Analysing the experience of being guided by a mobile guide app

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Resumo

Este trabalho é parte integrante de uma pesquisa que objetiva identificar e gerar recomendações para o design e desenvolvimento de guias multimídia móveis para o uso em espaços abertos. Além disso, a pesquisa pretende aprimorar métodos de coleta e análise de dados adquiridos em pesquisas de campo com visitantes de espaços culturais ao ar livre. Este artigo se concentra em como turistas se comportam e que tipo de informação eles requerem usando telefones celulares que identificam a localização do usuário. Doze participantes fizeram um pequeno tour seguindo um aplicativo que descrevia os monumentos da cidade de Brighton, Inglaterra, em campo. No total, 57 requisitos para o aprimoramento desses tipos de aplicativos foram identificados, cobrindo assuntos relativos ao uso de ferramentas multimídia, contexto e conteúdo. Mais ainda, o estudo proveu insights em diferenças culturais; colaboração, influência da tecnologia e linguagem; e fatores ambientais.

Palavras-Chave: Mobile design; MobileIHC; Design de Interface.

Abstract

This work is part of a study to deliver design guidelines for developing outdoor mobile multimedia guides and refine methods to collect and analyse data from field work with visitors of cultural heritage settings. It concentrates on how tourists behave and the kinds of information they require in location-based contexts with mobile guides. Twelve participants took a tour, making use of a mobile guide app describing monuments in Brighton, England. Overall, 57 recommendations for improvement were gathered and covered issues of multimedia use, context and content. Additionally, the study gave insights into cultural background differences; collaboration; influence of technology and language; and environmental factors.

Keywords: Mobile design; MobileHCI; Interface design.

1 INTRODUCTION

There are currently a large number of initiatives in mobile technology related to culture and tourism (Cheverst et al 2000); (Krosche et al 2004) which have become an understandably popular domain for handheld information devices. Some mobile guides are designed for use in museums and indoor settings, and others are for use in restricted outdoor settings. For this work, the relevance relies on outdoor mobile guides.

Much recent mobile city guides research 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 in a particular point of interest. Additionally, location-based games show the history of a city in an entertaining way. In addition, Cell ID and Wi-Fi help to identify user location and enable context-sensitive information access . Sensors are employed to enhance the use of maps and the interaction of visitors with systems. 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. Overall, the application of technologies has to make sense and involve visitors culturally and historically. Therefore visitors and residents might experience, entertain themselves and learn more of historical cultural places.

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. Hence, principles to develop those mobile interfaces are essential to guide both designers and cultural heritage professionals. A number of projects have concentrated on guidelines to develop mobile systems. For instance, a framework to support different application scenarios for map-based city routing was developed by (Grun 2005). Additionally (Savio& Braiterman 2007) display 10 heuristics for mobile interactions considering the human and devices limitation arising from the context of use. Likewise (Paay & Kjeldskov 2007) created a method for providing mobile system designers with

knowledge about elements in the user's physical context, so that information which already exists in the user's environment can be indexed into the mobile interface. Applied to mobile learning settings (Grasso & Roselli 2005) developed guidelines for designing contents and courses on mobile devices. Similarly, (Damala 2007) brings a new perspective of designing mobile guides based on museum learning theories and object oriented learning in museum settings. All of these perspectives are of major importance; however, there is a lack of studies of how people interact with representations of content on the mobile screen, in different contexts.

For this reason a series of design activities were undertake to uncover how users interact with representations in outdoor cultural settings. The first study focused on observing group of visitors being guided for a human tour guide (Candello & Pemberton 2008). The second aimed to examine users following a paper based guide (Candello & Pemberton 2011). And the third study, the one that is described here, concerned visitors exploring the monuments of a city through a mobile application. The overall design activities assisted in collecting requirements to develop a mobile prototype guide and generate design recommendations for developing such systems.

This paper describes the experience of twelve users of diverse nationality using a mobile app (Wikitude) to explore monuments in the city of Brighton, UK. It presents the findings of a study concentrating on the impact of the use of mobile technology on the visitor experience.

2 BRIGHTON SCULPTURE TRAIL – MOBILE PHONE STUDY

Twelve participants from diverse nationalities and backgrounds took a tour, using a mobile phone app with multimedia content. The tours took place during the autumn of 2009 in Brighton. The average age of the participants was 20-29 years old. Some of them were accompanied on the tour by friends and children.

The aim of this study was to understand how the historic and cultural information was accessed in outdoor settings with mobile technology. Moreover, it aimed attention at the design of multimedia content, looking at the main benefits and drawbacks of its use. Additionally, results of this study were compared to a previous study with a paper based guide (Candello & Pemberton 2011).

2.1 METHODS

Even though a rich set of requirements were addressed with the paper-based booklet study (Candello & Pemberton 2011), an understanding of how people access

cultural information with mobile devices and an understanding of technical characteristics of this platform were missing.

Twelve participants aged from 20 to 49 years old took part in the field study. Two were UK citizens, the remaining ten participants from outside the UK (Brazil, Taiwan, Mexico, Finland, Sri Lanka, France, Ireland and Nigeria). Three participants were English speakers. Five of them had lived in Brighton for less than three months (considered visitors), five were short-term residents living in Brighton for about one year and two were locals. All the participants identified themselves as interested or very interested in cultural heritage artefacts. Ten participants had previous experience with multimedia guides, two participants used city guides and the remainder reported experience with indoor mobile guides in museums and galleries. Four of them mentioned they had never used a touch screen device and other eight had used it or had their own mobile touch screen phone. Seven participants were familiar with the HCI field and five of them were attending the module on Usability Evaluation at the University of Brighton, so might be expected to have a professional interest in the topic.

Content for the tour was created within a widely available mobile app, Wikitude, which delivers the functionality of attaching multimedia content to points on a map. The mobile phone app selected was Wikitude by Mobilizy[1] available for Android and Iphones. The majority of mobile map apps employ modes of interaction that are also available in Wikitude system such as: map, list (Sprice multimedia travel guides, Schmap, Frommer's and Lonely Planet) and camera view (Layers and Yelp) in order to show points of interest (POI). The content, in those popular mobile apps, is usually displayed with text and pictures. Some of the mobile guides available on the market have audio and video content. The Wikitude app was chosen because it incorporates all these possibilities to present and access information.

Figure 1 - Wikitude views

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1 http://www.wikitude.org/
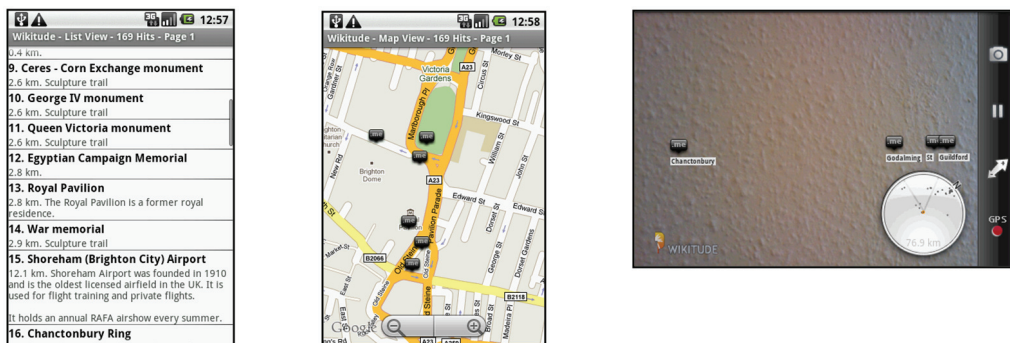
Additionally, adding information to the app was a smooth process. The content was added via the Wikitude.me[2] facility, where it was possible to tag points of interest and location-specific hyperlinked content on the Web. Users accessed the tagged content in the Wikitude app version 715[3] through the touch screen of an HTC Magic mobile phone. Users could also select icons using a scroll pad, although this was rarely used. The app was available for downloading without any cost.
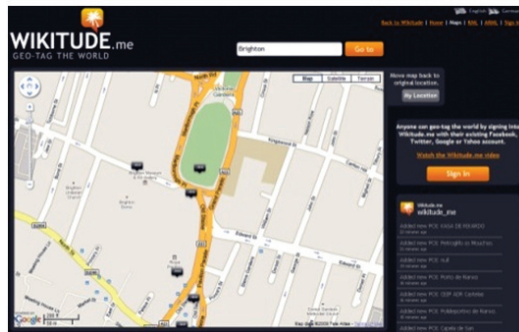

Figure 2 - Wikitude.me

The mobile trail was constituted by four POIs (points of interest). At the beginning of the session, an explanation of how to use the system was given to participants. The first POI information was used as guidance. In sequence, participants used the mobile phone to access the other three spots available. All the participants started the tour in front of the same monument.

The content for each point was displayed on a webpage containing the same information as the previous study with a booklet. For the first three monuments, visitors could acquire more information available on the Web (Wikipedia or Public Sculptures of Sussex website) and listen to a podcast. At the last monument the podcast was not available. Additionally, two other POIs were added to the map in case participants wanted to access them as they walked. These additional items were the Royal Pavilion and the Egypt memorial; they were linked to Wikipedia and Public Sculptures of Sussex website. Users accessed content by clicking on the icons displayed on the map, list or camera view.

2 http://wikitude.me/
3 Version installed in 14/10/09

Figure 3 - Content pages
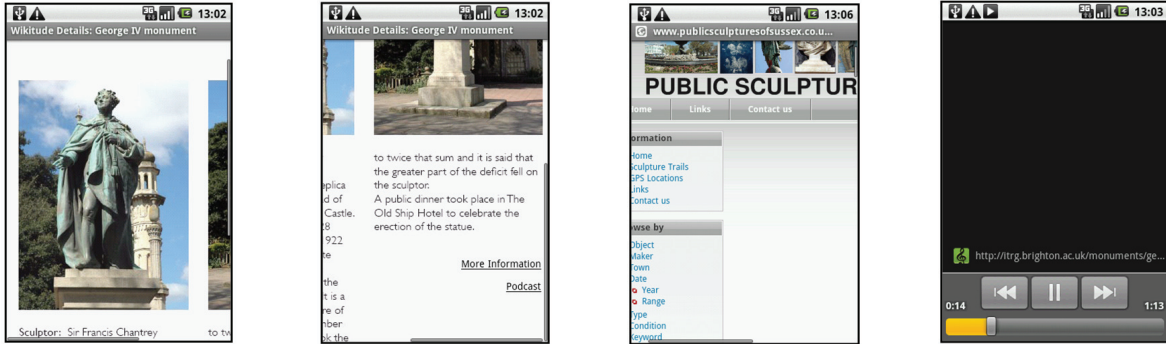
Participants were free to stop and gather information about any POI on the way. They were also asked to express their thoughts aloud as they proceeded (Think aloud technique). The length of the tour was on average 15 – 25 min. A video camera with a microphone was worn by the participant, attached to a baseball cap. After the tour, a questionnaire and semi-structured interview was conducted. Participants were rewarded with a 12 pound food voucher.

The questionnaire contained a mix of questions, including Likert scales, Semantic differential scales and System Usability Scale (SUS). The semi-structured interview contained four open-ended questions. Participants were given the choice of answering the questionnaire in open air places (square benches) or inside the Public Library of Brighton. The researcher made herself available to answer any questions participants could have during the tour and after the experiment. Besides, they were advised to include any information that they thought relevant to report in the questionnaire.

Figure 4 - Participant doing the tour with the Wikitude app

2.2 Data analysis

Video observations, questionnaires and interviews were the resultant data. The data analysis was also based on the categories uncovered in the previous study with paper based guides. Although the emergent categories had similarities to the prior study (Candello & Pemberton 2011), the interaction between users and informa-

tion source (mobile phone) resulted in new insights and requirements for developing mobile guides. A pilot analysis session was settled with usability experts in order to discuss the validity of preliminary findings and guide the process.

2.2.1 Pilot analysis session

A pilot analysis session was undertaken by three usability experts[4] once all the tours have been conducted. The aim of this meeting was to guide the observation analysis. Accordingly, the tour selected for the session was one in which participants visited all the points of interest and followed the Think aloud technique. The participants in this tour were aged 20-29 years old, students and had lived in Brighton for less than three months.

Usability experts were asked to take note of user frustrations, positive and negative comments, wayfinding and content issues and/or other behaviours that would call their attention. Significant points included:

- Traffic safety – warnings of traffic safety should be recommended to users before the tour starts. The consent form should have warned participants of traffic risks. Once in a while, they crossed several dangerous roads and did not respect the signs.

- Own phone – it would be interesting to have participants familiar with the type of phone used in the study and examine if the problems that appeared are related to the Wikitude app or because they are not used to the phone.

- Language – none of the participants in the tour pronounced the name of the last monument "Ceres". It could indicate they did not know how to speak it, or were afraid to commit mistakes.

- Podcast – participants looked for podcast in every monument that they visited. Some POI did not have a podcast available, which resulted in user's frustration and waste of time attempting to access it. They sought for short podcasts as well.

- Information at your finger tips – participants accessed the information available for them during the tour. The advantages of having information any time they wanted to consult it was noticeable.

- Immersion – The focus of attention was sometimes on the attributes of the device and not on the surroundings. A participant was looking for a sculpture in the tour. She passed beside it and did not notice the sculpture be-

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4 Marcus Winter, Richard Griffiths and Lyn Pemberton.

cause her attention was on the phone screen. An alternative might be to have less information on the screen, making the participants more aware of the area. The podcast was a good example: it directed those users to the context as their eyes were free.

- Imagination and interest – The content should engage the imagination. In the opinion of experts, the system should give a small amount of information and if it is requested provide more. The system also should lead users and tell users things that are interesting. For example, it might give links among monuments, such as the relation between George IV and the Pavilion and his love life.

Those points were considerate in the subsequent data analysis.

2.2.2 Findings

The preliminary expert analysis highlighted major and general issues to guide the analysis. However, observation of details and focus on participant's behaviour and speech were employed to provide a better view of their experience. Categories employed on the previous study with paper based guides, served the foundation for this analysis as well. Major attention was given to multimedia features on the screen and how users interacted with them. The Interaction perspective was focused on the overall behaviour of participant while they navigate in the space. Additionally, this perspective covered environment elements that possibly disturbed or interfered with their access to information.

The major focus of this analysis remained the ways information was displayed on mobile devices to help users to access the content. Consequently, the attention was not on how users find their way, but how the multimodal interface and context led them to engage with POIs and content displayed on the screen.

Presentation, Context and Content were examined through the interaction perspective. The Presentation category is here labelled Look and Feel due to the nature of information source. Participants used their senses of touch, hearing and sight to navigate with the mobile device app.

In the same way as the previous study, issues were identified and rated according to the occurrence in the tours. Additionally, requirements for improving or supporting these issues were generated.

A) Look and Feel
Presentation of the elements on the screen played an important role during the

tours. Haptic technology, the sense of touch, was also a crucial element in the user's interaction. Graphic and haptic issues were found here with the aim of gathering requirements to improve the experience of users. Organization of the information on the screen and audio features were also covered. Quotations of participants are formatted in *Italic*.

a) Text and Typeface

Most of the participants found the text length not too long to read and the type size readable. Participants read much less text on screen than in the paper based experiment. Nearly all participants were distracted by the technology and their primordial goal. At least for most of them the primordial goal was to find the monument and not to access the content. While they accessed the text page, they scrolled the pages to see what was available and did not always read the whole text.

> *It shows like the details of the place when what I want to know is how to get there first. International/ Short term resident*
> *I'm just reading relatively quickly. So it's First World War. Visitor*

The only participant who found the text too long also found the type too small to read. It was a local, 40-49 years old, accompanied by children. In the video observation, it was apparent that the focus of attention was not just on the text but also on the children. Interruptions in the reading occurred, making it difficult to return attention to the text.

Another clue that the majority of participants did not read all the text was noticed when they were accessing the information about George IV. The text in the first column was cut out; it was a display error, but only few participants noticed it.

> **Issue: Participants did not read the whole text on the main page. S/E
> *********
> (R01) The system should display brief information of POI and display possibilities to access extra information.
> Issue: Participants appreciated to have more information available in hyperlinks. *******
> (R02) The system should display possibilities to access extra information.**

Only three participants agreed that the type size was too small to read. Two participants were over 40s and all them worked or had background in the graphic or/ and interaction design sector. Therefore, it was not clear if they really found small the type size or if they were concerned at how others would read that. Some of them men-

tioned that it would be harder for elderly people to read it. They also expected to have possibilities to change the type size. During the tours some of those participants tried to make the type size bigger pressing on the zoom button, which was not working in this section.

> *If I zoom in (he clicked on the magnifier button) this is not zoom in this is search interesting. Ok. I would like the text a little bigger but I can read. I can't read the bottom of the text the last line is cut. Local and expert in HCI*

Participants also found difficult in identifying the icon labels in the camera view mode. The type size was smaller than the one displayed in the text and the list view. Additionally, interference from the background made it even harder to read the characters on the screen.

Issue: Participants tried to zoom in the text. S/E ***
(R03) The zoom function should be working in all sections of the system.

Issue: Participants identified the type size in the camera view mode small to read. S/E ***
(R04) When the background is in movement, tests are necessary to identify what is the preferable type size for users.

Figure 5 - Example of camera view mode

b) Hyperlinks

Two links were present in the system: "more information" and "podcast". Podcast is discussed as the next topic. Seven participants marked it as essential to have a "more information" hyperlink. Users also appreciated the presence of this link, even if they did not use it. In their opinion, it gave credibility to the system having extra information.

This link retrieved WebPages not designed for mobile phones which caused a bit of frustration in certain participants. For this reason, participants enjoyed the pictures on the web sites but did not engage with the content. Additionally, participants

identified the information displayed on the Public Monuments of Sussex website as being very technical.

> *It is a big of scroll down I'm not sure why there is this big place here. Why you can't have in that side, it is most like you don't know if it is loaded or not. Ok I know what that is I'm not looking to the right thing. Ok. This is not exciting info to watch back. Why is it an obelisk? It is an obelisk because it was done in the Egyptian Campaign I understand. Information seems quite a technical; it is like I'm reading a manual. It is not singing to me. Perhaps more narrative will be more valuable. I'm kind of not interesting on that. It must be presented in a more natural narrative sentence.* Local is accessing the webpage of Egyptian Memorial.

> **Issue: Users were satisfied to have links to access more information about the subject. S/E *******
> **(R05) The system should have more information of the subject in case users want to know more about it.**

> **Issue: Participants did not engage with technical information about the monument. S/E ******
> **(R06) The information should be displayed in a more narrative way. ***
> **Issue: Participants had difficulties to navigate on websites not tailored to mobile phone displays. S/E ********
> **(R07) When displaying websites on the app, a mobile version should be available. ****

The label "More information" created misconceptions. In wayfinding situations, participants clicked on this link to get directions. In addition to this, any time they were looking for something, such as podcasts, they accessed it. The context indicated and gave meaning for the label (more information). In order to avoid misunderstandings the name of the link should be clearer, or the system should identify in which situation the user is.

> **Issue: The label "more information" caused misunderstandings. S/E******
> **(R08) The system should be sensitive to user context.**
> **(R09) The links should have clear names according to their function.**

c) Podcast

Podcasts were available for participants to access on the app. The audio files were extracted from a podcast available on the website VisitBrighton[5]. The podcast was an informal conversation about the POIs and it was recorded in outdoor settings.

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5 http://www.visitbrighton.com/site/maps-guides-and-interactive/podcasts

Participants largely appreciated the presence of the podcast on the system. They mentioned it during the tours and in the questionnaire. Additionally, there was clear evidence that they were interested in accessing the podcasts. For instance, in some monuments there was not a podcast available and they looked for it, which caused disappointments. Participants accessed the podcasts in front of the monument, but also used the time to walk to the next monument and the waiting time at the traffic light. None of participants questioned the label "podcast" as well. This was a sign this concept was internalized.

A substantial difference between non English speakers and native speakers was identified. Long-term residents, most of them from England or English speaking countries, appreciated the idea to listening to two people talking in the same podcast. In the questionnaire answers, five internationals rated this podcast as useless. Those users had problems with the structure of the podcast, language and background noise. It could be said that participants familiar with the language were less susceptible to the noise of the environment (traffic, people talking on the street) and understood the speakers better. Internationals suggested having one speaker in the podcast. Audio files should be recorded in a studio and be more formal. In their opinion, it was difficult to understand one of the speakers already, and even more when the other replied demanding more attention and focus on the task.

The audio guide was like a debate, a TV show. I'm not there to watch; you have to be relaxed to listen to that. You need someone to give an idea. I was very distracted by the audio, because it requires effort to listen and pay attention. It has to be something that does not interfere in the experience. International related her experience in the questionnaire.

I don't know why there are two persons speaking in the same time, it is quite hard to understand. Maybe I prefer one person to speak and to have more details with one person, one voice I prefer that. Because of the noise of the road it is hard to understand everything so I prefer one person to speak. International visitor

Issue: Internationals had difficulties to understand the podcasts. S/E *****
(R10) The audio should not demand so much attention of the user in outdoor settings.
(R11) The audio should be recorded by one speaker and in a studio. ***
(R12) The system should display different language choices. ***

The screen was black while the podcast was playing. This was done on purpose, in order to identify user's attention to monuments. It was not expected that sever-

al participants would focus their attention on the screen while listening to the podcast. Moreover, they proposed possibilities to see visual information on the screen while the audio was playing.

Several other suggestions were made about the podcast format. Some wanted the podcast in other languages, while others suggested having more podcasts. In the context of the experiment, it was not considered necessary to provide the audio in different languages. International participants were in Brighton to learn and improve their English skills. In a context that does not privilege language learning, this recommendation might be necessary. The second suggestion was to have different podcasts organized by theme.

Let's check the podcast. This is the left one. I don't know if all they have. There is no picture anything. For tourists if it is not your natural language it is very difficult to understand. Too quick for many people, it is like a conversation. You have the other voice behind and it is low. We have just only one set (headphones). You could have this in other languages. Traffic noises… Sometimes you cannot listen because of the traffic. It is a nice idea though you can only read but just listen. You could be walking and listen. You should have for two people (headphones). Like a split. International and short-term residents were discussing about the podcast.

Issue: Participants looked at the screen while the audio was playing. S/E *****
(R13) The system should display visual information on the screen while the podcast is playing. **
(R14) Information should be displayed on the screen in order to incentive users to look at/ touch the monuments.

The participants who made the tour in company complained of the volume of the audio, mainly because they had to split the headphones. Consequently, the noise from traffic and density of people disturbed even more the experience. They also more often felt the lack of volume controls on the screen. Additionally diverse participants pressed the podcast link and then the podcast started playing immediately, not allowing them to put on the headphones before listening. One alternative could be to press on the podcast link and then select play when they are wearing the headphones. More tests are necessary to confirm this situation.

It automatically started it is kind of frustrating so I plug in and if I knew I would set up the volume out. Let's start again. Is there any volume control? Yes, this is quite gathering. This is the kind of narrative that I'm up into. I probably even not click for more info I might read that introduction page and click on the podcast particularly if I listen to it, more engage it is just 2 min long I quite like this. I quite like the way that they talk and give me some context about. That's quite good. Native speaker

Issue: Participants with company had problems to listen to the podcast with one pair of headphones. S/E ***
(R15) Users with company should use different devices or the system should advise in the beginning of the experience the necessity of two set of headphones to follow the tour.
(R16) The system should allow users to see the transcription of the audio on the screen, in case they cannot hear it because of the environment noise.
(R17) Volume function should be available on the screen. **

Issue: The audio file started before participants wearing the headphones. S/E **
(R18) The podcast should not start playing before users press play. *
(R19) Users should be advised to wear the headphones as soon as they access the audio page.

d) Pictures

Overall participants agreed that the pictures were useful to identify the POIs in the study. It was also apparent in the video observations. Besides, pictures helped short-term and long-term residents to remember where monuments were located. The background of pictures showed nearby monuments and context, hence, it also helped them to localize themselves.

> *I see the monument. I got here because I know my way around and because I know the pavilion and you can tell from the picture that it is close to the Pavilion. Short-time resident*

Issue: Pictures assisted participants to localize monuments and themselves in the environment. S/E *******
(R20) The system should have visual information that provides clues where the monument is; e.g. visible background showing elements around it.

The interest for pictures was not only way finding, but also better visual access to the sculpture details. Eight participants stated the pictures helped them to see better the details. Four disagreed. It was observed that those who disagreed seemed to interact more with the environment and monuments. They more often got closer to the sculptures. Certain participants were immersed in the experience of being guided by a mobile phone. On some occasions, pictures substituted for their interaction with real monuments. Very often they looked at the pictures on the mobile phone and did not get closer to the monument or even notice the real monument. In the case of the Corn Exchange, certain participants found the place, knew that the sculpture was on the façade and did not cross the street to see it. Sometimes the monument was hidden by vehicles parked in front of it. They were satisfied by seeing the picture on the system.

Where is the sculpture? Ah we can't see - Big bus. We can see the picture anyway Visitors
I can see Corn exchange in front of me because of the sign. I haven't seen the real sculpture. I was interested in getting there and I got here. Short-term resident looked at the picture to make sure she was in the right place.

The ones that found useful to have pictures to see details were a little frustrated with the way the pictures from the websites were displayed. The pictures were cut out or not easy to find on the screen, unless users scrolled the page. Those participants also suggested how they would like to see the pictures:

The page is not well designed because the photos are out of the page. It is strange to take some info here. Visitor

I would like to see the whole picture. One picture per screen but it is like easy enough to say that I'm in the right place. This info is more nicely laid out than when I was back to Egyptian Memorial (website) that *info was a little bit like statistical, this is more interesting to read ... Ok. Local*

Issue: Pictures assisted participants to see details of the objects. S/E ******
(R21) The system should provide pictures of the monument.**
(R22) Users should be able to zoom in/out the pictures

Issue: Participants looked at the pictures and not at the real monuments. S/E ****
(R23) The content should engage the visitors with the monuments, not substitute the experience with the real object.**

Issue: Pictures were cut out on the website screen. S/E *
(R24) When displaying websites on the app, a mobile version should be available. ****

Moreover, the pictures helped participants to know what was inside the buildings. Participants who did not know or visit the buildings before were more excited about it. Others who knew the buildings did not accord much value to those pictures.

It is beautiful! Oh! Yeah! Impressive! Visitor looks at the pictures inside the Pavilion. Pretty nice pictures you can see the inside of the Royal Pavilion. It is good I didn't pay to visit. I'm zooming in the internal picture of the monument. It is very beautiful. I will check other details, maybe history… Visitor

Issue: Participants were curious to know how is inside the landmark buildings S/E ***
(R25) The system should add new information to the experience, such as pictures of inside the buildings.**

Sometimes participants touched pictures on the screen and the system started loading the same image bigger, making them wait for the download.
I accidently press on the picture. It is open now ahhh… I go back. Visitor

Issue: Participants tap the pictures displayed on the screen by mistake. As a result a large version of the picture opened. S/E * (R26) Users should be able to control the zoom function.**

Participants did not often take pictures with their cameras of the monuments they visited. Only two visitors took pictures of the monuments in the tour. It might be because the sample used in the study was composed of long term residents, short term residents and visitors in the city for three months, rather than short term tourists. Those participants had opportunities to see points of interest another time, as they were not in the city just for the day.

B) Context

In this section we discuss elements that had an effect on the interaction of the user with the device. Characteristics of the system, environment issues and participants collaboration during the tour are taken into consideration. Most of the time participants were immersed in the experience and did not engage as expected with the monuments. In addition, participants accompanied by families and friends collaborated to find the monuments and interacted with their surroundings more often.

Not all the participants had used touch screen devices and the Wikitude app before; as a consequence they learnt how to interact with those technologies on the tour. The System Usability Scale was applied to obtain feedback on the strengths and drawbacks of the mobile device and application. The system had three ways of accessing information on the screen: List, Map and Camera View. Participants used the map to locate themselves in the environment, the list view to identify the monuments around them and the camera view was not frequently used.

The weather was also an issue; it was a little cold and raining on most of the days. The tours happened when the autumn started, and not everybody was properly dressed for the season. Besides, the urban noise and traffic issues also made the experience less of a pleasure.

a) Immersion

The use of a mobile device to show points of interest in the city was an artefact that required visitor's attention to interact with. They explored less the environment than in the paper based study. In the previous study, visitors touched the monuments, shared their ideas and opinions about the content and also read the text more. Some of

those issues appeared in this study but at a much lower scale.

Participants taking the tour alone rarely took their eyes from the screen. They used the app while crossing several roads. They passed by target monuments without noticing them. They bumped into others citizens on the sidewalk. And finally, after finding the monument, they looked for the next one without offering the deserved attention to the current content.

It is true that information displayed in the app did not invite them to offer more attention to POIs and explore the surroundings. Consequently, they did not engage with public monuments by themselves. This is also discussed in the Pictures section.

Nowadays, there are huge possibilities to employ multimedia information on mobile device apps. Information multimedia design for this purpose should be presented to attract and engage visitors. It should be projected for interaction with the real world artefacts, and not keep user's attention only on the screen. Some participants also noticed this drawback:

> *I think you can get lost with the information rather than you engage with the buildings. […] You actually miss a lot of stuff. You know what I mean. You keep looking at that (mobile) you try to get this sorted out and you miss the rest. Of course it would be different with a town that we don't know of course we saw this already. Quite nice thing I think is the podcast you can listen for the stuff. But that is also one person kind of thing. […] It is like a quite impersonal way to see a town in that way. It was what I was thinking you don't really engage town. You get very lost in that thing (mobile). Too surfing… Residents discussing about the mobile device*

Issue: Participants were immersed on the digital experience and not engage with monuments and surroundings. S/E*********
(R27) The system should engage users with monuments and history.

b) Company

When participants were accompanied by friends or children, two situations occurred. Firstly, the person holding the mobile phone read the text aloud and gave directions. The other person listened and gave comments. Secondly, both looked at the screen and read together the text in silence. It was noticeable in both situations that these participants paid more attention to the content than the others who did the tour alone. Likewise, they collaborated and interacted with the system more often. Consequently, they gave more feedback and suggestions to improve their experience.

Agreements were necessary to move forward and satisfy all participants taking the tour together. Certain tasks were cumbersome to achieve, listening to the podcast with one pair of headphones for example. It was common to see participants tap-

ping the screen while their partners were holding the phone. Typically, they helped each other to localize themselves and find certain features on the app. This attitude sometimes restricted the interaction freedom of the ones holding the device.

Participants accompanied by children also found it difficult to follow the tour and concentrate. This did not occur so often during the booklet study, in which participants had a more established division of tasks and the information source was not interactive. It is not possible to affirm whether participants would have the same drawbacks using their own phones.

Issue: The system was not so attractive to children. Parents were not able to focus on the activity. S/E*
(R28) The system should have activities, or questions that provide engagement between parents and children.

c) Learning the system

The majority of participants had used touch screen devices previously. Four in twelve had never used this type of device before. At the first monument, as mentioned before, a short explanation was delivered about the main functions of the device and application. Participants with previous experience with other devices asked more for clarifications of app functionality.

In order to gather feedback of the device and application we employed the System Usability Scale (SUS).

While answering the SUS questions, non-native English speakers misunderstood certain words such as "cumbersome". Six users asked for the meaning of this word. The same issue was pointed out by Finstad (2006), who replaced this term for "awkward". It is advisable to change this term in future tests.

A study that looked at overall usability in mobile phones found the total mean score as 65.9 in 372 surveys (Bangor et al 2009). In this study the overall score was 62.71. Therefore, the score indicates marginal acceptability. As a result, it was possible to identify relevant elements to improve the experience. If the system is not acceptable or has low acceptability by users, technical and usability issues might suppress other relevant issues to enrich systems.

With regard to the device, several participants had problems with the location of the volume button; it was placed on the side of the android HTC phone. Users constantly pushed it by mistake, mainly in situations where they turned the screen to landscape. Users of other touch screen phones (e.g iPhones) had certain difficulties in understanding how to interact with the Android phone in the beginning of the tour. This issue appeared when they used other modes of interaction, such as zoom in/out the screen.

The screen is not so sensitive you have to press the button to zoom in I prefer to use the finger, like in the Iphone to zoom in. Participant with previous experience with Iphone device

Issue: Participants familiar with other kind of devices had problems to learn a new mode of interaction. S/E***
(R29) Consider previous user's experience with touch screen mobile phones. Use modes of interaction that may be intuitive for a wide range of users.

Issue: The result of system usability scale (SUS) answers was in the marginal acceptability. S/E***********
(R30) When testing apps with users, designers should consider solving usability and functionality crucial problems. Therefore, new interesting issues might emerge from the user tests for improvement.

d) List

In the list view, the information on how far the monument was from their location was displayed in a linear way; the closest monument appeared in the top of the list. When they tapped on the name of a POIs that was part of the tour they saw its content and the picture. Additionally, they observed the list view in order to see how many points of interest were available in the tour and which one was the next to visit.

I thought that it would be like a tour that tells you what to do next. Me too - You can even have a little tour there like you would use or not, but you know. Short-term residents

I'd like to know which sculptures I have to find. From the map I don't know which ones I have to find. Now I'm waiting for the list and it is coming out. Ah Ok. Now I have to find 4, 5 and 6. Short-term resident

Issue: Participants found valuable to know how far the monument is from their current location. S/E******
(R31) The information of how far the monument is essential. The system should show closest monuments to participants in an ascendant way when a list view is available.

Issue: Participants used the list view to access the next monument information. S/E*********
(R32) The list view is essential to make participants aware of how many monuments are around and to access content.

Issue: Participants expected to be guided by the system. e.g. A linear tour. S/E****
(R33) The system should provide a linear tour.

e) Map

Eight in twelve participants found it easy to find the monuments in the tour. Participants used their previous experience of the city, environment signs and distinct modes of interaction. The modes of interaction provided by the system were: map, list and camera view. The most used mode to help in wayfinding was the map. Not all the participants identified the POIs on the map easily. The answer to this question was very diverse. Users with previous experience with touch screen devices and Google maps identified the POIs more easily. On the other hand, three participants who found it trivial to identify the monuments on the map disagreed that it was easy to identify how far they were from where they were. Not all participants used the scroll pad to select their targets. The ones who used it saw a white balloon with the name of the monument and the distance they were from it written down. These participants appreciated knowing how far the monument was on the map screen. The others were not aware of it. In the list view this information was clearer and easy to access; consequently participants consulted the list view more often for it.

> I can walk I can see that I'm getting closer to it as well in the map. It was 0.3 km and now it is 0.1km. So I suppose I'm getting closer. I'm going to the list so ok the George and the Queen is getting closer as well. Participant identified how far she is from her target.

Unlike what happened when they accessed the list view, participants were not satisfied at seeing the POI content when tapping on the icon labels. They usually looked for directions when pressing on the map icons. This situation occurred mainly with the short term residents.

> *I want to go to Queen Victoria monument.* She presses the balloon in the map and says *it is like 2min away from here and I'm…* Presses the balloon once more by mistake *Ops!* She goes back to the map. *You see when I click on Queen Victoria monument actually show me information about it. And with this Egyptian it didn't show me anything. Short term resident was looking at the map.*

> **Issue: Participants expected to be guided by the system. e.g. linear tour. S/E******
> **(R34) The system should provide a linear tour.**

> **Issue: Participants looked for directions on the map. S/E*************
> **(R35) The map should display a way to retrieve directions to go to a point of interest.**

Not everyone who did the study found maps easy to use. Recent residents could not identify distances on the map readily and interpret the units. According to a

field study by Vertesi (2008), users found it easy to use the London underground map because they identified which station they were at and where they wanted to go. They also saw the trajectory between these two points in simplified lines and colours. Participants on the mobile app study felt the lack of a trajectory traced from where they were to their destination. Their expectation came from familiarity with other way finding systems , such as Google maps and mobile maps.

I don't know some sort of guide of how to get in would be useful I guess like you are in a certain place exactly, so ok, you select where you want to go show me the route. It might have one I suppose I don't know. Ok says 1.2 km can I click on it? It just gives me the details. Local
Issue: Participants were lost and expected to have a way to consult directions to their destination from where they were in the map. S/E*******
(R36) The system should provide a trajectory traced from the current location to the target location.

Participants really appreciated the GPS technology present in the app. This made it possible to identify on the map their current location represented by the icon "You are here". Ten users found this icon on the screen helpful . However, they noticed an update delay in displaying their current location.

Issue: Users found helpful the icon "You are here". S/E**********
(R37) Icon "You are here" is relevant to show user's current location. It should be updated regularly.

The icons added on the wikitude.me system by the researcher had the same graphic – a balloon with dot me. Consequently the identification of POIs at first glance was not straight forward . Participants had to select the icon to identify the POI, which caused disappointment and resulted in complaints. Moreover balloons with the name of POIs prevented users viewing what was around of their target in the map.

The map is a bit confusing I would say. Because it shows me a bunch of me me me (very upset) *and when you click on one thing It shows like the details of the place when I want to know how to get there first.[…] I can't really understand this map to many things like me me me together – Short term resident*

Issue: POIs had similar graphic and shape (.me) on the map. Participants had to select them for identification. S/E*******
(R38) If POIs are illustrated in a map, they should be displayed in different colours or/and shapes for users identify them easily.

Issue: The icons and labels covered the map, making difficult for users identify their way on it. S/E**

(R39) When open overlays on the map don't hide the surroundings it is cumbersome for way finding.
(R40) Users should be able to open and close overlays (icons/labels of the monuments) on the map easily.

Furthermore, the map displayed some POIs that were not part of the tour, such as: Brighton Dome, Brighton Museum and a plaque in front of Queen Victoria. Links were not available; however, participants thought they could access it. This resulted in frustration and waste of time looking for those POIs and content.

Issue: Participants wanted to access information not available in the app of monuments on the way. S/E******
(R41) The map should display only the POIs for a particular tour, or have information available for the attractions on the way.

f) Camera view mode

The novelty of the augmented reality application and how participants interacted with it brought some issues to be considered when choosing modes of interaction. Seven in twelve participants used the camera view mode to find their way. Most of users found this complicated to use. They were first time users and were figuring out this functionality. None of the participants adopted the camera view as the unique tool: they utilized the list and the map together. It was not easy to identify the POIs in this view, as well the directions. Likewise in the map, icons were displayed in the same format ".me". This made the identification of POIs difficult. Besides, this mode displayed the name of the monument only when participants tap on the icons. As participants moved through the environment, the non identifiable icons moved on the screen. Consequently every time they looked at the screen while in movement the icons were displayed in other spots. When they were in front of the POI, sometimes the camera view mode did not display the respective POI they were in front of. Additionally, it was noticeable participants were more immersed in the experience when using the camera view mode. Even though they could see the environment through the screen, they did not notice what was around them, traffic lights for example. Very few participants (2) used the camera view for way finding. They realized the icons on the screen where moving according to their location, so that when they were getting closer to their targets. Respective icons were shown bigger on the screen. Others identified all tagged POIs on the screen, which gave a sensation of awareness and control. Suggestions of how they would like the elements on the screen also came into sight. For instance participants suggested they would prefer to see the content projected on their view through the screen instead of POIs pictures.

Issue: POIs had similar graphic and shape (.me) on the camera view. Participants had to select them for identification. S/E***
(R42) If POIs are illustrated in a camera view mode, they should be displayed in different colours or/and shapes for users identify them easily.

Issue: The camera view did not show participant's current location. S/E***
(R43) An Icon such as "You are here" should be present on the camera view mode to show current location.

Issue: Participants found unnecessary to have the pictures of the monument in this view. They preferred to see the real POIs on the background with content. S/E***
(R44) The content should be displayed as an overlay on the camera view.

Issue: Icons moved according to participant's steps. It was not easy to identify their destination point. S/E***
(R45) Participants should be able to control the elements on the screen and return to previous state of the system. e.g. identify where they started and where they are going to.

Issue: Participants used the camera view to see which monuments were around them. S/E**
Issue: Participants identified where they were getting closer to POIs in the camera view. S/E**
(R46) The camera view mode should offer an overview of POIs in the tour showing them closer to user's location.

Issue: Participants used the map and list view to support their interaction with camera view. S/E*******
(R47) The camera mode is a very abstract mode for way finding and not easy of comprehension for all participants. It should be supported by other modes of view.

g) Environment

Not all participants mentioned the interference of weather and environment conditions in the tours. Only five participants marked on the questionnaire that weather, traffic and noise had an effect on their experience. Others, once in a while, verbalized their complaints during the tours. It was possible to identify behaviours that occurred as a consequence of environment issues. For instance, they turned up the volume in noise conditions or were in a rush to finish the tour in certain weather conditions.

In some tours weather was not pleasant and it was cold and raining. Despite this, it was decided to keep the schedule in order to examine how participants would interact with the mobile phone in adverse weather conditions. Participants were without gloves and they tried to warm their hands in their pockets. In spite of that, partici-

pants who were cold accessed similar number of functions to others. Otherwise, they were faster, stay less time in front each monument and did not stop so often on the way.

> *I would like to know more about George (reads the text in silence and looks at Queen Victoria). Uau! Ok it is in 1928. I'm really getting cold. Do you have tissue? Visitor*

Unlike the experiment with booklets (Candello & Pemberton 2011), in this study participants were more careful with traffic safety. Seven participants respected the traffic lights and took advantage of the waiting time to read the text and find their way. However, few participants crossed the streets recklessly (3). Four participants identified traffic as a factor that made difficult to use the app. They complained of the number crossing streets and the traffic noise. The noise of surroundings disturbed users mainly when they were listening to the podcasts.

> **Issue: Participants that were cold did the tour faster stay less time in front each monument and did not stop so often on the way. S/E*****
> (R48) Information should be available on the system to be accessed after the tour. In case of environment conditions disrupt the experience.**

> **Issue: It was difficult to listen to the audio and focus on the text because of noise surroundings. S/E ****
> (R49) The system should display visual and verbal information, so that users can make their choices of which representation is suitable to environment and weather conditions.**

> **Issue: Participants crossed the streets without paying attention. S/E ***
> (R50) The system should advise users when is required attention to cross the streets.
> (R51) The route of the tour should privilege ways that participants do not have to cross several streets. It requires attention and accidents may happen.**

C) Content

Participants did not give substantial feedback in relation to content. They usually scanned and scrolled the text to see what was available. They spent more time looking for the places than accessing the content. The primordial questions were "what" and "where". The secondary ones were "who", "how" and "why". The necessity for the basic information after finding the target was apparent. Participants wanted to see this information in the first sentence they read, and most of the time the basic information was distributed in the text. Their level of attention was very low; some users were dis-

tracted by the technology and couldn't focus on the content. The novelty of the camera view was the main distracting feature in those cases. They moved their focus very fast to other tasks.

Sometimes, after reading or scanning the text they tapped on the "more information" link. It showed basic information works as an anchor to engage users and instigate their interest. Additionally, the system should allow participants to go further if they want to explore more the content in a clear way.

Why is it and obelisk? It is an obelisk because it was done in the Egyptian Campaign I understand. Information seems quite a technical; it is like I'm reading a manual. It is not singing to me. Perhaps more narrative will be more valuable. I'm kind of not interesting on that. It must be presented in a more natural narrative sentence. Long-term resident

Issue: Participants were distracted by app features. S/E ***
(R52) The basic information should work as an anchor to instigate user's interest.
(R53) The content should be able to engage users in the beginning of the text, because they might lose their focus of attention in detriment of the options available to interact with.**

Issue: Participants had to read great part of the text to find essential information in it about the subject (Who? How? Why?). S/E *******
(R54) Users should be able to see essential information straight away; consequently they do not have to search for it in the whole text.**

In the main text, participants did not find it interesting when the text described the monument and did not add any new facts to it. Otherwise, they appreciated it when relevant contextual information was presented, such as data, location and the meaning of some symbols. Contextual information provided by the surroundings called the attention of few participants. There was a plaque in front of Queen Victoria, which participants tried to decode while reading. It was not legible what was written down on it. A copy of this text would be useful to have in the app.

Issue: Some parts of the content described information users were able to see on the POIs. S/E *
(R55) The system should not display information that users can see anyway. It should engage users not describe what they can see.**

International participants who had lived in Brighton for less than 3 months, called here visitors, were unwilling to pronounce some words in the tour. It might be because they were not confident with their language skills and also because they were

being filmed. Additionally that they also did not know the meaning of some words.

Hehe George V, it is IV (starts reading). What does unveiled mean? Visitors

Issue: International participants did not know or where not confident how to pronounce certain words in the information system. S/E ****
(R56) The system should have available an audio sample of the text, or at least the name of the monuments. Hence, international users can learn to pronounce some words.
(R57) The system should have an audio glossary with words and meaning, just in case users need to use it.

3 Requirements gathered in the mobile phone based study

Some issues occurred more than once in different contexts. For example the need for the "You are here" icon was identified when participants used the map and the camera view. Others were related to single features, such as the requirement to have visual information on the screen while the audio was playing.

The issues with high score resulted in requirements to improve wayfinding (R37) and interface design elements (R20). Besides, several recommendations about modes of requesting information (R35 and R30) were also highlighted. The last requirements in this list (R24, R39, R40, R44 and R28) were specific to participant's context (with children) or mentioned by participants familiar with the HCI field. The latter group observed more functions on the app and spent more time doing the tours. Not always other participants noticed those issues pinned by them. Despite this, they were very relevant for improving mobile guide interfaces. In other cases, participants suggested requirements to overcome issues. (Table 1). Not only participants familiar with HCI issues, but also internationals (R11, R12) were in a majority in suggesting improvements.

Table 1 - Requirements suggested by participants

	1	2	3
R11	*	*	*
R12	*	*	*
R13	*	*	*
R07	*	*	
R24	*	*	
R13	*	*	
R17	*	*	
R06	*		
R17	*		

Table 2 - Issues by strength of evidence

	1	2	3	4	5	6	7	8	9	10	11	12
R30	*	*	*	*	*	*	*	*	*	*	*	*
R35	*	*	*	*	*	*	*	*	*	*	*	*
R32	*	*	*	*	*	*	*	*	*	*		
R37	*	*	*	*	*	*	*	*	*	*		
R01	*	*	*	*	*	*	*	*	*			
R20	*	*	*	*	*	*	*	*	*			
R27	*	*	*	*	*	*	*	*	*			
R54	*	*	*	*	*	*	*	*	*			
R21	*	*	*	*	*	*	*	*				
R22	*	*	*	*	*	*	*	*				
R02	*	*	*	*	*	*	*					
R36	*	*	*	*	*	*	*					
R38	*	*	*	*	*	*	*					
R47	*	*	*	*	*	*	*					
R07	*	*	*	*	*	*						
R23	*	*	*	*	*	*						
R31	*	*	*	*	*	*						
R41	*	*	*	*	*	*						
R25	*	*	*	*	*							
R10	*	*	*	*	*							
R11	*	*	*	*	*							
R12	*	*	*	*	*							
R13	*	*	*	*	*							
R14	*	*	*	*	*							
R15	*	*	*	*	*							
R16	*	*	*	*	*							
R17	*	*	*	*	*							
R48	*	*	*	*	*							
R52	*	*	*	*	*							
R53	*	*	*	*	*							
R05	*	*	*	*	*							
R06	*	*	*	*								
R18	*	*	*	*								
R19	*	*	*	*								
R08	*	*	*	*								
R09	*	*	*	*								

R33	*	*	*	*										
R34	*	*	*	*										
R49	*	*	*	*										
R56	*	*	*	*										
R57	*	*	*	*										
R03	*	*	*											
R04	*	*	*											
R26	*	*	*											
R29	*	*	*											
R42	*	*	*											
R43	*	*	*											
R44	*	*	*											
R45	*	*	*											
R50	*	*	*											
R51	*	*	*											
R55	*	*	*											
R24	*	*												
R39	*	*												
R40	*	*												
R46	*	*												
R28	*													

4 Discussion

The public who answered the study was very varied with diverse technology backgrounds, length of residence and nationality. This resulted in a rich set of data and reflected, in a small proportion, the kind of audience interested in using mobile guide applications in cultural heritage settings. The sample number was enough to trace participants' experience with mobile devices. In the later tours, the repetition of some issues was noticeable, showing that more tours would not add new findings.

The method of data collection using a head camera with microphone built-in was efficient. It focused on where participants were looking, their interaction with the mobile phone and surroundings. Participants felt less awkward about being filmed. The head camera was not in their sight, which resulted in a more natural behaviour in the tour. On the other hand, the presence of researcher, for traffic safety reasons, might have interfered on the results. Lone participants were more likely to welcome the presence of the researcher. For them, this made it easier to employ the thinking aloud technique.

The post tour activities, questionnaires and interviews, gave participants the chance to give their opinions and suggestions. The setting for answering the questionnaire was also an important detail. Participants who answered the questionnaire and interviews in public spaces were more dispersed. The ones who used the Public Library to do the post activities answered the questionnaires faster and had more comments about their experience. International participants had problems with some words, such as "cumbersome" present in the SUS scale. Pilot tests with non English speakers are necessary to avoid those mistakes.

The use of a scale rate in the data analysis gave credibility and assurance to requirements gathered. The level of confidence to employ those requirements with the paper based results is higher with this method. The same method was utilized in the prototype data analysis.

5 Conclusion

The field study emphasized issues of using mobile devices in outdoor settings. On occasion, the use of mobile devices distracted users from consulting information about POIs in the tour. They spent more time interacting with mobile device features than experiencing cultural heritage information. Several opportunities were opened up by this study for improving user experience with these devices: for example, engaging users with real objects. The podcast screen was a good illustration for showing how immersed participants were. Even though the screen was black, while audio was playing, participants fixed their gaze on it. In this case, the app should lead participants to notice more details about POIs instead. Audio or text instructions displayed on the screen might be a good solution to direct their sights to real objects.

The attention awareness was also identified as restriction in outdoor settings. Participants did not spend a great amount of time reading the texts and observing the sculptures. They sought for basic and brief information of POI. Hence, opportunities to use hyperlinks more often was offered to deliver extra information. Participants more interested in the content followed the hyperlinks available; this showed they did not have a problem accessing further pages. Pictures also intensified the experience, working as a fast tool for identifying POI location. Pictures of inside the buildings also pleased participants.

Another interesting point was remarked on by international participants. The noise of surroundings while listening to the podcast record disturbed them much more than UK residents. Additionally, internationals would prefer not to listen to a conversation about sculptures, but having one speaker recorded in a studio. More tests are

necessary to identify those preferences to deliver audio, because in this tour only three native speakers were participants.

It is also true that participants with company were in a more natural environment than lone participants. They followed the talk aloud technique simply by having a conversation with their partners. Besides, they gave more feedback and explored the app more thoroughly.

The most used view mode was the map, followed by list and camera view. Participants were more familiar with the map, and expected to retrieve clear directions using this feature. List was employed to see an overview of content available, and identify closer POIs by distance in numbers. The camera view was not so well received by users. It might be because it is a new technology users are not familiar with. Some elements in this view should be improved, such as the type size and visual graphic of icons. Users did not find it easy to orientate themselves consulting this feature.

In general, the use of the same information of the paper based study displayed by mobile phones did not enhance the content. On the contrary, participants were more focused in interacting with the app features to find points of interest than finding out about them. Some opportunities were found to improve and engage users with cultural heritage employing mobile technology. The content of a paper based guide has to be adapted to a multimedia perspective in order to add to, instead detract from, user's satisfaction and experience with cultural heritage content.

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