

Room Temperature Data – Final Report

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ABSTRACT

Room Temperature Data is a web application done for the University of Vienna, Faculty of Computer Science and Faculty of Communication Studies, during the visualization class of summer 2014. During the summer of 2013 the room temperature for many rooms on five floors of the Faculty of Computer Science and Faculty of Communication Studies was measured due to very hot temperatures and concerns of the faculty staff. The focus of this project is to analyze and display the measured data accordingly to easily identify hot spots.

Keywords: Temperature data, Visualization, Javascript, Data-driven Documents

1 MOTIVATION

The indoor temperatures at the Faculty of Computer Sciences and Communication Studies of the University of Vienna are getting pretty high during the summer months. This fact, and the lack of air conditioning in some rooms raised concerns among the faculty staff. The Faculty of Computer Science conducted measurements in many rooms on five different floors between June 17 and October 8, 2013 to get a better understanding about how high these temperatures really get and how they change over time. This resulted in an Excel spreadsheet with over 60,000 rows of raw data. The spreadsheet contains the date and time the measurement was taken, the temperature, relative humidity, dew point and on which floor in which room the measurement was taken. Of course without any further help, like a tool or a visualization, this is just a bunch of data with not much meaning to it. The Room Temperature Data web application is the solution to this problem. We focus on displaying the data according to the users need, to analyze the data and get the information he needs. The typical user for this application is a teacher, assistant teacher or any other faculty member of both faculties, the Faculty of Computer Science and Communication Studies.

2 RELATED WORK

We didn't find much related work which is similar to our project. There are some visualizations about global temperatures [3][4], but they aren't comparable to our measurements in a building. However, Minho Kim, a UX designer has a data visualization about three days of a room temperature [5], but that was no inspiration for us. We developed our room temperature visualization without any reference to related work.

3 APPROACH

It was very clear since from the beginning that we need to filter this bunch of data. Our data consists of over 60,000 rows with information of the temperature, humidity and dew point for various rooms on the first, third, fourth, fifth and sixth floor. We decided to live by Shneiderman's Mantra: Overview first, zoom and filter, then details-on-demand [2]. We therefore thought of

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displaying the average maximum and average minimum temperature over all measured rooms from June to October. The user should have the choice for either selecting the maximum or minimum temperature and then be able to filter for the data he wants to see, for example, filter for a specific room on a floor and per date or a date range, according to Shneiderman's mantra. We first give the user an overview, he is then able to zoom in on the area of his desire and filter for some criteria.

3.1 Design choices

Our initial design consisted of four basic filtering steps:

- Overall mean temperature
- Temperatures by floor
- Temperatures by room on floor
- Temperatures in a specific room

Each step contains the temperature over a certain period of time, which the user of this application is able to specify.

Following Screenshots are taken from our initial paper prototype:

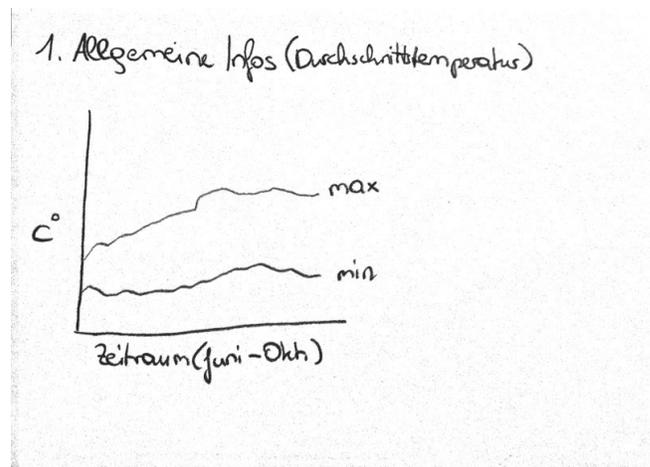


Figure 1: Step 1, Overall mean maximum and minimum temperature from June to October.

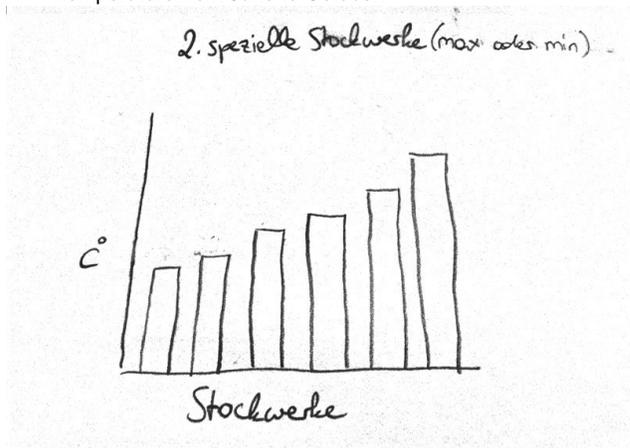


Figure 2: Step 2, Maximum/Minimum temperature for each floor.

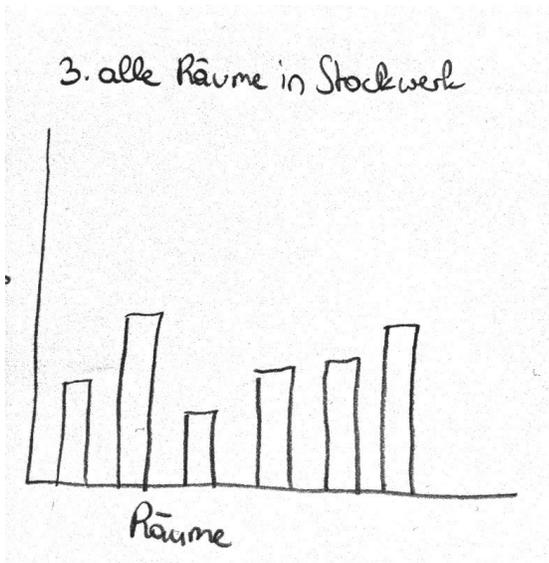


Figure 3: Step 3, Mean maximum/minimum temperature for each measured room per selected floor.

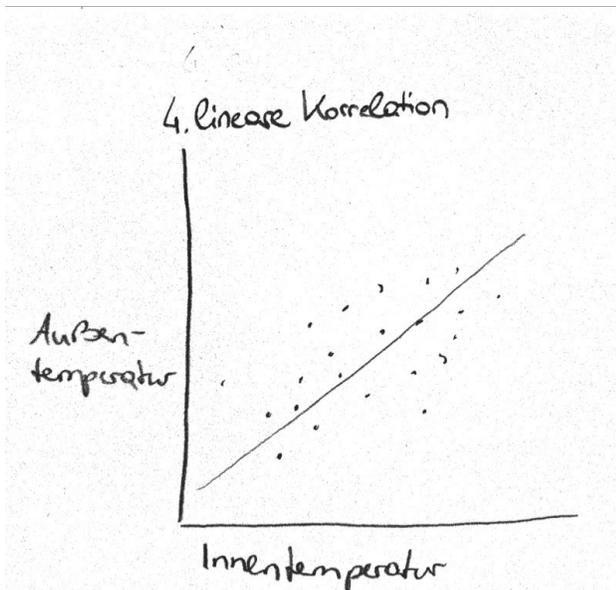


Figure 4: Step 4, Correlation between outside air temperature and room temperature for the selected room. Note: This step was kicked out later, during the implementation phase, due to some serious time issues.

During the early implementation phase we kicked the idea of clicking through the various graphs and therefore have the user go through each step. We considered this an awful waste of time in some user scenarios and came up with a different approach. We still wanted to give an overview first, but then let the user decide the amount of filtering he wants to do, maybe all at once or step by step. We think this is a much better approach than the one we tried to do with the paper prototypes. The new approach puts the user in control of the amount and speed of filtering, whereas the

step-by-step method, previously encourage by us, would limit the user in many ways.

The user has the ability to filter for these criteria:

- Maximal temperatures in a room on a specific date
- Maximal temperatures in a room
- Minimal temperatures in a room
- Temperatures on a specific floor
- Temperatures on a specific date
- Minimum and maximum temperatures over the whole time period
- Maximum temperatures on all floors
- Minimum temperatures on all floors
- Temperatures over a specific date range

The date range a user can filter is bound to the date range of the measures and is therefore restricted to mid June to early October 2013.

In addition to the filter criteria mentioned above, the user has also the possibility to display the maximum or minimum temperature for each floor in comparison to each other.

The following screenshot displays the overview and the filter criteria in the header of the web application:

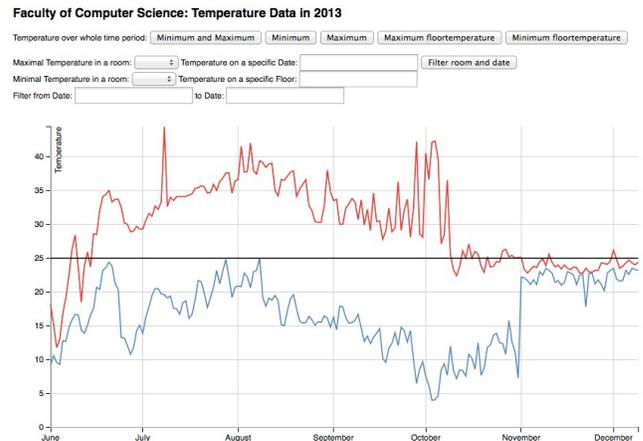


Figure 5: Room Temperature Visualization: Overview (maximum and minimum) temperature over the measured period of time with filter criteria above.

This screenshot displays the filter criteria for the maximum temperature per floor in comparison:

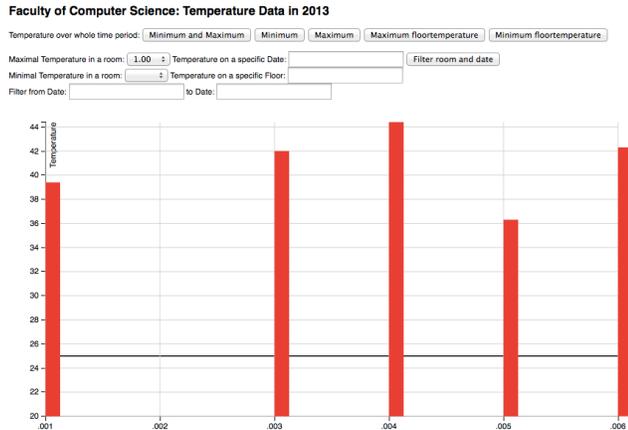


Figure 6: Maximum temperature per floor in comparison to each other. Note: there are no measurements for any room on the second floor.

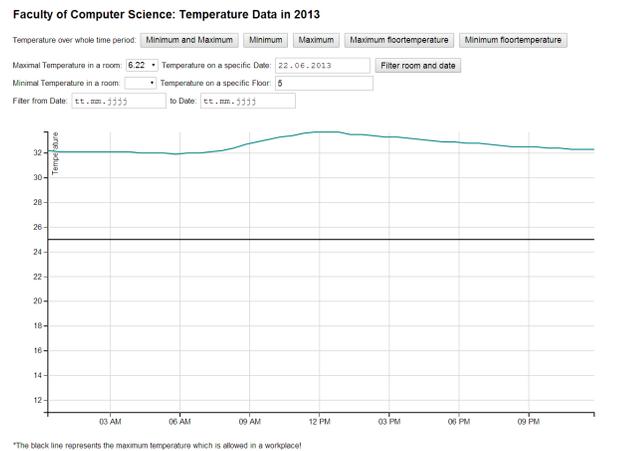


Figure 7: Maximum and minimum temperatures in a specific room on a specific date

Faculty of Computer Science: Temperature Data in 2013

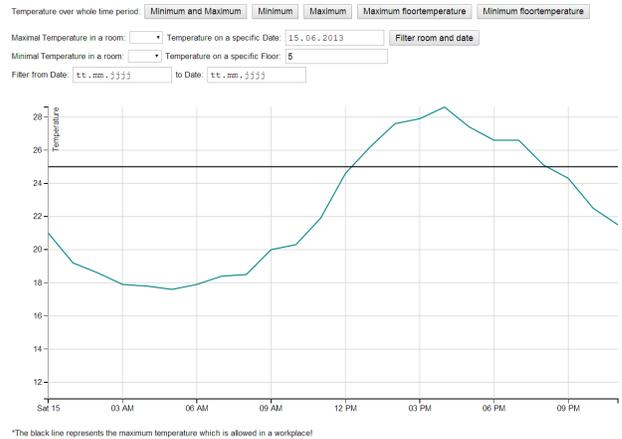


Figure 8: Temperatures on a specific date

4 IMPLEMENTATION

The room temperature visualization was done as web application because a web application is platform independent and therefore can be accessed from any device with a browser and an active internet connection. This enables the user to use every device, from a smartphone with internet connection over Tablets to any Computer or Macintosh to display and use the visualization. The visualization is implemented with Javascript in combination with D3 (Data-Driven-Documents) [1].

4.1 Implementation challenges

At first we planned to implement this project as a client application using Java in combination with the Prefuse Toolkit. One of our first and major requests for this project was the platform independence hence many users in both faculties use different operating systems. With Java we would support the most common ones, f.e. Microsoft Windows, Mac OS X, Solaris and different kinds of Linux Distributions.

After we learned that the Prefuse Toolkit is no longer supported, we looked for alternatives. D3 (Data-driven Documents) in combination with Javascript was recommended to us, therefore we adapted our design and created the room temperature visualization as a web application using Javascript and D3.

We had really trouble trying to incorporate our visualization ideas with Javascript and D3, mainly because we aren't very skilled in Javascript and we just started using D3 in the visualization class.

Unfortunately the forth step of our visualization, the scatterplot displaying the correlation between the room temperature and the outside air temperature, had to be kicked out of the implementation phase due to some serious time issues. The data of the outside air temperature was freely available to us but was differently formatted than the data that was provided to us and we didn't plan enough time to re-format the data and implement this step of the visualization.

5 RESULTS

5.1 Scenarios of use

We encourage the staff of the University of Vienna, mainly teachers and assistant teachers of the Faculty of Computer

Sciences and Communication Studies, to use our visualization. There are two major scenarios of use:

1. A Teacher at the University of Vienna probably wants to know how high the temperatures in his office raise during the summer months, so he selects his room and filters for the highest temperature during the summer months, probably from June to early September. Afterwards he is able to see if and how often the temperature overcomes the legal limit to work and is therefore entitled to request air conditioning in his or her office.

2. The second type of user is any staff member or student at the Faculty of Computer Science or Communication Studies at the University of Vienna who is curious how high or low the temperatures get during the measured date range. He or she wants to compare rooms and floors and dive right into the displayed data and explore most or all filtering options, not for a single purpose, but for the joy of gathering information. This user is able to do tasks which aren't bound to an underlying specific goal.

5.2 Performance

The performance of the web application is adequate. It takes about 3 seconds for the first time loading to handle the amount of data which is more than 60,000 rows of data. This data is read by the application line by line and then split up into multiple arrays for each floor, room and for every date. After the bunch of data is loaded the application performs very good, that means no more waiting time for data loading, and the user experience is quick and fluid.

6 DISCUSSION

6.1 Strengths of our approach

One of our biggest strengths is that our application is easy to use and pretty intuitive. The UI (User Interface) responds quickly and there are no more loading times after the data is loaded initially, which takes about 3 seconds to complete.

The user of this application is able to easily filter for some criteria and select one of the rooms where the measurements were taken. It is easy for a staff member to locate his or her room (or a room nearby if there were no measurements taken in his or her room) to compare the temperatures over a specific period of time.

All the graphs are easy to understand and easy to work with, there is almost no explanation needed.

6.2 Weaknesses of our approach

We currently have no implementation of comparing two or more rooms to each other.

Unfortunately we had to kick the implementation of the correlation between the indoor temperature and the outside air temperature per room, because the data that is freely available was differently formatted and we didn't planned enough time for us to format the data and implement a scatterplot before the deadline was due.

6.3 Lessons learned

We learned multiple lessons during this project:

- Handle a large amount of data
- Try different visualizations to display the data
- Get experience in Javascript and D3

The far most important aspect in this project was how to handle the visualizations. What types of different visualization can be used to display our data accordingly, what different approaches can be taken and how is the data best represented. Unfortunately the implementation in Javascript and D3 was far more to handle than expected, therefore we had less time to think twice about our used visualizations.

REFERENCES

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