URBANITE: Messina Use Case in Smart Mobility Scenario

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ABSTRACT

The urban transformation and the changes that the world is undergoing lead, today more than ever, to the need to make faster and more timely choices in the field of mobility management. Technology is therefore essential for providing decision support tools that help managers and politicians to better manage cities. The European project URBANITE (Supporting the decision-making in URBAN transformation with the use of disruptive Technologies) aims to put in place a sustainable mobility with the support of disruptive and innovative technologies for this sector. The proposed study describes the URBANITE project with reference to the technologies and the strategies implemented in the city of Messina. As a partner and pilot use case, in the municipality of Messina, software tools have been created starting from a series of local data regarding traffic and public transport tracking. These tools allow technicians to quickly view traffic status or bottlenecks for public transport on a map.

KEYWORDS

Urban Transformation, Disruptive technologies, Urban mobility, URBANITE project, Decision making, Data Access, Data Analysis, Data Visualisation.

1 INTRODUCTION

In the context of Smart Cities it is crucial to pay attention to issues relating to mobility. Today Smart Mobility allows people to optimize their travels by reducing the stress associated with them, while Sustainable Mobility helps to protect the environment by improving the quality of life in Smart Cities. Institutions around the world are implementing policies that allow to decrease CO2 emissions. The issues of mobility and its optimization are therefore protagonists in the identification of these policies. In particular, the European Commission encourages projects in the field of Smart Mobility and Sustainable Mobility with H2020, Horizon Europe and the Next Generation EU programs. The URBANITE project was financed within the H2020 funding program. Among the objectives of URBANITE the main one is to promote the use of disruptive technologies in the nascent Smart Cities in technological terms through the use and analysis of Big Data, AI algorithms, etc. An innovative element, however, is that related to the promotion of innovative tools for participatory decision-making processes such as the Laboratory Social Policy (SoPoLab). The aim of the project is to provide the Stakeholders of the project with a series of innovative technological tools in order to support the decision-making processes of managers of public administrations and companies. Within the project there are four pilot cities: Amsterdam, Bilbao, Messina and Helsinki. In each of the pilots, the needs are studied and analysis tools developed which will then be applied to each of them. As regards the city of Messina, analysis were conducted on traffic and its effects on local public transport. This work describes the reference scenario and the actions implemented for the municipality of Messina within the URBANITE project regarding the purely Information Computer Technology (ICT) aspect. In particular, in section 2 the state of the art of the technologies studied and applied to achieve the objectives is described. Section 3 introduces the reference scenario. In section 4 the tools implemented will be illustrated, while in section 5 the final considerations and future developments are reported.

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2 STATE OF THE ART

In [1] a case study concerning the home-office mobility of the University of Messina staff is discussed. The home-work commuting of public employees in the city of Messina is one of the main critical issues related to daily life. Traveling at particular times of the day causes both traffic congestion and pollution. Authors analyze different performance indicators to be used for the design and development of Smart Mobility services by adopting FIWARE technologies. After analyzing the travel habits of workers at the University of Messina, authors described how FIWARE can lead to an agile development of Smart Mobility services capable of minimizing traffic congestion, fuel consumption and CO2 emissions. In [2] authors describe the results of a Sustainable Mobility project in Messina. The presented application aims to encourage citizens to use low-impact vehicles instead of private cars. Through a partnership between different stakeholders a digital application to assign citizens electric bikes was developed, free of charge for a limited time period. Authors describe cyber security issues, both in terms of secure authentication for citizens that access the service and tracking of the whole assignment process. The flow is described from the user's request to the e-bike restitution. The adopted solution uses two-factor authentication (2FA) and Blockchain as the main technologies in the implementation phase. Innovative and advanced smart devices and virtual devices are described in [6]. Authors have designed, for one use case in the city of Messina, an abstracted component characterized by specific high-level functionalities. The system offers the chance to access the needed information with the most appropriate frequency and accuracy, avoiding information overload and allowing a more efficient computation. In this case it is important the access control and the security of the data. An interesting work for this purpose is described in [5]. In [3] authors show the use of customized generic Edge devices to carry out multiple activities at the same time, also focusing on how the proposed solution can lighten the work of cloud infrastructures. The presented concepts were implemented and tested in a real use case in the city of Messina by means Function as a Service (FaaS) paradigm. The proposed work allows users to perform multiple tasks on the same device. Applications such as vehicle counting, license plate recognition, object identification, etc. are proposed. In the considered use case two cameras were connected to a Raspberry PI 4 and the performance was compared. It is possible to connect different sensors to the proposed Edge devices and imagine each sensor as a different service. In [8] authors introduce a tool for studying mobility data. The basic principle is that technological innovation has led to the spread of various data tracking systems. The data are accumulated and can be used in various applications such as the analysis of mobility, urban planning and transport engineering. It is possible to use the data to extract information in matters relating to rough space-time trajectories, or by relying on statistical "laws" governing human movements [4]. However, authors do not neglect the attention to user privacy [7]. From the study and development comes an interesting Python library used in URBANITE for the analysis of mobility data in particular in Messina use case. From the state of the art it emerges that the city of Messina has been the subject of various scientific studies that have found practical application. Various national and European grants made it possible to achieve relevant innovations in the field of mobility. It is not clear how the data collected can be useful to administrators and managers in the decision making phase. This paper, therefore, want to synthesize and demonstrate how, thanks to URBANITE project, it is possible to put together what is already present in the systems of the city of Messina, creating the basis for the creation of new useful decision-making tools.

3 REFERENCE SCENARIO

The URBANITE project was created to provide communities with a long-term sustainable ecosystem model. Through a co-creation strategy we want to bring stakeholders (civil servants, citizens, etc.) closer to the use of disruptive technologies in the field of mobility. This model is supported with a data management platform and algorithms for data-driven decision making in the field of urban transformation. Furthermore, the model is validated by pilot mobility use cases in the context of the proliferation of sharing services. The URBANITE platform encapsulates the experiences of four pilot cities and acts as a junction point to create a unique analysis model for cities. Thanks to the platform it will be possible to have information regarding mobility that can be as a support in order to take serious technical and practical decisions.

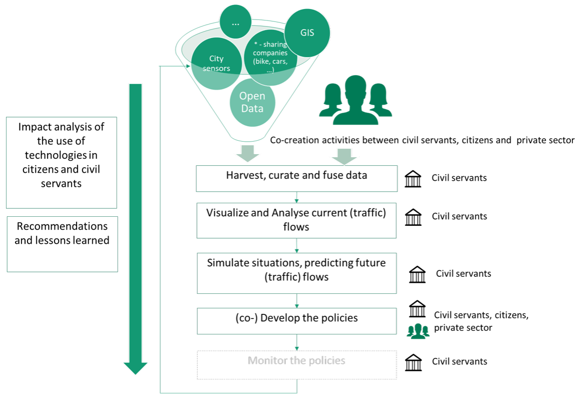

Figure 1: Urbanite Approach

In each pilot the data, useful for the mobility analysis, were analyzed and collected. The data considered funcional are collected on a single data storage. Thanks to different visualization and AI techniques/algorithms, the data were processed and made possible to create decision making tools that currently need validation (Figure 1). The use case regarding the city of Messina is described below.

3.1 Briefly on Messina Use Case

The metropolitan area of Messina is one of the most extended areas of the south of Italy, the first in Sicily and counts over 620.000 citizens. The city counts over 250.000 citizens and most of them are commuters between Sicily and Calabria. The local transport of the city of Messina consists of both sea transport (hydrofoil and ferry boats fleets) and land transport (buses, tramway and rail transports network). They are managed by public and private companies. The main issue that affects both kinds of services (sea and land transport) is the lack of facilities that can permit interoperability between different departments of the municipality and the communication with citizens and stakeholders. In order to overcome this problem, the Municipality of Messina is investing in intelligent infrastructures and services for the city and citizens. In particular, the main activities are focused on vehicle access detection in LTZ (Limited Traffic Zone) and pedestrian areas, centralised traffic management based on smart lights, traffic flows and analysis, incentives to use public transportation and video surveillance. URBANITE, for the city of Messina, is focusing on light and pedestrian mobility. Concerning the light mobility there are two main action lines:

(1) the extension of the cycle paths and the spread of bike mobility (but the main goal is to promote the use of bicycles and to offer better services to citizens)
(2) create new bike-lines and links between the centre and suburbs zones of the city.

Regarding pedestrian mobility, the objective is the definition of an integrated system of pedestrian areas and paths. Furthermore, from a wider perspective concerning public transportation, the city of Messina aims to extend the transport network in urban and extra-urban areas. The use case scenario in Messina (Figure 2) aims to evaluate the effects of the extensions of the public transportation services in terms of frequency, itineraries and stops on traffic and multi-modal transportation. In particular, a comparison of the impact on traffic between the different version of the public transportation network was performed. Moreover, the scenario includes an analysis of the suburban roads around the city of Messina (that represent an important connection with the surrounding towns) in terms of traffic congestion and connection with public transport network.

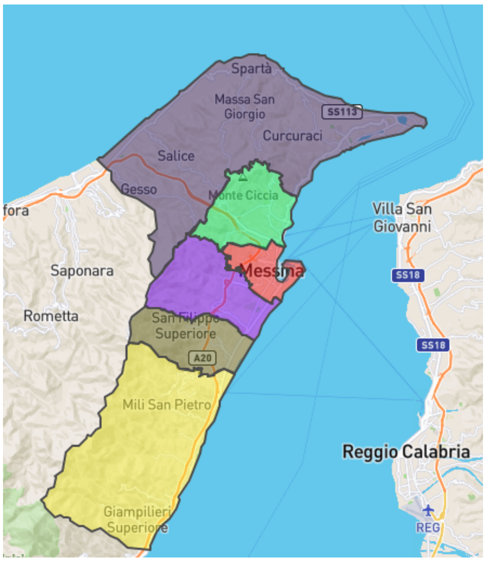

Figure 2: City of Messina

3.2 The URBANITE Architecture

The architecture created within URBANITE is made up of several abstract components that interact with each other. Thanks to the interaction between the different components, it is possible to provide all the tools necessary to achieve the objectives of the project. In Messina this architecture has been enriched by building new dedicated components, at the Edge level, which fully integrate with the existing Cloud ecosystem as shown in Figure 3, in which these components are highlighted.

In particular, for the Messina Edge Components, a local component called *Messina Data Storage* has been added. This component acts as a support for the parent component *Data Storage & Retrieval* (reported in URBANITE Cloud Components) through the *Data Harvester & Preparation* and is filled with data by the *Data Importer*. The *Data Processor* allows both to expose the data via Restful API and to process them ensuring correct formatting. Finally, within the *Urbanite UI*, three new specific components for the Messina use case have been built: *Messina Traffic Evolution*, *Messina Traffic Flows*, *Messina LPT Critical Areas*.

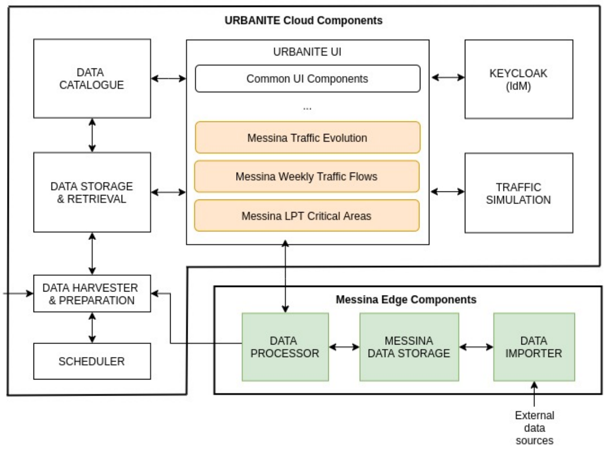

Figure 3: URBANITE Architecture - Messina

4 MESSINA IMPLEMENTATION

The use case scenarios described in Section 3 are accessible thanks to the functionalities provided by the URBANITE UI, the integrated URBANITE's framework at the UI level. The different analysis and visualizations provided aim to help the municipality's technicians in the extension of the current public transportation network. The tools allowing the users to interact with each visualization by filtering and querying the underlying data. Concerning the traffic congestion analysis for the municipality of Messina, Figure 4 depicts the temporal evolution of traffic flow on selected roads entering or leaving the city of Messina.

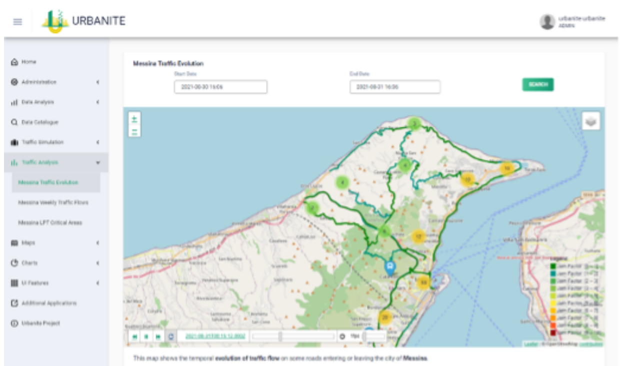

Figure 4: Messina Traffic Evolution

The traffic jam factor of each road, in a specific time of the day, is represented by the colour of the road itself, following the provided legend. Data used to this purpose are acquired and stored for real-time and historic analysis. Figure 5 illustrates the comparison analysis of the jam factors on two different roads of the city considering the time window of a week.

Figure 5: Messina Weekly Traffic Flows

The data source is the same of the previous analysis, but this time the purpose and the target users are people with a more technical background. For each road, if the road is bidirectional, the dashboard provides a chart for each direction using a different symbol for each one. The colors indicate the jam factor value. Finally, to identify areas of Messina where vehicles of public transportation are stationary for a certain time in a specific observation period, the heat-map analysis, depicted in Figure 6, is provided.

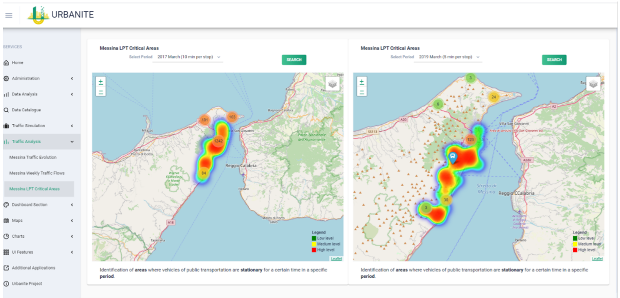

Figure 6: Messina LPT Critical Areas

To investigate if public transportation means use to be stationary in the same place for different time periods, the dashboard allows to compare two different time slots. In this case the data source is an historic database for the bus and tram position of the Local Transport Company. The data are elaborated with the scikit-mobility [8] Python library with the aim to obtain the heat-map visualization. In each described visualization, in order to have further information, the dashboard allows to visualize Points of Interest and Public Transport Stops on the map.

5 CONCLUSIONS

This paper describes the current state of the ICT systems put in place for the URBANITE project as regards the case of the Messina pilot. From the first results it is evident that, thanks to the use of data analysis and their appropriate visualization, it is possible to obtain information that is often difficult to understand. The visualization methods allow for immediate analysis and support decision-making policies. Thanks to the presented tools, in fact, it is possible to determine the effectiveness of the mobility policies used compared to the past, thanks to the historical harvested data, and possibly try to improve them. The next step will be to extend the functionalities. The scenario of each single pilot must be applied to all the case studies of the project. Moreover, it is necessary to improve smart algorithms in order to have responsive systems even in real-time. Finally, the system will make the APIs available for open-data, giving other scholars or stakeholders the possibility to carry out analysis or develop innovative solutions.

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