RASD

Requirement Analysis and Specifications Document

Software Engineering for Geoinformatics

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SUMMARY

1. INTRODUCTION

1.1 PURPOSE:

The current RASD document reports the Requirement analysis of 'Bugs_project: Air quality analysis'. The application is designed to be a support for users in querying and visualizing data retrieved from Dati Lombardia air quality sensor dataset. This is offered in a client-server system, that integrates and process historical air quality measurements in order to provide insights into pollution distribution, trends and exposure risks.

1.2 SCOPE

The scope of the project is to develop a client-server application that supports users in querying and visualizing data retrieved from the Dati Lombardia air quality sensor dataset. The system should integrate and process historical air quality measurements to provide insights into pollution distribution, trends, and exposure risks at different administrative levels within Lombardy.

2. REQUIREMENTS

2.1 STAKEHOLDERS:

The application will be a support for decision-makers, such as environmental agencies and public health organizations. It will be a support also for regional and local (provinces, municipalities) administration.

It can be accessed also by citizen interested in knowing the quality of the air in their cities or by students/teachers for educational purposes.

2.2 USER TYPES:

The user can be:

- Standard user: he/she can choose from preselected options and visualize the data accordingly.
- Expert user: he/she can do the same things as a standard user. Additionally, he/she has the ability to input some thresholds and areas and get a more personalized visualization of the selected data.

2.3 DOMAIN ASSUMPTION:

The application uses air quality data retrieved from "Air quality data" and sensor data from "Sensor Data" both given and belonging to "Arpa Lombardia".

The system, consequently, acts under the assumption that the data will remain free and available, in fact the stability of the data source is an essential asset for proper functionality.

For visualization purposes, the system also includes data about the shape of provinces and municipalities in Lombardy, obtained from "Shape Limiti amministrativi Comunali 2020 con aggiornamenti DbT/PGT poligon | Open Data Regione Lombardia" as well as DTM data, from "Metadati - Geoportale della Lombardia".

2.4 FUNCTIONAL REQUIREMENTS

DATA INTEGRATION:

Requirement ID: DI-1

Title: Air quality data
Description: The system should store in the database air quality data from Dati Lombardia.

Requirement ID: DI-2

Title: Sensor data
Description: The system should store in the database sensor data from Sensor Data.

Requirement ID: DI-3

Title: Connection between data
Description: The system should combine air quality data with sensor data through the sensor ID.

Requirement ID: DI-4

Title: Valid data
Description: The system should filter invalid data and let the user process and visualize only valid data.

Requirement ID: DI-5

Title: Data update
Description: If new data are uploaded to Dati Lombardia and Sensor Data, the system should be able to store and process them.

Requirement ID: DI-6

Title: geometric visualization
Description: The system should integrate geometric data about the shape of municipalities, provinces and contour lines when the visualization requires it.

DATA PROCESSING

Requirement ID: DP-1

Title: Database query
Description: The system should query the database and return to the client only the requested data, correctly processed and aggregated.

Requirement ID: DP-2

Title: Statistical analysis
Description: The system should be able to perform data aggregation and statistical analysis, for example by computing the mean over a period of time and over a given area.

DATA VISUALIZATION

Requirement ID: DV-1

Title: User selection
Description: The system should let the user choose which profile he/she prefers between standard or expert user.

Requirement ID: DV-2

Title: User upgrade
Description: The system should let the standard user upgrade its profile to expert user

Requirement ID: DV-3

Title: Map visualization
Description: If there is a map, the system should allow the user to choose between different basemaps and to select only the layers he is interested in.

Requirement ID: DV-4

Title: Data availability
Description: The system should alert the user if no data is available for the visualization he selected.

Requirement ID: DV-4.1

Title: Data selection
Description: The system should alert the user if he hasn't selected all the parameters needed for the visualization

Requirement ID: DV-5

Title: Single sensor time series
Description: The system should allow the user to select a pollutant and then select a sensor between the ones that measure that pollutant and visualize the time series of the monthly average of the concentration.

Requirement ID: DV-6

Title: Sensor location
Description: The system should allow the user to select one pollutant and visualize on the map where the relative sensors are located.

Requirement ID: DV-7

Title: Pollutant comparison over same area
Description: The system should allow the user to select one province or one municipality and visualize the time series of the selected pollutant, the time series will be obtained calculating for each pollutant the monthly average over the selected area.

Requirement ID: DV-8

Title: Average concentration – histogram
Description: The system should allow the user to choose a pollutant and a time window and visualize in a histogram the average for each province (along with the global average) concentration of the selected pollutant over the selected time.

Requirement ID: DV-9

Title: Average concentration – map
Description: The system should allow the user to choose a pollutant and a time window and visualize on the map the average concentration of the selected pollutant over the selected time for each province. The administrative areas should have different colours accordingly to the computed average.

Requirement ID: DV-10

Title: Correlation with altitude – map
Description: The system should allow the user to select a pollutant and visualize a topographic map (made with contour lines each 100 m for heigh < 600 m, and each 200m for higher height values) with layers for each available year. On the map it's shown the monthly concentration of the selected pollutant, for the selected years.

Requirement ID: DV-11

Title: Correlation with altitude – graph
Description: The system should allow the user to select a pollutant, a year (between the available years for that pollutant) and a month, to visualize a graph that highlights the correlation between a monthly concentration of the selected pollutant and the altitude of the related sensor.

EXPERT USER DATA VISUALIZATION

Requirement ID: EU-DV-1

Title: Polygon definition
Description: The system should allow the expert user to define a polygon and visualize if the area selected contains sensors, and which pollutants are measured by those sensors.

Requirement ID: EU-DV-2

Title: Threshold definition – time-series

Description: The system should allow the expert user to select a pollutant, a time window, a province, define a threshold and visualize a time series showing in which days the threshold has been exceeded and a percentage (exceeded days/total days).

2.5 TECHNICAL REQUIREMENTS

DATA INTEGRATION:

Requirement ID: TDV-1

Title: Database
Description: The systems database should be PostgreSQL / PostGIS

CLIENT-SERVER:

Requirement ID: TCS-1

Title: Query
Description: The system should query and retrieve data from the database.
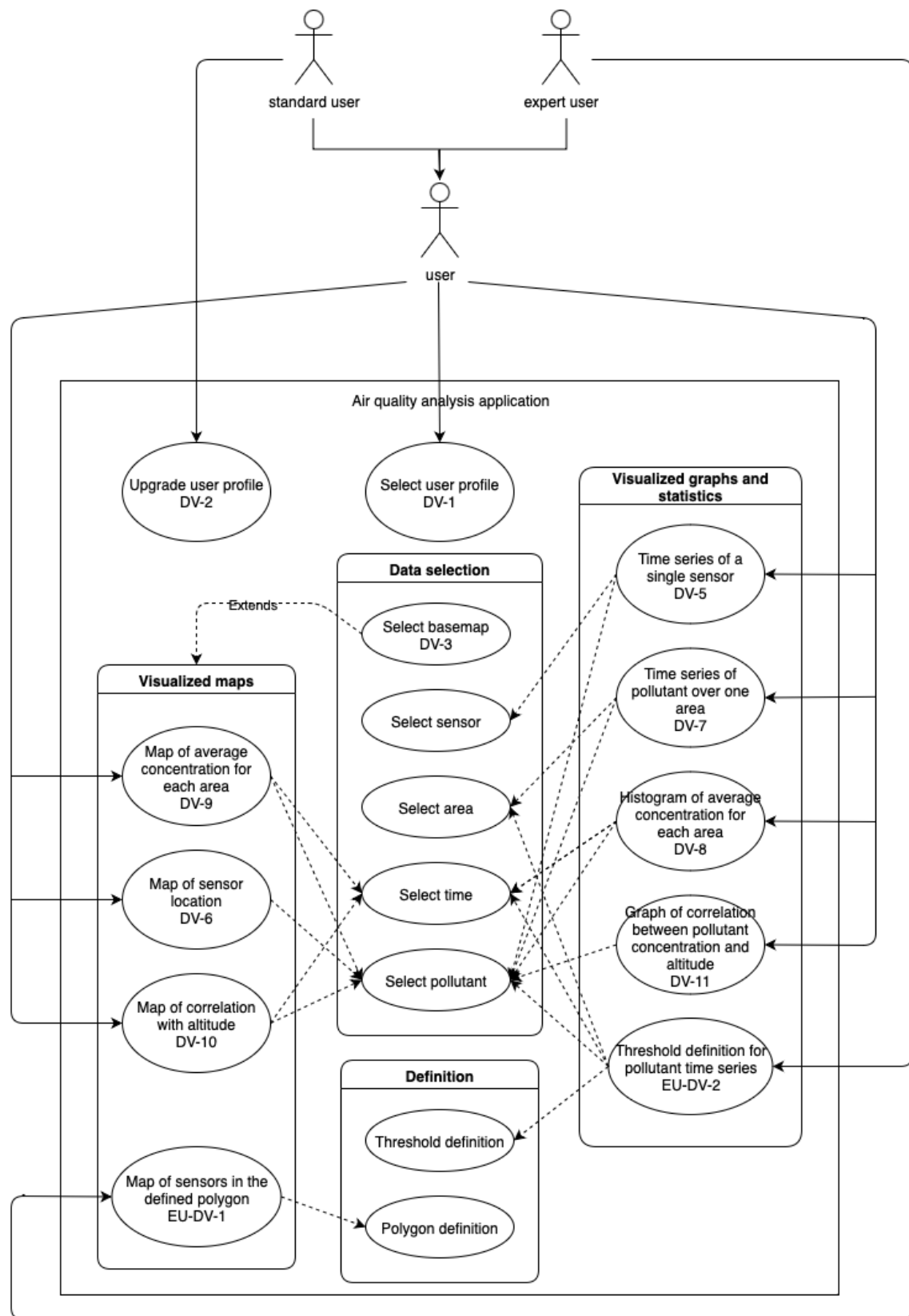
Requirement ID: TCS-2

Title: Data format
Description: The system should return data to the client using the JSON format.

Requirement ID: TCS-3

Title: Data format
Description: The system should have an interactive dashboard developed using Jupiter Notebook.

Figure 1: user case diagram

	USER SELECTION	**MAP VISUALIZATION**	**GRAPH VISUALIZATION**
GENERIC USER PARAMETERS SELECTION AND VISUALIZATION	As a user I can select to be a standard/expert user, so that I can decide to personalize or not my future visualization [DV–1]	As a user I can choose what basemap will be put in the visualization [DV–3]	
	As a standard user I can decide to update to a expert user, so that I can improve my visualization possibilities [DV–2]	As a user I can select one pollutant, so that I can visualize on the map where the relative sensors are located [DV–6]	As a user I can select a pollutant and a sensor, so that I can visualize the time series of the specific pollutant measured by the selected sensor [DV–5]
			As a user I can select one province or one municipality and the pollutant, so that I can visualize the concentration time series of that pollutant [DV–7]
		As a user I can select a pollutant and a time window, so that I can visualize on the map the respective average concentration for each province [DV–9]	As a user I can select a pollutant and a time window, so that I can visualize the histogram of the respective average concentration for each province (along with the global average) [DV–8]
		As a user I can select a pollutant, so that I can visualize, on a topographic map with layers for each available year, the monthly average concentration of that pollutant. [DV–10]	As a user I can select a pollutant, so that I can visualize a graph that highlights the correlation between the monthly average concentration of that pollutant and the altitude of the sensors [DV–11]

EXPERT USER PARAMETERS SELECTION AND VISUALIZATION	As an **expert user** I can define a polygon, so that I can visualize if the area selected contains sensors and the pollutant measured by that sensor [EU–DV–1]	As an **expert user** I can define a threshold and select a pollutant, a time window and a province, so that I can visualize a time series showing which days the threshold has been exceeded [EU–DV–2]
		As an **expert user** I can define a threshold and select a pollutant, a time window and a province, so that I can get a percentage of which days the threshold has been exceeded with respect to the total days considered [EU–DV–2]

Table 1: user stories

5. FUTURE CONSIDERATIONS

Given its modular structure, the dashboard could be extended in the future with new selections and visualizations. For this reason, we left in the database some data that were not strictly necessary for the requirements that we implemented (e.g. coordinates of projected data, geometry of municipalities), but that could be useful for further analysis.