



Sensory Network Monitoring the Air Condition, Installed in the Town of Litomerice

Josef DOUŠA¹⁾

¹⁾ VSB-Technical University of Ostrava, Faculty of Mining and Geology, 17. listopadu Str. 15, 708 33 Ostrava - Poruba, Czech Republic; email: josef.dousa.st@vsb.cz

<http://doi.org/10.29227/IM-2020-01-34>

Submission date: 10-01-2020 | Review date: 05-03-2020

Abstract

There is a strong transit car traffic in Litomerice. A monitoring network was installed in the town of Litomerice (Czech Republic, Usti nad Labem Region) to explore the condition and impact on the environment. This monitoring uses a network of sensors and data is centralized.

In this work we will deal with the evaluation of the two-year operation of this network and function description.

Keywords: sensors, monitoring network, protecting the city's environment

Introduction

In most European cities, air quality is strongly affected by all kinds of human activities. Litomerice, as well as a number of other cities across Europe, face air pollution prevention problems. [1, 2] The low cost and availability of sensors and their involvement in measurement networks is becoming an effective option to monitor, evaluate and respond to air quality influences. In this work we will focus on the sensory network installed in the town of Litomerice and its almost two-year operation.

Description

In Litomerice are historically operated two measuring stations. One owned by the Czech Hydrometeorological Institute (CHMI) – monitors PM₁₀, SO₂, CO and O₃ [3] and the other owned by the Institute of Health (ÚZ) – monitors SO₂, PM₁₀, O₃, NO_x, H₂S and CS₂.

In September 2017, a network of 12 measuring stations measuring PM₁, PM_{2.5} and PM₁₀, 4 measuring stations VOC and one station measuring metrological values was installed for the city's needs. The location of the stations is shown in Figure 1. [4]

The installation was carried out with the assistance of The Faculty of Transportation Sciences, Czech Technical University in Prague.

The network is made up of AirTracker units that provide a comprehensive solution for on-line indicative environmental measurements (dust, noise, emissions). In addition to the sensors themselves, they are equipped with a wireless communication interface and a patented power supply system capable of uninterrupted operation from the public lighting network. The whole system is complemented by a web interface for visualization and analysis of current and historical data, see Figure 2. [4]

Measurements are thus PM₁ particulate concentrations (0.3 to 1.0 μm), PM_{2.5} (1–2.5 μm), PM₁₀ (2.5–10 μm) in the range from 0 to 500 μg.m⁻³ with an accuracy of 10%; maximum and average noise value (50–120 dB SPL), accuracy ± 1dB(A) SPL in full range; VOC concentrations with ionization potential <10.6 eV (range 1–1000 ppb, nonlinearity <3%). Optionally, the units can be supplemented with concentration measurements: CO, H₂S, NO, NO₂, O₃, SO₂. [5]

Results and discussion

As can be seen from Table 1 [4], the amount of data as of January 12, 2019 collected by this sensory network is enough to allow us to evaluate this data. Prior to the actual evaluation, the data is adjusted by the float diameter with averaging window 500 and the finding and clearing of the outlier's data using the generalized extreme Student's test for outliers. This



Fig. 1. Station locations [4]
Rys. 1. Lokalizacje stacji [4]

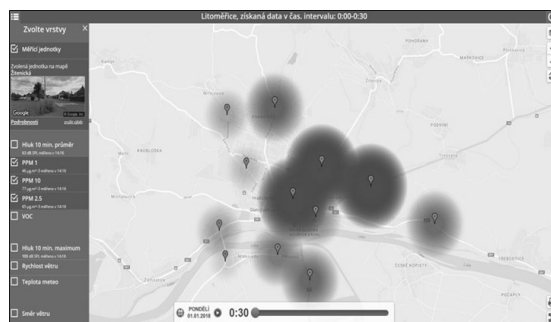


Fig. 2. Visualization interface [4]

Rys. 2. Interfejs wizualizacji [4]

Tab. 1. Number of measured data [4]

Tab. 1. Liczba zmierzonych danych [4]

ID of unit	number of data records
301 - Pokratická	148 312
302 - Miřejovická	176 779
303 - Kamýcká/ ČHMÚ	216 741
304 - Žitenická	134 529
305 - Na Valech / Tržnice	172 734
306 - Českolipská	191 115
307 – Ostrovní	207 990
308 - Žernosecká / Most G.Ch.	189 217
309 - Nádražní	188 841
311 - Mlékojedská	163 396
312 - Želetická	189 441
313 – AirTracker (metrological data)	88 101

Tab. 2. Measured data without outliers [4]

Tab. 2. Zmierzone dane bez wartości odstających [4]

ID of unit	number of data records	Outliers data
301 - Pokratická	148 312	340
302 - Miřejovická	176 329	403
303 - Kamýcká/ ČHMÚ	216 741	2 701
304 - Žitenická	134 529	9 874
305 - Na Valech / Tržnice	172 734	2 206
306 - Českolipská	191 115	1 995
307 - Ostrovní	207 990	885
308 - Žernosecká / Most G.Ch.	189 217	220
309 - Nádražní	188 841	3 801
310 - Mlékojedy most	218 754	14 876
311 - Mlékojedská	163 296	542
312 - Želetická	189 441	495
Celkem	2 197 299	38 338



Fig. 3. Installed humidifiers

Rys. 3. Zainstalowane nawilżacze

iterative method is useful when masking different outlier's data values, as shown in Table 2. [4]

Conclusion

We will evaluate the cleaned data with the assistance of the Faculty of Transportation Sciences, Czech Technical University in Prague and the output should be the detection of causes of increased dustiness in Litomerice. Part of the monitoring of the air condition is the elaboration of a dispersion study in cooperation with CDV (Transport Research Center).

It is also possible to connect some sensors to humidifiers installed on public lighting poles, thus ensuring a controlled improvement of air at a critical time, see Figure 3.

In addition, sensors are connected to CO₂ sensors located in schools for efficient ventilation, excluding ventilation with poor air quality in the environment.

Despite the relative error of measurement or the amount of outliers data, sensory networks have a great potential for use in urban areas due to their relatively low purchase price and will certainly find their place in other fields and activities.

Literatura – References

1. U. A. Hvidtfeldt, M. Sørensen, C. Geels, M. Ketzel, J. Khan, A. Tjønneland, K. Overvad, J. Brandt and O. Raaschou-Nielsen, "Long-term residential exposure to PM2.5, PM10, black carbon, NO2, and ozone and mortality in a Danish cohort," *Environment International*, vol. 2019, no. 123, pp. 265-272, 2019.
2. "WHO | Air pollution," World Health Organization, 12. 05. 2016. [Online]. Available: <https://www.who.int/airpollution/en/>. [Accessed 14. 01. 2019].
3. ČHMÚ, "ČHMÚ," [Online]. Available: http://portal.chmi.cz/files/portal/docs/uoco/web_generator/aqindex_slide4/mp_ULTTA_CZ.html. [Accessed 15. 01. 2019].
4. "Litoměřice :: Mapa," [Online]. Available: <http://litomerice.fd.cvut.cz/index/publicmap/>. [Accessed 02. 03. 2019].
5. "Data sheet of AirTracker," FD CVUT, [Online]. Available: <https://security.fd.cvut.cz/wp-content/uploads/2017/09/Airtracker-CTU.pdf>. [Accessed 18 03 2019].

Sieć sensoryczna monitorująca klimatyzację, zainstalowana w miejscowości Litomerice

W Litomericach panuje duży ruch tranzytowy. W mieście Litomerice (Czechy, Usti nad Labem) zainstalowano sieć monitorującą w celu zbadania stanu i wpływu na środowisko. Monitorowanie wykorzystuje sieć czujników, a dane są scentralizowane. W niniejszej pracy przedstawiono ocenę dwuletniego funkcjonowania tej sieci i opis funkcji.

Słowa kluczowe: czujniki, sieć monitoringu, ochrona środowiska miasta