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A Smart City platform to manage information and data in smart environments

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Abstract. Modern technologies are becoming an essential tool for city government and territory in general. In the urban context it is possible to acquire, in various situations, large quantities of data from many types of sources, such as sensors (both fixed and mobile), images from video cameras or drones. In order to be able to manage all these data, a technological platform is necessary to handle the holistic representation coming from the elaboration of each individual topic layer. The present paper describes a smart city platform designed and developed for the city of Cagliari as case study

Keywords. Big Data, GIS, IOT, Smart City platform, Environmental Control

Introduction

Smart cities are urban aggregates which use technological innovation to manage the social and functional structure as a network of cutting-edge services. To be considered smart, a city must respond to human needs - in everyday life - in a simple, easy, intuitive and fast way, through digital and urban planning approaches tailored to the inhabitants of a specific area.

The present paper describes a platform developed in the context of the Smart City of Cagliari, which covers the data acquisition, persistence, processing and presentation parts. The platform has been developed as activity for the Joint Innovation Center Project, having the aim of studying new scenarios for the urban management.

The development of this platform has been a very broad and challenging task, requiring proper tools able to connect a vast territory and to acquire large quantities of data related to various topics; its architecture is designed as a modular structure in order to handle all the functionalities, from data management to the presentation of the processed information. In particular it:

- simplifies new data acquisition and elaboration
- allows the visualization of the operational status of the city through a geographic information system
- facilitates the decision maker with an interactive centralized control room
- stimulate citizenship to be more active, aware and more participatory

1. The architecture of the smart city platform

The architecture can be summarized into the following four main parts:

1. acquisition

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2. persistency
3. processing
4. presentation

Each of these layers heavily is built on Open Source software to have a better and open approach to urban computing issues and openness.

1.1 Data acquisition

Depending on the kind of data, the platform allows three different types of acquisition:

- incoming stream (pushing)
- incoming stream (pushing) with pre-processing or buffering
- pulling of external data

To a higher point of view, data ingested could be generated by a service (web or RESTFul), by sensors, fetched by a database or even produced as a report with a smartphone app to make alerts.

1.2 Persistency

The persistence performed by the platform is extremely flexible in order to be able to work with many kinds of data structures. Moreover it is not limited to relational databases, but also no-sql ones.

1.3 Data processing

The raw data is processed by the backend of the platform in order to produce useful information to be shown in effective graphical ways on the presentation layer.
Raw or pre-processed data could easily be redirected to an open data layer to enable a collaborative and inclusive approach to problem solving and planning actions.

1.4 Presentation layer

The presentation layer has been developed according to HTML5 roles, in order to be accessible through different frontend devices. The main client is the web platform, which of course allows a broader view of all the information, but also zooming to a more detailed vision of specific singular layers is possible. The georeferenced nature of most data led the choice toward a Geographic Information System working as Decision Support System and as analytic tool. The backend of the system provides both raw data and elaborated information to the application layer and then to the end user.
The main client is a web application (in Figure 1) which shows the overall view, allowing also the selection of specific layers from the main menu (on the top of the window).
The integration in the same map of datasets coming from many sources provides the decision maker with a powerful tool to bring to light relations between events that otherwise would be difficult to discover. These features make this kind of platform a valuable instrument for smart cities.

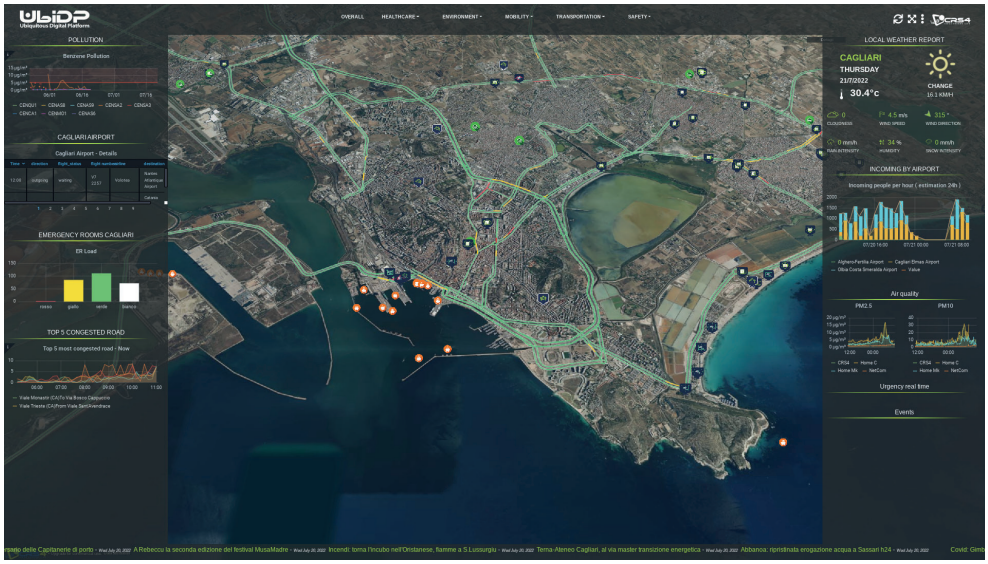

Fig. 1 shows the overall view for the case study of the city of Cagliari, where the central part is the georeferenced information in an interactive 3D satellite map working as a GIS; in fact, selecting an icon, the related information are shown in a dedicated widget and in some cases also more actions can be taken from it through links or buttons. Further information and statistics are available in the side panels (visible in Figure 1, on the left and on the right).

2. Tematic layers

The specific layers developed so far strongly depend on the dataset available for the city of Cagliari. In this particular scenario they cover information about the following topics:

- tourism
- environmental security and control
- health
- mobility
- management of emergency scenarios

The design of the platform guarantees extreme flexibility and other declinations of the platform have been made, each with specific other topics for further study. One of these, created at the beginning of the pandemic, collected the main public data available to give a visual representation of the state of the Italian regions, another one to simulate and coordinate an operative training in-site between different agencies to check emergency protocols and collaboration strategies

3. Conclusions and future work

The paper describes a platform for smart city management, from the data acquisition to

its elaborated presentation with an interactive 3D satellite map. It has been developed for the city of Cagliari, as a case study, but could be applied to other cities; its flexibility in data acquisition, processing, storing, and presentation allows its application also to other contexts. The platform can promote the governance of smart cities by following new paradigms of collaboration and participation giving a valuable tool to a decision maker to take actions and reactions. This platform could be further improved in many ways, for instance, extending it from the level of one city up to a whole region. Another future development could involve innovative solutions for persistence, such as blockchains.

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