Politecnico di Torino
Dipartimento di Automatica e Informatica

PhD in Computer and Control Engineering
XXXV cycle

Supervisor
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Multivariate analysis and augmented reality visualization in research and industrial environments

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1. Introduction

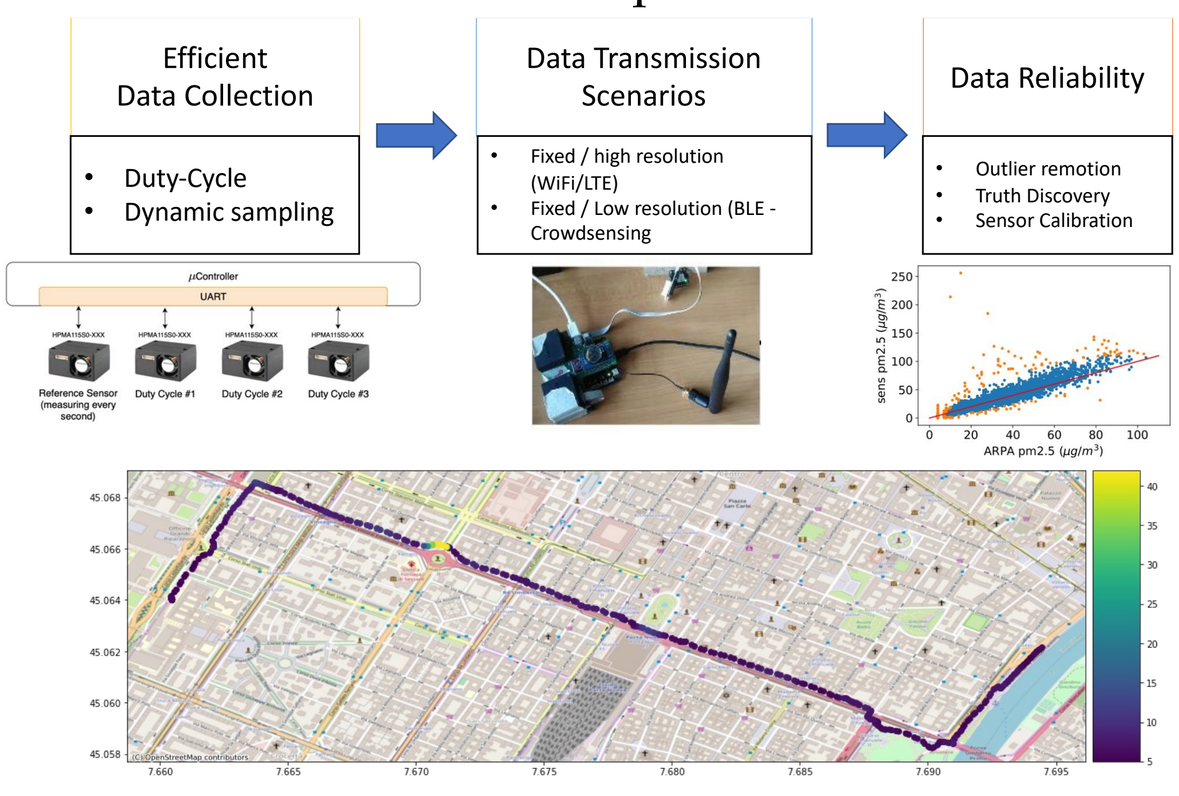
In smart cities, different ICTs are required to acquire variables of critical factors to know what currently happens. IoT is a crucial technology for obtaining good spatio-temporal coverage in an urban environment. However, IoT still presents some open issues related to efficient applications, such as sensor calibration, energy consumption, efficient data collection, and data reliability. This research focused on analyzing air pollution as a case study.

2. Goal

The goal of the Ph.D. is to analyze hardware, architectures, and software systems tools to monitor and control urban sustainability issues under an IoT architecture. This allows to enhance spatio-temporal resolution and provides truthful and accurate information.

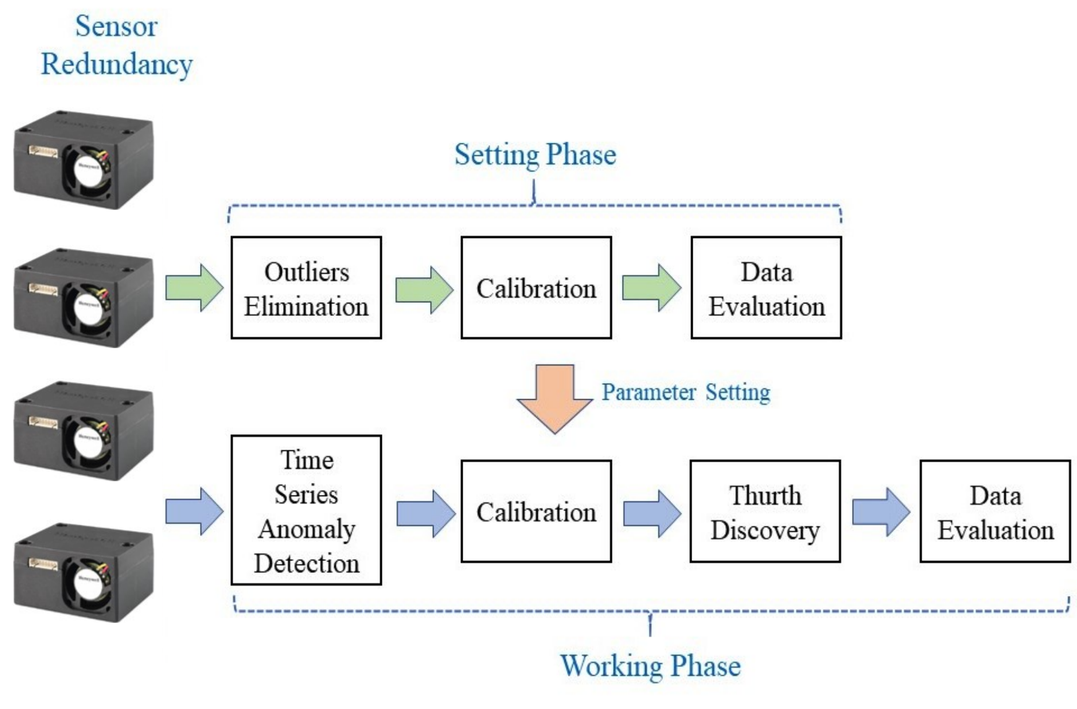
3. Method

The research was focused on the definition of an IoT framework evaluation for energy-efficient data acquisition and the performance of diverse collecting spatio-temporal scenarios under mobile and fixed IoT sensor devices. Moreover, computer algorithms were exploited to discard erroneous or spurious data.



4. Results

Different air pollution measurements were made in different seasons and diverse scenarios of an urban environment. Based on the data analysis, a set of sampling frequencies ($\mathbb{F}_s$) was evaluated to reduce the amount of data to 90% compared with the maximum sampling rate [1]. $\mathbb{F}_s$ also permits low-consumption profiles that minimize consumption by up to 43% [2]. The developed device was used to evaluate as a tool to find the relationship between the characteristics of the urban environment and their influence on the distribution of pollutants [3]. The following algorithm was developed to solve the air pollution sensor measurement uncertainty.



5. References

1. **G. R. Espinosa** et al., "Frequency Analysis of Particulate Matter in Urban Environments under Low-cost Sensors," 2021 International Conference on Computer Communication and Artificial Intelligence (CCAI), 2021.
2. **G. R. Espinosa** et al., "Low-cost PM Sensor Behaviour Based on Duty-Cycle Analysis," 26th International Conference on Emerging Technologies and Factory Automation (ETFA 2021).
3. **G. R. Espinosa** et al., "Promoting Healthy City through ICT technologies. An experience of low-cost particulate matter monitoring" PLEA2022
4. **G. R. Espinosa** et al., "A Novel Redundant Validation IoT System for Affective Learning Based on Facial Expressions and Biological Signals." Sensors 2022.