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APPLICABILITY OF MOBILE AUGMENTED REALITY USAGE AT MELAKA CULTURAL HERITAGE SITES

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ABSTRACT. Augmented reality (AR) technology may help the existence of cultural heritage sites to a better position by communicating the history behind them. With AR, visitors are invited to come, learn and enjoy at the cultural heritage sites. However, to date none of these sites in Malaysia provides AR application as a media although it has many potential benefits. Therefore, this study tries to promote AR usage at cultural heritage sites by examining the applicability of mobile AR usage at Melaka heritage sites. At first, such mobile AR application was developed, and then a user study was conducted by providing visitors with the application and questions to answer. The findings reveal that 90% of the respondents agree that mobile AR is applicable to be utilised at the cultural heritage sites. In conclusion, the findings provide evidences of the potential usage of mobile augmented reality at cultural heritage sites and give better visiting experiences to the visitors.

Keywords: mobile augmented reality, cultural heritage sites

INTRODUCTION

Augmented Reality (AR) is a breakthrough which contributing various fields in terms of technological changes. AR does not replace the whole environment but rather adds certain virtual object into the real world (Azuma, 1997). AR on mobile allows users to use AR anywhere and anytime (Höllerer & Feiner, 2004) using their mobile phones (Vlahakis et al., 2001; Zoellner, Stricker, Bleser, & Pastarmov, 2007). Mobile AR has been developed since 1997 by Steven Feiner which is named as the Touring Machine. Since that, mobile AR has developed rapidly in many fields, such as in cultural heritage, education, entertainment, construction, tourism, architecture, marketing, navigation, and path finding and geographical field work (Kounavis, Kasimati, & Zamani, 2012; Hakkarainen, Woodward, & Rainio, 2010; Höllerer & Feiner, 2004). In general, cultural heritage has six types of attraction: natural heritage (national parks, natural protected areas), living cultural heritage (fashions, food, customs), built heritage (historic buildings, monuments, ancient ruins), industrial heritages (textiles, coal), personal heritage (cemeteries, religious sites) and dark heritage (places of atrocity, symbol of death and pain) (Timothy & Boyd, 2003). All these heritages are important to be preserved before it gets decayed and extinct for future generations. In cultural heritage sites, AR may help the existence of cultural heritage sites to a better position by communicating the history behind the sites. AR is a good opportunity for sharing what cultural heritage sites have and invite visitors to come, learn and enjoy at the sites.

THE NEED OF MOBILE AR AT CULTURAL HERITAGE SITES

As time goes by, tourism has new changing needs especially the tourists themselves. They want to have meaningful experience however the standard package is not enough anymore for tourists. They look for something different which allow them to broaden knowledge. In cultural heritage sites there are many information displays that can support the learning experiences. Information displays consists of interpretive boards, booklets, maps, and books. However, these kinds of information displays are considered as "traditional information display" which give the short descriptions about the cultural heritage sites. For example, the booklets which are spread over at the information centre contain description about each site in the form of text and images, while the interpretive board contains only short profile of the cultural heritage sites. Maps and books are also provided which usually explain more detail about the specific sites. However, all these traditional information displays are not interactive and interesting for visitors (Seo, Kim, & Park, 2011). A brief description and few pictures are not enough to reveal the history of the sites. Visitors need more than that because they want to learn something while their visit.

There are many cultural sites which are huge and large. Tourists sometimes have difficulty to explore all the area. Obviously, they do not have any idea which one is more important to be explored. This is not efficient and unreachable (Fritz, Susperegui & Linaza, 2005) as they think they should leave the heritage site if they would like to get more information. Therefore, the current supporting technology for information display is an AR that enables users to have the virtual and real world experience at the same time and space in real time. With AR, visitors are able to understand the historical value since it enhances visitor's perception without distracting them from the real world (Vlahakis et al., 2001). Based on the user survey done by (Grafe, Wortniann, & Westphal, 2002) for Heinz Nixdorf Museum Forum in Germany about AR, 74% of visitors prefer AR based presentation over traditional presentation and 95% of visitors consider that AR can be used for other exhibits. Further, AR is suitable for cultural heritage due to its faster development, cheap cost and rich interaction (Noh et al., 2009).

RELATED STUDIES OF AR AT CULTURAL HERITAGE SITES

First project proposed by Papagiakannis, Ponder, Molet and Kshirsagar (2002) that reconstruct the ancient fresco-paintings in Italy by using the virtual simulation of flora and fauna (humans, animals and plants) in real time. The simulation involves a cloth simulation, facial expression and speech animation. Next, the 3D model of building reconstruction is presented in Augmented Reality based-Cultural Heritage On-Site Guide (ARCHEOGUIDE) along with the virtual athletes during the Ancient Olympic Games. While enjoying the open nature, tourist is able to listen to the audio description about the sites. It is also provides visitors with digital map of their current position and the next direction (Vlahakis et al., 2001). Thirdly, the Intelligent Tourism and Cultural Information through Ubiquitous Service (iTacitus) offers an effective way to explore historical sites by overlaying 3D virtual model, video and audio on real environment. The multimedia elements are presented in interesting ways, such as superimposed environments, annotated landscape and spatial acoustic overlays (Zoellner, Stricker, Bleser, & Pastarmov, 2007).

Fourth project is the 3D model of architecture and places along with the virtual characters are presented in GEIST Project. It uses the storytelling as the method to immerse tourist at Heidelberg Castle, Germany (Kretschmer et al., 2001). Next, in virtual Calakmul simulation, it superimposes the tomb of Garra de Jagauris on current site by using AR technology (Ruiz et al., 2002). Next is at the Els Vilars, an archaeological Iberian Site of the early Iron Age in Spain, is reconstructed by using 3D reconstructions, drawings and photographs presentation (Yamane & Lorés, 2005). Lastly, the Mobile Augmented Reality for Cultural Heritage

(MARCH) project augments the captured images with the expert's drawings of the animal engravings in museum environments (Choudary et al., 2009). All these projects exhibit the potential benefits of AR usage at cultural heritage sites which could be similarly utilised in Malaysia.

AVAILABILITY OF MEDIA AT MELAKA CULTURAL HERITAGE SITES

Melaka is a historical city that has mosques, temples, churches, museums, historical buildings, and cultural heritage sites. Melaka is chosen as our study due to the fact that Melaka has been inscribed as a World Heritage Site in 2008 by UNESCO. In addition Government of Malaysia and Malacca State Authority have given priority to identifying and promoting ways in which the conservation and adaptive reuse historical monuments, buildings and sites as well as intangible cultural assets which can contribute to regional and local economic regeneration. Five sites were chosen for this research in order to know the availability of media and its types; Porta de Santiago (A'Famosa), Saint Paul's Hill, Stadhuys Buildings, The Middlesburg Bastion, and Mountain of China.

Based on the observation, the cultural heritage sites in Melaka are mostly equipped by signs and interpretive board as interpretive media. These results indicate that only the traditional information displays are available at Melaka heritage sites with no mobile AR application provided at the respected cultural heritage sites. Therefore, this study examines the applicability of mobile AR usage at the cultural heritage sites.

METHODOLOGY

The main objective of this study is to examine the applicability of mobile AR usage at cultural heritage sites. Therefore, there main activities were conducted to achieve the objective; (i) mobile AR application development for Melaka cultural heritage sites, (ii) user study at Melaka heritage site while using the application, and (iii) result analysis of the applicability.

Mobile AR Application for Melaka Heritage Sites

Since, there is no application developed for Melaka heritage sites, a mobile AR application which named as AR@Melaka is developed to help visitors to experience their visit at Melaka heritage sites. The contents were developed for Junaio, a free AR browser available in iOS and Android operating systems. The application and development process are explained in detail in Pendit, Zaibon and Abubakar (2014). Figure 1 shows the example of live view of the application during the user study.

Figure 1. Live View of the Mobile AR Application at Melaka Heritage Site

Figure 2. Using The Application

Figure 3. Explaining The Features

RESULTS AND DISCUSSION

200 respondents from 15 to 50 years old participated in the study and this range is similar with previous study on perceptions survey of domestic tourists towards historical building in Ipoh, Malaysia (Ismail, Harun, & Zin, 2006). Most of them are male (54.5%) and the remainder is female (45.5%), with age range from 15 to 19 years old is the majority group of age of the respondents (38.5%).

As seen in Table 2, the result revealed that most of the respondents (95.5%) agreed to have enjoyable informal learning experience in cultural heritage site by using the mobile AR application. They think they learned something at the heritage site and enjoyed their visit. This study also disclosed that the visitors will consider using the AR application in the future (93.5%). In addition, the visitors were asked what they prefer between AR application and traditional media for learning at heritage sites. The results show that 94% prefer the AR application compare to traditional media (books, maps and brochure) for learning in cultural heritage sites (94%).

Table 1. Results of user's feedback on the mobile AR at Melaka heritage sites

Question	Yes	No
I agree that the mobile AR application helps me to learn informally in enjoyable way at cultural heritage site.	95.5%	3.5%
I will use mobile AR application for cultural heritage site in the future.	93.5%	5.0%
I prefer mobile AR application compared to traditional media (books, maps, and brochure).	94.0%	5.0%

Respondents also wrote some comments and suggestions related to the study. Table 3 depicts the comments from respondents which are divided into three categories, easy and useful, need improvement, and better than traditional media. Some comments are reworded and rephrased to convey better understanding. Most of the comments said that the application is easy, fast and useful. It has much information that helped respondent to gain knowledge. However, it is need to be improved by adding more places, features, and consider the platform to be standalone application. Overall, respondents said that it is better than traditional media at the cultural heritage site and the availability of application in the market is waited.

Table 2. Results of User's Comments and Suggestion

Category	Comments
Easy and Useful	(a) Good application for tourist and helps a lot in finding ways. *(Participant #3)* (b) I have learned a lot from this application. It makes me easier to get information without going to the place. *(Participant #45)* (c) It helps me to know about cultural heritage with interesting way and deeper. *(Participant #93)* (d) It attracts my attention. Got much information. Easy to use. *(Participant #55)* (e) Useful, worthwhile and save time. *(Participant #97)*
Need Improvement	(a) Would be helpful if the app would provide more cities. *(Participant #6)* (b) Add more features. Add more places. No connection when no internet data. *(Participant #53)* (c) Improve the graphic. *(Participant #102)* (d) Advertise in social media. *(Participant #66)* (e) Some more pictures / photos of information such as the local Malay/weapons and also the Dutch and Portuguese. Some more info such as the social conflict between the cultures. *(Participant #122)*
Better than traditional media	(a) It is convenient and helps me to reduce the weight of the books while enjoying the beautiful scenery. I hope this AR apps come out in market soon with free download. *(Participant #111)* (b) It was fast and useful. No need to bring books while travelling is enjoyable but learnable from the cultural heritage. If it is free download is better but if minimum charge is still acceptable. *(Participant #112)*

CONCLUSION

AR on mobile allows users to have the application without time and space constraints. Users can view and use the AR application that is installed on their mobile phone directly. This study revealed that mobile AR application for tourism has a lot of potential and benefits to tourist as they can experience learning while visiting at cultural heritage sites.

Currently, there is no implementation of mobile AR in Malaysia at cultural heritage sites. Therefore, this study tried to examine the applicability of mobile AR usage at Melaka heritage sites. The result shows that the respondents agreed that they had experienced in learning. They also prefer the AR application compared to traditional media and would like to use it again in the future. In conclusion, all results of this study provide the positive values. This is proven that mobile AR application is applicable to be used and utilised at the cultural heritage sites.

In future, the similar mobile AR application will be studied in different places around cultural heritage sites in Malaysia. The results will enhance other similar and related studies of mobile AR at cultural heritage sites.

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