Multimedia Information Delivery on Mobile Cultural Applications

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Abstract. In this paper we describe a user evaluation that aims to understand the use of multimodal features in mobile cultural guides. The object of the study was a mobile guide prototype that delivers cultural heritage information about sculptures in the city of Brighton – UK. The study was taken in situ with 32 participants from diverse nationalities. Participants followed a short sculpture tour using a touch-screen mobile phone to access the application. The data was analyzed using descriptive statistical methods and qualitative methods. Relevant findings were identified, such as: the presence of the volume controls on the screen, multitask functions and visibility of hyperlinks. The length and quantity of information accessed by users was proportional to their familiarity with the content, language skills and time available. Pictures assisted in learning about subject history and way finding. Additionally, audio served the purpose when participants want to see the details of the sculpture or light conditions were not proper to visualize the screen. Video was suitable for before or after the tour. Those results served the base to formulated design recommendations for developing audiovisual cultural heritage guides.

Keywords: user interface design, mobile HCI, mobile cultural guides.

1 Introduction

This work is part of a PhD research situated in the field of Mobile HCI and interaction design applications for cultural heritage visitors in outdoor settings. The scope of this research is restricted to the activity of using a touch screen mobile phone to access multimedia content at real points of interest and provide design recommendations to develop such systems. In this paper, we focus on the mobile phone potential to deliver multimedia content and users' expectations of using it in outdoor settings. A prototype mobile guide was developed in order to study the role of multimedia features (text, pictures, video and audio) play when accessed by visitors. This system was based on a previous study [2], [3], [5]. On the basis of this material, a low-tech prototype was developed, followed by a high-tech prototype for evaluation with experts [4], and users in outdoor settings. This paper concentrates on the user evaluation. The objective of user evaluation was to examine the usability of the prototype and identify users' preferences with regard to multimedia information delivery on mobile

applications in outdoor contexts. The city of Brighton & Hove, on the South Coast of England, was chosen to be the setting of the study. Brighton, the larger part of Brighton & Hove, is a lively city and welcomes a diverse visitor population throughout the year.

2   Background

Much recent research on mobile city guides has been focused on the kind of technology applied to supply historical and cultural information. Location-based technologies help visitors and also residents to localize themselves and receive historical, cultural and entertainment information at a particular point of interest [6] and [16]. Location-based games are another means of presenting the history of a city in an entertaining way [14]. Cell ID and Wi-Fi help to identify user location and enable context-sensitive information access [1]. Sensors are employed to enhance the use of maps and the interaction of visitors with systems input [13], [12], [15], [17]. Moreover, the use of augmented reality in the cultural heritage field allows users to find out what certain locations and monuments were like in the past [9], [8]. Overall, the application of technologies has to make sense and involve visitors culturally and historically. In this way, visitors and residents alike might have new experiences, be entertained and learn more about historical cultural sites. Not only must appropriate technology be chosen for handheld mobile cultural guides, but also interfaces need to be well designed to provide information to visitors. Additionally, the research in mobile multimodal interfaces in cultural heritage settings is still weak in understanding how people perceive, handle and interact with mobile systems in outdoor location-based contexts. Research in this area is particularly needed at this point as the number of mobile applications is increasing substantially. In three years (from 2007 to 2010) over 300,000 mobile apps have been developed. In 2010 these applications were downloaded 10.9 billion times [10]. On the other hand, one in four mobile application downloaded is never used again [18]. It may be that users abandon an app because of usability problems, because it did not meet their expectation or because it lacked engaging content and interactivity. Travel services were identified as being among the top ten mobile consumer services in 2010 [7] and kept their place on the prediction list for 2012 [11]. Location-based services and mobile search are also on the list. More apps available in the market increase competition and boost development of better mobile interfaces designed with focus on user experience. Design recommendations for developing mobile cultural multimedia apps are scarce. Therefore, this work may give some insights of how to use some multimedia functions such as: audio, text, video and pictures to transmit cultural heritage content.

3   Mobile Cultural Guide Prototype

The prototype was developed for the HTC Hero phone, using the Android platform. In order to test users' preferences in content presentation, two versions of the content were part of the high-tech prototype (Figure 1). One version had a more complete set

of multimedia features (Queen Victoria content) and another had fewer multimedia features (George IV content). The first content had text with hyperlinks, informal audio with two speakers discussing about the monument, pictures of the monuments with extra information and a shorter video length. The second content had a long text without hyperlinks, formal speaker in the audio file, pictures of the subject, and a video of George IV's life. This offered room for researching overall user preferences with regard to multimedia presentation of content.
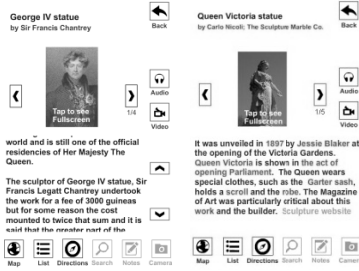
Fig. 1. Two versions of text display in the app

4   Method

Participants followed a short sculpture tour using a touch-screen mobile phone to access the application. The application was available on the mobile phone via mobile broadband in the Internet browser. It was launched in full screen format and ready for the users to access at the beginning of the study. The application had a map with points of interest[1] and two versions of content. The researcher asked participants to go to one of the monuments from their current position. Eighteen participants started the tour seeing "Queen Victoria statue" and the remainder "George IV statue" to counterbalance any effect of content access order. In the first part of the tour, participants were free to access any content that sparked their interest. In the second part of the tour, the researcher motivated them, if necessary, to look at any information that they hadn't accessed before. The researcher marked down the sequence of multimedia content accessed during the tour on a form. The researcher accompanied the participants and asked them to use the think aloud technique. Questionnaires were filled in before and after the tour. Before the tour, demographic information and consent for the study were requested. After the tour, participants answered questions related to prototype interface design and their preferences for media. Observational data was also gathered during the tours. Participants wore a video head camera, which recorded their interaction with the prototype and any sound occurring on the tours. The observation data was analysed supported by the notes the researcher took during the tours.

4.1   Participants

Overall thirty-two participants did the user tests in June and July 2010. The age range of the participants was between 18 to 71 years old. However, most of the participants were between 23 and 29 years old. This meant that the majority of participants either had touch-screen mobile phones or had used them before. According to the data, 50% of the participants used touch-screen mobile phones every day, 37.5%

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[1] http://www.cmis.brighton.ac.uk/users/hcdspc10/mo.html

not frequently and 12.5% had never tried this kind of mobile phone before. The data was diversified when looking at nationality. Participants were from three main continents: Europe (56%), South America (25%) and Asia (19%).

4.2   Data Analysis

Descriptive statistical analysis was carried out to analyse the data from the questionnaires - demographic data, semantic scales and design preferences. Tables and cross tabulation were applied to compare the results among participants and the use of the system. The transcriptions of the video observations, important notes taken during the fieldwork and suggestions given by participants while they were answering the questionnaires were considered. Research questions were established to guide the analysis, such as:

- What are the preferences for media usage and why?
- How much will users access text, audio, video and hyperlinks in front of the monuments?
- Is there any difference in interaction or preferences among diverse users profile?

These questions were kept in mind while the data was classified and codified. The main independent variables were: age, residence, level of English, familiarity with touch screen mobile devices, previous experience with mobile tour guides, time availability and environmental factors. Independent variables were used to investigate differences in participants' interaction with the application. Dependent variables, the issues we aimed to measure, were primarily the use of multimedia features on the mobile phones in outdoor settings. While carrying out the video observation, a table wasused to identify which features participants accessed during the tour and in which order functions were accessed. Only the first stage of the experiment was examined at this level, i.e. in other words, the stage participants were able to choose functions they wanted.

4.3   Findings

The findings are described here according to the use of multimedia features. Overall, participants accessed about four features (4.5 median) to gather information in the first part of the tour. They prioritized: text (56%), audio (28%), picture gallery (13%) and looked at the pictures in full screen mode (9%).

Text. Half of the participants started the tour by reading the text of the monuments. Others scanned the text and accessed other features. They also used their fingers to follow the text and found the typeface of George IV text was quite small to read. It was an interesting issue since the typeface was the same as Queen Victoria text. Users who identified this as a problem were over 47 years old and did not use touch-screen phones frequently. In spite of this, the evaluation of the type size for the whole system was satisfactory. The text of George IV was also difficult to follow, according to users. The main reasons were the use of arrows to scroll the text and the uneven

transition of the text. Touch screen device users expected to scroll the text when tapping on it, zoom in with double tap or press and drag to scroll the test. Novice users of this technology were lost in the text and mentioned that they needed to memorise the last word read before scrolling the text. When asked for choose the presentation of the text, ten participants (31 %) preferred to scroll the text instead of having hyperlinks.

Hyperlinks. Twenty-two participants (69%) reported they prefer to have hyperlinks on the text than scroll it. They mentioned they did not want to read long texts in front of the monuments, so that, with hyperlinks they can choose what they want to know more. In spite of this, eleven participants did not try the hyperlinks in the first stage of the experiment. Besides, external hyperlinks and links to the system were rarely selected. Participants from South America and Asia accessed links much later in the tours or did not access this function at all (90%). They were in majority visitors and spent a day in Brighton. United Kingdom participants read the hyperlinks more often (80%). They were residents of Brighton and were particularly familiar with the subjects. Visitors did the tour after a day of sightseeing or between touristic activities. They looked for basic information and wanted to move on. On the other hand, residents, who had some familiarity with subject, searched for additional information in the hyperlinks. The scarce access of this function in the first part of the tour might be related to unintuitive presentation of hyperlinks. Participants commented that most of the time they saw the highlighted words but did not realised that there was a hyperlink in the first place. In their understanding, the colours were used to emphasise the words. Their suggestions were to use standards from the early stages of the WWW, i.e. underline words and make them blue. Additionally, twelve people did not access the external hyperlink in orange. The ones who accessed mentioned it the colours were very flashy and that is why they clicked on the words. Some of them mentioned that they did not realise it was an external link despite the word "website". Suggestions were given to make this function more transparent, such as add an icon - beside the word highlighted.

Pictures. Accessing the picture gallery during the tour was considered a secondary activity. When visiting the first sculpture, 18 participants (56%) did not interact with the picture gallery. Otherwise, it is evident they saw the first picture on the way to the sculpture or in front of the monument. Some of the participants used the pictures of the statue to localise themselves. When asked their preference for having pictures of the subject or the sculpture on the app, 14 participants (41%) would like to have both kinds of pictures for every sculpture. They justified their choice affirming that one picture of the statue was enough to recognise it, and more pictures of the subject were necessary to give context and make the history alive. Besides, participants suggested having ancient pictures of the sculpture, when it was unveiled or pictures that showed the surroundings in the past. The rest were divided in their choices. Eleven participants (34%) opted for the subject picture and 8 participants (25%) opted for the sculpture picture. The ones who preferred the subject mentioned they were able to see the real sculpture on the spot; consequently they do not need illustration. However, in the observation studies it became clear that even those participants also used the pictures to identify the statue. Seeing pictures in full screen mode, according to the questionnaire results, is an extremely important function. (Table 1).

Table 1. Important functions for users

	I didn't try	Not essential	Neutral	Essential
Pictures in full screen mode	___	1	3	28
Audio	___	2	4	26
Subtitles	8	3	2	19
Video	2	9	5	16

It is worth mentioning that even though they rated this function as very relevant in the questionnaire, they did not access full screen pictures very often. In the first part of the tour, just eleven participants tapped to see the pictures in full screen. This may be because certain participants did not identify the possibility of seeing full screen pictures, despite the message: "Tap to see full screen". This message was present in the first thumbnail picture. Sometimes, participants tapped on the arrows to change the pictures, and did not always notice the message or were confused about it.

Audio. In the prototype, two audio files were available. The first was the Queen Victoria audio that was recorded by two British speakers having a conversation about the sculpture. The second was delivered by one speaker with an American, international accent telling the history of George IV. George IV audio was an overview about the figure of George IV and history. In the Queen Victoria audio the speakers had an informal conversation about the sculpture. It was clear the audio was an option expected on mobile cultural guides. Audio was the second most important feature chosen by users as a feature to have on mobile guides. Having eyes free was the main justification for this must-have feature. Eighty percent of the participants tried the audio files in the first part of the tour. The twenty percent who did not try the audio files were also not familiar with touch screen mobile phones; however, most of them had used audio guides in museums and galleries. The tour was very short: as a consequence, novice users might find it difficult to overcome the technology barrier. In this case, a help function or information on how to use the app would benefit these users. In general, participants listened to the audio files until the end. Each audio was approximately two minutes and twenty seconds. While listening to the audio, they explored other sessions on the app or followed the instructions written down on the audio screen to appreciate the monument. In the first case, the audio file did not stop when they accessed other parts of the system. This was an error: nevertheless they appreciated the possibility to have multi task functions on the app – listening to the audio while accessing other functions. The only problem was when they wanted to stop the sound and needed to return to the audio page to select this function. Ten participants who were not familiar with the device did not know how to increase the volume of the audio. The volume controls were essential as the playback buttons and fundamental on the mobile phone screen. In addition, some participants listened to the audio and explored the system on their way to the monuments. The researcher had to attract their attention several times while crossing the streets or merely walking in crowded places. Problems with traffic and crowded environments also appeared in the previous study with a mobile device [5]. To motivate users to look at the monuments,

we added a suggestion in the audio screen: "While you listen to the audio move closer to appreciate the monument". Twenty-one participants (67%) followed the suggestion. A few touched the monuments as well. It was pertinent to notice that the George IV statue was very high, so participants followed the instructions to get closer, but after a few seconds some distanced themselves to see the overall statue. Instructions clearly need to be given in a tailored way depending on the type of the monument. Perhaps audio or text suggestions should be given to lead visitors to stand in the best spot to appreciate the monument.

Video. The use of video in outdoor settings is a cumbersome activity. These include long latency while transmitting multimedia data over networks, mobile device decoding power, media formats and memory capacity. Some of these factors were also identified in the evaluation of the prototype. The videos in the application were streamed over mobile network and occasionally participants had to wait for watching it. Users familiar with the technology tried to forward the video, but were not successful. Likewise in the audio session, participants who were not familiar with the device had difficulties finding the volume controls that were not on the screen. Participants also had problems in understanding how the playback controls appeared by tapping on the screen. This action was learned by trial and error. For participants video was the least important feature to have in mobile guides. Additionally, not all the participants watched the video until the end. According to the sample studied, twenty-seven participants (85%) had never watched videos on mobile phones. Similarities of choices were found among eight participants who also did not mark video as an essential feature to have on mobile guides.

5   Discussion

Interesting facts are not only the ones that had high scores in the prototype evaluation. The qualitative analysis of videos and questionnaires highlighted issues present in designing multimedia mobile guides for use in outdoor settings. To summarise the findings, first the higher score of strengths of evidence will be discussed followed by the low scores highlighted in the evaluation. Few high score issues were related to technology and problems not possible to solve in the prototype development. Problems with Internet connection such as loading audio and video files, coming back from external links and the location tracker functions were primary in this category. Following these, it was the impossibility of scrolling the map, switching it according to the route taken and zooming in/out the map. These were features users expected to have in the guide based on their background using desktop applications and mobile applications.

Other higher score issues were more relevant to multimedia mobile interface and content design. For instance, the lack of volume controls on the screen, visibility of hyperlinks and instructions of how to go back from full screen pictures. In the first case, participants who were familiar with the type of the device did not mention this issue. Secondly, more evidence in the hyperlinks presentation was requested based on the user's technology background. Although the hyperlinks were in different colours,

as in certain Webpages, participants needed more evidence of it on mobile devices. Thirdly, coherence of controls was expected in all the pages of the app. In this case, the majority were not frequent users of touch screens. They often relied on the back button of the phone when they did not know how to proceed. Returning to the previous state of the system offered them confidence. However, they had difficulties to get back from full screen, by trial and error they learnt how to do this action. Certain actions appeared to be instinctive and intrinsic to the context. It was also true when participants by instinct turned the screen to landscape to see a video. Multitasking was also a trend observed in this study. Participants appreciated being able to listen to the audio and at the same time interact with other functions on the system. The text was recognised as the feature that requested more users' attention. Occasionally users had to restart reading the text in order to focus. They also identified the importance of messages to lead participants to see other parts of the system or observe carefully points of interest. Although international and visiting participants were sometimes overwhelmed with content and diverse ways of presenting it, it was found relevant to have diversity of choices. Availability of multimedia choices is not only related to a participant's profile but also with environmental context. Environmental issues were observed with participants in the field but were not possible to duplicate in the lab tests. Text was preferred when there was noise in the surroundings. Audio was supported by the use of subtitles in the same conditions. Additionally, audio was more strongly indicated when participants wanted to explore the environment with visually, observing the details of the sculpture or when light conditions were not proper to visualise the screen. Video was suitable for before or after the tour, in their words, to be accessed in a comfortable place. Overall, participants watched the video not more than two minutes.   The length of the tours and the quantity of sections visited was proportional to the familiarity with the content, language skills and time availability. Locals and UK residents spent more time in the tour and accessed more functions than Internationals and/or visitors. Participants who did not easily identify how certain functions worked requested the presence of a help system. In their opinion this should include information on: how to backtrack from full screen pictures, explaining the colour words were hyperlinks, how to close the application and interact by tapping instead of pressing on the screen. The presence of hyperlinks was positively identified as a factor to improve their experience. Text with hyperlinks was considered more organised and easier to understand than the other option. For the most part, the users' evaluation gave references on how to use multimedia features on mobile devices in outdoor settings. The presence of diverse ways to deliver information was essential to cater for the public of touristic and historical places. Tourists, locals and residents do not always have the same language, background and time available to visit the places. The use of tailored systems would facilitate and customise those applications. However, it is not straightforward to develop applications for a very mixed public. In the second part of the study international visitors were requested to interact more with the system. In real situations, they would not access those functions, as was attested in the first part of the tour.   Moreover, it was valuable for residents and locals to have more options to explore the system. Likewise, subtitles were relevant for those without advanced English. Native and advanced speakers were not uncomfortable with the

presence of this feature. Ideally, a system that has equilibrium of essential functions, for the clusters identified in this study, is the best option.

6   Conclusion

This paper described the user evaluation studies of the mobile guide prototype. Throughout, it was clear to see the variety of users' characteristics present in this study. A balance of essential issues for this diverse public should be utilised for developing mobile applications for outdoor settings. The environmental context played an important role in user experience. It affected the use of multimedia in outdoor settings in conjunction with user characteristics, such as residence, language skills and familiarity with technology. These issues would not have been possible to identify in lab tests. Moreover, it is relevant to mention that this research focused on user's characteristics and those tailored the application was tested. For instance, the use of subtitles/ transcriptions with audio and video files assisted international users to better understand the content in noisy environments. Requirements were confirmed during this last research stage and turn out to be some recommendations to develop future mobile guide apps.   More requirements might emerge if this research methodology were applied in a different setting with other user's characteristics. In diverse outdoor settings, such as Zoos or public parks, might appear, for example, requirements about how children or elderly people interact with mobile devices to consult information. Therefore, this research has the potential to be extended in the future, in other cultural and tourist settings.

This study served the base to build a framework of elements identified that influenced the user experience when visiting historical places in outdoor settings and a toolkit with a list of recommendations to help designers developing multimedia outdoor mobile guides. As this work described, the full list of recommendations is part of a PhD research named as Design for Outdoor Mobile Multimedia: representation, content and interactivity for mobile tourist guides, approved in March 2012.

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