Wolfsoniana Smart Museum. A Pilot Plant Installation of the PALM-Cities Project

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Abstract. This demo paper describes the pilot plant of the PALM-Cities Project, installed at a modern art museum in Genoa. The objective of the system is offering visitors a novel and immersive experience when visiting the exhibit. In fact, owing to automatic identification technologies, such as Near Field Communication (NFC) and the Quick Response Code (QR Code), people can interact with the surrounding environment by means of their own devices, e.g., smartphones or tablets, receiving personalized contents as they move in a given location. Different resources for the same artwork in the museum are delivered to different users on the basis of their preferences, such as, e.g., language, age and device.

Keywords: Smart device, smart museum, NFC, QR Code, mobile applications, personalized multimedia contents, user experience, user-centered design.

1 Introduction

The wide diffusion of low-cost smart devices with network connectivity capabilities is giving rise to a new generation of always-connected people. Besides, the evolution of automatic identification technologies based on the Radio Frequency Identification (RFID) is pushing the development of the Internet of Things (IoT) [1] and *smart museum* applications [2]. In this scenario, we developed a prototype, within the framework of the PALM-Cities (Personal Assistant for Mobile Liguria Citizens) project [3], whose objective is studying systems and networks for the delivery of personalized touristic and/or cultural contents on mobile devices in an easy way, in order to offer users a better experience in visiting a museum (see [3], [4] and references therein for a list of related works). To demonstrate the effectiveness of the

proposed paradigm, we have chosen a local cultural setting, specifically the Wolfsoniana museum, for which information about the exhibited items has been tailored on the users' needs according to their language (i.e., English/Italian), level (i.e., kids/adults)[1] and device characteristics.

The remainder of the paper is structured as follows: in Section 2 the pilot installation is illustrated; in Section 3 the information architecture lying behind the system is depicted. Finally, Section 4 concludes the paper outlining future developments and research directions.

2 The PALM-Cities Pilot Plant

The pilot installation is publicly available to the visitors of the Wolfsoniana from March, until July, 2013. In this period, a restricted number of works of art has been selected, for which additional information will be delivered to the interested visitors' devices, by means of contactless interaction (Fig. 1). Specifically, both the Near Field Communication (NFC) and the Quick Response Code (QR Code) technologies have been adopted, which are readily available in a large number of mobile devices and allow implementing non-invasive and low-cost solutions, suitable for indoor and outdoor activities.

Fig. 1. The labels used in the Museum and the start-page of the Wolfsoniana App.

The system is composed by a network infrastructure, enabling communications within the exhibition, and by a mobile application available for both Android and iOS on the Google Play Store and the Apple App Store respectively. At the entrance, a smart poster illustrates users how to connect to the local free Wi-Fi and to install the App on their own devices, to start enjoying the Smart Museum experience.

2.1 The Network Infrastructure

The installed systems is composed by some passive technologies (Mifare Ultralight passive tags - ISO/IEC 14443 13,56 MHz and QR Code) that, by interacting with an

[1] The level parameter is the age of the user: in particular the kids's cluster includes the range 0-14 and the adults's one includes all the other users. The selection is based on different educational levels and cognitive dimensions of the target.

active mobile device and a mobile application, trigger the retrieving of contents from the museum server on the visitors' mobile devices via Wi-Fi. In more details, the RFID passive tags and the QR Codes contain a unique code that triggers a server to provide information related to a specific tagged piece and according to specific users' data, in particular to his/her age (the adaptation logic is based on the rule: age 0-14 or >14), language and device, accessible only when the mobile application is used inside the Local Area Network (LAN) of the museum, to cope with copyright issues.

2.2 The Mobile Application

The mobile application is made available for Android NFC-enabled smartphones and tablets, such as, e.g., Samsung Nexus S and Galaxy S III, as well as for iOS devices such as, e.g., Apple iPhone, iPod Touch and iPad (Fig. 2).

The provided features are the following: (i) *users' profiles*. At the first launch, the profile is set by inserting nickname, age and language; (ii) *RFID tag reading*. By approaching the NFC smartphone to the RFID tag on the plates, the visitor accesses to multimedia contents and can leave feedback; (iii) *QR Code scanning*. For devices without NFC, a camera is sufficient to scan the QR Code on the plates; (iv) s*ocial activities*. The visitor can "like" the museum pieces; (v) *interactive map*. The visitors are given a map of the museum showing the tagged works; (vi) *help menu*; (vii) *fast switch*. Users can read a new RFID tag without returning to the NFC mode screen.

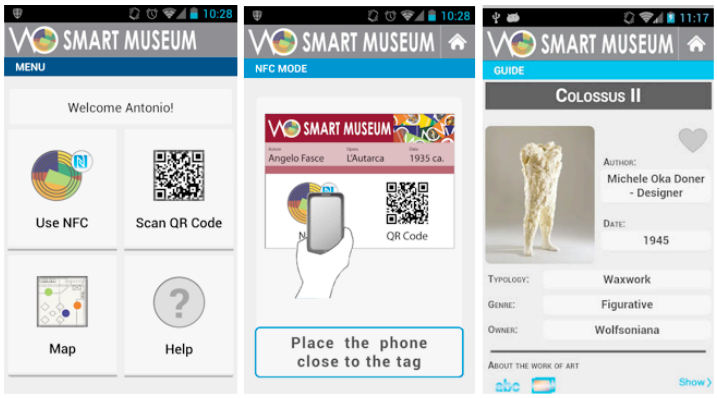

Fig. 2. Some screenshots of the Wolfsoniana App illustrating the NFC mode.

3 Information Architecture

To provide the system with the above listed capabilities, a suitable information architecture has been designed, reflecting users' profile and visualization issues. Summarizing, the system arranges the content to deliver according to *four* basic identifiers: (i) item; (ii) language; (iii) user level, and, finally; (iv) device type. Then, these four pieces of information are arranged in a tuple: *(item_id, lang_id, level,*

device), which is sent to the server through the wireless network via HTTP. Thus, the information structure is hierarchical and can be represented through a tree-shaped layout listing several resources for each item and, for each resource, a variety of implementations.

The flow of information happens as described in the above paragraphs describing the system and the App as well. Therefore, the device, by interacting with a given artwork, sends a parameterized URL to the underlying framework. We highlight that such a piece of information is composed by a *static* part embedded in the RFID tag, which is completed with a *variable* portion depending on users approaching the items, according to the schema of the tuple already introduced. This results in a query to be executed on the underlying data structure written in XML, which returns the selection of the best-suited contents for the user. Contents are transformed into a page through an XSLT transformation and they are further adapted to the specific capabilities of the device by means of Cascade Style Sheet (CSS) for performing the final rendering.

4 Conclusions

The described pilot plant offers the basic features of an adaptive system for the delivery of personalized contents. However, the whole project is based on a modular and flexible infrastructure, which may be the foundation of an integrated system of Tourism and Culture in the Liguria Region. In the future a holistic vision of Liguria territory, history, tradition and culture will be available to the visitors, who will be able to easily plan all the details about their visits to museums, theatres, historical sites, monuments, and tourist attractions in general.

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