Software Engineering for Geoinformatics 2025

**Requirement Analysis and Specification**

**Document (RASD)**

Air Pollution Data Display and Custom Report Generation

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**1. Introduction**

**1.1 Purpose**

This document outlines the software requirements for a web-based application aimed at analyzing and visualizing air pollution data in the Lombardy region. The application provides interactive features to view, analyze, and export pollution data in a user-friendly manner.

**1.2 Scope**

The software system allows users to explore air pollution levels without needing to register or log in for citizens but requires government/private sector users to register/login for advanced feature access. It includes an interactive dashboard, pollutant information, and data export functionalities. Users can view pollution levels across time and regions within Lombardy.

**1.3 Definitions, Acronyms, and Abbreviations**

* RASD: Requirement Analysis and Specification Document
* CSV: Comma Separated Values
* PM10/PM2.5: Particulate Matter

**2. Overall Description**

**2.1 Product Perspective**

The web application is a standalone system accessible publicly via a browser. It features client-side interactivity combined with backend data processing capabilities. The system is visual in nature, emphasizing clarity and user experience.

**2.2 Product Functions**

* Display pollution levels across Lombardy
* Provide pollutant information
* Interactive dashboards with map and time series
* Data export in CSV/Excel

**2.3 User Classes and Characteristics**

|  |  |
| --- | --- |
| USER | Access |
| Government | View/export data, access advanced reports, configure policy tools, access detailed graphs, Need to Register/Login |
| Private Sector | | View and analyze data, export for business or environmental purposes, Need to Register/Login |
| Citizen | View public data only, explore local pollution status |

**2.4 Operating Environment**

* Compatible with modern web browsers (Chrome, Firefox, Edge)
* Responsive design for desktops and tablets

**2.5 Constraints**

* Must handle pollution data from 01-Jan-2021 to 30-Jun-2025
* Frontend must load efficiently under normal broadband conditions

**2.6 Assumptions and Dependencies**

* Pollution data is pre-collected and formatted in a consistent structure
* Users access the system over a stable internet connection

**2.7 Stakeholder**

Stakeholder Goals/Concerns

- Government User: Monitor pollution trends, formulate environmental policies, access detailed reports and advanced analysis tools

- Private Sector User: Analyze pollution data for environmental or business purposes, support strategic decision

- Citizens: Stay informed about local pollution, protect personal health, increase environmental

**3. System Features and Requirements**

**3.1 Landing Page**

* Users can access the application via a public URL.
* Login or registration is required for government/private sector, not required for citizens.
* The app name is displayed clearly in the header.
* A short description explains the app's purpose: "Analyze and visualize air pollution data across the Lombardy region."

**3.2 Pollutant Overview Section**

* A dedicated section lists monitored pollutants (e.g., PM10, PM2.5, NO2, O3).
* Each pollutant includes a brief description and its environmental/health impact.

**3.3 View Pollution Data Interface**

* A clear button labeled "View Pollution Data" redirects users to the dashboard.
* Positioned prominently on the landing page for accessibility.

**3.4 User Authentication System**

* - Register/Login/logout support.
* - User types: Government, Private Sector.
* - Role-based access:
* - Government: Full access including export pollution data and graph visualizations.
* - Private Sector: Export Pollution data for analysis access.
* - Citizen: Read-only access to public data.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature / Permission | Government | Private Sector | Citizen |
| Access real-time air quality data | ✅ | ✅ | ✅ |
| Interactive map-based visualization | ✅ | ✅ | ✅ |
| Authentication required | ✅ | ✅ | ❌ (public dashboard) |
| Access historical data | ✅ | ✅ | ❌ |
| Download data (CSV/JSON) | ✅ | ✅ | ❌ (view only) |
| View pollution trend graphs and stats | ✅ | ❌ | ❌ |
| Generate & export custom reports | ✅ | ❌ | ❌ |

**3.5 Interactive Pollution Dashboard**

* An interactive map of Lombardy with hover and click actions.
* Hovering on cities or sub-regions shows pollution summaries.
* Clicking opens detailed daily data for each pollutant.
* Available for all type of users.

**3.6 Daily Data Table View**

* Displays pollution levels recorded daily.
* Data presented in a responsive table.
* Available for all type of users.

**3.7 Export Data Feature**

* Users can select a custom date range between 01-Jan-2021 and 30-Jun-2025.
* Option to download data as CSV or Excel.
* Optional enhancement: dropdown to choose format.
* Available to government/private sector users.

**3.8 Graph Feature**

* Users can select a custom date range between 01-Jan-2021 and 30-Jun-2025.
* User sees graph for each pollutant for the given date range.
* Available to government users only.

**3.9 Custom Report Feature**

* Based on selecting export graph option, user can generate & export a custom report.
* Available to government users only.

**4. External Interface Requirements**

**4.1 User Interfaces**

* Responsive web design
* Navigation bar with links to all major sections
* Login/logout forms
* Map with zoom, hover, and click interactions
* Data export form with date picker and format selector

**4.2 Hardware Interfaces**

* None (cloud-hosted web app)

**4.3 Software Interfaces**

* Backend services for data retrieval
* Libraries for interactive maps and charts (e.g., Leaflet, D3.js)

**4.4 Communication Interfaces**

* HTTPS for all communication
* REST APIs (internal)

**5. Non-Functional Requirements**

**5.1 Performance Requirements**

* App should load within 3 seconds on average broadband
* Map interactions must respond within 500ms

**5.2 Security Requirements**

* Public read-only access; no user accounts
* Secure APIs with CORS policies and rate limiting

**5.3 Maintainability**

* Modular design using components
* Clear documentation for future updates

**5.4 Portability**

* Platform-independent, works on any modern web browser

**6. Scenarios**

**Scenario 1: A government official wants to check the air quality over a period of time.**

* Goes to the export section
* Selects date range from 01-Jan-2022 to 31-Dec-2022
* Downloads CSV file with daily averages for each pollutant
* Goes to Graph section
* View graph with Pollutant Data for date range from 01-Jan-2022 to 31-Dec-2022
* Option to Download Graph with Pollutant Data, can generate & custom report (optional to user).

**Scenario 2: An environmental researcher from a university/company needs historical data for analysis.**

* Goes to the export section
* Selects date range from 01-Jan-2022 to 31-Dec-2022
* Downloads CSV file with daily averages for each pollutant

**Scenario 3: A citizen wants to understand which pollutant is dominant in their city.**

* Reads the pollutant overview section
* Clicks their city on the map to view real-time data
* Checks peak pollution hours in the daily data table

**7. Use Cases**

**Use Case 1: View Pollutant Details**

* Actor: User
* Precondition: User is on the landing page
* Flow:
  1. User scrolls to pollutant section
  2. Reads short descriptions
* Postcondition: User understands pollutant types

**Use Case 2: User Login/Register**

Actor: Government/Private

Precondition: Login page accessible

Flow:

- Enters email and password for Login

- Enters Name, government (government user) or company/university email (private user), password and confirm password for Registration

- System verifies and assigns role

- Redirects to respective dashboard

Postcondition: Logged in and access granted based on role

**Use Case 3: View Dashboard**

* Actor: User
* Precondition: Website is accessible
* Flow:
  1. User clicks "View Pollution Data"
  2. User clicks ‘Citizen’
  3. Dashboard loads with interactive map
  4. User explores regions
* Postcondition: Pollution details shown for selected region

**Use Case 4: Export Data**

* Actor: User
* Precondition: Data export interface is available
* Flow:
  1. User clicks "View Pollution Data"
  2. User clicks ‘Government/Private Sector’
  3. User needs to Login or Register
  4. Dashboard loads with interactive map
  5. User explores regions
  6. User selects a date range
  7. Chooses export format
  8. Clicks download
* Postcondition: File downloaded with pollution data

**Use Case 5: Export Graph**

* Actor: User
* Precondition: Graph download interface is available
* Flow:
  1. User clicks "View Pollution Data"
  2. User clicks ‘Government Sector’
  3. User needs to Login or Register
  4. Dashboard loads with interactive map
  5. User explores regions
  6. User selects a date range
  7. Chooses download format
  8. Clicks download
* Postcondition: Graph downloaded with pollutant data for selected date range

**Use Case 6: Generate & Export Custom Report (Use Case 5 follow-up)**

* Actor: User
* Precondition: Generate & Export Custom Report download interface is available
* Flow:

-Government user can generate & export custom report explaining the graph.

* Postcondition: Custom report with graph downloaded with pollutant data for selected date range

**Use Case 7: Logout**

* Actor: Government/Private Sector
* Precondition: Logout Button is available
* Flow:
  1. User clicks "Logout"
  2. User is redirected to Homepage

**8. Functional Requirements**

* **FR1: The system shall provide a landing page with app name and description.**
* **FR2: The system shall display a list of pollutants with descriptions.**
* **FR3: The system shall display ‘View Pollution Data’ button.**
* **FR4: The system shall be accessible without login for Citizen.**
* **FR5: The system shall be accessible with login (for new users- login after registration) for Government/Private Sector user.**
* **FR5: The system shall allow navigation to the interactive dashboard.**
* **FR6: The system shall render an interactive map of Lombardy.**
* **FR7: The system shall allow hover and click actions on cities.**
* **FR8: The system shall display daily pollutant data.**
* **FR9: The system shall respond within 3 seconds under normal load.**
* **FR10: The system shall support CSV/Excel data export for selected date ranges for Government/Private Sector User.**
* **FR11: The system shall support graph display & export for selected date ranges for Government Users only.**
* **FR12: The system shall support generate & export custom report for graph data generated in FR11 for Government Users only.**
* **FR13: The system shall support logout for government/private sector users.**

**APPENDICES**

**Data Sources**

* Pollution data provided by ARPA Lombardia or equivalent sources

**Future Enhancements**

* Add user registration for saving queries
* Integrate pollution forecast models
* Enable visualization comparisons between years