Immersive Museum Experience for Baba & Nyonya Heritage Tourism

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Abstract. Virtual reality (VR) has been increasingly popular in recent years, infiltrating many different facets of our life. Virtual exhibits emerge as a new artefact alternative including museum artefact exhibitions. The traditional museum touring faces challenges such as a visitor might not have sufficient time to spend the entire day to examine each piece of artefact closely, unavailability or insufficient of museum narrators and most importantly, many of the artefacts presentation of information is limited and outdated. In this research, a mobile-based VR prototype that introduces Melaka heritage tourism, specifically Baba & Nyonya culture is developed. The Baba & Nyonya museum application is an innovative application that employs Virtual Reality (VR) technology to offer visitors a captivating, interactive and educational experience. This research also discusses the technical aspects, challenges and solutions in developing the application, emphasizing its potential for enhancing education, preserving cultural heritage and transforming the way we learn and explore.

Keywords: Virtual reality, immersive experience, museum, Baba & Nyonya, heritage tourism.

1. Introduction

Virtual reality (VR) has experienced a surge in popularity in recent years, infiltrating various aspects of our lives. In today's digital era, the concept of virtual artefacts has emerged as a novel alternative. A virtual artefact refers to an object that exists solely within a digital environment, such as the Internet, virtual reality (VR) environment, cyberspace or augmented reality (AR) [1]. In the past, virtual artefacts were limited to digital representations such as photographs, prototypes, computer animations or virtual literature. Today, they play a crucial role in multiple fields, including museum exhibitions where real-world artefacts are digitally modelled or recreated [2-3]. The integration of technologies has transformed the museum sector, revolutionizing visitors' interactions and interpretations of cultural artefacts. In response to the challenges posed by the digital age, museums have rapidly embraced VR to explore new avenues and provide immersive experiences for their visitors [4-5].

VR has been utilized to recreate historical environments, improve on-site and remote interpretation, increase visitor participation and learning, and deliver interactive, engaging, and immersive experiences. In order to facilitate learning about and appreciation for Melaka heritage tourism, specifically Baba & Nyonya culture, the primary objective of this research is to create a VR based Baba & Nyonya museum.

Museums face challenges engaging visitors due to relic fragility, high travel costs and difficulty passing down cultural information. Not only that, a visitor might not have sufficient time to spend the entire day to examine each piece of artefact closely. Another common issue faced is the unavailability of museum narrators. Not every museum provides such service and as a result, visitors might leave the museum not knowing or learning the local culture and heritage. Most importantly, the presentation of information for artefacts could be limited and outdated in many museums around the world. VR is incorporated to address the aforementioned problems. It can help to preserve relics, provide accessible experiences and bridge generational gaps.

In this research, a mobile based VR application that introduces Baba & Nyonya cultural handcraft is designed and developed. The application focuses on spreading information about the gradual disappearance culture of Baba &Nyonya handcrafts [6], which are "Kasut Manik", Baju Kebaya and "Kamcheng". VR is used to showcase these handcrafts and enable user interaction. The application is Android based and requires

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additional hardware, namely Google Cardboard. By utilizing the wearable hardware, users are led to view the images up-close in multiple angles, reading and listening to the audio narrative and navigating the 3D cultural artefacts.

2. Literature Review

2.1. Heritage Tourism

The term heritage tourism is gaining popularity in tourism research. A world heritage site is an area of outstanding universal value (OUV) that requires long-term protection, which is non-renewable and irreplaceable [7]. It had been identified and endorsed by United Nations Educational, Scientific and Cultural Organisation (UNESCO) and World Heritage Committee (WHC).

Melaka was recognized as a world heritrage site in 2008 due to its OUV and Baba & Nyonya is one of its unique cultures [8]. Baba & Nyonya is an ethnic group characterized by a unique combination of Chinese and Malay influences, can be traced to Chinese traders who settled in Southeast Asia during the seventeenth century and married local women [9]. Without a broader sense of group solidarity, sustaining Baba & Nyonya culture is considered challenging [10]. Baba & Nyonya cultural heritage consists of the artefacts and traditions that have been passed down from generation to generation. Not everything passed down from previous generations is automatically considered legacy, but rather the term heritage is a social construct [11]. These ways of life include traditions, rituals, activities, locations, artefacts and traditional handcrafts. The handiworks on display in Melaka's public cultural museums are the most important items because they showcase the preservation of culture.

For the public to fully experience and interact with cultural items, virtual heritage projects aim to produce lifelike digital recreations of these spaces. It aspires to recreate ancient cultures as fully realised (virtual) worlds in which users may fully immerse themselves. The cultural heritage display broadens the distribution of legacy and its cultural value by providing several avenues for exhibiting heritage [12-14].

2.2. Related Studies

The utilization of VR technology in museum exhibitions has many advantageous. For one, it overcomes the drawbacks of 2-dimensional artefacts presentations. It also enhances the possibility of more detailed study, observation and research of artefacts. The original artefacts are being transformed into diverse forms of imagery, including 3-dimensional visualizations, continuous images and animations.

Over time, the rise of affordable, user-friendly software and hardware solutions has facilitated the growing appeal of virtual exploration. A cardboard-based VR application was developed to promote heritage tourism in Bari [15]. The VR scenes were reconstructed based on images captured using 360^0 photos and the virtual tour was implemented using Unity. The Google Cardboard visor was found to be an efficient, accessible and cost-effective option.

Besides Google Cardboard, more advanced hardware was utilized to enter the VR environment. For example, Shihsanhang Museum in Taiwan has launched an underwater archaeology VR by using HTC VIVE helmet display device [16]. Visitors are able to experience various sea animals and shipwrecks related relics. Due to the maintenance of hardware, the museum can only receive 100 visitors per day. While the focus was on static artefact viewing with informational overlays, this research proposed more interactive feature such as gamification to enhance visitor's engagement.

Other than VR, Augmented Reality (AR) technology has also been integrated in enhancing heritage tourism for museums. Visitors can walk into the virtual forest understory, listen to insects and birds, looking at botanical details in the virtual flowers, listen to the curator's narrative and access plant facts via a diorama museum mobile application [17]. In this application, all of the virtual plants are the accurate 3-dimensional models of real plants which had been vetted and approved by the museum's botanist.

On the other hand, a similar work was implemented to showcase Palembang's cultural artefacts in the Sultan Mahmud Badaruddin II Museum [18]. However, there is limitation with the museum's exhibition space. The AR museum application was developed using Vuforia and 3D Blender software. In contrast, this research focuses on Melaka's unique Baba & Nyonya culture. Prior to this, effort has been made to preserve

cultural heritage artefacts such as development of web based applications.

Alternatively, Mixed Reality (MR) was also proposed as a technology solution for heritage tourism and museums. MR is able to reshape physical space and heritage exhibitions for immersive interaction and innovative participation [19]. For example, MR was used to offer exciting ways to learn about dinosaur history [20]. Visitors are able to observe upfront the look of dinosaurs while palaeontologist are able to determine the dinosaurs' skin colour and texture.

Based on these literature findings, it was found that the future of heritage tourism has to be supplemented by use of technology. In this research, the aim is to create a mobile-based VR application to preserve and promote Baba & Nyonya heritage culture in addressing the declining interest among young generations.

3. Research Method

3.1. 3D Modelling

There is a total of five steps to creating high-quality 3D models for the VR Baba & Nyonya Museum as shown in Figure 1. To identify the subjects for this research, data collection was conducted. Visits to museums to capture the subject item was necessary. The acquisition procedure was repeated until the 3D models are of good standards of quality and precision via photogrammetry technology of Polycam. It converts multiple photos taken from different angles into 3D objects. This approach has proven higher efficiency and practicality, although it required taking an average of 800 photos for each item to achieve accurate 3D reconstruction. The 3D models generated occasionally contained unwanted elements such as surfaces of the objects and other noises. To address this, post-processing was necessary using two widely known 3D modeling software, Blender and Autodesk Maya.

To do post-processing, the first step was to import the GLB (.gltf) format of 3D models into Blender, as Maya does not support this format. Subsequently, the models are converted to .fbx format in Blender. Once in Autodesk Maya, all undesirable elements are meticulously removed, particularly surfaces captured in the initial 3D scanning process. Ultimately, the cleaned-up .fbx models are exported along with their corresponding texture JPEG files, ready for integration into the Unity game engine for the Baba & Nyonya VR application.
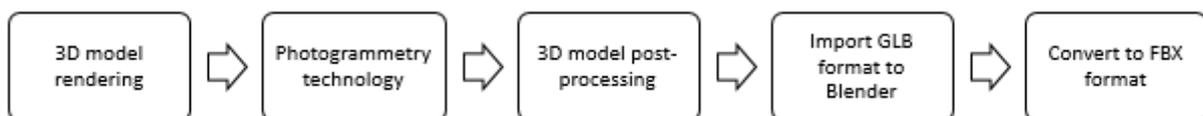

Fig. 1: 3D Modeling Process.

3.2. System Design

There are three core components for the architecture of this research, namely the User, Google Cardboard and the VR application software. Through Google Cardboard, users can enjoy an immersive virtual reality experience showcasing Baba & Nyonya cultural heritage.

For system development, C# (version 8.0) was the primary language of choice, offering the necessary versatility and functionality to create a captivating VR experience. The installation of the Google VR SDK for Unity is essential as it enables the development of VR experiences for Android and iOS devices. This SDK allows for the creation of apps compatible with various VR headsets, including Google Cardboard and Daydream, delivering a truly immersive and interactive experience for users.

The application is specifically designed to run on Android OS mobile devices, making it accessible to a wide range of users. Users can utilize the VR functionality and interact with 3D models using any Android smartphone capable of running the application smoothly and with an Android version of at least 8.0. It is

crucial to ensure that the hardware capabilities align with the software requirements to provide an optimal user experience.

4. System Preview

The VR application offers a user-friendly splash screen with two functions, "Start" and "Exit," ensuring easy navigation as shown in Figure 2. By selecting the "Start" button, users embark on a journey to navigate three types of Baba & Nyonya artefacts. Figure 3 shows a scene of artefact "Kamcheng". Users can view it upclose by zooming in and out. There is also a rotate button which can rotate a 360^0 view. When clicking on the "i" button, it will provide full information about Kamcheng and there is a sound button which will play an English audio narrative as depicted in Figure 4.
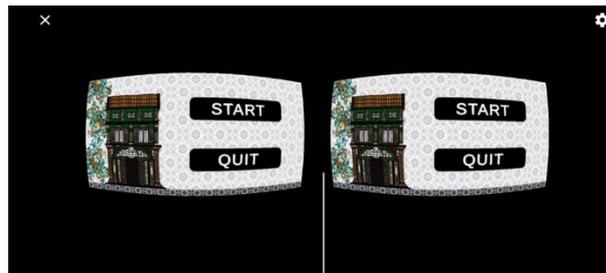

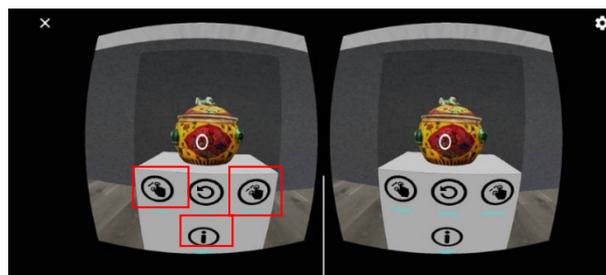Fig. 2: VR home screen.

Fig. 3: Artefact room scene.

Fig. 4: Audio narrative function.

Additionally, there is a video screen, offering dynamic insights into the historical background of the artefacts as illustrated in Figure 5.

Fig. 5: View video function.

Within the artifact-only UI, users can access more details by clicking on the target box, presenting textual and audio descriptions as shown in Figure 6. To reinforce further understanding, users can engage in a quiz as shown in Figure 7. During the quiz, correct answers are visually indicated by green buttons, while incorrect selections turn red. Upon completing the quiz, users receive their quiz results and have the option to retry, promoting continuous learning.

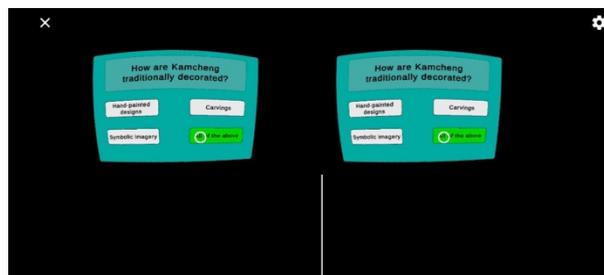

Fig. 6: View video function.

Fig. 7: Quiz function.

Figure 8 shows the application's "Game" option, leading users to the interaction scene. Here, users can interact with the artefacts, one at a time, through intuitive icons for movement and exploration by using the controllers as shown in Figure 9. The interaction feature combines customized visuals for an immersive and shareable experience.
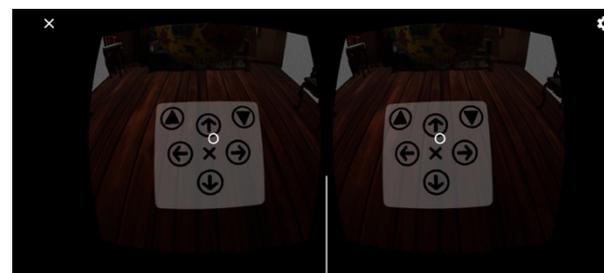

Fig. 8: Game interaction.

Fig. 9: VR controllers.

5. Conclusion

The VR Baba & Nyonya museum application has been successfully developed to provide users with an engaging and educational experience. Through different types of artefacts, the application offers a valuable resource for users seeking to immerse themselves in Baba & Nyonya culture. The integration of VR

technology and Baba & Nyonya elements has resulted in an efficient and effective system design, delivering an interactive journey through cultural heritage.

Despite the successful implementation, there are opportunities for future enhancement. One potential improvement is the introduction of a collaborative multiplayer mode, enabling users to explore artefacts together in a shared virtual environment. By incorporating collaborative activities and a leaderboard system, users can enjoy friendly competition, social interaction, and meaningful connections. Additionally, introducing virtual avatars and cross-platform compatibility would enhance personalization and allow users to connect with friends seamlessly, regardless of the devices they use. Such enhancements would create a dynamic and immersive environment, making the application even more enjoyable and engaging for users.

In conclusion, the VR Baba & Nyonya museum application has successfully provided users with an interactive and educational journey through cultural heritage. The integration of VR technology and Baba & Nyonya elements has resulted in an immersive experience. The project's future enhancements, focusing on multiplayer collaboration and expanded cultural content, will further enrich the application's offerings, providing users with an even more rewarding and enjoyable experience.

6. References

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