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Requirement Analysis and Specification Document

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Air Quality Monotoring

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1.0	17/04/2023	First submitted version

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1 Introduction

1.1 Purpose

In the Lombardy region, public authorities collect air quality and weather observations from ground sensor stations on a continuous basis. These observations result in a comprehensive dataset consisting of pollution measurements from Benzene, nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and nitrogen oxides, recorded at 128 stations throughout the entire year of 2022. This extensive dataset offers detailed information about air quality conditions across various locations in Lombardy, enabling us to perform in-depth analysis and generate meaningful visualizations.

1.2 Scope

The scope of our project is to design and develop an interactive Jupyter dashboard that retrieves air quality data from our local PostgreSQL database. The dashboard will provide users with seamless access to the collected dataset, allowing them to query and visualize air quality conditions across different regions and time periods within Lombardy. By incorporating advanced data processing techniques, intuitive visualizations, and interactive features, our application aims to empower public authorities and citizens to gain valuable insights into air pollution trends, identify high-risk areas, and make informed decisions to improve overall air quality and environmental health.

1.3 Short overview

Air pollution is a significant global challenge that requires collective efforts from individuals, communities, governments, and industries to address. By taking steps to reduce our contribution to air pollution and advocating for policies and practices that promote cleaner air, we can help protect the environment and safeguard our health for generations to come.
In a time of information saturation and global climate crisis, there is a need for distributed accessible high-quality information. This combined with the increasing propensity for the individual to find their own specific information sources tailored to their own needs means that tools are needed which allow individuals to cross-reference the information they receive using reliable and objective sources.
The application to be developed, therefore, aims to be a tool that provides easy access to air quality data in order to empower them both in their personal lives and as members of a community. The application is not a source in and of itself, but rather a visualization tool for existing and established data sources.

1.4 Anacronyms and other definitions

“The web app” or “app” : The application that is being developed.

“Use case” : An example of user interaction with the system.

“User” : any individual using the website that satisfies the description under the “ user characteristics” section.
“Bookmark” : Saving a snapshot of the information presented at a location on the map.
JSON : JavaScript Object Notation.
JS : javascript.
df : Dataframe, a pandas dataframe object.
gdf : geodataframe, a geopandas dataframe object
RASD : Requirements Analysis and Specification Document, easy later access.
“OpenAQ” : An organization providing open air quality data through API (OpenAQ, n.d)
“API” : Application Programming Interface

"REST" : Representational State Transfer

“Python” : High-level programming language we are going to use for building our software. It will be the basis of every functional tool used in our web application.

"AQI" : Air Quality Index.

2 Application domain and Use Case:

2.1 Users:

Our major user is the public, like students, families, clerks and workers. This application can be used for non-expertise uses, helping people to check the weather for their trips, camping and their other routine and daily plans.

2.2 Dataset:

Our data is collected from different stations of the region Lombardi in Italy. It is the stored data of different Air Quality indexes and air pollutants, in this region for the year 2022. Also we have the pollution factors volume which observed by that station.

The collected data consists of below information:

The data can be shown to the users in different ways:

1. on the map: By keeping the mouse cursor on the desired location on the map, user can see a brief pop-up containing information about the stations, sensor types, and province.

2. on a diagram: we have some diagrams that illustrates the minimum maximum and the average value of each sensor.

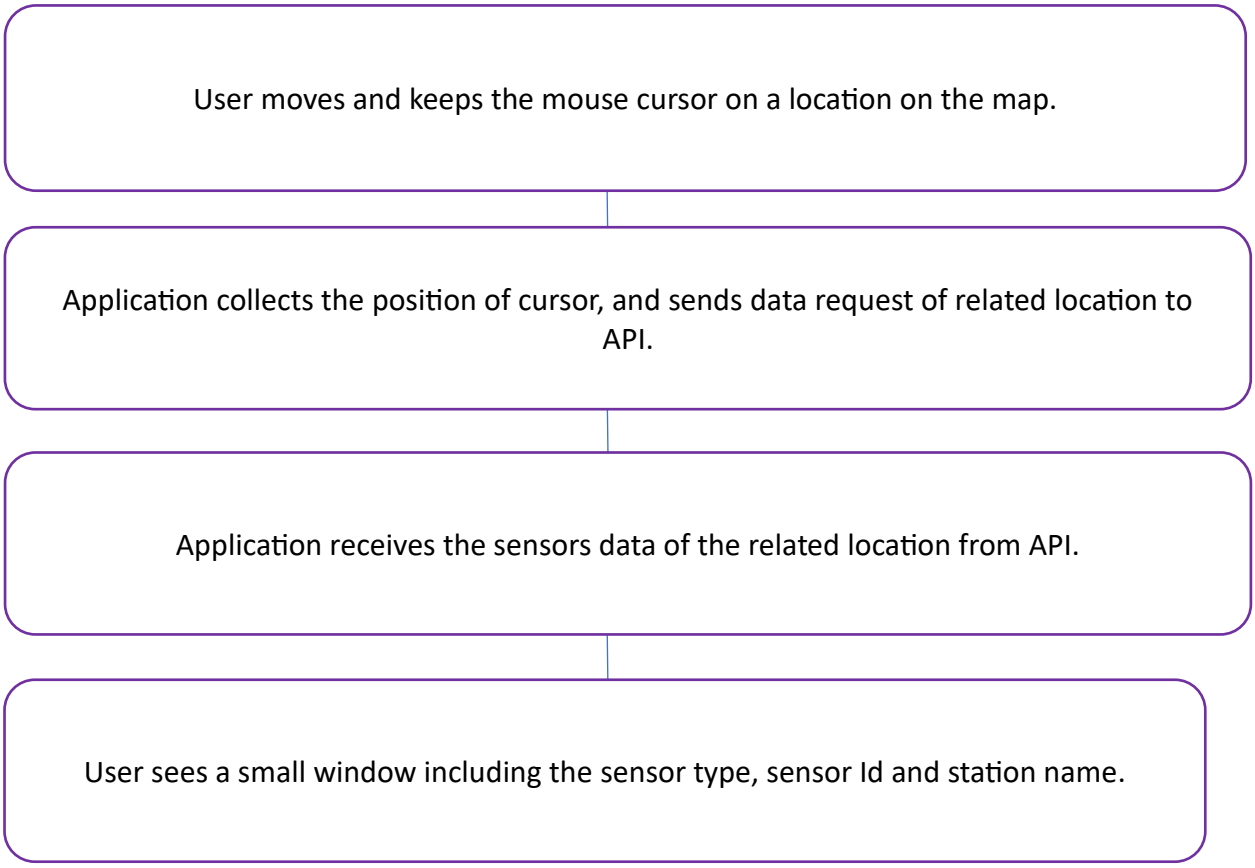
3. by choosing time and location: User chooses the city from a drop down menu and chooses the time and station and sees the result.

2.3 Use cases:

Here are some major user cases of operations that registered and non-registered users might do.

2.3.1 Pop-ups on the map:

User: all users
Exit condition: user sees the needed data.



2.3.2 Choosing from list:

User: all users
Exit condition: User sees the correct data with desired location.

User goes to one of the drop down menus and clicks on it and list opens.

User chooses one of the items in the list (sensor type, time, province,…)

The application sends a data request to API.

The application receives the data and shows the data in a table, graph or map.

The user is able to see the result in a table.

2.3.3 Plot of a sensor in a specific time:

User: all users
Exit condition: User sees the correct data with desired location.

User goes to drop down menu related to sensor and clicks on it and list opens.

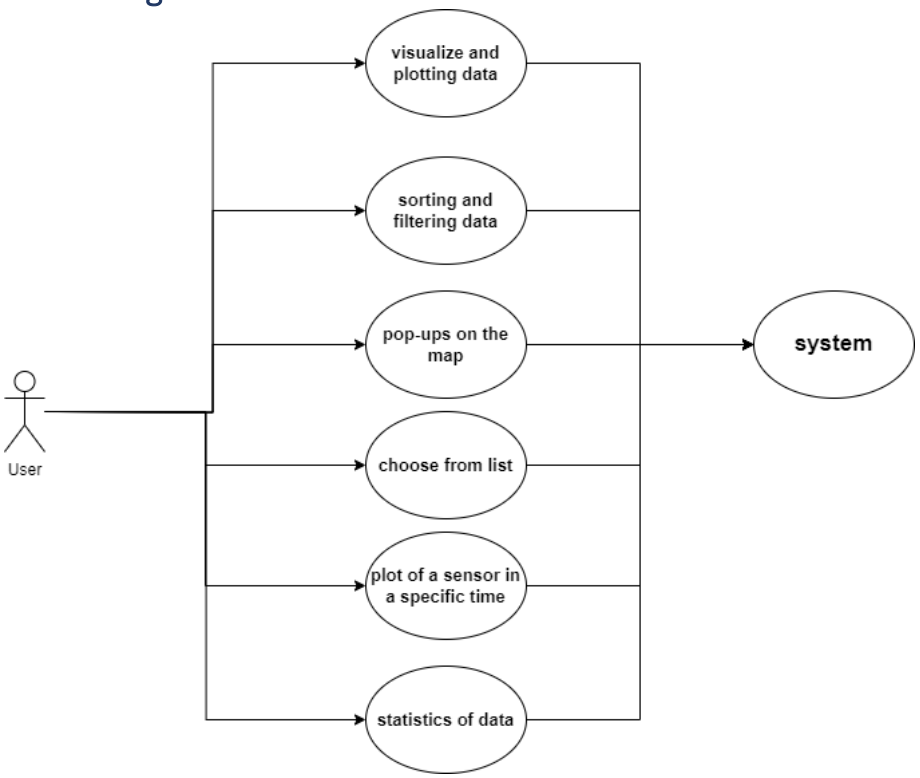
User chooses one of the sensors the list.

User goes the date pick widgets and chooses start and end time.

The application sends a data request to API.

The application receives the data and shows the data in a graph.

2.3.4 Use case diagram:



3 Requirements

3.1 Functional Requirements

Functional requirements describe the functions and features that "web app" plan to have in order to meet the needs of our users. Here are some functional requirements for our air quality monitoring application:

1. System should allow user to see a map of stations.

2. System should show a brief information about the stations and sensors in a pop-up.

3. System should allow user to choose province and sensor type and see the data of selected province and sensor type on the map.

4. System should allow user to choose period of time and sensor id and see the data of selected options in a graph.

5. User should be able to curse on the map, zoom in and zoom out and see the information by keeping the cursor on a map marker.

3.2 Non-Functional Requirements

Non-functional requirements define the quality attributes, attributes that cannot be directly traced to the functionality of the software, such as performance, usability.

1. **Usability**: The application should be user-friendly and easy to navigate, with clear instructions and feedback provided to users.

2. **Performance**: The application should be able to show the results within 1 minute.

3.3 Technical Requirements

Technological requirements are the hardware and software specifications that are necessary to support the system's functional and non-functional requirements.

1. Database: PostgreSQL
2. Web server: Flask
3. Dashboard: Jupyter Notebooks, Jupyter widgets
4. Programming language: Python 3.x
5. Data processing and utilities: Pandas, Geo pandas

3.4 Domain Assumption

1. The users can find the GitHub link of the project repository.
2. The system assumes that the web server and database will be hosted on reliable and secure servers with high-speed internet connectivity.
3. The system assumes that users accessing the application have basic knowledge of air quality and weather measurements.
4. The system assumes that the selected public digital archives have a stable and consistent API for accessing data.
5. The system assumes that the data provided by the public digital archives are available for free and do not require any additional licenses or fees.
6. The system assumes that the application will only be used for monitoring and visualization of air quality and weather data and will not be used for any other purposes.

4 Refrences

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