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VIRTUAL GAMIFIED SYSTEM FOR CAT MUSEUM KUCHING DBKU

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Final Year Project Report ☒

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VIRTUAL GAMIFIED SYSTEM FOR CAT MUSEUM KUCHING DBKU

AINUR NISHA BINTI SUKARNO

This project is submitted
in partial fulfilment of the requirements for a
Bachelor of Science with Honours
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(2021)

The project entitled ‘Virtual Gamified System for Cat Museum Kuching DBKU’ was prepared by Ainur Nisha Binti Sukarno and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Science with Honours (Cognitive Science).

Received for examination by:

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Date:

22nd July 2021

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A

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ABSTRACT

Virtual Reality (VR) is a computer-generated digital environment that can be experienced and interacted with as if that environment is real. With the technological advances we experience this era, virtual reality becomes more than just science fiction and are readily accessible by consumers. Therefore, this study proposes the development of a virtual gamified system in museum context for consumers. The main components of this application are the exhibits and information regarding the exhibits, museum experience and gamification. The application was developed using Mobile Application Development Life Cycle (MADLC) and was tested and evaluated quantitatively using System Usability Scale (SUS) and Museum Experience Scale. The findings of this study suggested that introducing virtual reality in museum context and integrating gamification provided good feedback, both in the usability and positive experience by the evaluators of the application.

Chapter 1
Introduction

1.1 Overview

This chapter discusses the background of study, problem statement, research questions, objective of study, scope of study, definition of terms and significance of study.

1.2 Background of Study

Museums exist as a building that keep various collections that aim to preserve and conserve artifacts of the past and documents historical evidence (Preziosi & Farago, 2018). Museums are mainly used as a medium of education for the public to gain knowledge of different historical artifacts and pique the public's interest through the short interaction time they are in the museum (Kersten, Tschirschwitz, & Deggim, 2017). Therefore, according to Kristianto, Dela and Santoso (2018), museums are simply not a place to preserve history anymore, but they are becoming a medium for education as well as a cultural space. Interestingly, Waltl (2006) stated that the museum's environment and the visitor's interaction experience are a healthy mix of entertainment and education, hence entertainment and education play an important role for museum visitors.

True to the previous statement, many museums nowadays are exploring the idea of virtual museum (VM) systems in order to attract more visitors by improving their visitors' experience using various technologies such as virtual reality, augmented reality and digitized technologies. This is to offer the younger generations an interactive experience compared to the mundane and non-interactive exhibitions offered by traditional museums. Since VM are able to communicate the cultural contents effectively with their entertainment and educational approach, they are considered to be an effective solution for museums (Barbieri, Bruno, & Muzzupappa, 2017).

Since entertainment is a factor that attract museum visitors, implementation of gamification as a way to continuously motivate visitors is an interesting idea. With meaningful gamification, museums can offer a unique, engaging and interactive experience for visitors that can motivate them to gain knowlege in a fun way. Gamification are able improve learning in museum perspective because its core mechanics increases visitors' interest, making them curious and thirst for more knowledge by giving them a clear direction on what to learn (Kristianto et al., 2018).

1.3 Problem Statement

Sarawak museums have not transition to cater their exhibits and knowledge virtually. Local information regarding local culture in museums are still offered traditionally which are deemed not interactive and unattractive, especially to youths who are used to the digital space. The younger generations might think twice before going to museums due to their monotonous experience and they also can easily find information on the internet if they want to learn things. If this continuous on, we are risking lost of information regarding cultural heritage and knowledge because they will fade with passing time if youths are not keen on learning about it. Therefore, by digitizing the artefacts available in museums and offering a more engaging and accesible way using Virtual Reality, more potential visitors are able to enjoy and at the same time, able to educate themselves on the cultural heritage. Furthermore, museums are also able to benefit having a visual space because they are not limited to any restrains such as space, time and damaged exhibits.

1.4 Research Questions

1.4.1 How to design and develop a virtual gamified system for Cat Museum Kuching DBKU?

1.4.2 How to integrate gamification during implementation of mobile virtual reality system successfully in museum context?

1.4.3 Is the virtual gamified system effective in creating an educational and entertaining interactive experience for Cat Museum Kuching's visitors?

1.5 Research Objectives

1.5.1 To design and develop a virtual gamified system for Cat Museum Kuching DBKU.

1.5.2 To integrate gamification during implementation of mobile virtual reality system successfully in museum context.

1.5.3 Evaluate the effectiveness of virtual gamified system in creating an educational and entertaining interactive experience for Cat Museum Kuching's visitors.

1.6 Scope of Study

This study will mainly focus on developing a virtual gamified system using Virtual Reality (VR) to create an educational and entertaining interactive experience for Cat Museum

Kuching's visitors. Gamification elements will be introduced in the system in order to motivate and improve learning experience for visitors. The whole system will cater towards the Cat Museum's artifacts and theme as it is the place of the study. Hopefully, this study will stimulate other museums to follow and transition towards a more modern approach in the way they offer their experience, at the same time preserving the knowledge and history within the museums digitally.

1.7 Definition of Terms

Table 1. Definition of terms

Terms	Conceptual Definition	Operational Definition
Museum	"A public or private nonprofit agency or institution organized on a permanent basis for essentially educational or aesthetic purposes." (Malaro & DeAngelis, 2012)	In this study, museum is a cultural space that display different historical artifacts and cultural heritage in order to educate the public.
Virtual Reality	"Computer-generated digital environment that can be experienced and interacted with as if that environment is real." (Jerald, 2016)	In this study, virtual reality is used as the medium to offer an interactive, engaging and entertaining experience for the visitors.
Gamification	"Integration of user-centered game design elements into non-gaming context." (Nicholson, 2012a)	In this study, meaningful gamification is used to create motivation in visitors to experience the museum more and making sure transfer of knowledge happens by giving clear direction on what to learn.

1.8 Significance of Study

The product of this study, Virtual Gamified System for Cat Museum DBKU will have significant impact on the museum sectors in Malaysia and the public as well in regards to:

1.8.1 Changing traditional museum experience by recreating the immersive feeling in VR creatively and integrating gamification in the system.

1.8.2 Preservation of cultural heritage and knowledge in Sarawak by documenting them in digital format (digitization).

1.8.3 Evaluate the effectiveness of gamification in virtual system in museum context.

1.9 Summary

This study focused on developing a virtual gamified system for Cat Museum DBKU where the medium that will be used is Virtual Reality. Gamification will be integrated within the system to motivate museum's visitors create an interactive, engaging and entertaining experience as well as improve tranfer of knowldge. The aim of this study is to evaluate the effectiveness of virtual gamified system for visitors. This study will impact the museum sector and the public in Sarawak. Chapter 2 will discuss the literature related to gamification and virtual reality in detail.

Chapter 2

Literature Review

2.1 Introduction

This chapter discusses past researches done on museum, virtual museum, virtual reality, gamification and real life application of modern technology Virtual Reality (VR) in museum sector.

2.2 Museum as an Educational and Social Place

Museum plays a role of bridging normal people and educate them on the cultural heritage and history by displaying different facts, documents and artifacts as their exhibits. Without it, the public are not able to access the artifacts and will not receive the knowledge that comes from the museum's education.

However, according to Kotler, Kotler & Kotler (2008) majority of museums' visitors visit the museum with family or friends because they consider museums to be a social experience. On the other hand, although museum's objective is to educate the public, they also need to allow visitors to experiment in order to empower learning by stimulating creativity and curiosity as their motivation because "if visitors do not see phenomenon right away, they usually will move to the next exhibit" (Feeney, Je, Shimkus & Worthington, 2019).

According to Falk and Dierking (1992), museum experience from visitor's perspective are divided into three different contexts: personal context, social context and physical context. Personal context relates to the knowledge, motivation and personal experience of visitor, social context relates to the social environment of the museum and the physical context relates to the architecture and exhibits within the museum themselves. Falk et al. (1992) also stated that the visitor's museum experience is highly dependent of the expectations of the visitors along with how they fit with the museum's experience and agenda. If the expectations and the actual experience is close, this will lead to a positive, reinforcing attitude about museum because the museum are able to put the content of museum within context (Schweibenz, 1998) and allow educational and social experience for visitors.

2.3 Virtual Reality

With the launch of Oculus Quest, a standalone head-mounted device that has consumer-friendly price tag along with the ability of using our smartphones to experience mobile VR, more people are able to experience the immersive experience without paying a hefty price. Hence, the growth of VR sector had grown significantly and due to the immersive experience

it offers, more museums are taking advantage of the technology available in order to create an innovative and interactive experience for visitors.

According to Han, Chen, Liu, Jang, Tsai, Chang and Hung (2019), using VR approach, visitors are not only able to gain knowledge regarding exhibits but at the same time they are able to immerse themselves in the real perception of the scale, the placement of the exhibits, the atmosphere and the spatial relationship within the atmosphere.

Figure 1. Virtual tour of Dunhuang Cave with immersive head-mounted display (Han et al., 2019)

2.4 Virtual Museum

With emerging technology getting more advance and more consumer-friendly priced as days pass by, the ways we use them are also evolving. Hence, it is only correct to embrace new technologies to bring a fresh way to stimulate and interact with museum's visitors.

According to Sylaiou, Mania, Karoulis and White (2009), technology such as Virtual Reality (VR), Augmented Reality (AR) and Web3D are able to help with the preservation, dissemination and presentation of exhibits for museums in innovative and interactive manner. Utilization of 3D multimedia tools along with computer graphics allow people to record, reconstruct and visualize archaeological remains. Han et al. (2019) had created an immersive virtual reality system for Dunhuang cave where the largest Buddhist art sites in the world reside. Using digitized data from Dunhuang Research Academy, they are able to digitally restore and preserve the murals that had been faded and damaged over time.

Figure 2. Dunhuang cave stimuli feedback

Experiencing virtual museums in VR, users are able to receive visual, auditory and haptic stimuli that can provide a sense of presence and immersive experience (Mania and Robinson, 2005). Therefore, it is important for virtual museums to have contents that are engaging and easy to read so users can enjoy the experience while learning from different stimuli triggers that keep them curious (Sylaiou et al, 2010).

Figure 3. Dunhuang cave VR interaction (Han, 2019)

Late October 2017, The Kremer Museum was launched with an innovative concept where it only exists as a virtual reality museum and no physical museum. All paintings in the museum had been photographed using 'photogrammetry' technique to create a high-resolution painting to be enjoyed by users in VR. George Kremer the founder of Kremer Collection stated that they believe they are making greater contribution in the art department by finding highest quality artwork and sharing them with the public, rather than buying a physical building (The Kremer Collection, n.d). Lierop, the architect responsible in designing the museum stated that VR enable users to escape into a different reality where spatial experience can be embraced by

users, especially in an architect perspective, they have no limitations when designing with their creativity in a digital world (The Kremer Collection, n.d).

Figure 4. The Kremer Museum

2.5 Implementation of Technology for Interactive Museum Experience

According to Addison, "the relationship between developing and disseminating virtual heritage can be divided into three stages: documentation, representation and dissemination." For the first stage, the team needs to gather authentic data and document them. For the next stage, the team needs to choose a system and plan their design in order to represent the tangible exhibit. The final stage is dissemination where the team needs to choose how to disseminate their final product such as the hardware, software and technology, depending on what type of experience do the team wants to offer to their users.

For Dunhuang Cave, Han et al. (2019) chosen to use PC-based VR to provide immersive and cinematic VR experience that allows users to navigate through the virtual cave using 6 DoF controllers. Users will use a head-mounted device that is linked to the PC in order to experience the spatial relationship of the exhibits and atmosphere.

Figure 5. Dunhuang cave VR experience

Wang, Jin, Shao, Li, Zha & Ikeuchi (2016) had developed a mobile VR app that allow users to view Buddha enhancements and restoration at Mogao Grottoes, Middle Binyang Cave. However, the limitation of mobile VR is it is not capable of supporting high-quality rendering and that may affect the user's immersiveness and presence in the virtual environment.

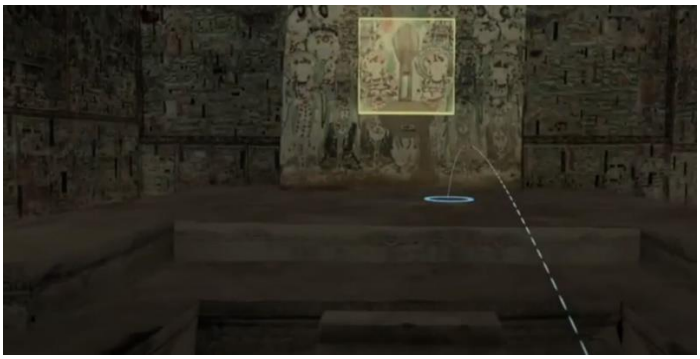

Figure 6. Mogao Grottoes VR experience (Wang et. al., 2016)

For both projects discussed previously, they focus on telling the stories of the murals and showing murals that is physically unreachable and obstructed throughout the cave. They also implemented different type of digital restoration on the damaged murals and lost statues will the help of historians.

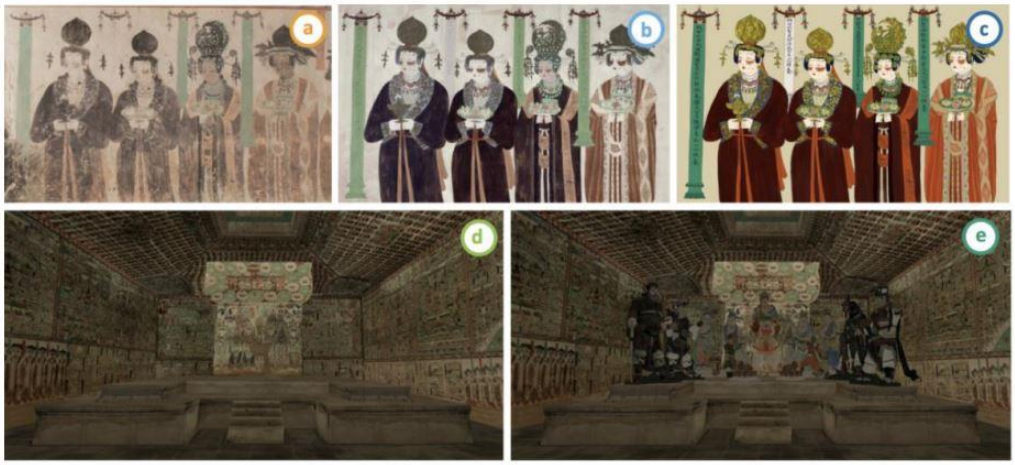

Figure 2. (a) Current mural; (b) Mural restoration by Wang Gengyu; (c) Mural restoration by Liu Mu-Ching; (d) Simulation of current grotto altar; (e) Simulation of grotto altar with restored statues.

Figure 7. Dunhuang Cave Mural Restoration (Han, 2019)

National Museum of Finland had created an amazing VR experience that allow user to step back in time when using their head mounted device, from reality and into the painting of R.W. Ekman called The Opening of the Diet 1863 (Hills-Duty, 2018). When wearing the head mounted device, visitors are able to delve inside the view of Diet of Finland, a legislative body that existed from 1809 to and is able to interact with different characters inside the painting such as emperor and representatives.

Figure 8. The Opening of the Diet 1863 Painting (Hills-Duty, 2018)

Figure 9. The Opening of the Diet 1863 *Virtual Environment* (Hills-Duty, 2018)

2.6 Gamification

When gamification was fist coined by Deterding, Dixon, Khaled & Nacke (2011), it was defined as "the use of game design elements in non-game contexts". Nowadays, a lot of application integrate gamification in their design by using points and rewards systems. Even in games, they introduce a daily reward system in order to encourage users to log into their account which will in turn motivate them into playing the game daily.

Figure 10. Genshin Impact Daily Reward System

Online shopping platforms and other applications are also using this step to increase the number of daily active users. However, Nicholson (2012a) stated that the problem with this model of gamification is the user's internal motivation for the activity is replaced by external motivation, leading to less returning user when the external reward is removed. This is because the reward loop makes users feel controlled and this controlling aspect causes loss of internal motivation (Deci & Ryan, 2004). Therefore, Deci and Ryan (2004) stated that users who integrates their personal goals with the activity will see an activity as positive compared to having an external control with the activity. Hence, game-based elements should be rewarding, relevant and meaningful to users (Nicholson, 2012a).

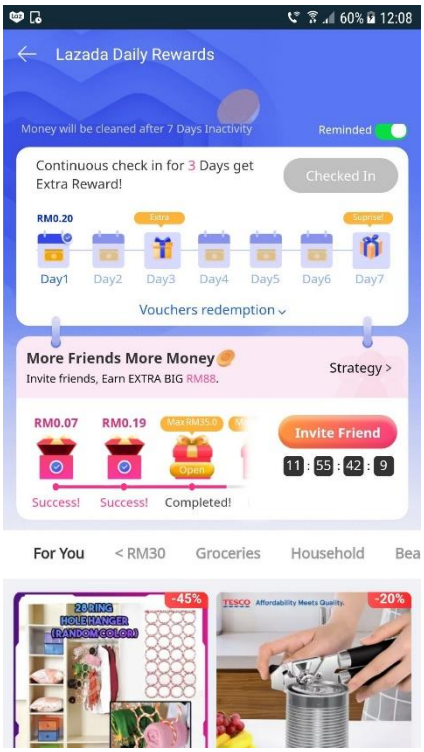

Figure 11. Lazada Daily Rewards System

Nicholson (2012a) coined the term meaningful gamification which is defined as "integration of user-centered game design elements into non-gaming context". Meaningful gamification as told by Nicholson encourages developers to understand users' goals and needs, in turn giving their users information and control so the users will find meaningful connections towards the activity. In addition, Nicholson (2012b) also stresses the importance of participatory activities through the 'play' element. Basically, if people are voluntarily playing, this will get rid of the need of a scoring system as the participation is voluntary. Under this voluntary participation, designers can integrate learning that encourage new perspectives or reflection. When the users are able to find new perspectives and reflection, they will understand their underlying reason and successfully create a meaningful connection to the activity. The result of meaningful gamification will be deeper and longer engagement between users and organization. In a digital space however, Nicholson (2012b) stated that participants should have the same affordances as physical space where there are different spaces to play, socialize and reflect. By having these spaces, it will be easier for participants to engage with others and reflect which will lead to higher chances of them finding their own underlying meaning and goals.