Street Web
A Framework for "Web on the Road" Smart Services

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Abstract: Many recent trends in mobile web and context aware applications are leading to consider new applicative scenario including the so called smart services which are characterized by the use of autonomous devices connected to internet (sensors, beacons, etc.) cooperating with user personal mobile devices (tablet, smartphone, etc.). In this work we describe a conceptual framework, called STREET (Sensor network "on The Road " for EnhancEd internet of Touristic things) WEB, aimed to support mobile users moving in smart scenarios (e.g smart tourism) 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 (smart museum, etc.) in an easy way by integrating micro servers, 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.

1 INTRODUCTION

With the continuous development of ICT technology we are seeing the widespread introduction of a new model of the Internet, called "Internet of Things" (IoT) (Atzori et al., 2010; Ashton, 2009).

According to this model, the things or smart objects include sensors which are interconnected and are able to exchange information on their condition or on the surrounding environment (Razzaque et al., 2016).

Day by day, smart objects become more numerous and will grow exponentially as they will be able to connect to the network not only computers and smartphones, but also cars, historical buildings, foods and more other cultural things (Gartner, 2013).

This will generate a big mole of information.

With the development technology and the spread of IoT paradigm (Kortuem et al., 2010) it was necessary for the tourist a web service usable directly in the territory (Angelaccio et al., 2012; Kenteris, 2009).

According to this new paradigm arises Street Web, a web service, based on Smart Tourist Box (STB), to distribute tourist information "on the road".

STB is a special IoT device designed and implemented to realize a Wireless Sensor Network (WSN) devoted to:

- store touristic data in a local database (MySQL or NoSQL);
- enable "mobile-first" web based application (optimized for mobile devices), to access stored data.

STB, properly located on the road, realize Street Web.

The paper is organised as follows: Section II introduces Street Web, the platform to distribute tourist information "on the road" based on Smart Tourist Box (STB). Section III introduces the Mobile First Architecture and presents the proposed approach and the main features of Mobile First Architecture. Section IV shows some scenarios of Mobile First application. Section V concludes the paper and discusses the future work.

2 STREET WEB OVERVIEW

Street Web is the platform to distribute tourist information "on the road" based on Smart Box (SB).

The name STREET derives from "Sensor network on The Road for EnhancEd Internet of

Touristic things". The platform is based on a network of micro servers (SB) placed in a touristic area with monuments (historical centers, museums, archaeological sites, etc.) devoted to:

- store touristic data in a database (MySQL or NoSQL;
- enable "mobile-first" web based application (optimized for mobile devices), to access stored data.

The aim is to provide a true local internet without the need to connect remote servers and with the capability to furnish the access to cultural contents to all visitors walking in the place.

The reason is twofold: former the system will be designed for high quality slow tourism (Pilgrim first) and hence with the purpose to avoid the need to have remote connections, the latter is related to the fact that cultural things and tourism booking are becoming a critical resource to escape from the control of OTT (Over-The-Top).

The working scenario depicted in Figure n.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.

The physical architecture is composed of a network of different nodes called Smart Box (SB), each representing a complete working station linked with a node sensor station composed of a localization device BLE Beacon), eventually enriched with QR or NFC tag to improve locality visibility and based on the Mobile First paradigm.

Each SB allows mobile users to access stored data.

SB is a micro server devoted to three main tasks:

- listen data sent by connected sensor;
- store data in database MySQL or NoSQL (InfluxDB);
- enable web based access to stored data.

The SB is realized by Raspberry Pi 2 - Model B.

Raspberry Pi is a fully-functional single-board computer with a Broadcom processor. It as programmable I/O pins where you can attach physical devices and sensors.

Main Features:

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

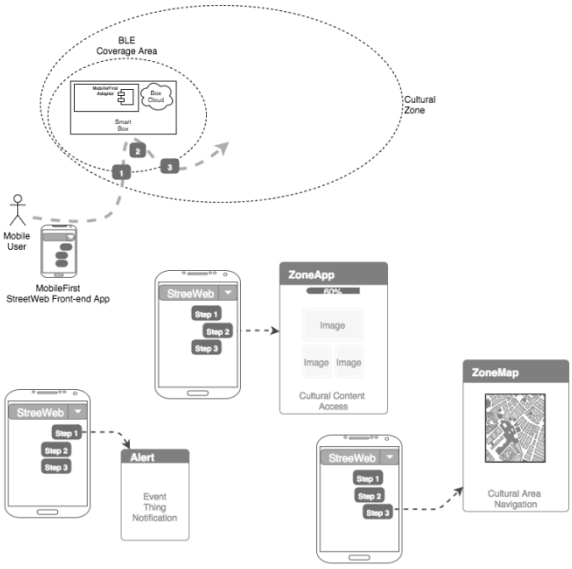

Figure 1: STREET WEB (1 STBs): working scenario of mobile users.

3 MOBILE FIRST ARCHITECTURE

Traditional web design approaches often strongly depend upon desktop interfaces, which could be hard to adapt for smartphone and mobile devices. It is a common practice to develop applications by starting from the overall set of functionalities put on the desktop interface and in a subsequent phase mobile requirements are addressed.

Responsive Web Design (RWD) allows to adapt a website's layout for multiple screen resolutions utilizing:

- Fluid grids that ebb and flow with a devices' screen size;
- Flexible images and media that keep content intact on any resolution;
- Media queries allowing designs to adapt by establishing dimension breakpoints.

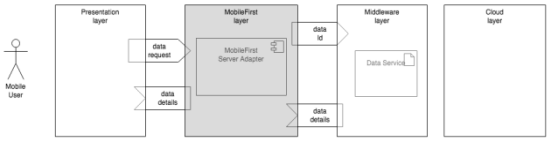

Figure 2: MobileFirst Architecture STBs.

However RWD strategies give a solution for particular cases such as menu, images and so on.
Recently it is becoming a common practice, instead, to develop by starting from existing mobile applications already optimized for mobile devices, with the aim to furnish a complete solution without using a desktop first approach.
This strategy, called "MobileFirst", therefore reverses the engineering development phases by starting from a native mobile application schema. This is meaningful in smart environments scenarios context (IoT) where mobile users interact with sensors (Egger, 2013; Jaraba et al., 2010; Kortuem et al., 2010).

MobileFirst approach is a methodology created by Luke Wroblewski (Wroblewski, 2011) for Responsive Web Design. It highlights the need to prioritize the mobile context when creating user experiences.

The Mobile First Architecture is one of the main solution which provides integration functionality through its adapter mechanism. Mobile First adapters are components that are deployed to the server on the Mobile First platform to access enterprise services. They serve as a mediator or gateway between mobile applications and enterprise systems, receiving requests from mobile apps and returning to them the data fetched from the enterprise. The Mobile First platform enable you to integrate cloud applications quickly, reducing integration costs, and optimizing resources and productivity

Mobile-First Features

Allows websites to reach more people (77% of the world's population has a mobile device).

Forces designers to focus on core content and functionality.

Lets designers innovate and take advantage of new technologies (geolocation, touch events and more).

The Mobile First Architecture shown in Figure n.2 is one of the main solution which provides integration functionality through its adapter mechanism.

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4 SMART SCENARIO USE CASES WITH STREET WEB

In the following we want explore different applicative examples of Street Web derived from Smart Tourism research field.

The result is that by means of same framework it is possible to obtain two different solutions (smart museum and smart shop centre) which could be integrated in a third one resulting in a street web for complete smart tourism solution useful for historical centres such as old towns.

A. Smart Museum

Figure 3 deals with a Smart Museum scenario, where Street Web may support the interaction between museum visitors and artworks. The system uses Beacons, deployed in the museum environment, and NFC Tags, storing data on the corresponding artwork, to deliver information based on proximity and to help visitor navigate through the museum to look at the artworks they most want to see.

Figure 3: Street Web in a Smart Museum.

B. *Smart Shopping Centre*

Figure 4 shows a possible Smart Shopping Centre Scenario. In this case Street Web uses Beacons to detect nearby smartphones and send them media such as ads, coupons or supplementary product information. They can also be used to collect information about consumers.

Figure 4: Street Web marketing.

C. *Smart Historical Towns*

Figure 5 shows the more general use of Street Web in a small town.

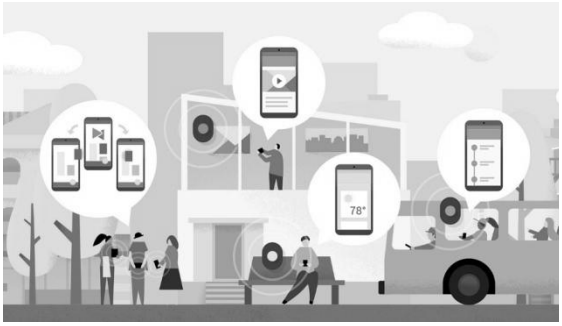

Figure 5: Small Town Street Web.

5 CONCLUSIONS AND FUTURE WORK

In this paper we have introduced Street Web a network of special micro server, called Smart Box (SB), placed in a touristic area with monuments (historical centres, museums, archaeological sites, etc.), to provide multimedia content (texts, images, audio, video, hypertext, hypermedia, etc.) for tourists equipped with smartphone.

Moreover we have introduced Mobile First, a new approach for developing web applications in smart environments. As example Street Web has been applied in different cultural scenarios for many touristic purposes.

We have shown that Street Web, thanks to its features:

- hardware architecture, composed of a network of different nodes called Smart Box (SB), each representing a complete working station with localization device (BLE Beacon), eventually enriched with QR or NFC tag
- a user interface based on the Mobile First paradigm,

makes possible to implement smart web services without remote internet access, working as a geo based Distributed Local Storage system,

The next step is the integration of Augmented Reality (AR) to allow the overlaying of additional virtual elements on the immediate physical environments that users see.

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