

# PROMET&O: A Multidisciplinary Approach to Monitor Indoor Environmental Quality

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**Abstract:** A poor indoor environmental quality may affect productivity, energy consumption, as well as health and behavior of occupants. To address such an issue, an innovative system encouraging a proactive behavior for indoor environmental quality is currently under development at PoliTo. The adopted approach combines low-cost, low-power and accurate multisensors for the on-line monitoring with the feedback of the perceived comfort from occupants.

## The importance of Indoor Environmental Quality

European citizens spend, on average, 90 % of their time indoors. A poor Indoor Environmental Quality (IEQ) may turn in negative consequences on occupants also affecting mental comfort and health. The assessment of IEQ is thus a complex task due to its nature that considers the thermal, air quality, lighting and acoustics domains at the same time. Also, exposure to day-to-day low-frequency electromagnetic fields should be monitored as well.

	Indoor air quality	15000 L the air you breathe on average every day	Particulate, formaldehyde, carbon and nitron oxides
	Thermal comfort	6 % reduction of office productivity at warmer temperatures	Air temperature, humidity
	Acoustic comfort	Up to 90 minutes loss productivity per day due to noise	Sound pressure level (SPL)
	Visual comfort	Depression and reduced cognitive faculties	Illuminance

## Objectives

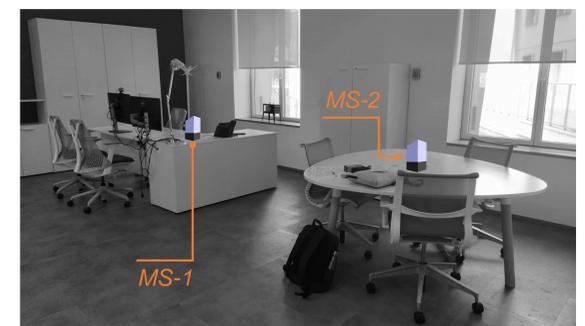
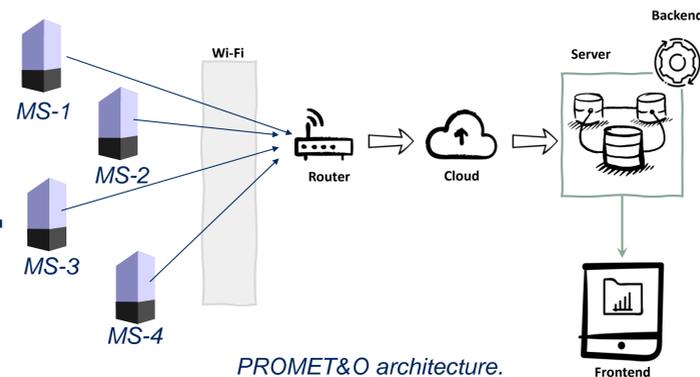
1. Innovative, accurate and low-cost system for in-field monitoring of IEQ.
2. Engagement strategies to encourage the occupants to provide feedback on the perception of IEC

A multi-disciplinary approach is required to cover all different aspects.

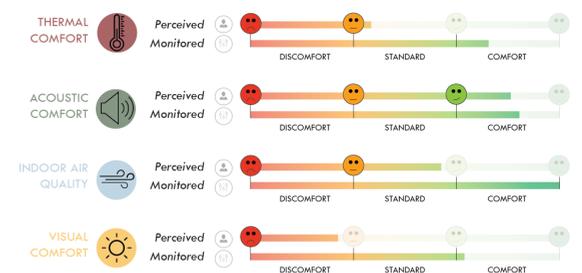
## The PROMET&O project

## Overview of PROMET&O

PROMET&O will provide the integration of the measured IEQ metrics with feedback of the perceived Indoor Environmental Comfort (IEC) from occupants, encouraging best practices for energy saving. The proposed system architecture consists in several Multi-Sensors (MSs) collecting data related to the IEQ metrics to be monitored, which are sent to an open-access platform for further processing and visualization.



Example of MSs positioning.



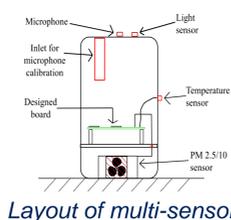
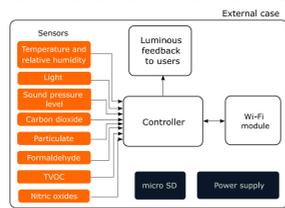
User interface providing IEQ metrics and feedback from occupants.

## The multi sensor

Physical quantity	Range	Accuracy
Relative humidity	0 % to 100 %	± 1.8 %
Temperature	-40 to 125 ° C	± 0.2 ° C
Light	0 to 120000 lux	10 %
Sound pressure Level	AOP=122.5 dBSPL	-
CO <sub>2</sub>	0 to 40000 ppm	± 3 %
PM 2.5 PM 10	0 to 1000 µg/m <sup>3</sup>	± 10 %
Formaldehyde	0 to 1 ppm	± 20 %
TVOC	0.16 to 10 ppm	± 15 %
ELF EM fields	Under development	

Low cost sensors.

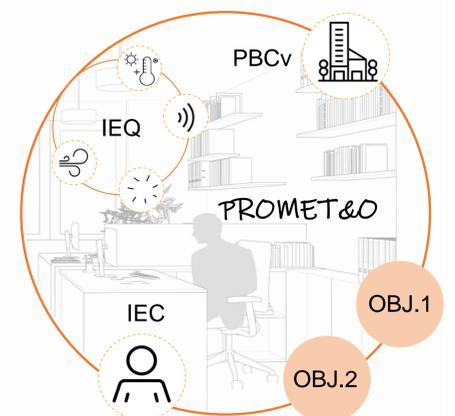
### Block scheme of the multi-sensor



Layout of multi-sensor.

Measurement range and accuracy of selected sensors agree with IEQ standards. To avoid self-heating or cross-sensitivity issues, MS layout should be carefully designed.

In-field monitoring and subjective feedback collection are performed with the aim of ensuring comfort in the workplace, increasing occupants' work productivity and obtaining energy savings.



Personal, behavioral and contextual variables (PBCv) influence the comfort perception. Within PROMET&O system those information will be collected and analyzed to better understand their relationship with IEQ and IEC.