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Research Article

A Pervasive and Mobile Computing Approach to Promote Heritage of a City

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Abstract

Cultural heritage is an extremely valuable set of materiality, traditions and knowledge from the Past that should be used to better understand the Past itself. However, even nowadays, there are still some difficulties to manage, preserve and disseminate cultural heritage. In this sense, the first step that we should take after preserving the heritage is to develop solutions that enable effective and democratic ways to promote it. This promotion starts with the ability of those who visit this heritage to be able to know and enjoy it. Information and Communication Technologies and specifically Pervasive and Mobile Computing ones represent nowadays a big opportunity to develop innovative solutions capable to inform tourists about heritage and even enable them to experience past realities related to immaterial heritage like ancestral legends and past events even with no longer existing physical patrimony.
This paper starts to make a reflection of the evolution, the Information and Communication Technologies role on tourism and present a technological architecture to respond to the challenge of promoting heritage and informing tourists in their travel experiences. After that, the paper presents also a developed prototype created to the Portuguese City of Mirandela which was capable to promote its historical and gastronomic heritage and also support the tours of the tourists through its territory. Finally, some remarks about the future growing and directions for technology applied to tourism are made.

Keywords: ICT, Tourism, Pervasive and Mobile Computing, Heritage

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Introduction

The tourist has always been, more and more, an actor thirsting for information about everything that surrounds him and about which he perceives. It is also demanding for the mechanisms to be available so that it can interact with the environment that surrounds him. Although tourism in Portugal, and in many other countries, represents an economic sector very relevant to national competitiveness, the information tools available to tourists are below the capacity to meet the actual requirements. This reality is deep especially in the innermost areas of the country.

To provide mechanisms based on ubiquity to access information and services is essential for a new generation of tourists and tourism support systems. The development of solutions capable of providing experiences of fusion of the physical-virtual is, in our point of view, mandatory to promote the material and immaterial cultural heritage that, in many cases, is no longer existent, or is no longer visible with its ancient splendour, or even, whose existence is not known to tourists.

With the evolution of the information society, a tourist is no longer content to see a leaflet with a few pages explaining what he can visit in a particular region. He wants more. He wants to be able to search everything about the visiting region before opting to visit it, he wants to have real-time support when he is there and also wants to share the experience he had with other users, with the certainty that the information provided after the visit, it will be useful to whomever plans to move to the same point of interest. This justifies the introduction of news information systems for supporting tourists and tourism (Watson, 2004), an industry traditionally focused on the application of technologies to support the Business-to-Business model (B2B). With the advent of the Internet, some of these services were extended to the client, but according to Watson et al (2002), there are three fundamental problems with the current systems: first, before the trip, the tourist has a lot of information, which will have to be filtered, and will have to spend a lot of time to find useful information. Secondly, there are few systems that support the mobility of the tourist, and finally, after the trip, the result of the experiences is not easily shared.

It is the stage where the tourist is at the place to visit that they notice the biggest failures in the availability of the information. Although the concept of ubiquitous computing is not new; in which a computer is not necessary to access the information and even the evolution of the devices can lead to believing that they are "invisible" and are everywhere (Brown & Chalmers, 2003), it is clear that the evolution in the number of tourist support applications for mobile devices is still small and incomplete specially in the deep interior regions of the countries.

To promote heritage and to enable new and richer cultural experiences, we must develop innovative solutions based on pervasive and mobile computing new opportunities that meet the desideratum presented.

Information and Communication Technologies & Tourism

Information and Communication Technologies (ICT) have an important role in the earlier development stages of modern tourism. The first major impact of ICT on the tourism sector was the introduction of the Computerized Reservation System (CRS) in the 1970s. In the 1980s, the Global Distribution System (GDS) emerged, as a logical upgrade to the reservation system, uniting a wide range of services and products and bringing global distribution information structure into the entire tourism sector.

The rapid development of ICT in general and the Internet in particular has dramatically changed the tourism industry. Factors such as a quality site, Digital Marketing, Social Networks, Multimedia, Mobile Technologies and Smart Environments are some examples (Morais et al., 2016).

ICT have provided a new mode for cooperative relationships among the members of the various distribution channels (Buhalis & Law, 2008). The formation of these cooperative relationships has been facilitated and encouraged by three major factors: interdependence among a wide range of goods and services (all part of the final tourist product), the small size of many individual operators, and spatial separation between the vacation and the home, (Fyall & Garrod, 2004; Wang & Fesenmaier, 2007). Beyond these particular factors of the tourism sector, the intensity of information exchange among companies operating in the same distribution channel has led to greater efficiency, as increased information exchange highlights shared interests and common goals, which in turn facilitate collaboration (Spralls, Hunt, & Wilcox, 2011).

The impact of ICT in tourism (e-tourism) has altered the ways tourism services are accessed and consumed (Law, Buhalis & Cobanoglu 2017). Ubiquitous and highly innovative ICTs provide different channels for consumers to use tourism services; thus, studies on e-tourism are numerous and fragmented. Because tourism is an information-intensive sector, a central reservation system was often used to store and retrieve information and conduct transactions (Buhalis, 2000), thus creating a central customer database. Booking in tourism services depended on travel agents, who mediated the relationship between tourism firms and customers (Buhalis, 1996). However, the ubiquity of computer systems and the emergence of the internet transformed and revolutionized the way tourism transactions are conducted (Buhalis and Jun, 2011). The internet has become a place for consumers to search for tourism-related information, purchase tourism products and services, and obtain others' opinions. Uncertainty about the safety of online tourism bookings and transactions influenced early streams of research to focus on security (Kim et al., 2006), privacy (Lee and Cranage, 2011) and trust (Wu and Chang, 2005). Particularly, security was considered the most important consideration for online booking (Kim et al., 2006). Increases in consumers' adoption and use of web-based platforms in tourism and hospitality services created website quality concerns, thus influencing research on website design quality (Ku and Chen, 2015). Ease of navigation and information quality became important considerations for attracting and retaining customers, as user-friendly websites enhanced information search and helped tourists arrive at quick decisions (Ku and Chen, 2015). Meanwhile, Destination Marketing Organizations (DMO) realized that the internet offered abundant opportunities for their operations. As a result, websites were designed to reflect destination attributes, thus influencing the perceived image of the destination and creating a virtual experience for the consumer. Moreover, the emergence of Web 2.0 redefined consumers' adoption of e-tourism. Web 2.0 is defined as "a wide array of electronic applications (e.g., social networks, review websites, blogs, interactive websites and photo-and video-sharing platforms), which facilitate interactions among individuals and among companies and users". Through these platforms, especially social media, consumers easily form communities of members who share similar interests in a structured set of social relationships (Zhu et al., 2016). Thus, experiences with tourism products and services are shared in the form of photos, comments and reviews and are easily accessed by others. Marketers also share content to promote their products; however, consumer-generated media are perceived to be more trusted and sincere, constituting the real experience(s) of the creator (Wang, 2012). Consequently, reading content about tourism products and services has become an important pre-trip decision-making process (Tsao et al., 2015).

Furthermore, the market penetration of mobile technology (Shaikh and Karjaluoto, 2016) also influenced the adoption of tourism products and services. The ubiquity, flexibility, personalization and dissemination features of mobile

technology make it a veritable tool for both marketers and consumers in tourism and hospitality services (Kim et al., 2008). For consumers, the functionality of mobile technology, such as the ease of access to travel information and trip guides, is an essential feature of its increased adoption, whereas for marketers, it is the opportunity to send marketing messages to a targeted audience.

However, individual differences determine mobile technology adoption in tourism and hospitality services.
The influence of ICT on tourism receives even more attention with the advent of smart tourism. Smart tourism, defined as the convergence of tourism content, service, and IT devices (GooglePlay, 2016), helps tourists to extend their cognitive boundary of travel planning with the destination details visualized and enhances the decision quality with data-driven and context-specific recommendations (Del Vecchio, Ndou & Passiante, 2016). As such, smart tourism greatly extends and sets apart from the earlier "e-tourism," which provides information via websites in pre-/post-travel phase, by offering smart technology-mediated tourism experiences through information aggregation, ubiquitous connectedness and real-time synchronization. As a result, smart tourism provides more relevant information, greater mobility and better decision support over e-tourism (Gretzel et al., 2015).

Proposed Architecture

In this chapter, a brief description of the proposed architecture is made (Fig.1) and developed to support the presented problem from a generic perspective. We were able to divide it into several conceptual components which represent the desired functionalities. The proposed architecture has been named Interactive Tourist Guide (ITG). The ITG aims to be a powerful system of dissemination and promotion of the cultural heritage of the city of Mirandela. In order to achieve this goal, the ITG is materialized as an application for mobile devices capable of interacting with information repositories. The guiding pillars of its structuring as a technology-based solution are organized as follows:

- To Know: The ITG provides geo-referenced information in a contextual and automatic way. In this way, the tourist, when traversing a given space, will receive alerts on all the important aspects that are indexed to the space where the tourist meet. Alerts will provide multimedia information (e.g. text, images, audio reports, and video). In this way, the tourist can freely walk through the space, regardless of his knowledge about the same, being informed about his surroundings and being able to, if he does, obtain more detailed information from the ITG about some aspects about which he was alerted.

- Tour: The ITG provides pre-defined routes so that the tourist can start a pre-defined structured knowledge process. This experience could be a small pedestrian route or a route that involves the visit of several points geographically dispersed by the Municipality of Mirandela. This strand can be catalogued according to predefined strands (e.g. architectural interest, gastronomic, landscape).

- Build and Share: The ITG allows the tourist to build their "travel album", that is, with each interaction with the system the tourist will be able, if they wish, to build the memory of their own enjoyment. This functionality is, in practice, the construction of a small digital album that will show the places that were visited, as well as the comments that the tourist may have made on those places and finally the photographs that the tourist indexed to those places. Finally, the tourist, at any moment, can share what they are

experiencing in their social networks.

- Support: The ITG provides geo-referenced support information to the other pillars previously presented. In this way, knowing that the tourist lacks several services to support his own human condition, geo-referenced information about utilitarian services such as hotel and catering, pharmacies and other public services is available. This information is extremely useful in any travel process. Lastly, the ITG have a "panic button" that automatically generates an alert to the competent authorities with the geo-referenced location of the tourist, if there is a tourist information record in the application.

- Understand and Evolve: The ITG can store, without violating the privacy of tourists, information about the activity developed by them. In this way, it will be possible to better understand the behavior of tourists so that actions can be developed to continuously improve the experiences provided within the expectations of the tourists and scrupulously fulfilling the respect of their privacy.

In Fig. 1 the proposed architecture is presented, where its main components, technologies and main flows of information are represented.

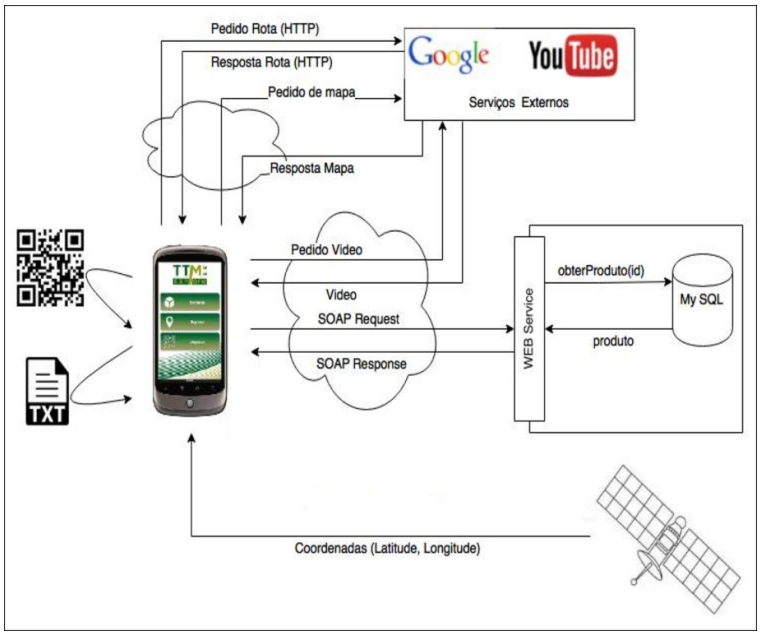

Fig. 1: Proposed Architecture

In the proposed architecture a multi-platform integration perspective is presented where a tourist through a smartphone mobile application, using its multiple sensors and Internet enabled, can query a Webservices platform and also

interact with external services providers. Developing effective and lasting solutions

to promote Heritage itself and also business geared by heritage can only be a reality through a cooperation perspective where several independent platforms feed mobile applications needs.

For validating the proposed architecture, we have developed a prototype focusing on the Portuguese city of Mirandela where heritage is a mix of architectural patrimonial, gastronomic heritage and also beautiful landscapes that enable several tours (mostly walking in old historical rails). The prototype's main goals have been supporting the tourists' information needs about Mirandela heritage and its gastronomic products and have also been supporting the tourist needs when they decide to walk in the historical rails, which in Mirandela case, can many times be outside of the city in paths through the fields from the city to its small villages.

The Developed Prototype

The use of mobile applications in everyday life is an increasingly present reality, and this reality, in our opinion, has come to stay.

Applications are able to meet the constant need for access to information in a simple and effective way, bringing many benefits both professionally and personally. Its use goes not only through the search for communication, but also through help in the most diverse tasks of everyday life. More than 95% of people use digital tools before, during and after their journeys in search of the best travel experience (Guggenheim et. al., 2014).

This prototype is the mobile application where it is possible to make Mirandela known as a Smart City in an easy and fast way trying to associate our region with a smart concept which is a worldwide trend. The developed application has several features such as:

- Make Mirandela city more "Smart".
- Provide product information since Mirandela city is well known for its regional products (e.g. "Alheira" that is a bread, olive oil and meat sausage, and that was nominated in 2011 as one of the seven Portuguese Gastronomic Wonders).
- Allow the user to explore fantastic locations that exist in Mirandela city, thus providing good moments to the user;
- Inform the user of monuments through information, the evolution, in the time that have existed in this monument, among others features.

Above, some screenshots of the Android App that have been developed as a Proof-of-Concept of the proposed architecture named "TTM Explore" are presented.

In Fig. 2, we can see the main menu of the Apps that represents three main perspectives: "Conhecer" (To know), "Explorar" (Explore) and "Degustar" (Taste). These three issues reflect the ability to obtain information about the heritage, explore historical rails and finally Taste the regional gastronomy (i.e. obtaining information about gastronomic products, such as recipes, where to buy, where to taste them).

Fig. 2 : App main menu

Fig. 3 and Fig.4 show a screenshot of the Apps where we can see a historical building and the association of multimedia information about it. In the figure, in the real time image, augmented reality elements are projected. Those elements enable users to have access to more information such as audio, ancestral pictures of the building and detailed text about the architecture period of the building. Fig. 4 highlights a video linked to the building presented by Fig3. Also in Fig. 5, we can see a screenshot of a detailed text explaining the origin of the building and many details about it. All these images are examples of the "To know" perspective of the App.

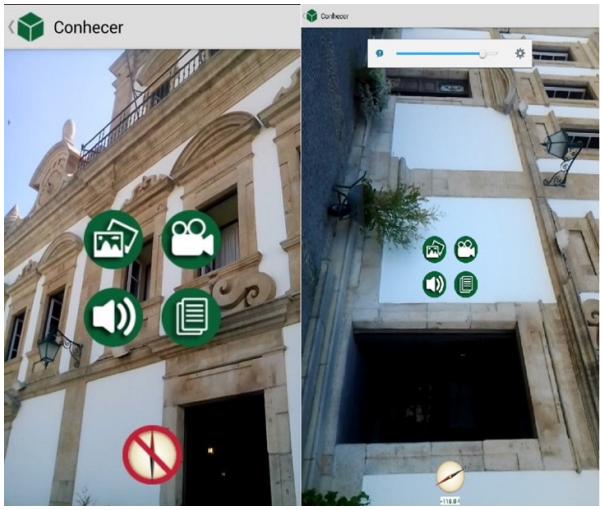

Fig. 3: Screenshot of a historical building

Fig. 4: Video linked to the a building

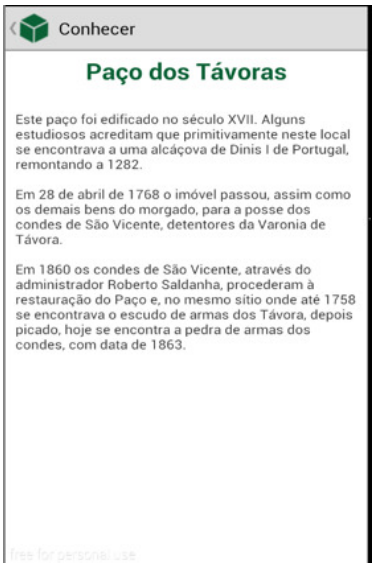

Fig. 5 : Detailed text about a historical building

The App perspective named "Explore" is presented in Fig. 6 where three screenshots are presented. The image shows some information about a historical building and how to go from the present geographical point of the user and the giving historical building. The picture shows that the user can have some multimedia information about the Point-Of-Interest (POI) and, if the user decides to visit it, he can obtain the route between his current position and the POI. Google Maps is used along to the smartphone GPS sensor as the feature engine.

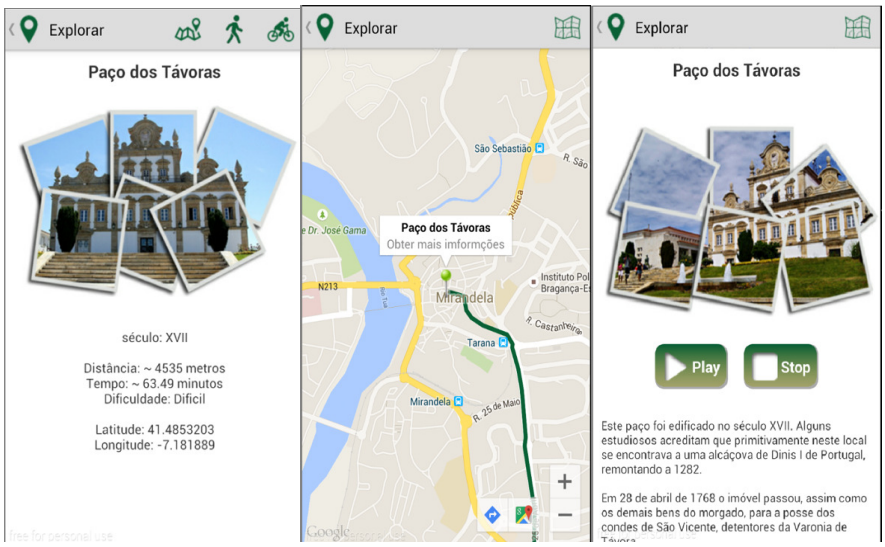

Fig. 6 : Three screenshots about the "Explore" feature

Finally, Fig. 7 presents two screenshots about the feature "Taste". We have put QR Codes tags in regional gastronomical products. With these tags, we can link the gastronomic products to multimedia information related to these products. From products traceability issues, recipes videos about how to cook the product or where to buy the product, there are several possibilities available to the user.

Fig. 7: Screenshot of the "Taste" feature

The presented prototype application has been developed to Android smartphones but in the future, we intend to enable it also to iOS users. Further information about the use of this App could give us important data for future improvements and further discussion of our approach.

Conclusion and Final Remarks

The use of ICT in tourism is a reality. From the future, we only expect to have a tourist profile more and more demanding about the capacities and quality of the existing technological solutions in the field of tourism. From the truly democratization of the World Heritage, through ICT solutions of virtual reality enabling everyone to enjoy the civilizational heritage; to the ability which enables us to pass on the heritage we inherit to future generations (without lapses or cuts), ICT has a fundamental role to play in rebuilding, informing and making people experience the heritage that is fundamentally of all of us.

This paper has discussed the importance and evolution of the ICT role in the tourism context. It presents an architecture and a proof-of-concept prototype as a contribution for the design of better and more innovative ways of bridging the gap between tourist and tourism entities needs, promoting the heritage and driving business opportunities and a better cities promotion.

Finally, we would like to state that this work is part of a long effort in the research of how ICT can help regional tourism development and regional promotion, in the Portuguese Northeast.

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