Course: Internet of Things - 521043S
Exercise 2: Tellus Arena Air Quality Data

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April 2019

Abstract

This assignment shows a visualization of features (co2, light, humidity, temperature) in Tellus Arena at the University of Oulu in a period (26 June 2017 - 20 August 2018). This visualization can support to answer dramatic changes in this period based on the number of students who present and also the impact of weather.

1 Introduction and Description Data

The data is collected with a set of different sensors set up in the Tellus Arena (a public area at the University of Oulu). The format of this data is Comma-Separated Values (CSV) [1] which separates different values by the comma. This data includes a set 9917849 records (around 613 MB) captured from 26 June 2017 to 20 August 2018 (more than one year). Each record contains the value of different fields such as Id, timestamp, co2, light, humidity, temperature and pir.

For a statistic, table 1 shows a short useful information for each different fields in the data. In particular, the general information includes mean, standard deviation, mean and a set value from min to max (min, 10%, 25%, 50%, 75%, 90% and max). Seven last rows are about the min, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} and max percentiles. From this statistic, it can be said that there are exist noise data when collecting due to a big gap between 90% percentiles and maximum values. For example, in the case of temperature filed, it can be a trouble with the maximum value (6508.600), while with 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles, the values are around 19.7, 20.5, 21.4, 22.5, 23.7. This observation is also the same in the case of co2, light, and humidity.

Table 1: A statistic for the whole dataset

	Co2	Light	Humidity	Temperature
Count	9917848	9917848	9917848	9917848
Mean	891.13	93.531	30.950	21.566
Std	4652.73	159.373	11.736	7.634
Min	0	0	0	0
10%	365	1	15	19.700
25%	427	2	21	20.500
50%	500	35	31	21.400
75%	635	139	40	22.500
90%	838	228	46	23.700
Max	65535	2394	100	6508.600

2 Visualization

In this section, a set of whole data is visualized with different fields including co2, light, humidity and temperature as fig 1, 2, 3 and 4, respectively. Moreover, the specific other periods are illustrated in Appendix A and Appendix B.

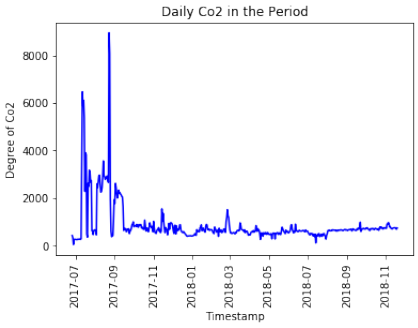

Figure 1: Co2

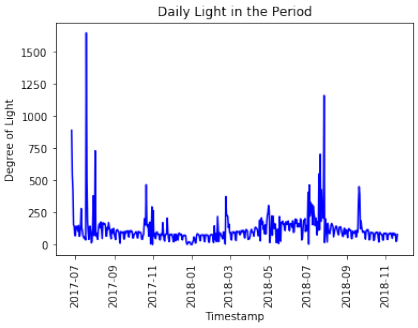

Figure 2: Light

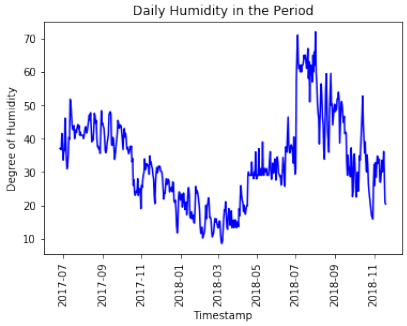

Figure 3: Humidity

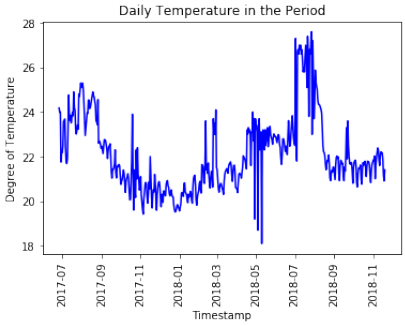

Figure 4: Temperature

3 Questions

In a general description, it can say that the amount of carbon dioxide was high from July 2017 to September 2017 as fig 1. However, it is quite weird that the amount of co2 in the same period in 2018 was low and similar to other periods. Actually, this period of each year is the summer holiday and the beginning of the academic year, which means the students do not need to go to university. Therefore, if this value reaches a peak of the year, it can be in September when the University has more new students.

In the case of the light field, there were two extremely high amount of light as fig 2 (from July 2017 to August 2017 and from July 2018 to August 2018) which was utilized in Tellus Arena. From this observation, the summer period of two academic years used the highest amount of light. Moreover, other periods were November 2017, March 2018, May 2018 and October 2018 when the light was utilized higher than other periods. These periods can be explained as the end of periods in academic years when students need to study pay attention to their study for final exams.

The humidity from July 2017 to November 2018 fluctuated in the whole data. From the fig 3, the amount of humidity started from a high position in July 2017 and constantly dropped until the beginning of March 2018. It can be said that the humidity started from a high value in the summer of 2017 and went down in the winter. From March 2018, the amount of humidity in Tellus Arena dramatically increased until July 2018 and rocked to reach a peak in July 2018 before decreasing after that. The reason for the changes in the humidity can come from the weather as seasons in a year. However, around July 2018 the value of humidity was higher than the previous year.

The line graph of temperature field was similar to the humidity's graph. This field was influenced by the weather from July 2017 to August 2018 through a fluctuation. The temperature's values were high and reach a peak in summer period each year (from May to September in 2017 and 2018). However, at the beginning of summer (May 2018), the degree of temperature declined to become the lowest degree around 18 in the whole period. The reason can be the heating

system of the Tellus Arena turned off in the summer.

References

[1] Y. Shafranovich, "Common format and mime type for comma-separated values (csv) files," 2005.

Appendix A

This appendix shows a set of different periods of 7 days or a week. In particular, a set of figs 5, 6, 7, 8 presents features (CO2, Light, Humidity and Temperature) in Tellus Arena from 26 August 2017 to 01 September 2017. Similarly, the other figs 9, 10, 11, 12 shows a gap (7 days) between 26 September 2017 and 02 October 2017.

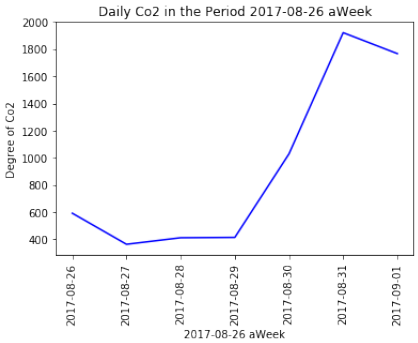

Figure 5: Co2

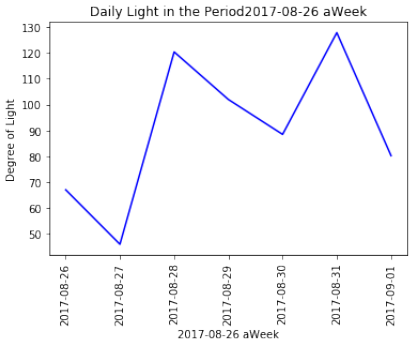

Figure 6: Light

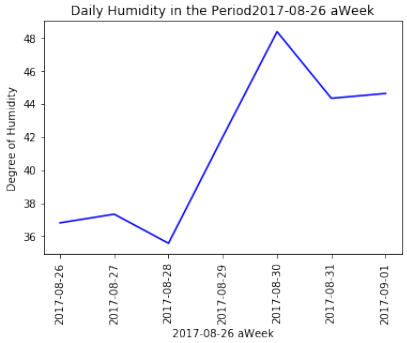

Figure 7: Humidity

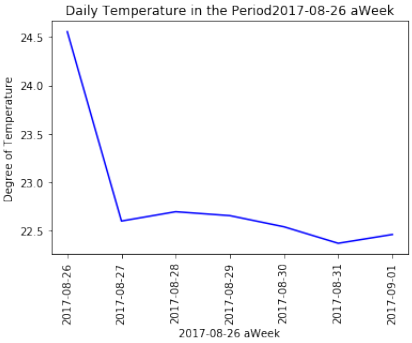

Figure 8: Temperature

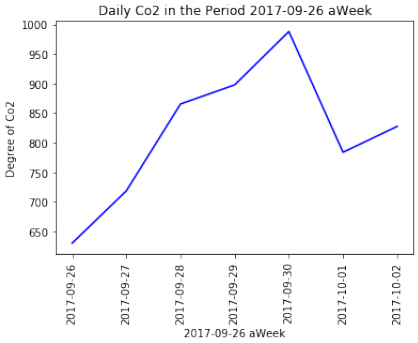

Figure 9: Co2

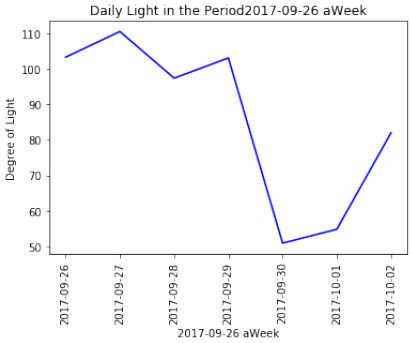

Figure 10: Light

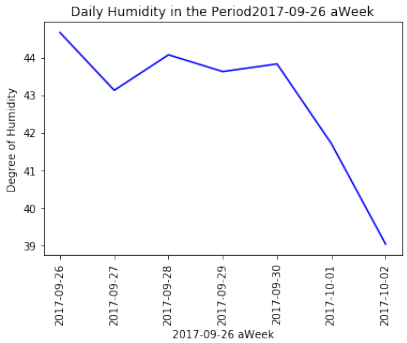

Figure 11: Humidity

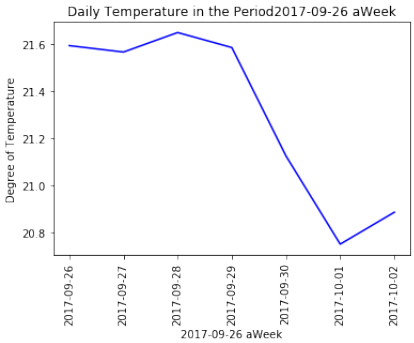

Figure 12: Temperature

Appendix B

A set of different periods with a gap (365 days or a year) is described. To consider the difference from features in a year since 26 June 2017, figs 13, 14, 15, 16 are respectively showed. In addition, the remaining figs (figs 17, 18, 19, 20) show line graphs based on different features in Tellus Arena in a year started 26 August 2017.

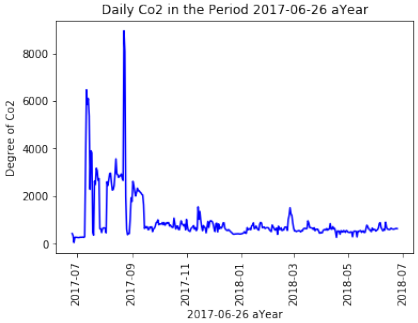

Figure 13: Co2

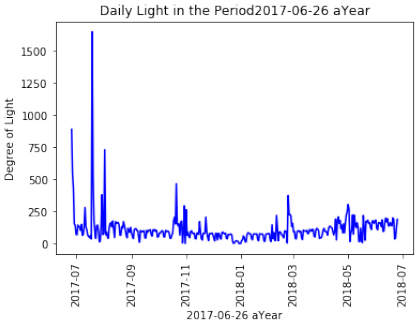

Figure 14: Light

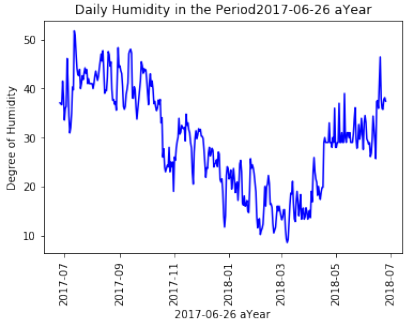

Figure 15: Humidity

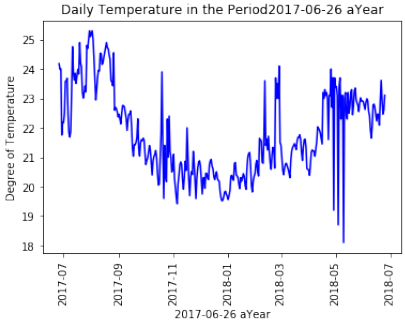

Figure 16: Temperature

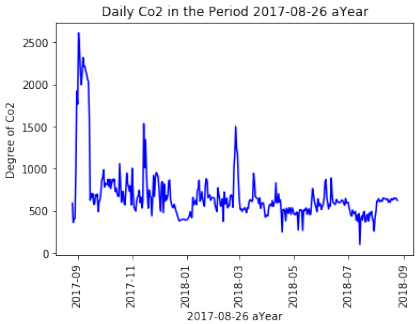

Figure 17: Co2

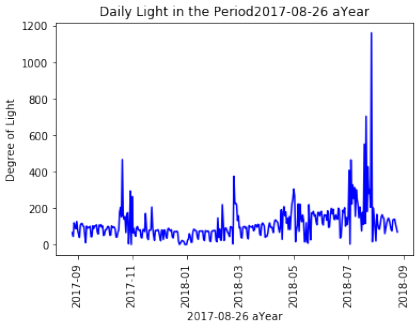

Figure 18: Light

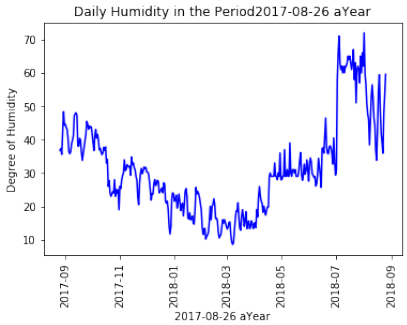

Figure 19: Humidity

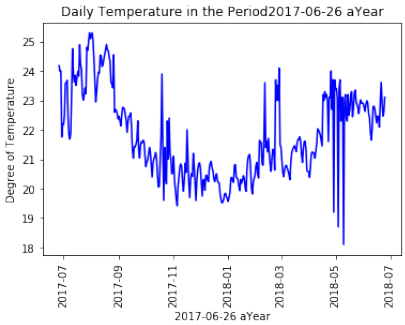

Figure 20: Temperature