Documentation of Historic Malay Houses in Kuala Lumpur Using Virtual Reality Modelling Language (VRML)

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In the last half of the twentieth century, historical building preservation became an increasingly important issue and had been recognized on local, state, national and international levels. The environmental, economical, educational, social and psychological benefits of preservation have been proven from time to time, and should not be underestimated. The purpose of this paper is to explore the role of usability on using virtual reality photography applications as a way to appreciate and preserve Malay houses at Kampung Baru in Kuala Lumpur. Attention was given to propose guidelines and educational potential of walkthrough simulations of Malay houses in Kampung Baru through linked virtual reality photography system. One of the most obvious applications of virtual reality was the familiar architecture walkthrough of the structures and the other interior parts of the buildings through a mouse pointer. The possibilities of applying virtual reality technology in city simulations can be used for city planning practice and will include the cooperation of Internet GIS and VRML (Virtual Reality Modelling Language). Users can walk around and fly through the real scene of Malay houses in Kampung Baru in Kuala Lumpur. This research will conclude with a short consideration of future development and recommendations relating to the delivery of information and documentation of our historical buildings through virtual environments. Furthermore, through virtual reality, we will discuss how interactive messages can be delivered to the public in a way to appreciate, protect and educate people about our valuable Malay houses in Malaysia. To address these issues, this project will focus on improving and facilitating current methods of recording and documenting historical buildings.

Key words: *Virtual reality modeling language, Usability, Malay houses, appreciation.*

Introduction

In this study, the research was based on a case study of Malay houses in Kampung Baru, Kuala Lumpur. The environment of Malay houses in Kampung Baru represents the physical and social environment of Malay lifestyles. The Malay village is characterized by a relative tranquillity and a neat layout of traditional Malay houses. The village is in accordance with traditional Malays houses, which were built since the 1900s. A glimpse of the past can be seen in traditional houses, as they are beautiful old architectural designs, which portray Malay culture and heritage.

Visualization of past cities, historical buildings, and sites, will definitely help us to understand more of their past and present appearances and will allow views from different angles and dimensions of interaction. Presently, VRML is catching up with the public demand each day. We can see and view almost anything and everything via a computer at anytime without going to a museum. The use of VRML is more than a tool, it is very advanced technology and can create vast impacts on social relations. It is now widely used in realistic simulations where it is useful for educating and training the public on the historical and social interactions of our heritage values. Another frequent response from experts is that VRML photography provides viewers with access to difficult information which is almost impossible to obtain through videos, still images or texts.

Furthermore, through VRML, we will discuss how interactive messages can be delivered to the public. So as to protect and educate the people about our valuable Malay houses in Malaysia. To address these issues, this project will focus on improving and facilitating current methods of recording and documenting historical buildings.

Research Problem

The problem in this study is associated with records and documentations. Malay traditional houses at Kampung Baru can be transformed into totally new modern centres within the Kuala Lumpur metropolitan, face development that intertwines the old and new but where the historic characters of the place remain sustainable. The values and identity of Malay houses can disappear or vanish if the excessive and rapid developments of Kuala Lumpur are ignored. Almost 60% of the local Kampung Baru residents do not live there but they prefer their houses to be rented out (Lim, 2015). Norshidah Ujang (2016) agreed that the heritage values and the social cohesiveness defining the uniqueness of the place should not disappear alongside the emerging redevelopment. Social unity, social coherence, place identity and quality of life can influence people's well-being and therefore, should be equally emphasized in any future redevelopment initiatives. The works of social appreciation toward Malay houses in Kampung Baru need to be a future guide. According to Jamshed (2016) in her CNN

report of 'A village lost in time: Inside Kampung Baru' a leverage of history within a local context is needed to preserve tradition, history and the stories within the Kampung Baru areas. She believed by documenting Kampung Baru in the context of cultural, lifestyle, belief and architecture, she could save the history for future generations. The culture and lifestyle of Malay village in Kampung Baru can immediately be visible, or lost, which provides the locals with a strong sense of belonging to their Malaysian roots and origin. The new generation especially former and present Kampung Baru residents are therefore encouraged to develop awareness and a deeper appreciation which is believed can save identity, heritage, culture and land.

Records and documentations are limited in numbers and they are not readily available. However, if these records and documentations are made available, there are normally made and produced in 2D presentation (graphics and images) and not in their normal original form. By constructing a virtual reality through panoramic photography for the Malay houses, it can help to appreciate and preserve the Malay houses and site environments in a virtual space and at the same time use other data to support the development and the implementation of Malaysia Tourism. Using VRML in tourism portals or websites will help to give a realistic interactive impression to potential tourists. To uptake these technologies, VRML may make a single contribution to the understanding and preservation of our collective heritage.

Objective

To examine the usability of VRML photography applications in preserving the Malay houses at Kampung Baru and to see whether it can be used as a form of historical archive storage so that information can be preserved for future generations.

Aim

This aim of this research is to propose a guideline for appreciating the Malay house at Kampung Baru areas by using VRML photography.

Hypotheses

HI: Compared to still photo, VRML will better help viewers appreciate historical buildings.

H2:   The system of VRML is reliable to convey information on the historic buildings.

H3:   VRML is capable of producing more accurate results than still photos.

Significance of Study

The use of the VRML application will allow for new research possibilities. Presently, advances in computer powered imaging and communication allow for the creation of many forms of digital photographs, VRML environments, three-dimensional textured computer models and the means of transmitting these digital resources around the world. The results, which can be virtualized and made real by VRML, are unique and remarkable. They can illustrate exactly, and be remarkably similar to reality. Multi-disciplinary research investigation will also involve the associated human factor issues.

There will be good significance: to conduct research training and public education programs, develop archaeological and museum-based educational applications (Department of Museum and Antiquities), and for the Department of Heritage (Malaysian Ministry Culture, Art and Heritage). At the same time, it can help to boost tourism and provide tourists the opportunity to admire and value heritage buildings (Lim, 2015; Joshua, 2016).

Literature Review
Re-Presenting Cultural Heritage with VR Panoramic Photography

Based on a study conducted by Thompson (2017) on Re-Presenting Cultural Heritage with Virtual Reality (VR) Panoramic Photography, a more robust history when developing VR panoramic photography involves not only the development of illusion and immersion, but also its contents. As the medium develops, a greater critical discourse may take place and those who are working within VR panoramic photography will not reinvent the existing technology. Thompson (2017) also stated that past disruptive immersive deliverables included the vue d'optique, panorama and stereo view. In any case, a repeating theme, which ties the substance utilized in these deliverables with VR panoramic photography, is the representation of cultural heritage. In his study, he explored how we can use past innovations for the preservation, interpretation and the dissemination of cultural heritage with the example of representation of Middle Eastern cultural heritage using VR panoramic photography. He also gave useful recommendations to inform current and future initiatives in developing artistic projects (Thompson, 2017).

Augmented, Virtual, and Mixed Reality System for Cultural Heritage

According to a survey of augmented, virtual and mixed reality for cultural heritage by Bekele, Pierdicca, Frontoni et al. (2018), the use of well-established trends in multimedia approaches for cultural heritage can enhance how culture is experienced. The advantages of these approach are that they can increase the number of people who can have access to the knowledge and improve the quality of the diffusion of the knowledge. These combined

technologies have been widely used including in reconstruction, education, virtual museums, exploration, and exhibition enhancement. Bekele, Pierdicca, Frontoni et al. (2018) identified application areas in digital cultural heritage, made suggestions as to which technology was most appropriate in each case, predicted future research directions for augmented and virtual reality, and explored the implications for the cultural heritage domain.

Photography in Social Context

Based on research conducted by Bank and Zeitlyn (2015), photography in the context of social life is more easily detected through our daily life and practices. Whether we realize or not, we see and use this photography technology almost every day. Furthermore, with today's technology, it is getting easier for us to practice the use of photography technology. People use their personal to constantly take images that will be uploaded onto websites, blogs, and social media platforms. Clearly photography is used by every level of society regardless of age. The tourism industry has grown tremendously with the presence of photography gadgets in smart phones allowing tourists to capture more memories and images. It has become a trend to visit tourist attractions so as to show your whereabouts on social media sites such as Facebook and Instagram. Photography technology in smart phones can also be used by students in schools and higher-level institutions to complete photography, videography or other tasks (Berry & Schleser, 2014; Kabir & Aftab, 2017).

The Usability Measurement

According to Shackel (1991), usability approaches raised questions about usability measurements at an operational level, usability objectives and relationship between usability, utility, product acceptance and the effects in relation to the interaction. Usability has been much used and modified. Shackel defined a model where product acceptance was the highest concept. The user has to make a trade-off between utility, the match between user needs and functionality, usability, ability to utilize functionality in practice and likeability, effective evaluation versus costs, financial costs as well as social and organizational consequences when buying a product. Furthermore, usability has two sides which consist of usability in a relative property of the system and being relative in relation to its users. Therefore, evaluation is context dependent, resulting in a subjective perception of the product and on the other side, usability relates to objective measures of interaction. Furthermore, Shackel recognized the ambiguousness of the definition and suggested a set of operational criteria. For a system to be usable it has to achieve defined levels on the following scales:

- *Effectiveness*: meaning the results of interaction in terms of speed and errors.

- *Learnability*: meaning the relation of performance to training and frequency of use, i.e. the novice user's learning time with specified training and retention on the part of casual users.

- *Flexibility*: allowing adaptation to tasks and environments beyond those first specified.

- *Attitude*: user satisfaction with system.

Another pioneer in the field of usability that recognized the importance of usability engineering was Jakob Nielsen (1993). Nielsen defined usability as a quality attribute that assesses easy use of interface by the user. The word "usability" also refers to methods for improving ease-of-use during the design process. Usability is one of the focuses of the field for Human-Computer Interaction. As the name suggests, usability has to do with bridging the gap between people and machines. In human-computer interaction and computer science, usability usually refers to the elegance and clarity of the interaction within a computer program or web site design. The term is also used often in the context of products like consumer electronics, or in the areas of communication, and knowledge transfer objects (such as a cookbook, a document or online help). Besides, usability and utility; there is also the ability to help users to carry out a set of tasks, which together form the usefulness of a system.

Different from Shackel, Nielsen did not give a precise definition of usability, but presented the operational criteria that clearly defined the concept. Nielsen defined usability measurement in five quality components by conducting usability testing:

- *Learnability:* systems should be easy to learn. Users can rapidly start getting some work done with the system.

- *Efficiency:* systems should be efficient to use. When a user has fully learned the system, productivity will be possible on a high level.

- *Memorability:* systems should be easy to remember, making it possible for casual users to return to the system after some period of not using the system, without having to learn everything all over again.

- *Errors:* the system should have a low error rate, which enables users to make few errors during the use of the system. When they do make errors they can easily recover from them.

- *Satisfaction:* systems should be pleasant to use; which make users subjectively satisfied when using it.

In fact, there are other different definitions which can be made. Usability attributes can be divided into objective operational criteria which a user can attribute performance to such as efficiency and learnability of the task given. In terms of subjective operational criteria, the user can assess attributes for the satisfaction and effectiveness. Usability is important because from the user's perspective, usability can make the difference between performing a task accurately, completing the projecting or not, and the enjoyment of the process. From the developer's perspective, usability is important because it can mean the difference between success or failure of a system. From a management point of view, software with poor usability can reduce the productivity of the workforce to a level of performance worse than without the system. In all cases, lack of usability can cost time and effort, and can greatly determine the success or failure of a system.

Research Methodology

Throughout this study, the researcher will use Qualitative and quantitative research methods to construct the framework of a research study. Quantitative and qualitative research methods involve very different assumptions about how research should be conducted and the role of the researcher. The major research approach in this study will be quantitative data. Quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon. There are two different variables to measure in this research. The goal in conducting quantitative research in this study is to determine the relationship between effectiveness of images and the usability measurement within a population.

The exploratory research used is a methodology to formulate this investigation. The researcher constructed a base on the prototype of historic buildings using virtual reality applications in order to experiment on the usability of the product. The idea of using the prototype approach is to help the respondents become more oriented and allow them to discover more of the new ideas than to limit them to the evaluation of existing ideas of still image of Malay houses at Kampung Baru, Kuala Lumpur.

**Figure 1.** Cresswell J.W (1994) Research Design
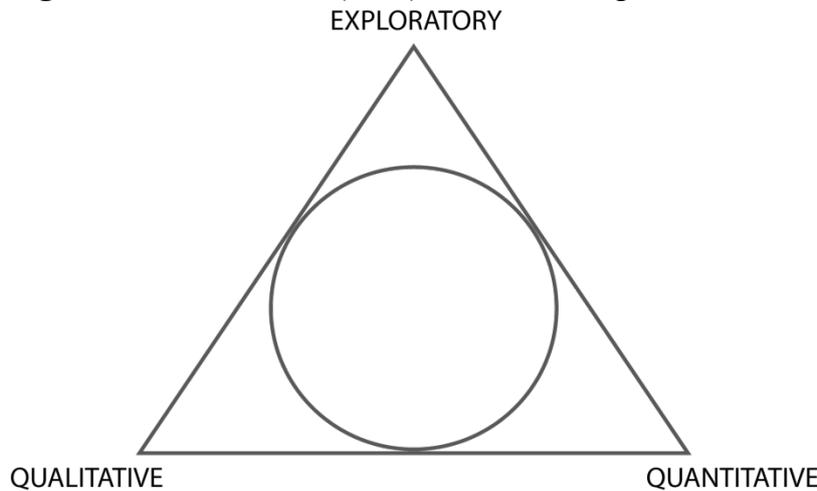
Exploratory research helps diagnose the dimensions of problems so that successive research projects will be on target. It also helps to set priorities for research. In some cases exploratory research provides an orientation for researchers by gathering information on a lesser known topic. Although a research project has not yet been planned, information about an issue is needed before the appropriate diagnosis of the problem can be developed.

Research Design

The case study of Kampung Baru Kuala Lumpur is important for evaluating the usability of VRML applications for preserving historical buildings in virtual space. Case studies are useful for providing an in-depth understanding of complex situations and also for suggesting models and mechanisms to integrate with theories. Case studies are powerful in providing demonstrations that are counter examples to theories (Kirkley, 2005). Many well-known case study researchers such as Robert E. Stake, Helen Simons, and Robert K. Yin (2006) have written about case study research and suggested techniques for organizing and conducting research successfully. This introduction to case study research draws upon their work and proposes six steps that should be used:

Figure 2. The Case Study as A Research Method by Robert E. Stake, Helen Simons, and Robert K. Yin (2006)
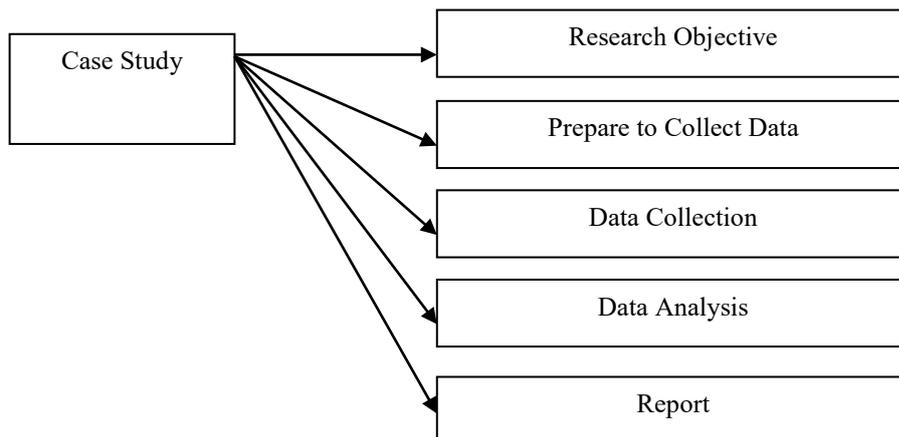
The researcher was asked about the usability of VRML applications in terms of presenting information for historic buildings in the context of preservation. There are a variety of approaches to usability evaluation that can be chosen. The approach of choice depends on cost of usability evaluation. In this project a combination of two types of usability evaluation (the instruments) will be used:

- Questionnaires in Usability Engineering by Kirakowski (2000)
  i. Two types of close- ended questions style which are Likert scale and multiple – choice question.
  ii. Three type of questionnaires for usability evaluation:
     a) *Factual–type questions*: for objective data that it would be uneconomic to obtain another way.
     b) *Opinion-type questions:* directing the respondent's thought outward, basically determining the popularity of something.
     c) *Attitude questions:* directing the respondent's thought inwards, determining their satisfaction with an artefact and design detail.

- Usability Testing Measurement
  i. Effectiveness
  ii. Memorability

Sample and Population

In this study, the researcher used stratified random sampling for the populations. A total of 150 respondents were recruited for this research. There were tourists aged between 25 to 56 years old. Using focus groups to evaluate a system is a very efficient way to obtain user feedback and gauge initial reactions to a design. Focus groups are also good at discovering how the system being tested differs from the user's current expectations (Foraker, 2000).

Research Setting

The effectiveness and usability testing sessions were conducted to observe respondents when using the VRML of historic building project prototype. During the usability test, both verbal and nonverbal behaviours could be observed. In such situations, the methods and procedures adopted would require the ergonomist to use specialized equipment for recording and monitoring this information. The effectiveness and usability testing were performed remotely using a laptop in different locations. Expected locations were at the international public transport centre, tourism centre and Kampung Baru, Kuala Lumpur. These locations were chosen because of the high density of people with expected sociological differnces. Feedback from differing types of people will lead to better results for this report. Respondents were

instructed to navigate two different types of images of Kampung Baru, still photos and VRML panoramic photography. Before the testing, the respondents were informed about the purpose of the research and the testing measurement for usability of virtual reality in historic building appreciation. They were also informed about the current scenario of historic building preservation using a lot of still photos.

Plate 1: Outdoor View of Kampung Baru Malay house by using VRML photography

Data Analysis

This chapter will analyze the data collected. The data analyzed will be divided into two categories, based on effectiveness and usability. The data will be based on questionnaires given to 150 tourists who were divided into two groups. The first group was for tourists who had not visited Kampung Baru or historical places before. They were asked questions based on the effectiveness of the images. The second group was for tourists who had already visited Kampung Baru or other historical places. They were asked questions about the usability measurement. Each category will be analyzed based on the respondent's profiles and actual data measurement.

The Effectiveness of Images Data Analysis

Table 1: The Effectiveness of Images Data Analysis

Still Photo	VRML Photography
4.2%	87.4%

Visualization of historical buildings through virtual reality photography is the most suitable method when used in the presentation of culture and heritage values. Images and information through virtual reality photography provide users with a highly interactive experience to explore virtual environments in a unique and dynamic way. In fact the use of VRML photography will encourage viewers to process the rich information provided by virtual reality worlds, and assist them to recall their new knowledge of historic building appreciation.

The Usability Measurement Analysis

Table 2: The usability measurement analysis

Effectiveness	70%
Memorability	64.1%

In conclusion, usability enables easy access to users interface when in use. Usability also refers to methods for improving ease-of-use during the design process. Besides that, usability and utility help users carry out a set of tasks to form while using the system. The result of the usability testing can be treated as a baseline or control measurement to indicate improvement. Overall the usability testing can be concluded as follows:

1. *Effectiveness* is accuracy and completeness where specified users can achieve specified goals in a particular environment. The user's ability to successfully use the system to find information and accomplish their tasks.

2. *Memorability* is a system which should be easy to remember, making it possible for a casual user to return to the system after some period of not using the system, without having to learn all over again.

Findings

From the respondent's feedback, the VRML system had recently received a lot of attention and wide spread media coverage based on how the system could be the main method of delivering information on appreciation of historical buildings. The effectiveness of images provided by this system could easily surpass and replace still photos which was the conventional method of documenting historical buildings. The respondents agreed that the system of VRML would be the most ideal and suitable method for presentation of our culture and heritage values as compare to still photos. The effectiveness of VRML photography provides viewers with a flow of information in an interactive and dynamic manner, which would be difficult or almost impossible to obtain through still photos or texts.

In the context of usability, the respondents felt more enhanced of its effectiveness on the perceived information. The respondents were able to experience, and later accomplished, the task of a walkthrough the historical building. The respondents were able to gain access to information easily, quickly and without any frustration while using the system. The longer the respondents accessed and navigated through the system, the more their productivity and performance increased. Most of the respondents had also agreed that the degree of remembering the task materials with this system was basically simple and easy, even after some period of time. The respondents did not have re-learn the system. Overall, the

respondents were also satisfied that with this system they were able to have many experiences and gained valuable new knowledge.

It was also found that the system is suitable and reliable in other areas of visual communication and transfer of knowledge, such as the preservation of valuable historical buildings. Generally, old but valuable buildings should not be left to rot and decay through time and all steps should be taken to salvage them. The public at large generally would play their part to save, protect and finally preserve those buildings. This way, these buildings could be saved and preserved for the next generation of future modern societies to appreciate and to be proud of their national and cultural heritage.

Conclusion

Using VRML allows for a greater appreciation of historical buildings. The simulations of real or imaged environments, can be experienced visually in 3D, and may provide additional interactive experiences in real time with sound and possibly with tactile and other forms of feedback compare. Usability in VRML is reliable. Furthermore, this system allows people to complete their task easily, quickly, with satisfaction and without frustration, which will ultimately save time and money for people to achieve their goals. Appreciation via VRML will allow the restoration of artefacts and monuments either to their presumed 'as built' buildings, or to a particular time period. The VRML system can also serve as a promotional tool for enhancing heritage tourism, cultural awareness, and education.

Acknowledgement

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