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Design and development of a web platform for the environmental monitoring of industrial emissions: applying to the Province of Ascoli Piceno

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INTRODUCTION

Data on industrial wastewater, urban sewage, atmospheric emissions and waste management of installations subject to environmental authorizations generate interest among stakeholders, but unfortunately, they are not properly digitized and processed, as they are often unavailable.

Therefore, the main goal of this project is to provide a flexible, interactive and easy-to-use tool for stakeholders to allow them to consult these kinds of environmental data. For this purpose, a **database integrated with a web-based Geographical Information System (GIS) platform** to collect, manage and share pollutant emissions data, is currently being designed and developed.

To evaluate the performance and benefits of the newly developed tool, a real-life pilot case has been applied using data from industries located in the **Province of Ascoli Piceno (Marche region, Italy)** [1].

MATERIALS AND METHODS

The overall layout of the framework comprises: (1) the **database server (MySQL)** for storing the environmental data of each installation, (2) the **GIS server (Apache Tomcat)** for managing and displaying the geographical data, (3) the **web server (Apache)** which communicates the data to the end users.

The data are accessible through the web application (developed in PHP language) available simultaneously to different types of stakeholders. Authentication is free but limited: users can access specific sections of the web platform, depending on their tasks. Currently, there are four different user account types:

- **Administrator** (e.g., the webmaster)
- **Staff** (e.g., the competent authority)
- **Operators**
- **Police forces and public institutions**

All users can visualize the GIS map on the main screen of the web application. The GIS server (developed in Java language) provides two services: (1) **cartographic service** for the publication of the supporting information layers (e.g., municipal boundaries and hydrographic network). (2) **Representational State Transfer (REST) service** for the publication of the industry data as a series of georeferenced points with the related attributes.

RESULTS AND CONCLUSIONS

All information concerning the authorization, the licensing processes and the analytical controls were entered in the database. Accordingly, the web platform (available at <https://www.alfa2020.it/>) proposed to the stakeholders the following interconnected modules:

- **Operator, Company Name and Installation Modules.** Users can consult data on the operator, company name and installation. They can also view the spatial-distribution of the installations on the territory in the GIS map.
- **Administrative Procedure and Authorization Modules.** Currently only staff can log into the administrative procedure modules, but the possibility of sharing some of this data with other users will be evaluated in the future. Data on environmental authorizations [2,3] are available to all users. Moreover, information on the administration deeds of communication or notification, not included in any environmental authorization, is entered too. It is important to consult this section for both current and previous authorizations. Here, the stakeholders can download the related documents and view the reports for monitoring the conditions or the deadlines set by the licenses.
- **Emissions Module (Industrial wastewater, Urban sewage, Atmospheric emissions).** The inventory includes qualitative and quantitative information on industrial pollutant emissions into air and water. Data are updated periodically and are always specific for each pollutant, source and emission point.
- **Environmental Inspections Module.** Users can consult the results of self-monitoring and inspections, enter new analytical data and download reports.

(a) Search interface for companies and installations.

(b) Detailed view of a company's data and emissions.

(c) Table of emissions data.

The web platform is: (1) **based on open-source software**, allowing it to be free of charge; (2) **Interactive, intuitive and readily accessible to end-users** and (3) **a dynamic tool that meets local demands**, to manage information as close as possible to its source.

It seeks to: (1) **promote collaboration among stakeholders**, (2) **simplify the monitoring of an installation's authorization status and industrial emissions trends**, (3) **optimize the environmental licensing procedures**, (4) **enhance the management of environmental control by the relevant authorities**, (5) **support health and environmental research**, and (6) **provide industries with innovative services for data transmission**.

A test period was scheduled to demonstrate the advantages of our work. Preliminary meetings with some stakeholders (staff, police forces, competent authorities and operators) were organized in order to present the project, collect the first data and evaluate opinions. Then, these stakeholders were involved in a testing phase from October 2021 to June 2022 to verify the functionality, flexibility and ease of use of the tool.

FUTURE PERSPECTIVES

Future perspectives are related to the design of the Waste Management Module. The conditions of the access of the consultants, researchers and citizens will also be evaluated. Further tests of the platform will help to improve the available functions according to the user needs and the features of various territories.

References

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