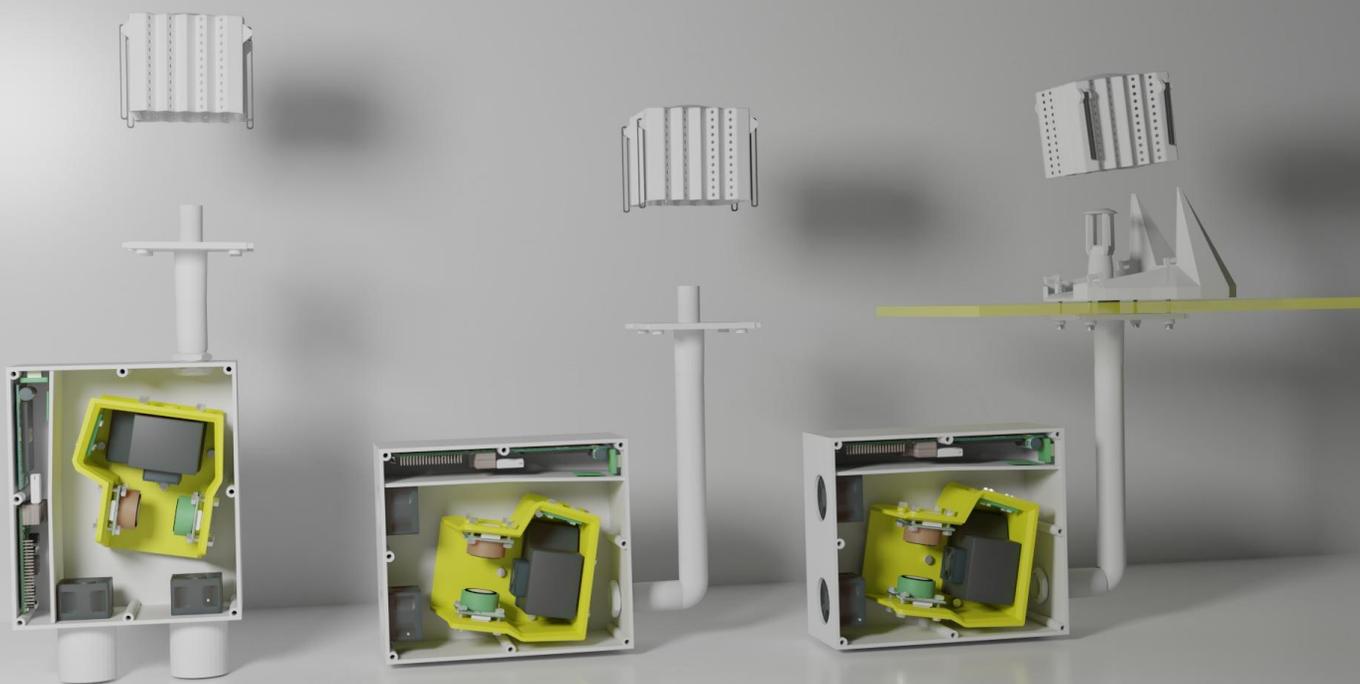


# ExpoLIS

Assessment of Human Exposure to Air Pollution  
to Change the Way People Move in cities

Newsletter 7

*February 2022*



# Welcome to the seventh edition of the ExpoLIS Newsletter!

*This newsletter is based on the ExpoLIS project. This and the future editions will aim to present the work that has been developed, the main outputs and dissemination activities.*



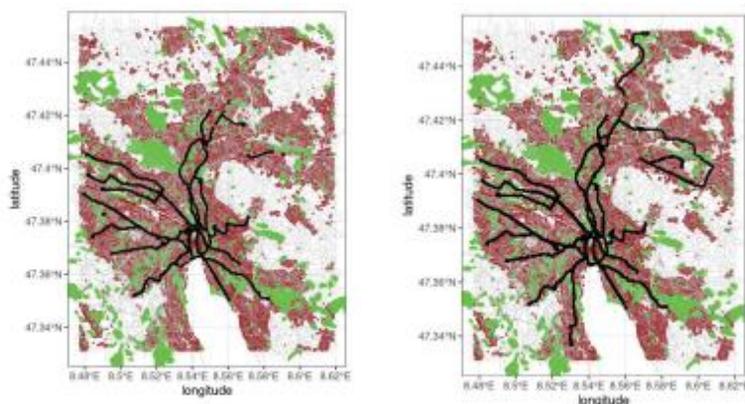
In 2018, two partners joined to propose a new project to the Portuguese Foundation for Science and Technology (FCT). In the last years there has been an improvement in Air Quality in urban areas due to the latest emission control strategies. However, the citizens are still exposed to levels of air pollution above the limits imposed by the legislation. The ExpoLIS project was created with the objective of developing a system that will characterize Air Quality, support air pollution improvement measures and ultimately decrease the citizens exposure to air pollutants.

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## On the automated learning of air pollution prediction models from data collected by mobile sensor networks

The ExpoLIS project addressed the problem of automated learning of air pollution predictive models that were trained using information gathered by a set of mobile low-cost sensors. Concretely, fast to compute machine learning methods (Decision Trees and Support Vector Machines) were used to build regression models that predict air pollution levels for a given location. The models were trained using the data collected by the OpenSense project, in particular, number of particulate matter, particle diameter, and lung deposited surface area (LDSA). We examined two different sets of attributes: one based on a geographical description of the location under analysis (e.g. distribution of households and roads), and another based on a time series of past air pollution observations in that location. Overall, we have found out that past measures lead to better pollution predictions. The best  $R^2$  score was 0.751 obtained with the model that predicts LDSA and was trained with the data set with time series attributes, while the worst  $R^2$  was 0.009 obtained with the geographical data set to predict number of particles. The performance of the best model is on par with similar air pollution systems. Moreover it can be used in a production system that requires frequent updates.

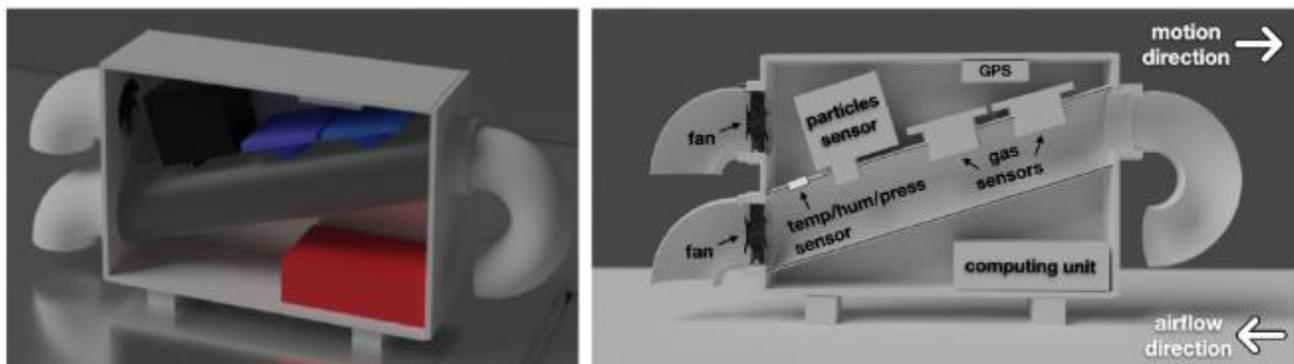


Read the complete article here:

<https://doi.org/10.1080/15567036.2021.1968076>

## Air quality mapping and visualization: An affordable solution based on a vehicle-mounted sensor network

ExpoLIS project developed an air quality mapping and visualization system, which aims at: (1) informing citizens regarding the air quality of their surroundings and how to cope with it (e.g., choosing commuting routes according to a health model); and (2) gathering dense spatiotemporal air quality data to support the empirical work of environmental experts. The system is composed of: (1) an affordable and custom vehicle-mounted sensor network for air quality monitoring; (2) a server to store, process, and map all gathered geo-referenced sensory data; and (3) a set of user-centred visualisation and prediction services tailored for citizens and environmental experts. Experimental validation of each component of the proposed system shows that the current prototype is capable of tracking spatiotemporal air quality changes and of providing users with access to these events via a set of interfaces. The results show evidence of a strong correlation in static situations ( $R^2$  of 0.96 for PM2.5) between the proposed low-cost all-weather system and a high-cost equipment with no weather protection. The results also show a weaker correlation ( $R^2$  of 0.57 for PM2.5), but still satisfactory, in dynamic settings. In short, this paper presents experimental evidence that supports the claim that the ExpoLIS system is feasible and valuable to both citizens and environmental scientists.

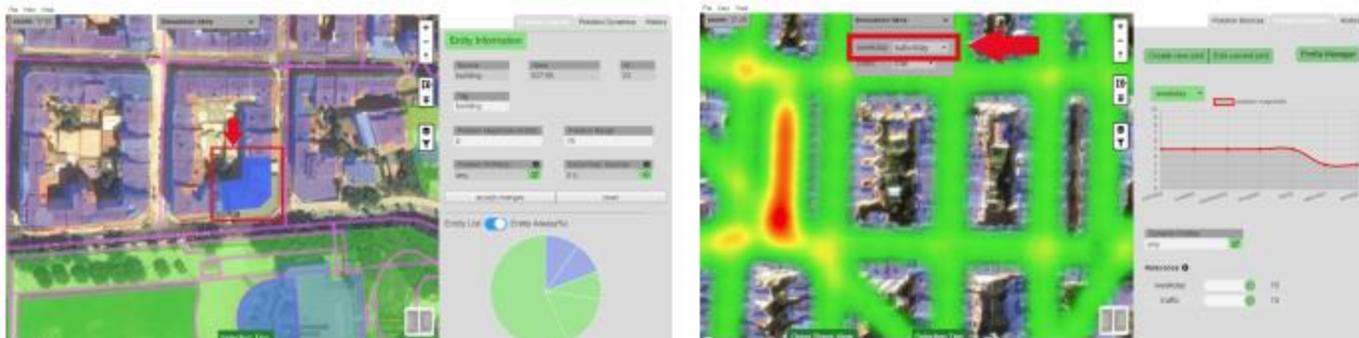


Read the complete article here:

<https://doi.org/10.1016/j.jclepro.2021.128194>

## A graphical tool for eliciting knowledge of air pollution sources

With tens of thousands of air quality monitoring stations installed in the world, this source of information has become the standard in air quality measuring. Air pollution becoming a growing concern for decades now, the need for an easy way to visualise pollution data arose. Extensive maps have been created to represent air pollution using data collected from monitoring stations, as well as other sources of information, such as traffic density or weather forecasts. The ExpoLIS project introduced a complementary source: direct environmental expert knowledge. By using the developed tool, the goal is to allow experts to express their knowledge about air pollution emission and diffusion as a function of the presence of key topological elements in a map, such as buildings or roads. The results of the usability tests performed with a sample of 30 participants are promising. Participants provided useful feedback regarding key application features to be implemented in future iterations.



Read the complete article here:

<https://doi.org/10.1109/ICGI54032.2021.9655276>

# ExpoLIS in the European Aerosol Conference 2021

The European Aerosol Conference 2021 was an on-line conference that brings together researchers from all around the world that are developing their work on the aerosol research field.

The ExpoLIS project was present at this conference. Carolina Correia presented an oral presentation entitled “Field performance and quality control of a network of low cost sensors for air quality monitoring” and a poster presentation entitled “Assessment of human exposure to air pollution to change the way people move in cities”. Furthermore, Vânia Martins from the ExpoLIS made an oral presentation entitled “Concentration and chemical composition of PM in urban transport modes”.

## Field performance and quality control of a network of low cost sensors for air quality monitoring

Carolina Correia<sup>1</sup>, Vânia Martins<sup>1</sup>, Bernardo Matroca<sup>1</sup>, Pedro Santana<sup>2,3</sup>, Pedro Mariano<sup>1</sup>, Susana Marta Almeida<sup>1</sup>

<sup>1</sup> Centro de Ciências e Tecnologias Nucleares, Instituto Superior Técnico, Universidade de Lisboa, Portugal  
<sup>2</sup> Instituto Universitário de Lisboa (ISCTE-IUL), Portugal  
<sup>3</sup> Architecture Research Center (ISTAR-IUL), Lisboa, Portugal

This study was supported by Portuguese Foundation for Science and Technology (FCT) through the project ExpoLIS (LISBOA-01-0145-FEDER-032088) and the contract CEECIND/04228/2018. Authors gratefully acknowledge the FCT support through the PhD grant UI/BD/150996/2021 and project IDB/04349/2020.

### ExpoLIS

#### Assessment of Human Exposure to Air Pollution to Change the Way People Move in Cities

C. Correia<sup>1</sup>, V. Martins<sup>1</sup>, P. Santana<sup>2</sup>, P. Mariano<sup>1</sup>, S.M. Almeida<sup>1</sup>

<sup>1</sup> Centro de Ciências e Tecnologias Nucleares, Instituto Superior Técnico, Universidade de Lisboa, Portugal  
<sup>2</sup> Instituto Universitário de Lisboa (ISCTE-IUL), Portugal  
<sup>3</sup> Architecture Research Center (ISTAR-IUL), Lisboa, Portugal

Keywords: Air Quality, Exposure, Commuting, Mobile Sensor Networks  
 \*ccorreia@ctn.tecnico.ulisboa.pt

Motivation	The Sensor Node
<ul style="list-style-type: none"> <li>Urban air pollution is one of the most significant environmental stress factors.</li> <li>Exposure levels above the limits set by the legislation in many countries and the WHO guidelines.</li> <li>In urban areas, the air quality data generated by fixed monitoring stations exhibits low spatial density, need to complement or reinforce knowledge based on empirical evidence.</li> </ul>	<p>The sensor node design ensures that the sensors are in contact with an adequate air flow and that they are protected against harsh weather conditions.</p> <p>The sensor node board computer is a Raspberry Pi 3B+ with a 1.6 GHz 64-bit quad-core processor, a dual-band wireless LAN, Wi-Fi and Bluetooth 4.2/BLE.</p>
<h4>The ExpoLIS System</h4> <p>Development of an affordable and custom vehicle-mounted sensor network for air quality monitoring.</p> <p>A network of 18 wireless low-cost sensing nodes installed on the top of the city public buses to maximize the spatial and temporal coverage of air pollution.</p> <p>ExpoLIS is a heterogeneous system composed of 3 parts:</p> <ol style="list-style-type: none"> <li>1) ExpoLIS Sensor Network that includes all mobile sensor nodes that sample the environment;</li> <li>2) ExpoLIS Server that collects and stores all sensor data in a database;</li> <li>3) ExpoLIS Users which can access individual and spatiotemporal aggregated air quality data.</li> </ol>	<p>The main process running in the sensor node computing unit is a Python script that runs endlessly while the sensor node has power. This script gathers sensor data periodically (by default 1 second).</p> <p>The data is immediately georeferenced, time-tagged and filtered (the filter smooths the data and removes outliers). Afterwards, the data is sent by the Python script to the ExpoLIS Server.</p>
<p>Equipment</p> <ul style="list-style-type: none"> <li>PM (PM2.5, PM10)</li> <li>CO</li> <li>NO<sub>2</sub></li> <li>T, RH</li> <li>GPS</li> </ul>	<p>Brand and Model</p> <ul style="list-style-type: none"> <li>AlphaSense (DPC-N)</li> <li>AlphaSense CO-BE</li> <li>B&amp;P</li> <li>Adinnet SHPCS</li> <li>Adafruit FAL0100</li> </ul>
<h4>ExpoLIS users</h4> <p>The data gathered by the sensor network is accessible through a set of four interfaces: 1) An Android App to provide a healthy routes planner and access to the data by concerned citizens; 2) An air quality game-like to raise awareness to air quality; 3) A sensor values experts can access the data and do a graphical interface in Python for the developers to monitor all sensor data in real time.</p>	<p><b>Acknowledgements</b></p> <p>This study was supported by Portuguese Foundation for Science and Technology (FCT) through the project ExpoLIS (LISBOA-01-0145-FEDER-032088) and the contract CEECIND/04228/2018. Authors gratefully acknowledge the FCT support through the PhD grant UI/BD/150996/2021 and project IDB/04349/2020.</p>

## ExpoLIS in the 2021 European Night of Researchers

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As it had already happened in 2019, ExpoLIS was once again at the European Night of Researchers.

This is an event that aims at bringing together researchers and the community. The ExpoLIS project was present in the 2021 edition and the citizens had the opportunity to be informed about the ExpoLIS system and APP.



# Meet the team

### Carolina Correia

Carolina Correia is PhD student that is developing her studies in the context of this project. She has been studying the exposure of commuters to air pollutants in urban areas and the use of low cost-sensors to contribute to the study of the citizens' exposure to air pollutants.



## What will you find in the next issue?

-  Exposure to air pollutants in ground transport microenvironments: a book chapter
-  Source apportionment of children daily exposure to particulate matter
-  An information system for Air Quality monitoring using mobile sensor network
-  ExpoLIS in the VIDIS Summer School
-  ExpoLIS in the European Aerosol Conference 2022

## Keep in touch!



<http://expolis.ctn.tecnico.ulisboa.pt/>



[expolis@ctn.tecnico.ulisboa.pt](mailto:expolis@ctn.tecnico.ulisboa.pt)



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