A framework for Itinerary Personalization in Cultural Tourism of Smart Cities

Gianpaolo D'Amico, Simone Ercoli, and Alberto Del Bimbo

University of Florence,
Media Integration and Communication Center (MICC) Florence, Italy
damico@dsi.unifi.it, simone.ercoli@unifi.it, delbimbo@dsi.unifi.it
http://www.micc.unifi.it/

Abstract. Smart tourism in cities of art is a personalized user experience that exploits smart city infrastructures to offer increased opportunities of visit and services and time optimization. Traditionally, this capability requires the availability of personal mobile systems and geolocalization, augmented with some smart computing that provides the due information and functions at the right time and location of the visit. However effective smart tourism should also account for the fact that they exist different user requirements at different stages of the visit and that interests and requirements not only differ from one user to the other but also may change through time for each individual user.
According to this, an effective framework for smart tourism should offer the possibility of an easy definition of individual user visits and offer to each user the capability of making changes or updates to his/her visit plan during the visit. It should also consider the possibility that different devices are offered and used at the different stages of the visit. In this paper we present the prototype of a framework where different devices are used for the definition and modification of a personalized visit. In particular it exploits a wall mounted touchscreen in a visitor center which permits the early definition of a visit plan and a mobile device which allows online updates and changes of the planes well as display of geolocalized information during the time of the visit. An application server platform and a network infrastructure allow to record user activities as well as search and retrieve personalized data.

Keywords: smart tourism, smart cities, personalization, natural interaction, mobile applications

1 Introduction

In the current Internet scenario [**?**] new tools for cultural tourism have emerged such as as E-commerce web-sites [**?**], mobile location-based systems [**?**] and social media platforms [**?**]; they all contribute to offer improved opportunities to travellers to organize their holidays, learn and discover unknown resources of some location or touristic area, discover traditions, food, arts, history, and quickly access to the available services.

Smart city infrastructures offer more integrated opportunities in urban areas that are expected to support sustainable economic development, high quality of life, and foster participation and engagement of citizens. Advanced technologies, such as Internet of Things, sensors, wireless connections and open data [?] will all contribute to these objectives. Cities of art, in particular, are a special context where such opportunities can be experimented in order to respond to requests and needs of visitors. In such a context, understanding of users needs during the visit, capability to adapt services and information to users requests and needs, time optimization, quality of information are some of the most critical aspects to consider.

People visiting a city of art are supposed to use some travel guide that provides detailed information about the most interesting points of interest and how to reach for them. While conventional tourist guides in paper format are rapidly substituted by personal mobile systems and geolocalization that provide the due information at the location of the visit on users demand, effective solutions to provide personalized travel experiences that adapt to the individual user requirements at the different stages of the visit are still missing. Instead, an effective framework for smart tourism should offer to each user the possibility of an easy definition his/her visit plan and offer the capability of making changes or updates to the plan during the visit. It should also consider the possibility that different devices are offered and used at the different stages of the visit.

This paper presents the prototype of a framework for personalizing the visit in a city via the adoption of different devices. In particular it exploits a wall mounted touchscreen in a visitor center, where people can discover the most interesting cultural points of the urban area (places of worship, historical buildings, museums, monuments, etc.) and then create a customized itinerary on daily basis which can be viewed and updated via a dedicated mobile application. An application server platform and a network infrastructure permit to record user activities in order to propose personalized data for the visit. The prototype system has been developed under the sponsorship and support of the Municipality of Florence and is expected to be available in a prototype version to the city visitors starting from January 2014.

The rest of this paper is organized as follows: in section 2 we shortly discuss related works of smart applications in cities of art. In section 3 the prototype of our smart framework is described in detail. Finally, in section 4 we provide conclusions and some future directions.

2 Related work

According to a report from IBM [?], smart city technologies provide solutions to: reduce congestion in transport systems, enhance public safety and emergency response time, enable access to healthcare, and improve education and training. Solutions for smart tourism fall in this last group and benefit from solutions and technologies adopted in electronic tourism (e-tourism) [?], [?].

Most systems exploit web mapping services (i.e. Google Maps) to track users actions and suggest information [?]. Regional land use information is released by combining map services and XML technology [?]. Mobile tourism location-based services have been widely developed as applications providing tour information services for informed access to cultural heritage [?], dedicated mobile tourist guides combining multiple data sources [?] and also advanced augmented reality applications ([?] and [?]).

Personalized services based on recommendation systems have been offered with the aim to assist tourists in choosing places to visit. Different strategies have been followed, such as: personalization based on preferences explicitly given by the users [?], personalization according to the user location (location-based) [?], context-based personalization [?], personalization based on the characteristics of the personal device [?]. A common trait of all these approaches is that they consider that a single-device is used by the visitor and that his/her requirements are mainly defined as a function of his/her current location.

3 The system framework

The system framework developed in our project has been defined to help visitors of large cities of art that have superficially planned their visit and aims at optimizing the time of visit, by offering at the same time the possibility of selecting the most interesting places (among the many) according to their interests, making a personalized plan and eventually update such a plan during the time of the visit. Two different stages are considered. In the first stage it is expected that the user finds the due information at the visitor center and defines a personalized plan of visit. In the second stage this personal plan is viewed through the personal mobile device with the support of functions that permit the access advanced services as well as the modification of the plan. The application server platform collects all the data and personal user profiles and provides the functions for access and distribution of information.

We will discuss in the following subsections respectively the application server platform, the mounted wall interactive display and the mobile system (figure 1).

3.1 Application server platform

The application server platform consists of a database system and a number of web services which have the following purposes: provide geographical information (mapping layer) and multimedia contents (*content layer*) to the end-user modules, record activities performed by users and build a profile of the individual user interests (*user profiling layer*), provide useful recommendations (*recommendation engine*). WiFi network services allow visitors to connect seamlessly to the platform. The application server platform is currently based on open source tools, namely the Apache webserver and MySQL database server. All the server side functions are developed in PHP and data are exchanged in JSON format. Google Maps is used as webmapping service, queried via Javascript calls.

In more detail:

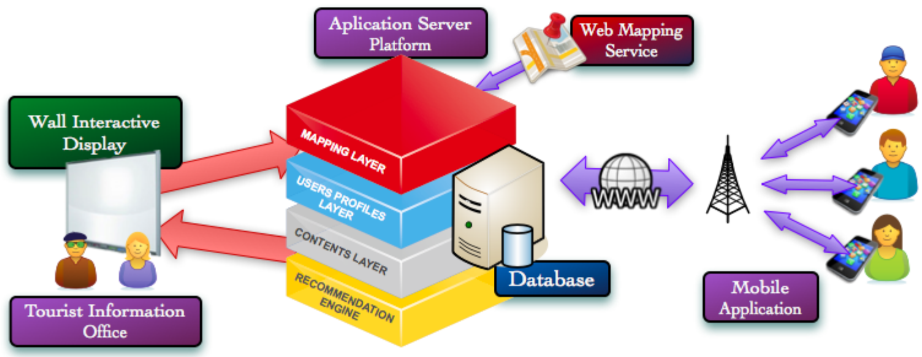

Fig. 1. An overview of the framework architecture.

The Mapping layer implements web map services functions to query external GPS web services API, extract geographic data and then guarantees real-time and dynamic updates of remote sensing images to be used both in the natural interaction system and the mobile application.

The Content layer is composed of a database containing geographic data and metadata describing the POIs, and implements functions to send them to both end-user systems in conjunction with the mapping layer service.

The User profiling layer archives all the data from the sessions of the users during any interactive session (whether at the wall mounted display or through the mobile device), creates the related user profile ID and then sends them to the mobile application, in order to query the personalised itineraries through the contents layer module. It also implements additional functions to let users update POIs of the itineraries directly from a location via the mobile application.

The Recommendation engine implements a set of web services for users using mobile devices and provides improved recommendations of POIs and extra con- tents based on their geographical location (location-based).

3.2 Wall interactive display

The visitor center is located in the main transport city hubs (train station, airport) and offers information in traditional format (guides and books on paper) and a professional dedicated staff. A wall mounted large tabletop device offers natural interactivity over a map of the town, allowing each user to select the most interesting locations and create a visit plan for the duration of the visit. The wall mounted display is a large touchscreen device (55 inch display with Full HD resolution). The application displays the map of the town of Florence (figure 2),

Fig. 2. An overview of the Wall interactive display system placed in the multimedia hall of the Visitor center.

centred at the geographical point of the visitor center, with an enhanced view of the most important cultural spots of the town, museums, churches and historical buildings. The zoom level of the map is set in order to satisfy a compromise between showing a meaningful number of points, represented with properly sized icons, and allowing the user to detect street and square names. The map can be shifted in any direction by a simple *swipe* gesture, so to inspect points of interest (POI) located in different zones. For each POI the user can activate a widget window that offers some detailed information of the location (figure 3), such as: *name*, *image*, *description*, *address* and *duration* (time spent to accomplish on average the visit of the place). As the POI is added to the itinerary the color of the icon is updated so to put into evidence it is part of the personal itinerary on the map. Locations of potential interest are also suggested on the basis of the users interests and can be selected either on the basis of a geographical proximity criterion or according to other criteria such as the type of monument, the historical period, the artist of reference. The application exploits the Google Maps API to update data in real-time.

As the visit itinerary has been completed, and all the locations of interest have been selected, the application computes the expected duration of the personal itinerary considering the average time of visit of each location and the average

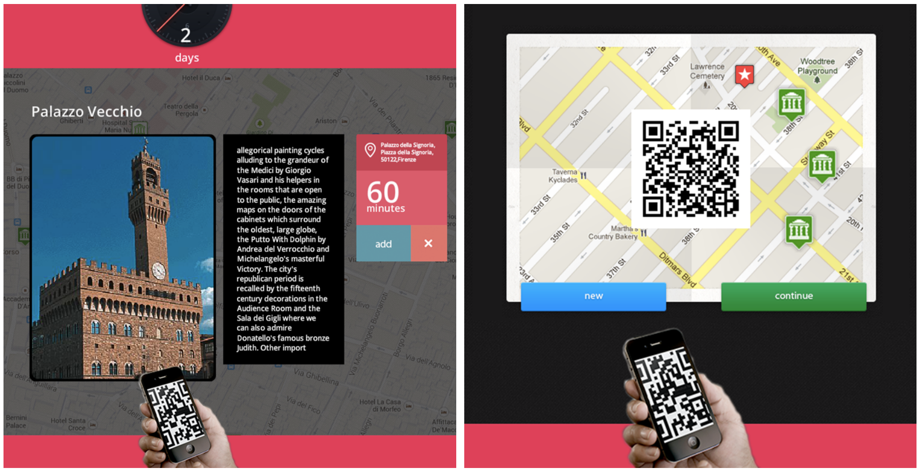

Fig. 3. The Wall interactive display UI. Left: a detailed view of a POI, with name, address, description and main image; Right: the QR Code image to scan and two interactive elements: new (to start a new itinerary) and continue (to go back to the previous itinerary).

time to pass from one location to the other. All these data are processed via a remote call to the application server, which stores them in a record of the database and then triggers the user profiling system in order to build dynamically a personal identifier of the session of interaction. This unique ID is then attached to a special web address for the mobile application activation and then a string in form of custom URL is built and stored. When the user activates an area visualizing a mobile device at the bottom of the UI, it retrieves the custom URL with the ID and dynamically encodes it as a QR code image in PNG format that is displayed in a widget window. Using any QR reader this can be read by the user personal device. In this way the user will be able from this time on to access the itinerary from his/her mobile device and eventually modify his/her plan and access all related data and services. All his/her activity and the related personalised bag of information is archived in the application server and is used to build a personal collection of user interests and needs.

The software module that supports user interactivity with the mounted wall display has been developed as a Rich Internet Application using Adobe AIR. The UI is based on Adobe Flash Builder software, Action Script 3.0 programming language. QR code generation is implemented via the AS3 QR Code encoder open source library. Google Maps is used as webmapping service, queried via Javascript programming language calls.

3.3 Mobile system

As the the QR code is read via the mobile device, visitors access a dedicated URL where the mobile application is activated for the first time, connect to

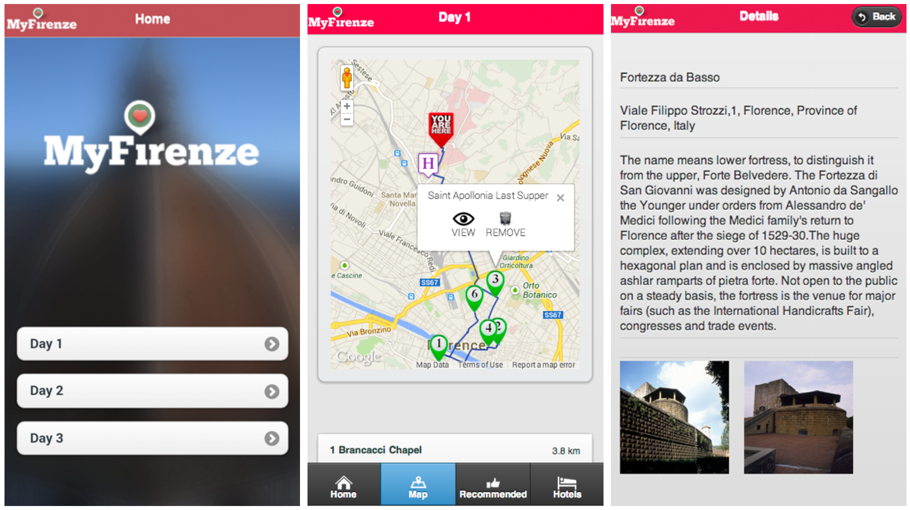

Fig. 4. The mobile application UI. Left: start page with the list of the days of the itinerary; Center: the interactive map with POIs and routes; Right: a detailed view of a POI, with name of the plcae, address, description and collection of images.

the application server platform and download the ID of the visitor which is permanently saved on the client device. The unique userID univocally identifies the personal users visit plan. As visitors leave the tourist information centre and start their visit in the town they can use their personal ID to connect to the application server, inspect the spots of their personalised itinerary and eventually update the itinerary by adding new places of interest recommended via the mobile application.

The user interface of the mobile application includes (figure 4): *header*, *content wrapper* and *navigation*. The itinerary that has been defined in the first stage is shown splitted into distinct days of visit according to a simple geographic proximity rule. POIs for each day can be immediately displayed onto the map and investigated to obtain more complete information related to the POI, related images, services.. The POI can be removed from the current itinerary and the entire visit plan updated and reloaded. The navigation system (figure 5): provides recommendations of nearby locations or locations to visit that fit with users interests as recorded during the session of interaction with the natural interaction system.

The mobile application is developed as a web app. This optimises and eases the user experience since it does not require any app download from web stores. Since it is platform and device independent it runs via the native browser of any smartphone. The UI is based on Sublime Text 2 editor using HTML5 as formatting language and CSS2 as style sheets. All the server side functions are implemented in PHP and data are sent in JSON format. Google Maps is used as the webmapping service, queried via Javascript programming language and

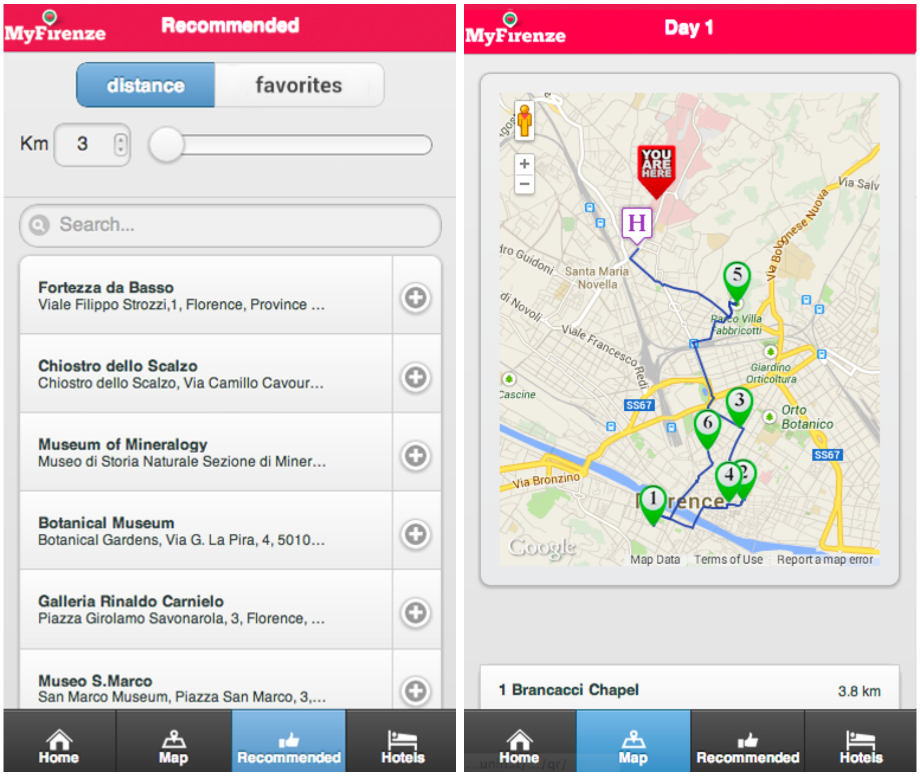

Fig. 5. Left: the list of recommended POIs to add to the current itinerary; Right: a new POI is added to the itinerary and the optimised route is updated in real-time.

JQuery library calls. Persistent local storage allows visitors to inspect and update their itinerary also in the case in which the Internet connection is out of reach.

4 Conclusions

In this paper we propose the prototype of a framework to enhance the travel experience of tourists in the context of a smart city. Our solution consists of a natural interaction installation where users can create an itinerary of the city, a web application platform to collect and process these data, and a mobile application which provides personalised and recommended information based on their location and preferences. Thus visitors and citizens can live a multi environment and multi device experience to improve their travel as a learning practice and have the opportunity to discover and visit resources of a geographical area thanks to the facilities provided by smart cities technologies.

The framework is currently under test at the Media Integration and Communication Center of the University of Florence and is developed in a joint project between the University of Florence and the Municipality of Florence. It will be part of the newly started project Social Museum and Smart Tourism which has been funded under the Cluster program of MIUR. It is expected to be in operation by January 1st 2014.

5 Acknowledgements

The project was developed in collaboration with the Municipality of the city of Florence. The authors would like to thank Simone Tani, Maura Fallani and Nicola Torpei for their contribution to the development of the project.