Designing Apps for Tourists: A Case Study

Virginia Tiradentes Souto[1(✉)], Caio Cristo[2], Maria Gabriela Araújo[1],
and Lucas Santos[1]

[1] Department of Design, University of Brasilia, Brasilia, Brazil
{v.tiradentes,shizen70,santoslucasls}@gmail.com
[2] Department of Computer Science, University of Brasilia, Brasilia, Brazil
caiocrivellente@gmail.com

Abstract. With the popularity of new digital media, such as smartphones and tablets, many applications have been designed in order to help tourists at different moments of their trips. This study shows the creative process of designing an app for tourists. The design of this mobile app is a part of a project that aims to investigate the design of mobile apps for tourists and their implications for interaction design and information visualization fields. It also describes the method, the stages, and different approaches taken during the creative process. In addition, some related studies on designing such apps are reviewed. It finally shows some reflections on the possibilities, difficulties and challenges designers have while trying to create an innovative app for tourists.

Keywords: Designing apps · Mobile tourist applications · Visualization information · Creative process

1 Introduction

With the popularity of new digital media, such as smartphones and tablets, many applications have been designed in order to help tourists at different moments of their trips. Maps, images, graphics and augmented reality can be used to help users locate places in a city. Tools like Google Maps offer a map service that helps tourists to plan their trip on foot, by car, using public transport, or cycling. According to Mayer, many Google Maps accesses (40 %) are already made from mobile devices, and Google Maps has 150 million mobile users [1].

The tourism industry is undergoing massive changes because of the Internet, information technology and the telecommunication industry [2]. The tendency to use mobile devices to help users locate places has driven the design of several applications for this purpose. Cities that receive a huge number of tourists, such as London and New York, have several applications to help tourists. The designers of such applications are creating new visual languages and new possibilities for interaction with users. Despite the effort that some researchers have made to better understand the user interface with these applications, much remains to be investigated. The way the visual elements are presented to users differs from what they have been used to. Interaction possibilities have been multiplied, and the control users have over the interface as well. Info-graphics, icons, text, 2D, 3D images, animated or not, have been created in a new

format, with new technology and with the possibility of further integration of the interface elements.

There is a growing number of tourists around the world. According to the latest UNWTO World Tourism Barometer, revenues from international tourism reached a new record in 2012 (U\$ 1,075 billion), 4 % over the previous year [3]. Many authors explain the importance of mobile applications for tourists [4–8]. According to Höpken et al. [7], the importance and success of mobile applications for tourists is due to their ability to support the tourist during all stages of travel. Although mobile devices are particularly useful because of their ubiquitous nature [2] it is relevant to consider that mobile devices present usability limitations [9].

This study presents research on the design of apps for tourists. It shows the creative process of designing an app for tourists, including the method, the stages and different approaches taken during the creative process. It also describes some related studies on designing such apps. It finally shows some reflections on the possibilities, difficulties and challenges designers have noted while trying to create an innovative app for tourists.

2 Designing Apps for Tourists

Research on the design of mobile applications with a focus on tourists is not so new. It is possible to find papers dating from the mid 1990s on this topic. In the last 20 years many studies have been published in this area. As said above, tourism is one of largest business areas and technological products related to it are a big market. Malaka and Zipf [10] explains the combination of tourism and IT areas. According to them, tourism is influenced by new IT products, and IT research is applied to the tourism domain in order to research new and complex interactive information systems.

Some reviews of studies on mobile tourist applications have been done. For example, Kenteris et al. [2] reviewed the research on mobile applications used by tourists to retrieve information, navigation and guidance. Another review on the literature on mobile tourist recommendation systems was done by Gavalas et al. [11]. The aim of this paper is not to carry out another literature review on mobile tourist applications, but some research on this topic is described in order to highlight important findings as well as some characteristics of mobile tourist applications.

It seems that one of the first studies on mobile applications for tourism was conducted by the College of Computing and the Graphics, Visualization and Usability (GVU Center) at Georgia Tech, in 1996. They developed the Cyberguide project. Cyberguide is a mobile context-aware tour guide that has four main components: map, information, navigation, and communication. The tour guide plays the role of cartographer, librarian, navigator and messenger. In designing the guide, they first thought about the activities the users would do and how they could be supported by mobile technology and then they decided how the technology would have to work. They used a modular approach for system development. This modularity in the design of the project helped them in developing one component without impacting on the rest of the system.

Another example of a study of this area through the design of a mobile system is the Deep Map research framework [10]. Deep Map is a mobile system that aimed to aid

tourists in navigating through the city of Heidelberg and to generate personal guided walks for tourists. Deep Map project addresses several research aspects, such as: intelligent integration of information from different data sources and services including geographical information systems, multimedia databases, and interactive Internet data sources. The researchers draw attention to usability aspects within mobile systems. They argue that usability is one of the main aspects for the success of tourism information systems, as these need to be intuitively usable. They also call attention to the system's multiple modalities for input and output. According to them, natural language is important for users that are hands-free and cannot visualize the screen. On the other hand, a graphical user interface is useful to visualize complex information, such as maps.

Like Malaka and Zipf [10], Schmidt-Belz et al. [12] also investigated maps and other services through the design of a system. The CRUMPET system was developed by the European IST project in order to create a user-friendly mobile service personalized for Tourism. The system's main functionalities are: recommendation of services (e.g. tourist attractions); interactive maps; information about tourist attractions; and proactive tips. In the interactive maps users could: overview maps of the area, find the current position of the user, pan out and zoom in on the maps, and could also have the maps highlighting sites of interest and tours. They concluded among other things that it is important both to add value by location-awareness and to provide interactive maps.

Also on researching interactive maps for tourism applications, Noguera et al. [9] designed a system that adapts the recommendations provided for users according to their current physical location and also presents a 3D map-based interface with a virtual representation of the world where the tourist is currently located. With this system they try to fulfill four tourist needs: to know where they are, which interesting items are nearby, how far they are from them, and how they reach them. The authors argue that the success of a mobile tourism system depends on both a recommender engine, and an intuitive and usable interface.

With a different approach, Kenteris et al. [2] created a categorization of mobile tourist guides aiming to extract design principles. The categorization was based on an evaluation of research and mobile applications used by tourists to retrieve information, navigation and guidance. They classified these applications into four groups: mobile guides, navigational assistants, web-to-mobile applications and mobile web-based. Based on their findings they claim that an application designer should follow at least these three principles: the information model to be used, the unique services to be provided and the input/output modalities to be incorporated in the overall project. They also claim that designers should keep in mind multilingualism. They provide a list of 'common denominator' services, such as: guided tours, communication between users and the system, e-services (e.g. currency conversion), group meeting scheduler, registering position for friends, and pre-visit and post-visit services support. Finally, they claim that more work is needed on social networking for tourist users. According to them, there is no study that connected content to social networks, such as Facebook and Twitter.

It seems that one of the most investigated kinds of mobile tourist application is the recommender system. Many studies have investigated mobile tourism recommender systems [9, 11, 13]. Recommender systems, such as Deep Map [10] and iTravel [13], are considered important as they can both offer travel recommendations to tourists and

reduce the information overload. Gavalas et al. [11] made a review of the state-of-the-art in mobile tourism recommender systems (RS). They investigated the main features of mobile tourism RS studies dated from 2000 to 2012. The features analyzed were: recommendation technique, categories, items recommended, additional services offered/unique features, criteria used for recommendation, and architecture/client application implementation platform. They also proposed a classi-fication of mobile tourism RSs with three different aspects: their chosen architecture, the degree of user involvement in the delivery of recommendations and the criteria taken into account for deriving recommendations. They conclude that mobile RSs represent a fast-evolving domain of research, and tourism in particularly is the most popular among these studies. They also highlight that the focus of these studies moved from dealing with the limitations of mobile devices, such as limited processing power and display resolution, to sensing, computational and visualization capabilities.

Still focusing on recommendation systems for tourist applications, Yang and Hwang [13] claim that most recommender systems fail to exploit information, evalu-ations or ratings of other tourists. According to them, most existing recommender systems use content-based approach for making a recommendation. In this approach, users state their needs based upon on selected parameters and the system then correlates their choices with catalogued destinations. The authors proposed a different approach in which mobile peer-to-peer communications (e.g. Bluetooth or Wi-Fi) are used to provide tourists with convenient means for exchanging ratings via their mobile device. They designed and tested a recommendation system for tourists using peer-to-peer communication and found that users liked the system, because having the information at the right time and in the right place helped them to make travel decisions.

The studies described above, as well as the literature reviewed on interaction design and information visualization, and an analysis of many different mobile apps with a focus on tourists were used to help us to define the application described below.

3   Designing an App for Tourists: A Case Study

In this section the project we are calling Facemap is described and discussed. The design of this mobile app is a part of a project that aims to investigate the design of a mobile app for tourists and its implications for interaction design and information visualization fields. Facemap is a mobile application that has three main functions: (1) connects people with similar interests that go to a particular event, (2) allows them to chat, and (3) helps them (by Google Map and Google Street View) to meet in a chosen place.

3.1   Defining the Concept

This project started with a discussion about mobile tourism design with researchers from different academic backgrounds. Headed by a designer researcher, also part of this project were researchers and students from different areas, such as: art media, design, computer science, software engineer, and robotics. The main question was: what are

the challenges for designers to create innovative mobile applications, specially focused on tourism? In order to answer this question the state of the art of such applications and fields related to it were discussed. Then an analysis was carried out in different mobile applications, on their graphic interface, visualization, usability problems. From this perspective, we thought how we could create an app in order to investigate this area with a focus on the graphical interface of such applications. With a brainstorming section, it was considered relevant to include a social approach to this study in the investigations. It was highlighted that tourism has a social aspect and that this has not been greatly explored in this kind of app. This is in line with Brown and Chalmers [6], in a study that considered tourism a social activity, and with Kenteris et al. [2], where a literature review did not find studies that connected social networks with content for tourist users, although this was considered a relevant topic.

The ideas generated for the project were based on real situations and current problems. Some of the ideas were related to the World Cup, which was about to happen in Brazil (in June 2014), just a few months from the start of this project. The initial idea of this project was to design an app that could help the international public to find people from their own country in order to watch the games together.

Based on this initial idea, the design of the app was created. The aim was to do something new not only in the concept idea, but also in the graphical interface design. Studying the state of the art for mobile apps in general, and more in particularly for tourism, we saw that there are hugely different functions, services and approaches among them. However, what we realized is that maybe because of the restrictions of the user interface guidelines, provided by the companies of the operation systems of such apps [14, 15] they look very similar. Users can nowadays find many apps that have the same function. So, what makes one more used than another? What constitutes the success of an app? How can designers create innovative apps that help users to use them? Good usability is certainly one of the answers, and indeed usability and intuitive interfaces are considered to be two important aspects for the success of tourism information systems [9, 10].

3.2 Defining the Visualization Systems

So how should user interfaces be made intuitive? Information visualization also seems to be one of the key areas for that. Gavalas et al. [11], in a recent review of literature, mentioned in Sect. 2, found that one of the main areas of study on mobile tourism systems is their visual capability. According to them, the major design challenge for mobile recommended systems is to use adequate interface techniques to visualize recommended items [11].

One of the areas of study was the different type of visualizations for social networking. Network systems are "patterns of connections between elements in the systems" [16]. There are some research projects on this topic [17] and many samples of network visualizations [18]. It was agreed that in order to make it easier to visualize their social network for mobile use, simplicity in the visual aspect of the interface should be achieved. However, when dealing with a large size of network keeping it simple is a challenge.

At this phase of the project we decided that one of the main functionalities of the app would be to allow users to find people with a chosen profile that would be going to the same event. How to do that? And how to show the people the user is looking for?

To solve the issue of how to do that we decided to use the Facebook social network. The use of Facebook facilitates the connection among users and also allows their existing profile to be used. Therefore, the profile characteristics chosen were taken from the ones used by Facebook: where you live, where you studied, where you work, profession, age. The idea was to give users the possibility of choosing the characteristics of people they would like to meet. But how would people they were looking for appear on the display? Typically the visualization of query results is displayed as a ranked list of information items [11]. However, we did not think that a list of names would be the best way of showing this result.

We thus decided to study and analyze different types of network systems. According to Meirelles [16] there are three main methods for representing networks. They are: lists, matrices and node-link diagrams. According to her, lists are rarely used because of the large size of many networks; matrices are good for avoiding the problem of too many link crossings; whereas node-link diagrams are good for physical network systems as they "provide the spatial attribute to locate both nodes and links into the spatial structure of the diagram".

It seems that there are not many samples of diagram network visualizations for mobile applications. One of the reasons may be because they are too complex to be seen on small screens, or it may also be related to the complexity of developing such visualizations for mobile systems. Studying possible visualizations that would make it easier for the users to see the people they were looking for we found the hierarchical structure called Treemap.

Treemap is a defined as "a space-constrained visualization of hierarchical structures", that "enables users to compare nodes and sub-trees" and is considered to be "very effective in showing attributes of leaf nodes using size and color coding" [19]. In this structure the shapes are organized according to their hierarchy or categorization. Treemap visualization structures have been used since the 1900s when they were created by Shneiderman [20]. One well-known sample that uses the treemap algorithm is called Newsmap, designed by Weskamp in 2004 [21]. This application takes the Google news output and shows it with a treemap, where color codes the type of news (e.g. national) and the size of the shape indicates how many stories there are on this topic [19]. Other samples and the history of treemaps can be found in Shneiderman and Plaisant [20].

The treemap algorithm was not used in the design of Facemap. However, we took the concept of this type of structure and adapted to our context. We verified two main advantages of this type of visualization for our app: (1) the fact that it is a space-efficient display of large datasets [16], which therefore makes it possible to use the whole display; and (2) the fact that it allows shapes to be organized according to their hierarchy, by using different sizes to indicate which people have a profile that is more like the profile sought. Figure 1 shows (a) the screen with the search criteria in which the participants will be ordered and (b) sample of screen with the participants ordered as defined in the previous screen.
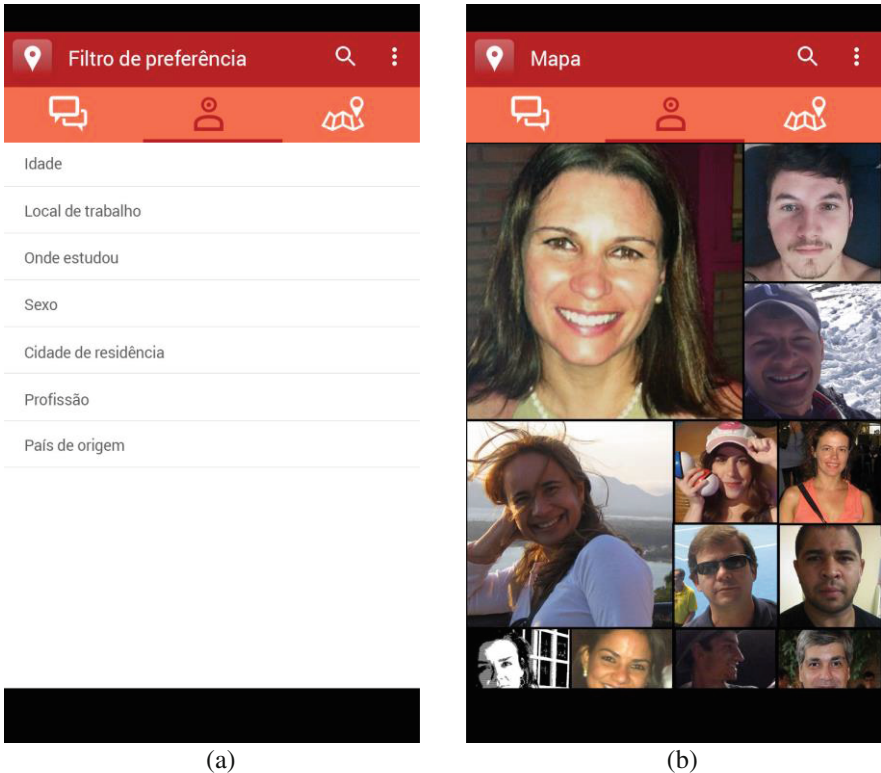
(a)   (b)

Fig. 1. (a) Screen with the search criteria in which the participants will be ordered and (b) sample of screen with the participants ordered as defined in the previous screen. Photos from the authors' personal archive.

Apart from social network visualizations and hierarchical structures another area of study was interactive maps. As said, when we are talking about apps for tourists one of the main functions is to provide a map for the users. Valuable interactive maps are considered important in a mobile system for tourism [12]. Interactive maps for mobiles have been studied by many researchers [12, 22, 23]. It is incredible how some maps like Google Maps can give us our current position, and help us to go somewhere with a precise description of the way, in different forms such as geographic maps, 3D maps, satellite maps, and street maps. The best type of map seems to be dependent on the context and on the user and her needs, among other things [24].

In the context of the app, the map would be used by two people that would be chatting and deciding where to go. A sample scenario would be of two people who do not know the city they are in, who are in different places and want to meet somewhere that would be convenient for both. For that, the map should point to the current location of each one, show the places between them, and then direct them to the place chosen. To show the current location and the places around we chose to use Google Maps. However, as the purpose of this app is not only to design a functional and appealing

app, but also to investigate the state of the art of interactive maps in order to choose the best that would fit the requirements of the project, we studied and discussed how we could enhance the user's experience. What types of maps, how many types and how could they be shown? Studies points out that one of the problems with digital maps is the fact that they do not give contextual clues, as the visual area is small and you cannot see the whole map [24].

In a search for different types of maps and how to combine different maps, we found an interesting sample from the Louvre Museum. In the Louvre Museum website there is an option for users to navigate through the Virtual Tour. The tour offers an interactive visit of the galleries of the museum, allowing the users to navigate within 360 panoramic views, zooming to certain works of art. The tour provides an interactive map (located under the panoramic view displays) that displays the current position of the visitor and gives access to a chosen gallery [25].

Based on this type of interface we decided to integrate Google Maps with Google Street View. Google Street View provides users with panoramic imagery captured in hundreds of cities in 50 countries across seven continents [26]. Anguelov et al. [27] explains that Street View is a powerful tool for finding local businesses, among other things, as they can be combined with other data sources. In this paper, they showed some images with the use of 3D data, with Google Maps data and Street View images combined in the same image, resulting in "3D-annotated" Street View images. However, in our project we decided not to integrate the map with the street view in the same image. Users will see the map and the image in the same screen but the street view is shown small and will only increase when the user decides. This decision was based on the fact that having the map in a different layer from the image would make the interface/image simpler. In addition, it allows users to choose when they want to see the Street View image, and therefore provides them with contextual information whenever they want. Figure 2 shows an example of the map screen with Google Maps showing the places of the two participants and with (a) the Street View window reduced, and (b) with the Street View window expanded.

3.3   Comments About the App Development Process

It is important to highlight that although, as mentioned at the beginning of this section, researchers and students from different areas participated in some phases of the project, three designers and two programmers developed most of it. In specific issues some other professionals, designers and users were asked to contribute to the project.

Facemap is being designed with the main aim of investigating the design of a mobile app for tourists and the implications for interaction design and information visualization fields. We have not followed a particular type of methodology, because research questions that appeared during the development process would be considered, and this would have implications for the design of the app. However, the research project lasted for one year and had a deadline, and some issues could therefore not be investigated and implemented, such as map customization.

A multidisciplinary team seems to be one of the key factors for the success of such projects. Diversity in the team's academic and professional backgrounds, as well as
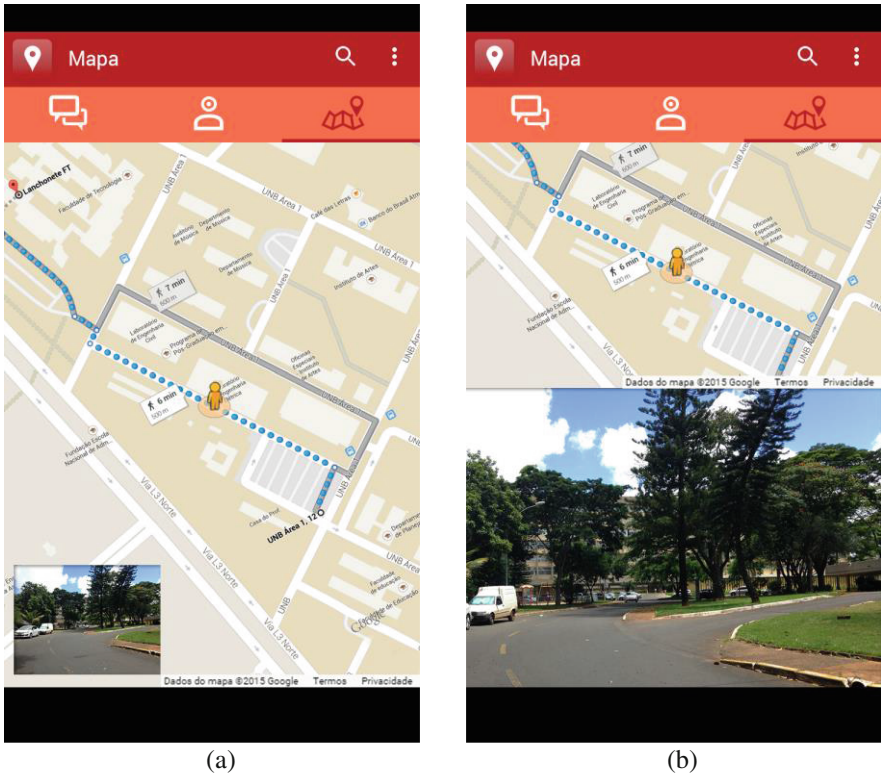
(a)   (b)

Fig. 2. An example of the map screen with Google Maps showing the places of the two participants and with (a) the Street View window reduced, and (b) with the Street View window expanded. Photo from the authors' personal archive.

mobile experience, and the presence of both men and women on the team, among others, can help to understand the problems and propose solutions in a more efficient way. Although target users were consulted about specific issues in different phases of the project, it did not happen in a systematic way. This also seems to be one of the main issues for projects with a restricted time. At the same time that it is considered relevant to have the participation of target users at different moments of the development of the app, having this participation requires time to plan, to execute and to analyze data. It seems that one way to have users' participation in the project without affecting its deadline, is to carry out informal consultations. In this approach, target users that are easy to access are from time to time asked to give an opinion, or to do a task. However, this approach should be used only to decide about smaller issues. Big issues should be analyzed with a careful and formal user test seeming to be more appropriate.

It is also important to highlight that good communication among the members of the team seems to be one of the keys to the success of a project. We noted a certain level of difficulty for the members of the team to understand the problems and the tasks of others. Although designers and programmers frequently work together on projects

like this, their approaches and methods are different. Spending time to explain better the activities, thoughts and challenges of each member of the team may save time for the project and also make the team more engaged, and as a result help to design a successful final solution.

4   Conclusions and Final Remarks

Designing an app for tourists can be a real challenge. The current technology allows designers to create new experiences. However, there are also many obstacles to overcome in order to create effective, useful and usable apps, and these challenge include the desirability of smaller screen sizes and the complexity inherent in most usage contexts [28].

During the design of Facemap we faced many challenges. The first one was the definition of an innovative concept. The market for mobile apps for tourists is huge and there are many possibilities for designing new apps. However, innovating in an area where there are already so many is not easy. Many apparently pioneering ideas were already taken. In addition some good ideas are not feasible. Moreover, it seems that a good environment for innovation is needed. It should be composed of people with different points of view and previous experiences, forming a heterogeneous environment conducive to innovative ideas.

This project looked for this environment. We also carried out thorough research and analysis on the possible ways of designing the app. Considering that the key issue of this project was the visualization of information, we sought to investigate different types of visualizations. The use of a Treemap seems to be an interesting solution for visualization of query results. The use of Google Map – My Place and Google Street View displayed on the same page may help people to have a contextualized view of the place, and therefore increase their sense of assertiveness. We also worried about interaction design, trying to make the interface as intuitive as possible.

This project is in its final stage; the beta version of Facemap is almost ready, and the next step is to conduct empirical studies. The studies will be conducted in a real situation, which means we will ask people to install the app and use it during an event. Apart from checking the usability problems that the app may have, tests will be conducted in order to try to understand the perception and feelings of users in relation to the design of mobile apps in general, mobile apps for tourists in particular, and especially in relation to the visualizations.

References

1. Geller, J.: Google VP Marissa Mayer dishes Google mobile stats, 150 M mobile maps users. In: BRG (2011). http://bgr.com/2011/03/13/google-vp-marissa-mayer-dishes-google-mobile-stats-150-m-mobile-users/

2. Kenteris, M., Gavalas, D., Economou, D.: Electronic mobile guides: a survey. Pers. Ubiquit. Comput. **15**(1), 97–111 (2011)

3. UNWTO: International tourism receipts grew by 4 % in 2012, World Tourism Organization. UNWTO (2013). http://media.unwto.org/en/press-release/2013-05-15/international-tourism-receipts-grew-4-2012

4. Benyon, D., Quigley, A., O'keefe, B., Riva, G.: Presence and digital tourism. AI Soc. **29**(4), 521–529 (2013)

5. Bødker, M., Browning, D.: Tourism sociabilities and place: challenges and opportunities for design. Int. J. Des. **7**(2), 19–30 (2013)

6. Brown, B., Chalmers, M.: Tourism and mobile technology. In: Kuutti, K., Karsten, E.J., Fitzpatrick, G., Dourish, P., Schmidt, K. (eds.) Proceedings of the Eighth Conference on European Conference on Computer Supported Cooperative Work (ECSCW 2003), pp. 335–354. Kluwer Academic Publishers, Norwell (2003)

7. Höpken, W., Fuchs, M., Zanker, M., Beer, T.: Context-based adaptation of mobile applications in tourism. J. Inf. Technol. Tour. **12**(2), 175–195 (2010)

8. Rodríguez, B., Molina, J., Pérez, F., Caballero, R.: Interactive design of personalised tourism routes. Tour. Manag. **33**(4), 926–940 (2012)

9. Noguera, J.M., Barranco, M.J., Segura, R.J., Martinez, L.: A mobile 3D-GIS hybrid recommender system for tourism. Inf. Sci. **215**, 37–52 (2012)

10. Malaka, R., Zipf, A.: DEEP MAP - challenging IT research in the framework of a tourist information system. In: Fesenmaier, D., Klein, S., Buhalis, D. (eds.) Proceedings of ENTER 2000 on Information and Communication Technologies in Tourism 2000, pp. 15–27. Springer, Vienna (2000)

11. Gavalas, D., Konstantopoulosb, C., Mastakasb, K., Pantzioub, G.: Mobile recommender systems in tourism. J. Netw. Comput. Appl. **39**, 319–333 (2014)

12. Schmidt-Belz, B., Laamanen, H., Poslad, S., Zipf, A.: Location-based mobile tourist services - first user experiences. In: Proceedings of the International Conference on Information and Communication Technologies in Tourism (2003)

13. Yang, W., Hwang, S.: iTravel: a recommender system in mobile peer-to-peer environment. J. Syst. Softw. **86**(1), 12–20 (2013)

14. Apple: iOS Human Interface Guidelines. https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/MobileHIG/

15. Android Design. http://developer.android.com/design/index.html

16. Meirelles, I.: Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations. Rockport Publishers, Beverly (2013)

17. VIDI group: Visualization and Interface Design Innovation (ViDi) research group. http://vidi.cs.ucdavis.edu/about

18. Ortiz, S.: Twitter Company One week of conversations at Twitter Co. From 2/15/13 to 2/22/13. http://moebio.com/newk/twitter/

19. Human-Computer Interaction Lab: Treemap, Human-Computer Interaction Lab, University of Maryland (2003). http://www.cs.umd.edu/hcil/treemap

20. Shneiderman, B., Plaisant, C.: Treemaps for space-constrained visualization of hierarchies: Including the History of Treemap Research at the University of Maryland. Human-Computer Interaction Lab, University of Maryland (2014). http://www.cs.umd.edu/hcil/treemap-history/

21. Weskamp, M.: Newsmap. http://newsmap.jp/

22. Abowd, G.D., Atkeson, C.G., Hong, J., Long, S., Kooper, R., Pinkerton, M.: Cyberguide: a mobile context-aware tour guide. Wirel. Netw. **3**(5), 421–433 (1997)

23. Poppinga, B., Magnusson, C., Pielot, M., Rassmus-Grohn, K.: TouchOver map: audio-tactile exploration of interactive maps. In: Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services (MobileHCI 2011), pp. 545–550. ACM, New York (2011)

24. Santos, F.A., Souto, V.T.: Mapas digitais e impressos: um estudo sobre a facilidade e a preferência de uso. In: Interaction South America 2012, São Paulo. Anais do Interaction South America 2012 (2012)

25. Musée du Louvre. Virtual Tour (2015). http://musee.louvre.fr/visite-louvre/aideENG.html

26. Google: Street View. https://www.google.com/maps/views/streetview?gl=us

27. Anguelov, D., Dulong, C., Filip, D., Frueh, C., Lafon, S., Lyon, R., Ogale, A.S., Vincent, L., Weaver, J.: Google street view: capturing the world at street level. IEEE Comput. **43**(6), 32–38 (2010)

28. de Sá, M., Churchill, E.F.: Mobile augmented reality: a design perspective. In: Huang, W., Alem, L., Livingston, M.A. (eds.) Human Factors in Augmented Reality Environments, pp. 139–164. Springer, New York (2013)