Mobile Phone Augmented Reality Postcard

Low Wei Shang, Mohd Hafiz Zakaria, Ibrahim Ahmad
Creative Media Lab, Faculty of Information and Communication Technology,
Universiti Teknikal Malaysia Melaka, Malaysia.
jason@tinka.my

***Abstract*— The purpose for this project is to introduce and empower the technology of Mobile Phone Augmented Reality (AR) into the usage of everyday souvenirs for the tourism industry. AR technology these days have advanced into a mainstream technology that can easily be executed with modern day smartphones be it on the Android or iOS platform. The idea is to construct a 3D model of a historical monument which allows the tourist to obtain information and a 360 degree view of the monument itself. Therefore, this project is believed to be able to bring up the idea of using AR technology and its application on a souvenir. The type of souvenir that will be focused on would be the postcard as it is still one of the main purchased items by tourists while travelling. A pilot study based on 50 respondents around Melaka tourist hotspots will be conducted after the completion of this project to determine that by implementing AR into souvenirs, tourists are able to gain information interactively.**

***Index Terms*— Augmented reality; Mobile phone; Postcard; Vuforia; 3D Unity.**

I. INTRODUCTION

Augmented Reality (AR) technology is one of the technologies that originated from Virtual Reality (VR) technology, yet the difference is where VR has virtual objects that is superimposed upon or composite in the real world and the users of this technology are interacting with virtually constructed objects in real-time [1]. One of the few mainstream AR devices that have been used in the past is the head-mounted displays (HMD) that supports the freedom of movement of a rigid body in three-dimensional space. This device must be a tangible interface object where the pose tracking must be inexpensive, work robustly and changes in time according to changing environmental conditions [2]. All this however has changed where smartphone manufacturers has successfully created powerful smartphone devices that has sufficient processing power to create AR applications. Modern day smartphones are able to facilitate data access and processing with a considerable amount of computing power [3]. According to [3], a smart phone is like a small networked computer in the form of a cell phone which usually provides personal information management (PIM) applications and some wireless communication capacity. According to [2], smart phones are aimed to provide a different market in AR as compared to more power and larger ultra-mobile PCs (UMPCs, Figure 1b). Achieving optimum performance for AR applications therefore requires careful choice of algorithms and also optimized code as smart phone has limited processing capabilities as compared to the PC platform [2]. Most of smartphones these days comes with a built in camera where it is able to portray itself towards computer vision approaches, therefore enabling it to conduct AR activities with its users.

One of the main concerns of tourists when they visited a historical monument is the lack of historical information or data obtained during their visit. Often, the information was provided through sign attachment parts along the building façade. Therefore, an idea to implement facts regarding these historical monuments onto souvenirs was devised. However, standard postcard sizes which are found regularly in souvenir stalls are within the size of at least 3-1/2 inches high x 5 inches long and no more than 4-1/4 inches high x 6 inches long. (USPS.com). These sizes of postcards often includes the giver's name, address, and message with an area allocated for stamp placement. Therefore the standard size of a typical postcard is unable to allocate enough space for the placement of historical facts onto it.

Hence, the main objective of this project is to develop and implement interactive and also interesting ways to solve the problem of limited physical space found on a postcard through Mobile Phone Augmented Reality technology.

II. LITERATURE REVIEW

A. AR in Mobile Phones

Mobile phones have become a very attractive platform for augmented reality technology in recent years [4]. As before AR was being used in smartphones, some research had been done in the field of mobile AR to replace the original backpack plus head-mounted display setups. These equipment's are known as ultra-mobile PCs (UMPCs, Figure 1b). This evolution was then continued by the replacement of UMPCs to PDAs (Figure 1c) and finally the current day Smart Phone (1d). According to research done by [2], smart phones are aiming for a different market in AR as compared to the initial days of UMPCs. The smart phones are designed for a large and wide range of consumers with surprisingly robust and foolproof AR performance. Most smart phones has a built-in camera which allows the full functionality of AR to be used by a modern day consumer. However, the quality of computer tracking is still highly influenced by its camera and also the underlying image sensor characteristics like frame size, update rate, or lens distortion [2].

B. Current Research on ICT technologies and Tourism

The ICT driven engineering has gradually generated a new paradigm-shift, altering the industry structure and developing a whole range of opportunities [5]. One of the biggest changes is the capability to allow consumers to identify, customize,

and purchase tourism products and supports the development and distribution of offerings worldwide. The latest underlying trend of all developments is through the integration of hardware, software, and intelligent applications through networking and advanced user interfaces [6]. This led to a number of new technological creations and experiences which technology is able to provide for tourists. Virtual Tourism is coined through the implementation of Virtual Reality (VR) technology into day to day tourist's activities. The Virtual Environment is augmented by various sensory simulations such as sight, sound, and even touch, together with some respective feedback, which creates an excellent way to access, conceptualize and manipulate Tourism information. Tourists are highly dependent on accurate, relevant and also timely information in order to help them in their travel decisions. The provision of certain elements such as video clips, animation and also virtual walkthroughs of Tourism destinations, hotel attractions and local environment are able to give tourists added value, therefore for this reason VR technology is likely to have a major impact on the future of the Tourism Industry.

C. Augmented Reality on Smartphones for Tourism

With the advancement of technologies, the tourism industry has started to venture into the Smartphone Application field for promotional purposes. One of the few smartphone applications that are of AR origin are Wikitude, Yelp Monocle, where when used, a series of pop-up cards of information will appear onscreen—particularly useful for travelers. (www.cntraveler.com).

This new display method which stems from the synergy of new mobile devices, context-awareness and AR has a vast potential to enhance a tourists' experiences and make them exceptional [7]. As such, it is possible to say that mobile AR applications allow users to explore the world by adding new layers to their reality, thus resulting in a new interactive and highly dynamic experience [8].

D. Current Research on Augmented Reality Postcards

Postcards are a popular choice of souvenirs as they are not only highly affordable, but a personal message can also be attached on it as well. Therefore, the idea of enhancing this piece of traditional souvenir even further has made way into researches around the world. A research [9] enables a postcard to display personalized videos to its senders. Using a specialized video management module, it enables playable videos and creates an ID as a link between the video and the card. Another research done by [10] enables a postcard to promote traditional Thai folk musical instruments. This method allows the user to view media as video, 3D modelling and original sound by using a trigger image in a postcard via their smart device [10].

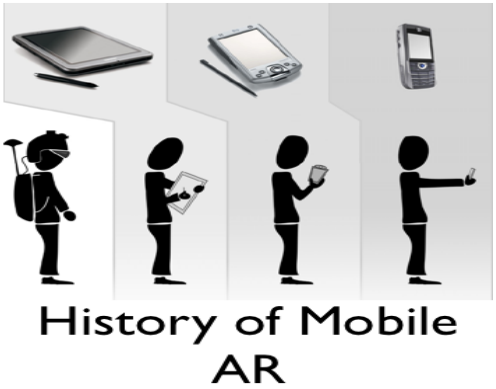

Figure 1: The evolution and miniature of mobile AR: (a) Backpack with HMD, (b) UMPC, (c) handheld, (d) Mobile phone

III. DESIGN AND DEVELOPMENT

The main development tools used for this project are Android SDK, Vuforia and also Unity 3D with the main programming language of C#. Vuforia allows developer to build vision-base augmented reality application. By using the Vuforia platform, the application can see a wide variety of object such as image, simple 3D object, frame markers, and user defined image. Unity 3D enables the creation and implementation of 3D models to our Vuforia package which enables the creation of Augmented Reality. While lastly, the Android SDK is used to compile the project into the .apk format which android smartphones use.

The artwork of the postcard is selected from one of Malaysia's most famous historical monument, the A'Famosa fort which is found in Melaka.

IV. APPLICATION ARCHITECTURE

The main SDK architecture which will be used in this project is the Vuforia SDK. The core components found within this SDK are:

- Smarrt Phone Camera
- Camera to Pixel Converter
- Image Target Tracker
- Camera Preview Renderer
- Application Code
- Device Target Database
- User-Defined Targets

The flow of these components is stated in Figure 2

V. IMPLEMENTATION

A. Postcard Marker and Artwork

Through the research on current postcard trends, the design of a cantered piece of historical monument has been chosen. The process of producing this artwork was done using the Wacom Bamboo tablet with edits using Adobe Photoshop. This image was then sent to the Vuforia database to be generated into an AR plugin. Figure 3 shows the final product of the AR Marker.

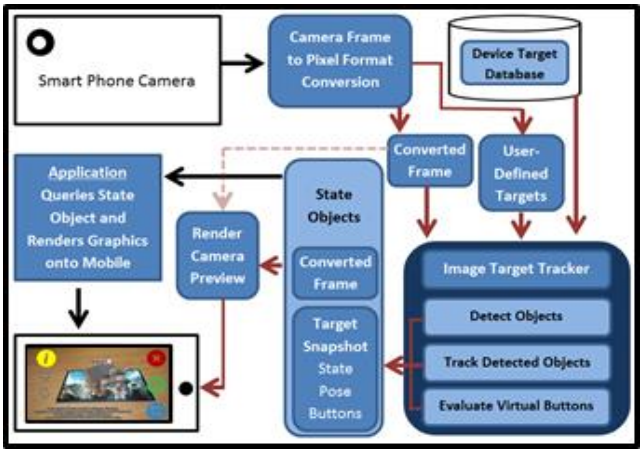

Figure 2: The Vuforia Architecture for this project

Figure 3: The AR Marker

B. Development Environment with Android SDK , Vuforia & Unity 3D

The Vuforia SDK requires the Android SDK to process. The Android SDK lets Android developers build performance-critical parts of their applications in native code. The Vuforia AR Extension for Unity enables vision detection and tracking functionality within the Unity IDE and allows developers to create AR applications and games easily. The Vuforia AR Extension is compatible in both Unity Standard and Unity Pro. The target image which was presented in the previous section will be imported into the 3D Unity working space and was then chosen as the Image Target Behaviour as seen in Figure 4. The Data Set that represents the image marker will be implemented in this system which is displayed in Figure 5.

C. 3D Model Construction

The modeling was done through a series of 3D rendering and various techniques created using Blender. The entire product was then exported in .obj format for the import into 3D unity. Figure 6 shows the completed process of constructing the 3D Model in Blender with the implementation of textures and lighting conditions.

D. Implementation of Buttons and 3D Constructed Model

A few features and buttons have been added into this project in order to provide the user with an enhanced interactive experience whilst using the application. These UI buttons are coded and compiled into a script with the C# language. The buttons that was created are “Rotate”, “Information”, “Focus”, “Snapshot”, and “Exit”. The 3D Model that was exported has also been imported into Unity 3D to match the targeted marker. When everything has been recorded and put in place, we then compile the file into the android .apk format. Figure 7 shows the development.

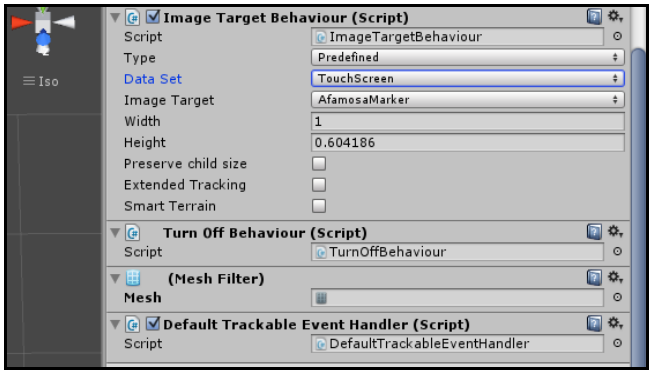

Figure 4: Image Target Behaviour Script Settings

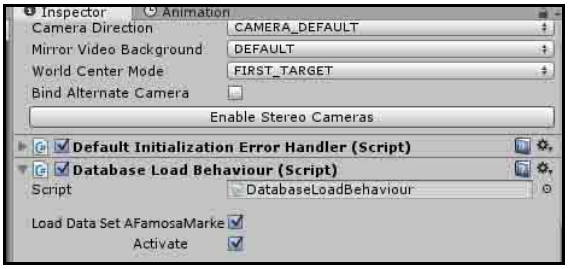

Figure 5: Loading Data Set for AR Detection

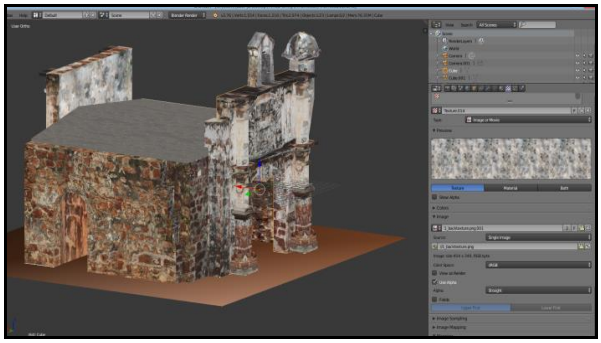

Figure 6: Completed 3D Model of Santiago Bastion

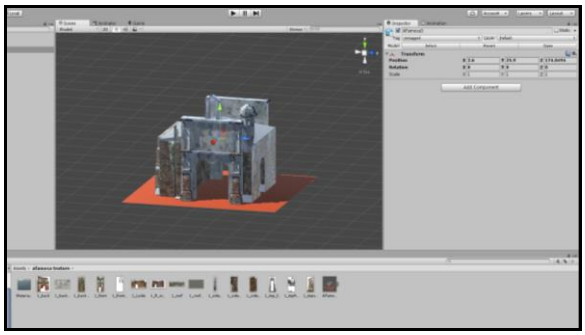

Figure 7: Implementing the 3D Historical Model

E. Implementation of Application Features & Functions

a) Generated 3D Model Feature

Upon detection of the application with the marker, we are able to observe a 3D Monument being generated in real time. Figure 8 below shows the overall outlook of the application when in use.

Figure 8: The Final Output Image

b) Information Integration Feature

The button displayed in Figure 9 shows the capability of the application to display historical information regarding the monument. This provides educational value for the user where additional information regarding the historical monument can be obtained.

Figure 9: Displaying the Historical Information

c) Screenshot Capture Feature

The button shown in Figure 10 below shows the capability of the application in capturing the generated 3D image into the user's phone gallery. This enables the user to share the historical monument or information via social applications with the user's friends and family.

d) Camera Focus Feature

Figure 11 and 12 depict the Camera Focus feature and it's comparison of the function in actual use. This function was found out to be crucial in modern day AR applications. This is due to certain phones not being able to support the general autofocus feature which would render the marker blur when in actual use. If the image marker is blur upon detection, this would render the AR application to be unable to detect the marker, thus making the application unreliable.

Figure 10: Demonstrating the Camera Capture Function

Figure 11: Out of Focus Image Causes the Tracker to be Unreliable

Figure 12: A Focused Image Enables the Marker to Work Reliably

VI. DISCUSSION

The mobile phone AR for tourism is developed to reinforce the local tourism sector and also for the purpose of introducing the AR technology to the public easily. In this Mobile Phone AR Postcard application, the basic AR flows of Video Capturing, Marker Tracking, Overlaying, and Virtual Object Rendering were fully applied in the Android OS mobile phone and the application has been developed successfully.

The application works by displaying the 3D monument model on the mobile phone screen once the marker was detected. Users can therefore interact with the 3D model through touch of the on screen buttons found on the mobile phone. By providing a function like this, tourists are expected to have a better overall view of the monument in multiple angles surrounding the historical monument as seen in the model found at Figure 8.

The other main function of this project is the ability to display historical information through AR itself. By including a function like this, we are able to provide extra information regarding the historical sites to tourists which would provide an educational value for the application itself. Figure 9 demonstrates this capability.

Another function which the application also includes is a camera capture function which enables the user to have a certain degree of interactivity with the product and their personal social media accounts. Captured photos can be published online or sent to friends and relatives digitally which gives added value towards a souvenir as shown in Figure 10.

Lastly, one of the most crucial feature that was developed for this project was the capability of camera focusing using the application. It was found that many smartphones do not possess the capability of auto focusing with their cameras. This would create a scenario where the detected AR Marker is out of focus which renders the tracker useless. Thus, by developing a focus button for the smartphone, the tracking of the Marker will be made clear and more reliable for the users.

VII. STRENGTHS AND WEAKNESS

There are a few strengths of Mobile Phone AR postcard application. Firstly, it is able to introduce AR technology to tourists while sharing information like the 3D Building and educational information regarding the historical monuments for the tourists. Secondly, mobile phone AR solves the problem of space limitation in the real world scene by providing information in the virtual world. Thirdly, the application is found to be light in size which enables faster rendering in real time as compared to PC based AR technology.

This project requires a very long production time as it involves the creation of artwork, the construction of a 3D model, and lastly the implementation of programming language to bind things up together. The marker for the application detection must be an image that is not reflective in nature as these lighting effects might render the marker not detectable by the mobile phone's camera, thus failing to produce the functions which have been developed.

VIII. CONCLUSION

All in all, the application developed has achieved its objective as stated in the introduction where a 3D Historical monument with educational information was successfully implemented into the Android OS platform of mobile phones. The application has been proven to work efficiently through several processes of application validation which has been done to assure suitable algorithms are selected. According to [4], choosing suitable algorithms carefully is needed to achieve the sufficient performance of an AR application. The virtual information of historical monuments can now be channeled everywhere through the availability of Mobile Phone AR technology by the public. It not only solves space limitation issues in the real world scene, but also augments the mobility information into the real world to be viewed by the public. Mobile Phone AR application also provides convenience to the modern day public since mobile phones are generally used by the mass these days [4]. A pilot study will be conducted in the coming future to further validate the strengths of this completed project.

ACKNOWLEDGMENT

We are grateful to Universiti Teknikal Malaysia Melaka and the Ministry of Higher Education for the Research Acculturation Grant Scheme (RAGS/1/2014/ICT05/FTMK/B00090) that provided financial support of this publication.

REFERENCES

[1] J. R. Vallino, *Interactive Augmented Reality*, 1998, Retrieved August 29, 2009, from http//www.se.rit.edu/~jrv/publications/VallinoThesis.pdf

[2] D. Wagner, and D. Schmalstieg, "History and Future of Tracking for Mobile Phone Augmented Reality", in *Proc. International Symposium onUbiquitous Virtual Reality*, 2009, pp. 1-4.

[3] P. Zheng, and L. M. Ni, *Smart Phone and Next-Generation Mobile Computing*, San Francisco: Morgan Kaufmann Publishers, 2006.

[4] L. Rosenblum, and S. Julier, Projects in VR, Making Augmented Reality Practical on Mobile Phones, Part 1, 2009, pp. 1-4.

[5] D. Buhalis, and P. O'Connor, "Information Communication Technology - Revolutionising Tourism", *Tourism Recreation Research*, vol. 30, no. 3, 2005, pp. 7–16.

[6] H. Werthner, S. Klein, "ICT and the Changing Landscape of Global Tourism Distribution", *Electronic Markets*, vol. 9, no. 4, 1999, pp. 256–262, http://doi.org/10.1080/101967899358941

[7] Z. Yovcheva, D. Buhalis, and C. Gatzidis, "Overview of smartphone augmented reality applications for tourism", *E-Review of Tourism Research*, vol. 10, no. 2, 2012, pp. 63–66.

[8] C. D. Kounavis, A. E. Kasimati, and E. D. Zamani, "Enhancing the tourism experience through mobile augmented reality: Challenges and prospects", *International Journal of Engineering Business Management*, vol. 4, no. 1, pp. 1–6, 2012, http://doi.org/10.5772/51644S.

[9] H. Cho, J. Jung, K. Cho, Y. Seo, and H. Yang, "AR postcard: the augmented reality system with a postcard", in Proceedings of the 10th International Conference on Virtual Reality Continuum and Its Applications in Industry 2011, pp. 453–454. Retrieved from http://dl.acm.org/citation.cfm?id=2087843

[10] Suwichai Phunsa, "Applying Augmented Reality Technology to Promote Traditional Thai Folk Musical Instruments on Postcards", in *Proc. International Conference on Computer Graphics, Multimedia and Image Processing*, Kuala Lumpur, Malaysia, 2014.