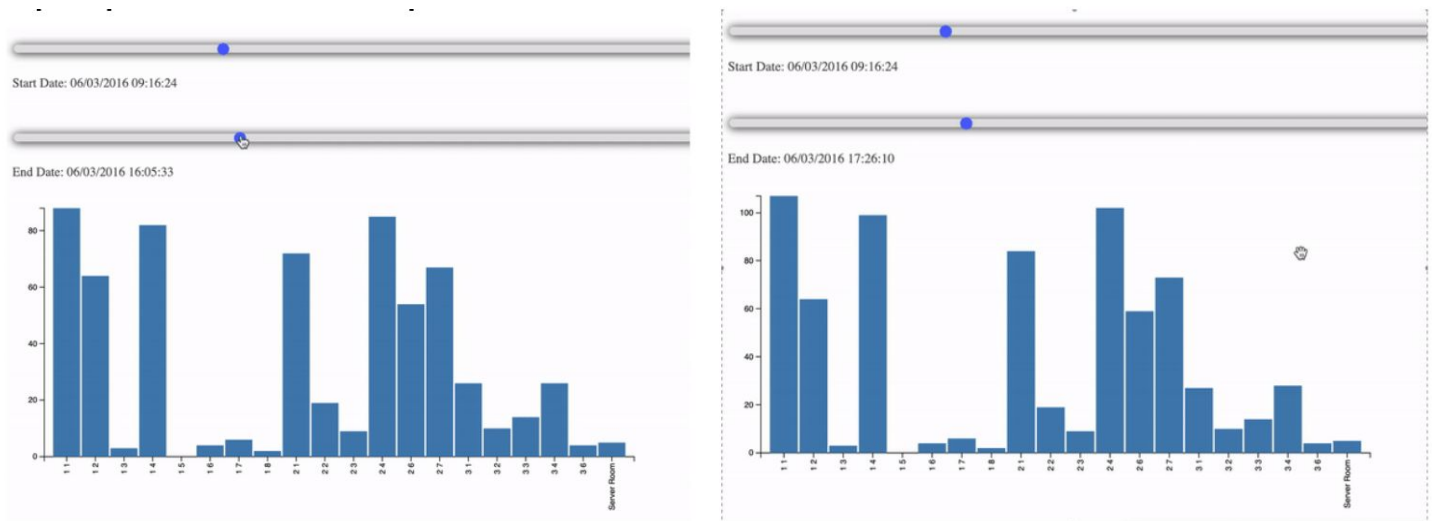
### 1.1. Daily meeting from around 2pm to 3pm every working day.



The chart represents the number of people who visited each zone. Y-axis number of people through some fixed time interval. X-axis each zone in the building.

We have checked each working day during given 2 weeks data, where it can be seen that between 2pm to 3pm the majority of workers gather together at 2nd floor (proximity zones: 1st and 6th). Which is interesting because at these exact zones, there is meeting room and conference room.

### 1.2 Around 30 people come to work after 4pm.

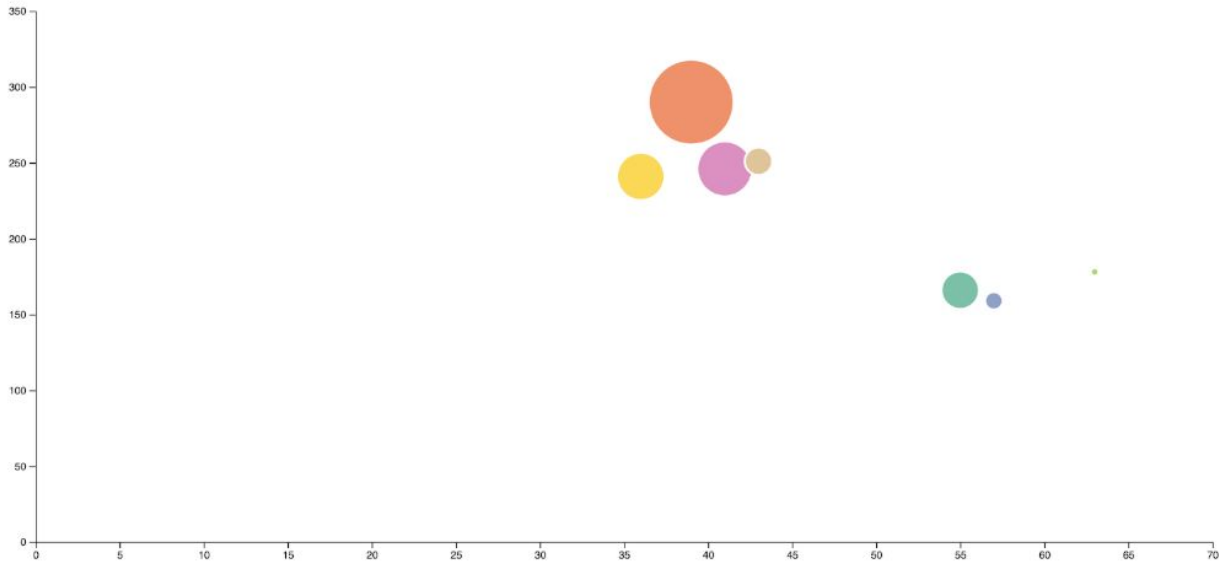


Please focus only on 1st floor, 1st zone. This zone is the entrance of the building, so it determines how many people have entered to the building and started working. As you can see, before 4pm there are just 80+ people, but after 4pm this number changes to 110+ people.

The assumption to this pattern is that the company's working hours is flexible.

### 1.3 Number of Zone changes OVER Floor changes

## Zone changes OVER Floor changes



Y-axis is zone changes. X-axis floor changes.

Each bubble is the average person from each department.

Orange - engineering, Yellow - IT, Purple - Facilities, Brown - security, Green - Administration, Blue - executive, Light-green - HR.

**Pattern:** There are 2 classes of jobs, 1st type: who change zones a lot. 2nd type: who change floors a lot.

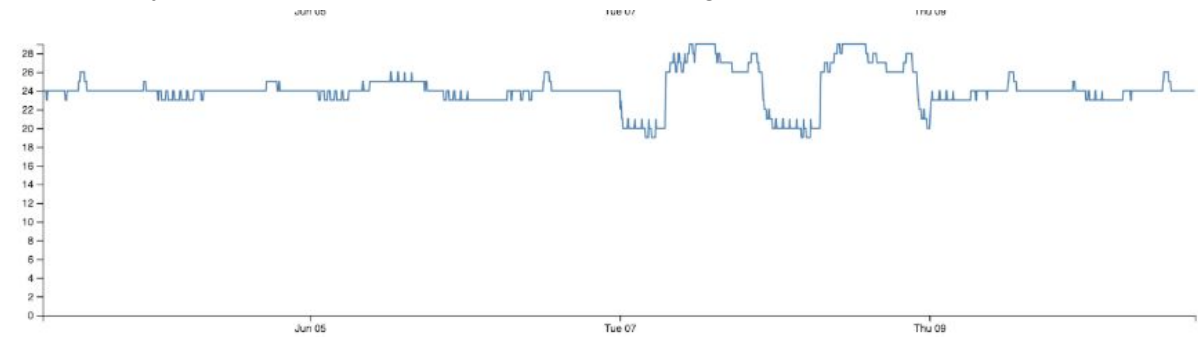
HR people change floors a lot, because their work is literally "Human related" job, so that their work require them to work with all departments. They change floors as twice much as engineers.

Engineers change zones in a very high amount, because there are a lot of offices in the 2nd floor, so that they are likely to interact with other people from other departments and maybe setting mini meetings within their teams.

Executive and Administration people don't change zones a lot and don't change floors as much as HR people.

It's understandable because their offices are located at 3rd floor.

2.1 Anomaly pattern in Temperature sensor on building zones.

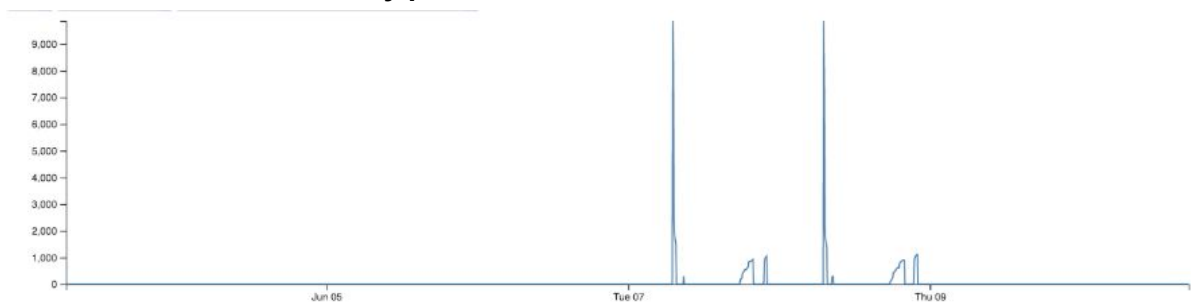


The picture represents the temperature data for whole 2 weeks of observation.

First anomaly that we found is related to temperature. As you can see that same pattern changes dramatically from 7th June and continues until 9th June.

Temperature suddenly drops from 24 C to 19 C and goes up to 27 C, which is abnormal for such short amount of time. This patterns repeated one more time at 8th of June.

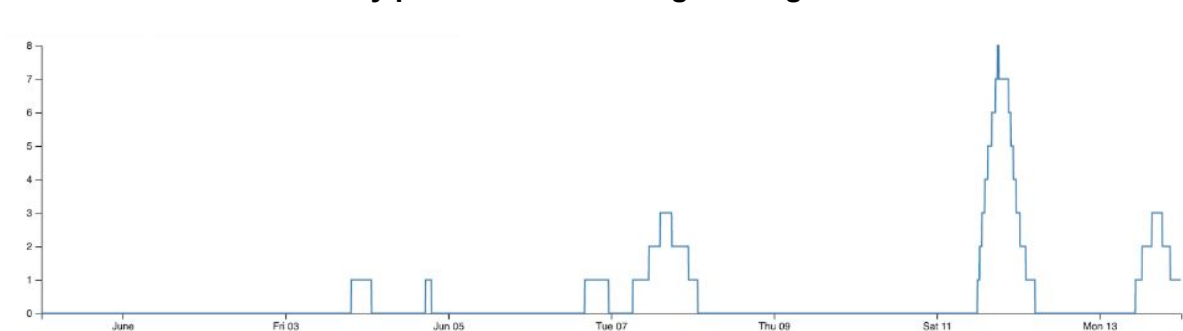
2.2 Understandable anomaly pattern in REHEAT Coil Power



We decided to understand why temperature went up from 19 C to 27 C in that short amount of time. We have analysed another sensor called "REHEAT Coil Power", which basically represents the behavior of the device which is responsible to regulate the temperature within the building.

This anomaly in this sensor observation is explainable by the anomaly of the temperature stats explained before. In order to make the office warmer REHEAT Coil Power was raised up, which resulted on sudden temperature rise.

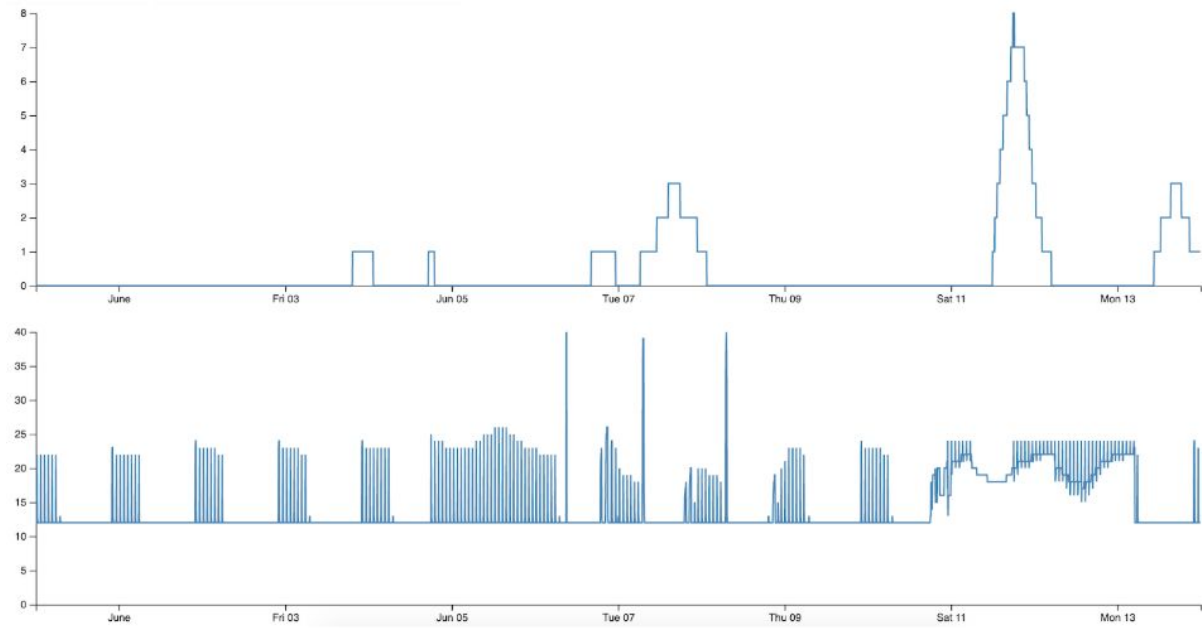
3.1 Hazium sensor anomaly pattern found on engineering zone.



This is the chart depicting the stats of Hazium chemical throughout the 2nd floor of engineering zones. As we can see there is a small rises of Hazium at 7th June and 13 June. In addition, the highest rise of Hazium took place at 11th June, while reaching high of 8.0.

In further investigation we have found more interesting patterns which could somehow explain the Hazium concentration.

3.2 Impact of Inlet Temperature on Hazium concentration.



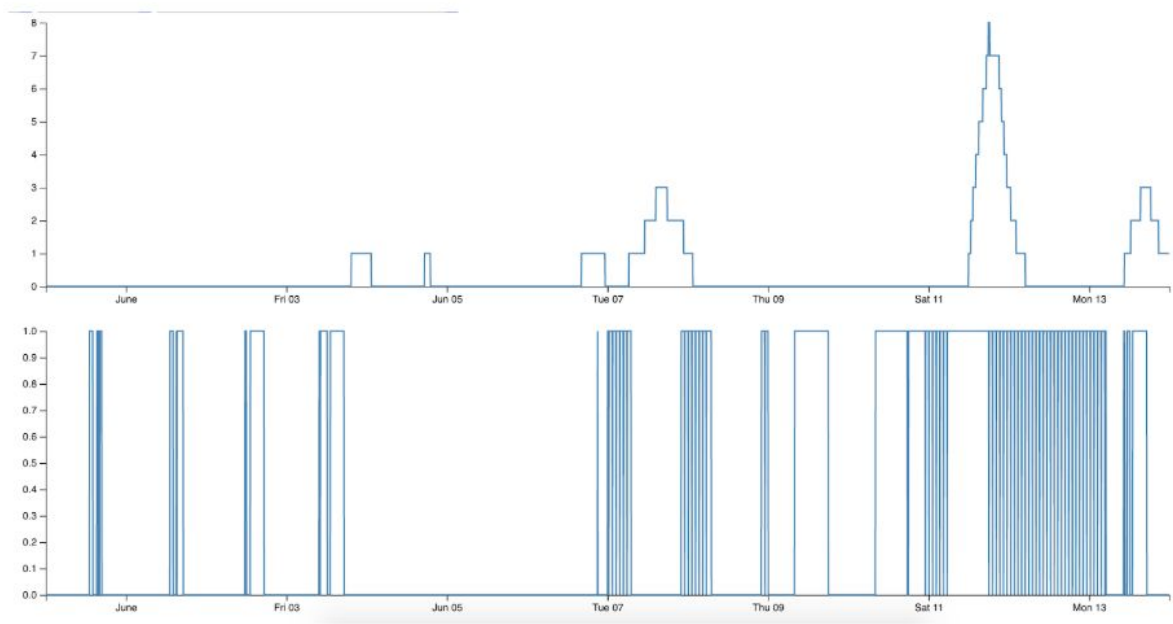
We have compared the Hazium concentration with the sensor called "Inlet Temperature". In other words, inlet temperature is the air density inside the building.

Why we think it's important pattern and correlation? Because the sudden and gradual rise of air density always happens before the actual rises of Hazium. For example, it clearly can be seen at Saturday 11th June, where the air density rose gradually and kept high value for about 2 days before the rise of Hazium, which happened half-day after this one.

We have concluded that air density can be one of the reasons for Hazium concentration rise. At least, they are correlated.

It can also be seen at 3 jumps of air density from June 6 to 8th of June. They are happened **before** the rise of Hazium.

### 3.3 Impact of VAV REHEAT Damper position on Haziium concentration



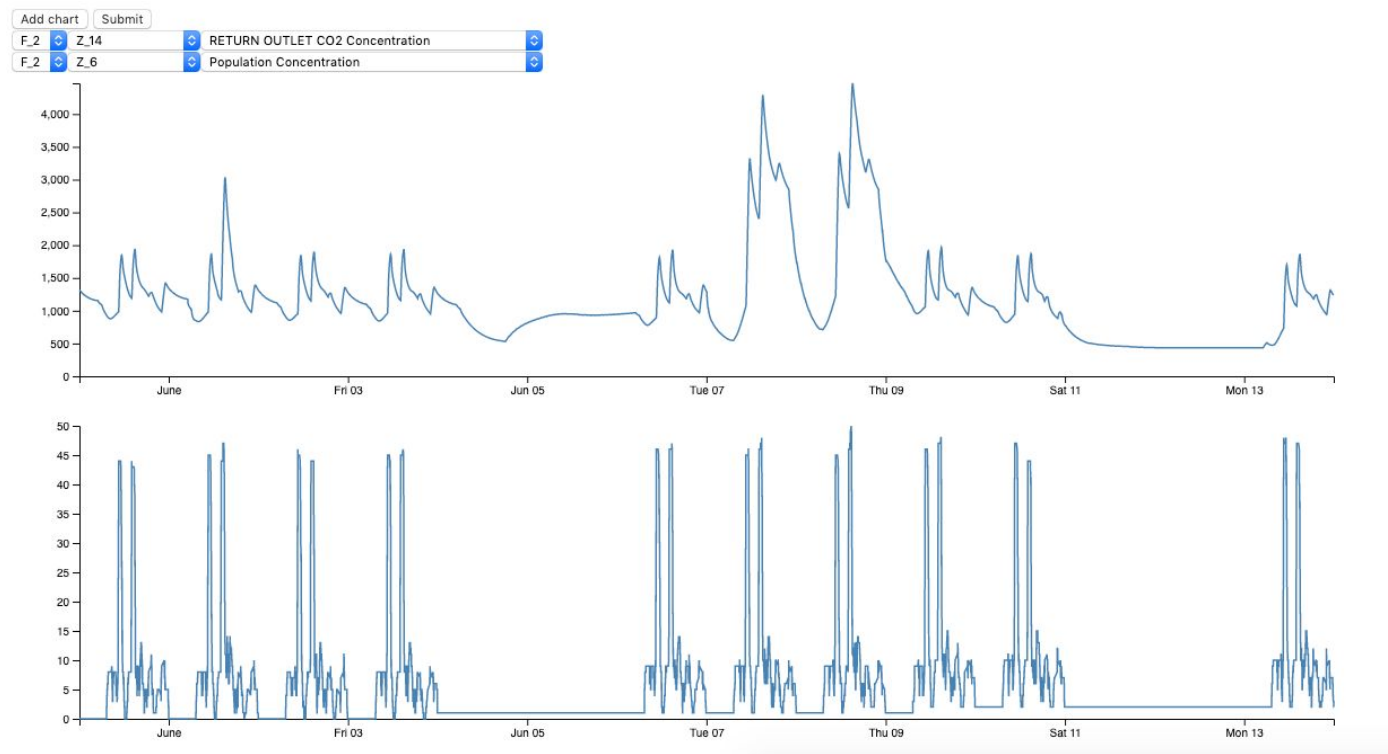
Another obvious correlation of Haziium can be seen with the sensor data of VAV REHEAT Damper position. The **damper position** is defined as the terminal unit air mass flow rate divided by the terminal unit's maximum air mass flow rate.

As you can the damper position function is **binary**, which means that either air mass flow reached its high or not.

As you can see, the function was positive just before the Haziium rise, as it was with the air density.

Possible conclusion: Haziium is the chemical which is correlated with the air density and the air mass flow.

4.1 Impact of Workers meeting at 2 pm on concentration of CO2.

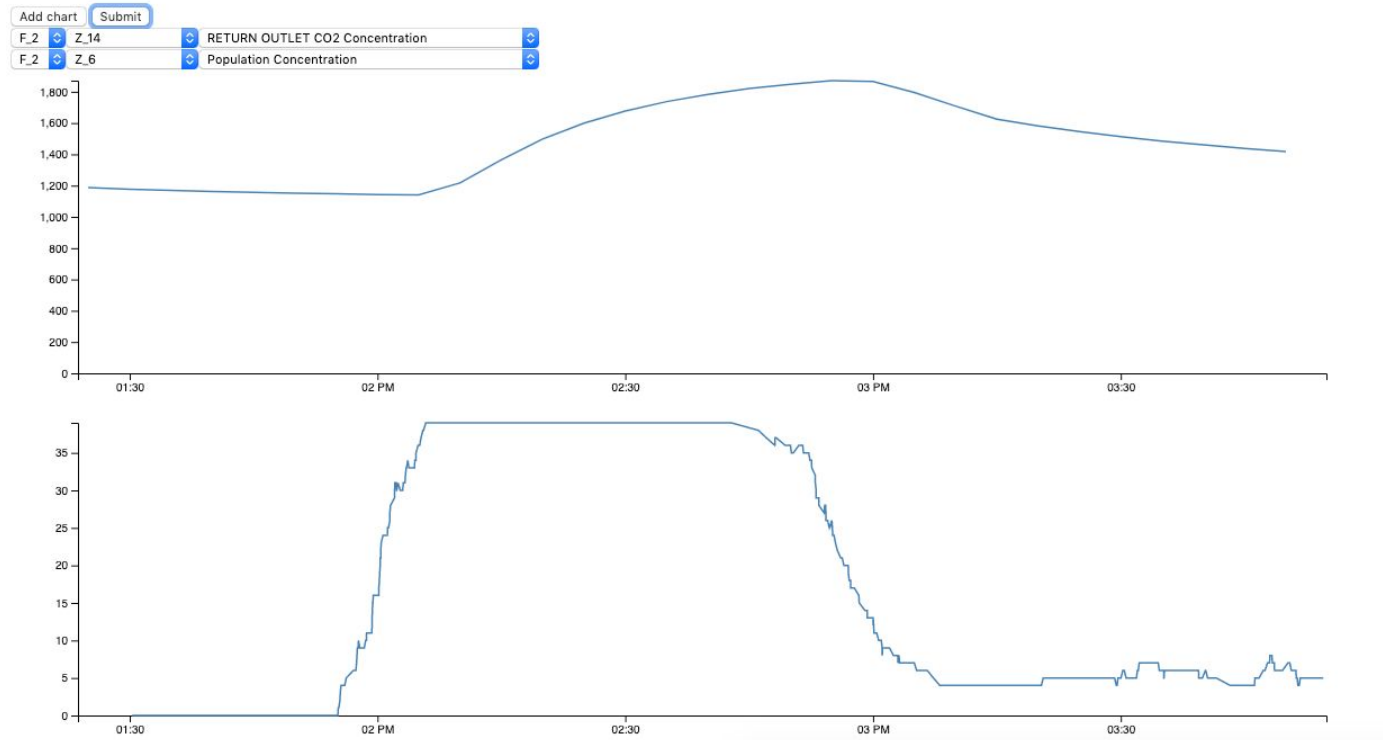


This is the comparison of CO2 concentration (Above chart) VS Population Concentration (Below chart) over 2 weeks time interval, in the 6th proximity zone at the 2nd floor of engineering building.

As you can see, every day there are sudden jumps of people number and sudden jumps of CO2. The patterns have the same local maximas and local minimas every single day. Which concludes that CO2 has strong relationship with the number of people in the zone.

Start Date: 06/10/2016 13:23:44

End Date: 06/10/2016 15:54:53



This is the zoomed view of the same charts, but considering exact one day of 10th June.

As you can see the meetings held at the zone #6 are impacting on the sensor data of CO2, from around 2pm to 3pm.

Pattern: as more people are in the zone, the higher is CO2, which is understandable. More people, more CO2.

Our team also has uploaded **3 minute demo** and **runnable code in GitHub**. Please refer to the zip file, which we have submitted.

Thanks.