Smart Mobility and Cultural Tourism: The Termini-Centocelle Train Museum, an Example of "Smartourism" Project in Rome

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***Abstract*—Many recent trends in mobile Web and context aware applications are leading to consider new applicative scenarios including the so called smart services which are characterized by the use of autonomous devices connected to the Internet (sensors, beacons, etc.) and cooperating with user personal mobile devices (tablet, smartphone, etc.). In the case of urban mobility management, several issues are related to local mobility especially for tourism and cultural cases. We consider one of this related to old train re-using in Rome which has been selected as a pilot test for future sustainable transportation systems. We are able to show that, in this case, an effective system with mobile applications could leverage a real contribution both for mobile museums and for geo annotation of peripherical urban lands.**

Keywords*—*Internet of Cultural Things, Internet of Things, Mobile First, Mobile Web, Smart City, Smart Mobility.

I. INTRODUCTION

With the continuous development of Information and Communication technologies and Smart City for Cultural heritage, it is possible, thanks to the Internet of Things (IoT) implementation, to have smart systems connected to Wi-Fi, to revolutionize the management of tourism, promoting sustainable economic development, engaging the citizens effectively, as well as reducing mobility costs and resource consumption. To this purpose, we proposed the first applicative framework for Smart City named STREET WEB [1]. STREET WEB is a platform to distribute tourist information "on the road" without Internet connection. The physical architecture of STREET WEB is composed of a network of different nodes called Smart Box (SB), each representing a complete working station linked to a node sensor station to improve locality visibility. It is based on the Mobile First paradigm for adapting graphical user interface to multiple browsers and device sizes. In this paper, the purpose is to extend STREET WEB functionality to provide cultural contents and services to all visitors in the context of Smart Mobility (an important field belonging to the ecosystem of the Smart Cities). The fundamental issues of this approach, based on the integration of tourism, cultural heritage and mobility, are not only to enhance the cultural heritage present in the territory, but also to increase the tourists flow (cultural, scenic, artistic, gastronomic, etc.) and finally, to create new conditions for sustainable territorial socio-economic development. The paper is organised as follows: Section II introduces the Smart Mobility Context of the Mobility Project and the main issues of the Architectural Design. Section III gives the detailed description of the Platform used to distribute tourist information "on the road", based on Digital Niches Model and Microservers System. Section IV concludes the paper introducing implications and potential results yielding in the field of Sustainable Transport and Smartourism for obtaining information related to touristic Point of Interests in the land.

II. SCENARIO OVERVIEW

The use case scenario is related to a mobile system for exploring the "Ecomuseo Casilino", a type of museum [3] managed by the "Association Ecomuseum Casilino - Ad Duas Lauros" which aims to show and protect the cultural area [2] named "Comprensorio Casilino - Ad Duas Lauros"." The Ecomuseo Casilino hosts many archaeological resources, such as: Mausoleum of Elena (the mother of Emperor Constantine), the Catacombs of Marcellinus and Peter, the Roman villas in the Park of Centocelle, the Park of Villa dei Gordiani, and various Roman tombs. The archaeological and green area of the Ecomuseo Casilino includes two ancient Roman roads: via Casilina and via Prenestina and is traversed by the railway Roma-Giardinetti. Since 2012, the Association "Ecomuseum Casilino Ad Duas Lauros" promoted the use of the train as a cultural and tourist discovery tool. To enhance the public transport infrastructure and at the same time to enhance the area in which it travels, it was necessary to equip the train with a technological tool that can "augment" the features as a comprehensive virtual guide.

These reasons motivate the use of an ad hoc mobile system designed for such cultural train. To this purpose, we combined STREET WEB architecture with Digital Niches Model to implement a mobile cultural info-system. As shown in Figure 1, each train stop is represented by a sensor included in a Digital Niche and managed by a devoted Web-gis (Microserver Niche). Through a set of train stops and urban surroundings,

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which are geo tagged and linked to a mobile cultural info-system, it is possible to notify passengers and citizen in Ecomuseo Casilino while walking close to train stops. As referred in [9], a Digital Niche includes a set of sensors managed by a devoted Web-gis microserver.

To our knowledge, our proposed solution is a new wireless mobile system which differs from others due to the following reasons:

- It is the first mobile Web gis which is configurable and tailored to the scenario
- It will integrate map based on the wi-fi location system working on the train
- It is a complete Web based app connected to a local server providing up to date information

III. The Mobile Cultural Transport Digital System Overview

This section gives the detailed description of the platform used to distribute tourist information useful for exploring the "Ecomusem Casilino" by using the the railway Roma-Giardinetti [6], called Train-Ecomuseum in Figure 1. The platform used consists of some microserver and sensors, distributed on the area to support mobile users moving in smart scenarios with the aim to combine context aware information and high quality geo marketing services. Our App works on the same web infrastructure enhanced with sensor and it is composed by two front-ends. The first one for interfacing the train, and showing the various stops of the route by highlighting that to which we are closer. The other one serves to locate on the map georeferenced the touristic points of interest (t-PoIs). To this purpose, a platform is used, which is able to manage the set of train stops and the urban surroundings which are geo tagged and linked to a mobile cultural info-system able to notify passengers and citizen in Rome while walking close to train stops. Generally speaking, Info Urban Mobility systems are well known systems, often implemented through Internet connected geo-referenced apps. Unfortunately, it also happens that these applications are not well designed and synchronized with peripheral areas where there is a great amount of cultural elements distributed at different levels and that are hard to explain without being close to them. Moreover, there are technical problems to keep the user connected while using the train due historical problems and consequently connecting technology must be adapted to be used through IoT (Internet of Things) paradigm in which it occurs to sense mobile users in proximity and trying to push as much as possible the information close to them without using an external Internet provider. These reasons motivate the use of STREET WEB as an ad hoc mobile system designed for such cultural train museum. We adopt a paradigm defined in accord to Digital Niches Models in which each train stop is represented as a set of points included in a Digital Niche and managed by a devoted Web-gis (Microserver Niche).

A. STREET WEB and Digital Niches

STREET (*S*ensor network "on *T*he *R*oad " for *E*nhanc*E*d Internet of *T*ouristic things) Web, as described in [1] is a conceptual framework, useful to support mobile users moving in smart scenarios with the aim to combine context aware information and high quality geo marketing services in the same Web infrastructure enhanced with sensors. STREET Web makes possible to implement smart services in an easy way by integrating microservers, distributed in the scenario (servers on the road), called smart boxes, working as a geo based Cloud system in an autonomous way, as a Distributed Local Storage system, without remote Internet access, working as a geo based Distributed Local Storage system. The physical architecture of the system is based on a network of microservers (called Smart Box -SB), each representing a complete working station linked with a node sensor station composed of a localization device BLE (Bluetooth Low Energy) Beacon, eventually enriched with QR (Quick Response) code or NFC (Ner Field Communication) tag to improve locality visibility and based on the Mobile First paradigm. Each microserver is devoted to three main tasks:

1) to allow mobile users to access stored data;
2) to listen to data sent by the connected sensor;
3) to store data in database MySQL or NoSQL(InfluxDB);

The proposed microserver is realized by Raspberry Pi 2 - Model B. Raspberry Pi is a fully-functional single-board computer with a Broadcom processor. It has programmable I/O pins where you can attach physical devices and sensors.

Main Features:

- RAM:1GB LPDDR2 SDRAM
- CPU: 900 MHz quad-core ARM Cortex-A7;
- Raspberry Pi 2 can run as Operating System the full range of ARM GNU/Linux distributions.

Through STREET Web platform, the users fit together all necessary activities concerning communications, mobility, environment, energetic efficiency, shopping (digital business) and social networking. The icon depicted in Figure 2 shows the logical architecture of STREET Web model, based on a generic mobile device, equipped with a Mobile-First application front-end working in accord to three types of interactions: event-alerting, local content interaction, dynamic map navigation. The logical architecture of Street Web assumes that a Wi-Fi zone is offering local service without connection to a global Internet provider.

If we consider that a Wi-Fi zone is defined as a logical zone useful to be considered equivalent to a niche of tourism or set of touristic Point of Interests (t-PoIs), we can merge different niches contiguous or close to each other in a cloud of niches (Figure 3).

B. Microservers and APP Definition

As mentioned before, thanks to the microservers platform, it is possible to acquire information about cultural points of interest that are the one for which the user interested to reach from the selected stop without the need to connect to remote servers. To furnish the access to this cultural content to all visitors walking in such place, we consider two app layers:

- APP on TRAIN (TRAIN APP)
- APP niche (STOP APP e other t-PoIs APPs)

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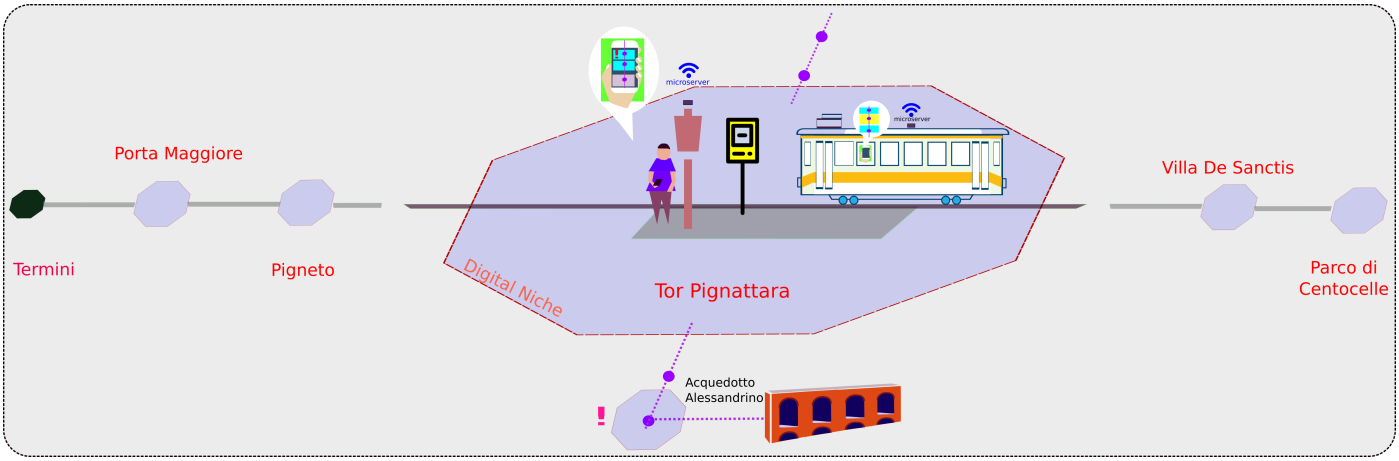

Fig. 1: TRAIN-ECOMUSEO Working Scenario

Fig. 2: The STREET WEB Model for Web 4.0

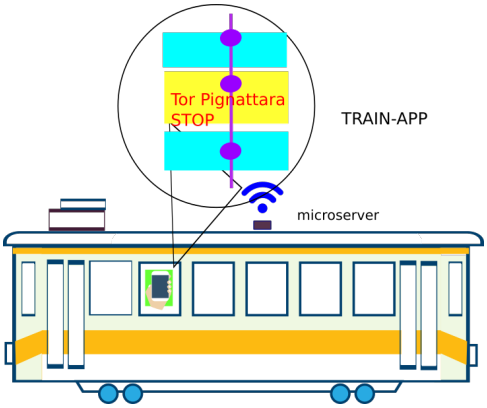

Fig. 4: Screen Train APP -Microserver

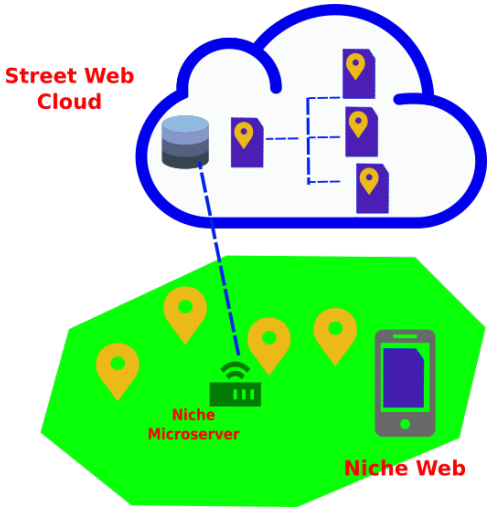

Fig. 3: The Application Architecture of Digital Niches.

The former one (TRAIN Mobile APP) at each train stop shows the name of the train-stop place. Then, once a passenger gets off the train area, he can adopt the STOP APP front-end to see what's interesting in the neighbourhood. Figure 4 shows the front end of the STOP APP that is useful to display the digital niches on the map.

When being near a niche, the user can access digital content using 2 buttons: the button that indicates the global access makes use of the Web Internet. The button that refers to the t-PoIs is coupled to the local Cloud (represented by Street Web microserver). It is linked through the Wi-Fi address. If the user clicks the t-PoIs button, he goes to the microserver home where the local content can be found. The working scenario depicted in Figure 1 shows the pathway executed by a generic mobile visitor, equipped with a Mobile-First application front end. Through a localization/alerting system (based on BLE Beacon) the user, while walking, is notified of all application steps. These steps are organized in accord to three types of interaction: event-alerting, local content interaction, dynamic map navigation. Figure 3 describes the type of application used

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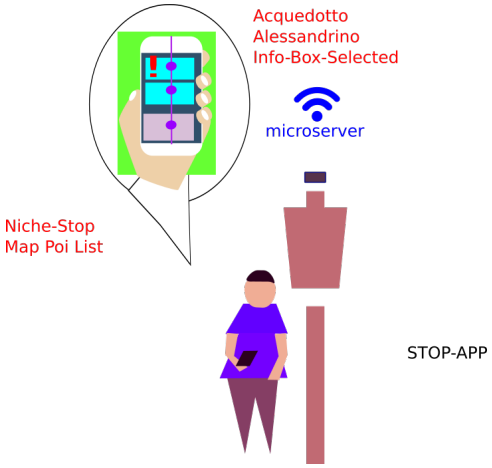

Fig. 5: Screen STOP APP –Microserver

Fig. 6: Home Screen of the APP–Microserver

in the TRAIN while moving and before arriving to the next stop. In this case the user is notified of the next stop and could be alerted for any message related to that niche before to leave the train. After niche-stop notification from the microserver, the user automatically is guided to selected an area in which further details on the selected monuments will be provide by the corresponding microserver of the niche (5).

In every case, the user is alerted without any external beacon or another means but just through well known alerting system prompting a pop up window for selecting current wifi network address (see Figure 6).

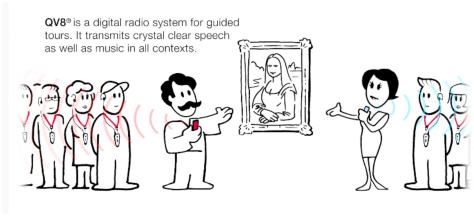

Fig. 7: Wireless Audio systems scenario

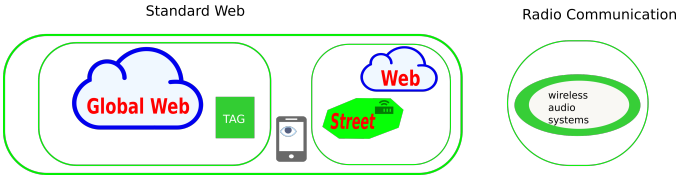

Fig. 8: TRAIN-ECOMUSEUM by STREET WEB comparison with global Web and local audio wireless systems

IV. Discussion and Conclusion

The Microserver based TRAIN – Mobile System (Figure 1) allows an effective way to mobile users for obtaining information related to touristic Points of Interest on land. To our knowledge this might be considered a first Web 4.0 solution in the sense that the host provider is no long external to the current niche but it is implemented inside the niche through a complete local Wi-Fi. The only comparable solutions come from a different technological point of view, that is wireless audio system. For instance, Quietvox [8] is a wireless audio communication system. As shown in Figure 7, the system is related to wireless audio communication designed primarily for museum with a large nuber of people. In the case of TRAIN ECOMUSEUM, however, the problem is due to the fact that such systems are not adequate. On the contrary, Digital Niches and Street Web Model gives the access through a generic smartphone (hence alwais connected system principle) following a mobile first interface paradigm.

Our solution hence goes a step further with respect to voice systems thus providing a true and effective mobile system without any non standard device and by following Web application paradigms (see Figure 8).

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