

Graphical representation of the navigation status in a virtual tour

By

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Dissertation submitted in partial fulfillment of

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Universiti Teknologi PETRONAS
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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Business Information System Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirements for the
Bachelor of Technology (Hons)
(Business Information System)

Approved by,

(Dr. Suziah Sulaiman)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

April 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NGUYEN MINH TUAN

ABSTRACT

Nowadays, the term “panoramic virtual museum’ has become familiar among us since there are numbers of existing panoramic virtual museums throughout the world. However, despite Malaysia being a country with developing technology infrastructures, it can be realized that there is still a lack of museum websites that have applied this technique successfully. Furthermore, looking at most current existing museum websites in Malaysia today, it is found that, these entire websites are poor at implementing website navigation usability and focused primarily in text rather than graphics. Thus, it may result in the loss of interest to the users and they may unable to find the content that they want to view. Therefore, this project is aimed to develop a web-based panoramic virtual museum for a local museum in Malaysia (Pasir Salak Historical Complex). By using the prototyping-based methodology, an application of virtual museum will be developed based on user requirement collected through interview and questionnaire. Within the scope of the project, it will focus mainly on developing a graphical representation of navigation for user to interact with; avoid navigational confusion and make it become more attractive.

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ABBREVIATIONS AND NOMENCLATURES

ICT	Information and Communication Technology
SDLC	System Development Life Cycle
RAD	Rapid Application Development
SUS	System Usability Scale

CHAPTER 1

INTRODUCTION

1.1 Background

According to U-seng, H. (2012) in her previous study: Panoramic Virtual Museum Website [1], a survey question was raised whether respondents have experience in visiting actual museum. Surprisingly, only 21% of 145 answers reckoned they had not been to any actual museum before. The fact that nearly 80% of the respondents interested in visiting the museum indicates that museums still play a vital role in society as informal learning institutions where people can visit, find and obtain knowledge besides library and school.

However, in the next part, U-seng continued her study by asking the participants two questions. The first question is about whether they have experienced any museum website in Malaysia before and the second one is concerned with their acknowledgment of panoramic virtual museum website. Unfortunately, 79% and 88% of the respondents, respectively, answer with the “no” option. This result shows that there is a lack of user’s interest toward museum websites in Malaysia. In addition, people have no idea what a panoramic virtual museum looks like whereas this type of museum has becomes more and more popular these days in many countries.

Therefore, this project is carried out to; firstly, develop a virtual museum for a local museum in Malaysia (Pasir Salak Historical Complex) which helps users interact with, acquire knowledge and enhance their feeling like experiencing in a real environment. Secondly, the project will focus more on the usability of the application which will construct a graphical representation of navigation which enable audience to find the content they want to see easily and effectively. Basically, the focus on navigation aspect was supported through a research paper conducted by N.Rahim et al. (2011) [2]. In that paper, navigation was mentioned as one of the three most important factors needed in

developing a virtual museum. The completion of this project will be one of the first panoramic virtual museum website in Malaysia.

1.2 Problem Statement

Recently, with the rapid development of the information technology and mass media, the concept of interactive virtual museum constructed with 360 degree panoramic images has been applied widely in several museums in all over the world and yet become new way to attract a huge number of audiences. Nowadays, it is not difficult to find a museum website that implements that kind of technique. However, when it comes to Malaysia, this kind of model has not been popular. Currently, many museum websites only come up with ordinary 2D pictures and unattractive descriptions. Therefore, author wants to develop the first panoramic virtual museum in Malaysia.

Furthermore, this project is a continuation from a previously developed virtual museum project. In that virtual museum, navigation usability have not been taken into account and based primarily in text rather than graphics. Therefore, it will result in the loss of interest to the users since most of them are getting difficulties and confusing in navigating their location, result in unable to find the content that they want to see.

1.3 Objective

- To develop a web-based virtual museum application with graphical representation for users' navigation, for reducing loss or disorientation in obtaining information, based on the user behaviors.
- To evaluate and improve the usability of the developed online virtual museum.

1.4 Scope of study

The scope of this project is to conduct a study on users behavior in web-based interactive virtual tour to evaluate which navigation tools are preferred among them Based on the result of the research, a virtual muse for the local museum in Malaysia (i.e.

Pasir Salak Historical Complex) with effective navigation tools will be developed. User can experience the virtual tour like they are visiting an actual museum.

1.5 Feasibility of the project within scope and time frame

As stated in the academic structure, this final year project will be conducted in eight months (2 consecutive semesters). During that time, the author is able perform several tasks like research, gather and analyze data from user, implement the prototype of virtual museum and conduct testing to enhance better functionality. Besides that, the size and complexity of the project is categorized at medium level; therefore, it is suitable for a Final Year Project at undergraduate level. This figure below illustrates the deliverable for each phase of System Development Life Cycle:

Planning	Analysis	Design	Implementation
<ul style="list-style-type: none"> • Problem Statement • Objectives • Scope of project • Feasibility 	<ul style="list-style-type: none"> • Literature review • Data collection • Data Analysis 	<ul style="list-style-type: none"> • Activity Diagram • Use Case Diagram • System Architecture • System Framework • System Interface 	<ul style="list-style-type: none"> • System Prototype • User Testing • Enhancement

FIGURE 1.1: Deliverable for each phase of SDLC

For further reference, detailed Gantt chart and Key Milestones were designed and shown in the later chapter (Chapter 3).

CHAPTER 2

LITERATURE REVIEW

2.1 Information and Communication Technology (ICT) used by Museum

According to Nick Poole et al, the term of Information and Communication Technology (ICT) refers to several ways that computers can be used to communicate and interact among people [3]. With the rapid development of technology, nowadays, ICT plays an important role in changing how people share and obtain information, hence, affected the way of learning and teaching as well, especially by the use of Internet.

On the other hand, the word “museum” is defined as “a non-profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment”, by the International Council Of Museum, also known as ICOM [4].

Through this importance of their roles, the ICT should be applied and implemented in related institutions. That is why during the *International Conferences on Hypermedia and Interactivity in Museums* (ICHM) in 1991, the idea of applying information technology in museum to display objects, artifact as well as preserve heritages of a nation in an interactive way was introduced for the first time and fully supported. It was said to be changing how museums deliver information to the general public using advanced technology and multimedia means [5]. After that, in 1997, Yang G. in one of his study demonstrated that more and more museums are interested in using technology information (i.e. Internet, World Wide Web) for the purpose of enabling audiences to access to and find information from profound collections of these institutions [6].

2.2 Virtual Museum Tour

Nowadays, the concept where ICT is implemented in museum for the purpose of attracting more audiences of virtual museum tour is become more and more popular. Virtual Reality Panoramic is fallen under the category of image-based Model in virtual reality technology. A panoramic virtual museum will generates a 360 degree image of a museum's real environment to the audiences with an aesthetically pleasing and greater sense of reality [7]. By using the advanced technologies to efficiently distribute resources on the network, the virtual museum compensated for the limitations of traditional museum and become a new trend of modern museums nowadays. Besides offering to site visitors such modern tools like virtual graphical representation, personalized searching engines as well as a virtual community of users, this kind of museums also comes up with a perfect solution of maximizing sharing of helpful knowledge via Internet. Having the same idea with this, Ben Davis in his article for *Aperture Magazine* clearly concluded that the virtual or digital museum would become the visitor-centered rather than the curator-centered [8].

A sample of panoramic virtual museum website nowadays is the *National Museum of Natural History*, a part of Smithsonian Institution, U.S. It is one of these museums in the world that quickly applied and implemented the virtual museum tour paradigm for their website and was successful. Regarding to the amazing statistic number provided by their website, there are more than 15,000 visitors come to museum a day and nearly 600,000 visits for the collection data bases available on the web. This statistics reveal an undeniable fact that virtual museum model can attract a massive number of audiences [9].

However, when it comes to Malaysia, in the level of information and Communication Technology use by museum in Malaysia, Abu Bakar et al in their recent study, stated that nowadays, despite having been developed in all over the world, the concept of virtual reality are still unfamiliar with most of Malaysia's museum. Furthermore, at the end of their research, the writers came up with a clearly conclusion that the level of ICT using by Malaysia's museum is still very low and not adequate to the advancement of

technology. There is a lack of studies as well as research work to enhance the technology utilization among these institutions. Therefore, it is a must rather than an option for them to take into accounts the model of virtual museum [10].

2.3 Navigation issues in websites

In this project, a web-based virtual tour application with graphical representation will be implemented for the purpose of providing an effective communication tools to the museum's audiences to interact with; enabling them to find and obtain easily content from the place being visited. However, according to Fang X. et al (2007) [11] in their study, the writers pointed out that nowadays not all websites are successful in disseminating content to web site users due to several problems with the website usability. There is no doubt that designing a website with high level of usefulness is a tricky task to any developers. The study also revealed one of the most frequent problems encountered in websites is that the users are suffering from confusion and disorientation caused by disorganized or inappropriate navigation structures.

Having the same problems, Jacek G. et al in implicit measures of lostness and success in web navigation (2007) [12] mentioned that it may be a burden for the web site users to acquire knowledge or simply navigate their location in a complex, huge websites which contain variety of information. Also in their paper, the writers found out that navigation issue in designing website is being aware of for a very long time ago as an obstacle on the users' experiences by a number of previous studies. "Disoriented searchers seem to have difficulty forming a cognitive model of the information structure (Kim and Hirtle, 1995; Dieberger, 1997; Boechler, 2001). Since the structure of the information space is usually not transparent it is often difficult for users to navigate in a goal-directed way (Dieberger, 1995). Users can become lost because of the non-linear nature of hypertext systems (Chen and Macredie, 2002) and, if there is considerable cross-referencing among pages, looping behavior may result (Boechler, 2001)"

Since the web navigation played an important role in the success of a website, Eric Miller -a website graphic designer with more than 10 years experiences-[13] shared 5 valuable rules of how to make effective web navigation.

TABLE 2.1: 5 Valuable Rules to Make Effective Web Navigation

No	Rule	Description
1	Navigation Should Be Easy to Find	Navigation should be put in a separate place that audiences can easily go for it and more important, it will not be lost among other contents of the website.
2	Keep it Consistent	The design the navigation should be kept consistently in the same style, color and positions rather than changing for every page.
3	Less is More	Designer should avoid putting too many navigations options since they will make web site users become confused and disoriented.
4	Use Obvious Section Names	It is necessary to mention to the audiences which location they are visiting in the website by highlighting the sections. To do so, the designer has helped users whether they are finding the right pattern or information that they need or not.
5	Remind the User Where They Are	It is recommended that website developers should clearly label section names to avoid confusion to users.

2.4 The importance of graphical representation for websites

From the study of the previous part of this report, it can be seen that an inappropriate navigation structure would have a tremendous impact on the level of acquiring knowledge and information of audiences. Therefore, it is necessary to conduct a research on which option of navigation is suitable for large number of users when they want to visit a virtual website. Although not directly related to navigation topic, Nielsen [14], in paper: Flash and Web-based Application, founded that it is important to make the web-application be immediately understandable since the users always spend less time for

this type of application and they have no motivation to learn if the application's features are too advanced. Applying this finding from Nielsen, a scholar named Bastanlar, Y. (2007) [15], in his studies about user behavior in web-based interactive virtual tours, conducted a research on which preference of navigation structures will be the best choice for a virtual tour. The writer came up with 3 options for the audiences that are simple and usually used for web navigation; asked the user to choose which tool they believed it would be the effective way:

1. Navigation arrows: hotspots that can link from one section to related sections in the virtual museum.
2. Floor plan: A graphical representation of real map. Users can click on different sections in the map to visit the places that they want.
3. Drop down menu and image.

By looking at the results of this study from 15 participants, Bastanlar founded that all participants agreed floor map or graphical representation would be the best alternative choice. By contrast, only six of them believe the navigation arrows would work well and interestingly, none of participants think that drop down menu would be an effective way. Another conclusion that is taken out from this research is the option of navigation arrow would be preferred to people who would like to expose to natural visit by passing to the neighboring sections; drop-down menu would work well if the audience intends to visit only certain part in the museum. According to Nielsen (1993), the reason why users prefer graphical interfaces than character-based interfaces is because the graphical interfaces provides better usability characteristics, especially with respect to learning for beginner users. In addition, the graphical interfaces also offer to users the feeling of natural and compelling [16].

CHAPTER 3

METHODOLOGY

3.1 Project methodology

During the developing process, Rapid Application Development methodology or RAD methodology was adopted. In a nutshell, it is a new system development methodology that enables to adjust the System Development Life Cycle (SDLC) phase so that the system can be developed rapidly in order to be delivered to customers. By doing this, customer or the users of the system can have an overall understanding about the main functionality of the system and thus, be able to suggest modification to improve system's functionality effectively and efficiency.

3.2 Prototyping-based methodology

Since the main objective of this research project is to develop a web-based virtual museum application which is served for a numbers of audiences, changing would be a factor that should be taken into consideration carefully. Therefore, it is recommended that the methodology used for designing the application should be prototyping methodology because it will quickly deliver a prototype at the early stage to the users. Besides, this type of methodology also can provide a higher quality product due to users' involvement in the developing process

In a nutshell, a prototyping-based methodology comprises of 4 stages: planning, analysis, design and implementation. A prototype which comprehends limited numbers of main functionalities of the proposed system will be created and quickly delivered to user for the purpose of evaluation to obtain revision or feedback. Therefore, a better secondary prototype with improved features will be re-analyze, redesign and re-implement. These three stages will be performed concurrently in a cycle until the system is completed. [17]

This below figure will illustrate the core framework in the prototyping-based methodology:

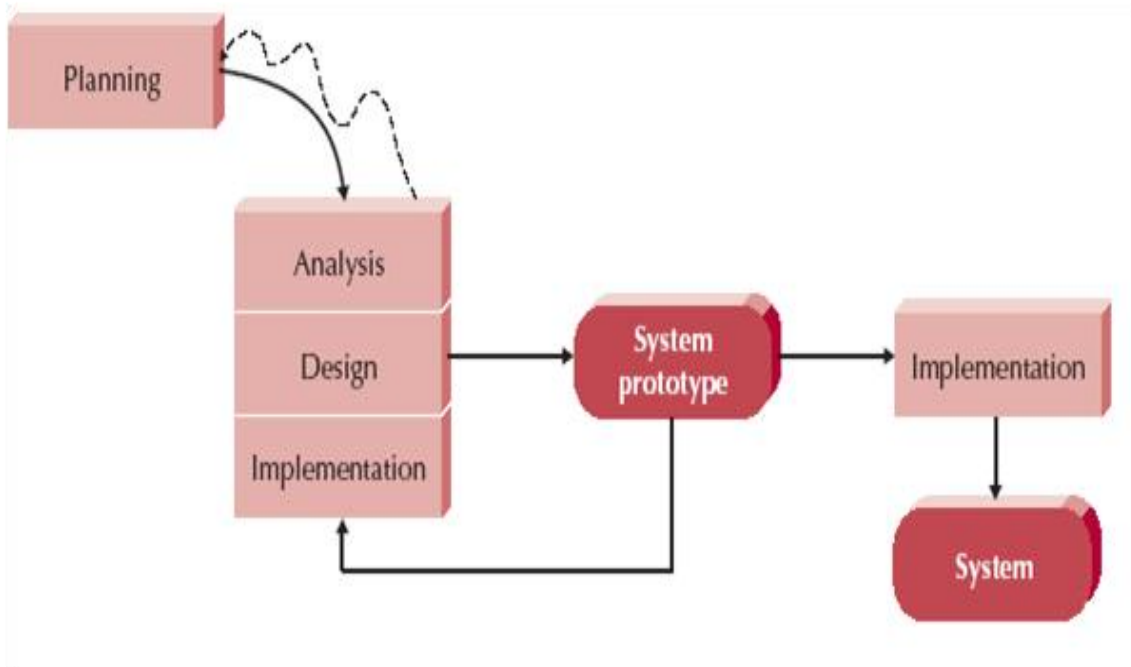


FIGURE 3.1: The Prototyping-based Methodology [17]

3.3 Project activities

TABLE 3.1: Project Activities

Stages	Activities
Planning	<ul style="list-style-type: none"> • Clearly define problem statement and propose solution. • Clarify the main objectives of this research project • Plan for project’s Gantt Chart and Key Milestones • Analyze feasibility to examine the key aspect of the project • Identify the required tools and software involved.

<p style="text-align: center;">Analysis</p>	<ul style="list-style-type: none"> • Investigate on preceding studies by collecting, analyzing information from several previous research papers and studies, articles, scientific journals and existing application of virtual museum. • Collect primary data through an observation test to investigate and evaluate the interests of general public toward the concept of panoramic virtual museums, therefore collect necessary requirements from the users in order to support for the development of the web-based application. During the test, both closed-ended and opened-ended questions were provided to the participants to gather more information accurately. The detailed of the testing will be discussed in detail in the next chapter.
<p style="text-align: center;">Design</p>	<ul style="list-style-type: none"> • Visit Malaysia local museum (Pasir Salak Historial Complex) to collect more data for the development process: <ul style="list-style-type: none"> ❖ Collect data that has not been captured in the earlier project. ❖ Get the permission from the local museum for taking picture and the floor map of the whole museum that will be used in developed the floor map navigation tools later. ❖ Seek for feedback, comment from the officers at the local museum for new add-on features of the website. ❖ Merge the 2 sets of feedback from the observation test above and from the officers in local museum and finalize first website requirements from this. • Create the flow chart for the system and design the system architecture based on the foremost website requirements. • Design the framework and interface for the application. The interface should be well-organized, user- friendly and provide proper information to website users.
<p style="text-align: center;">Implementation & Testing</p>	<ul style="list-style-type: none"> • Quickly establish a virtual museum website prototype and deliver to users for the purpose of gathering their feedback and

	<p>recommendation.</p> <ul style="list-style-type: none"> • Based on customer revision, re-analyze, re-design and re-implement the museum website for better functionality. • Conduct functionality test to check again whether proposed functions have been achieved or not. • A testing will be performed once the system is accomplished to evaluate the level of acceptance from the audiences of this museum website.
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3.4 Tools and Software involved

In order to successfully implement this research project, the following designing tools and software will be used:

3.4.1. Eclipse Integrated Development Environment (IDE)

Eclipse is introduced as a multi-language software development environment that comprise of integrated development environment (IDE). With this kind of tools, the programmer can develop application in Java language easily and rapidly. It also plays as a graphical HTML/JSP/JSF editor or a profound library of plug-ins for the view of developing application as recommended by many outstanding Java developers.

3.4.2. My SQL Query Browser 5.5

In this project, MySQL tool will be uses as the database management system whose main function is data management, data mining for the application. The reason why the author choose this tool is because it is considered as one of the most effective open source software for databases and due to its high performance, high flexibility that can on multiple platforms.

3.4.3. Sun Java SE Development Kit (JDK)

The Java Development Kit (JDK) is a product of Oracle Corporation that is created for the purpose of developing Java applets and application. This kind of tool is said to be easy for both new and experienced programmer to quickly construct a web-based as well as full-featured applications.

3.4.4. Apache Tomcat Server 7

Since the main objective of this project is to develop a virtual museum website that can serve a huge number of audiences at the same time, it is necessary to find a server that is strong enough to fulfill this requirement. Apache Tomcat is an open source web server that is aimed to deliver a "pure Java" HTTP web server environment for Java code from Oracle Corporation. As the programming language used for this project is Java, this tool is the best choice for the system.

1.4.5. Creating and Editing Panoramic Pictures Software

The author will use designing tools and software

- ❖ **PTGui:** is used for the process of stitching image that combines a collection of small images into a large panoramic image.

- ❖ **Adobe Photoshop CS5:** to edit the brightness of the taken pictures so that the users would not recognize panorama pictures in the website are stick from a numbers of different images.

- ❖ **Pano2vr:** a professional software to create virtual tour by adding features into panorama pictures, linking them together and automatically converting into Flash output.

- ❖ **Audio Converter:** to create narration for the popup window.

3.5 Gantt Chart

No.	Deliverable /Week	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
	Planning Phase														
1	Preliminary Research For Project Title														
2	Identify Problem And Propose Solution														
3	Identify Objectives ,Goals And Scope Of Project														
4	Identify The Required Tools And Software														
5	Submission Of Project Title Proposal														
	Analaysis Phase														
6	Research on the preceding studies														
7	Define Methodology Approach For Project														
8	Submission of extended proposal														
9	Collect Data For System														
10	Analyze Collected Data														
11	Prepare System Requirement														
12	Develop Activity Diagram For System														
13	Proposal Defense														
14	Submission Of Final Interim Report														
	Process														
	Activities														
	Suggested Milestone														

FIGURE 3.2: Gantt Chart And Suggested Milestones for FYP1

No.	Deliverable /Week	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Design Phase															
1	Get the permission from local museum														
2	Seek for feedback and recommendation from museum's officer for new add-on features of the virtual museum														
3	Prepare required equipment														
4	Take pictures and create panorama images														
5	Submission of Progress Report														
6	Design and Develop Virtual Tour with floor map navigation in Flash														
7	Design and Develop Website using Flash output from above step.														
8	Finalize System Prototype.														
Implementation and Testing Phase															
9	Pre-SEDEX														
10	Functionality Testing														
11	User Acceptance Testing														
12	Documentation														
13	Viva														
14	Submission of Dissertation														
15	Submission of Technical Paper														
16	Submission Of Final Dissertation														
	Process														
	Activities														
	Suggested Milestone														

FIGURE 3.3: Gantt Chart And Suggested Milestones for FYP2

CHAPTER 4

RESULT AND DISCUSSION

4.1 Study 1

4.1.1 Data Collection

The main objectives of this study are aimed to collect primary data from investigating and evaluating the interests of general public toward the concept of panoramic virtual museums and parallel gathering necessary requirements from the users in order to support for the development of the web-based application in these following ways:

- Rating the preference among current Malaysia museum websites.
- Determining which option of navigation structures is preferred among users.
- Gathering feedbacks from users for the concept of graphical representation for navigation structures and its effectiveness.

The study was conducted from November 14th to November 21st, 2012 with the participation of 15 respondents who were the both undergraduate and post graduate students in Universiti Teknologi PETRONAS. According to one of Nielsen's researches [18], the writer had mentioned that 15 participants is an adequate number for a test in order to find all the usability problems in the design.

The study consists of 2 parts that combine both closed-ended and opened-ended questions so that participants can easily evaluate these given websites as well as provide their feedbacks, express their opinion or suggest new ideas for the concept of this project. In part 1, 15 participants had to perform some certain tasks with these following Malaysia museum websites:

1. **Museum Negara Malaysia** (<http://www.muziumnegara.gov.my>.)
2. **Virtual Museum Melaka** (<http://www.virtualmuseummelaka.com>.)
3. **Chengho Museum** (<http://www.chengho.org/museum/web/history.html>.)

They were asked to explore themselves and evaluate based on the given questionnaire. A questionnaire comprising of 11 questions was given to the testers. Among 11 objective

questions which are rated on a 5 point scale from “Strongly disagree” to “Strongly agree”, some questions are developed by the author and the others are taken from the System Usability Scale (SUS) questionnaire, developed at Digital Equipment Corp and the author had replaced the words “system” with “website” to adapt them with the purpose of this study [19]. For each question which is equivalent with a statement, the participant would indicate their degree of agreement by placing a cross in the appropriate box. After that, the participant would have to answer a question to investigate which websites they preferred the most as well as the reasons they choose that website.

According to U-seng, H. (2011) [1] in her previous study of panoramic virtual museum, she noticed that there is a lack of information and exposure from the users about this types of museum website as well as there are not many museums in the world could implement this technique in their website. Therefore, the purposes of this part are engaging the user with a real model of panoramic virtual museums and collecting the comments, feedbacks together with degree of satisfaction from the participants. For part 2 of this study, the participants will be brought to **Smithsonian, National Museum of Natural History** ([http://www.mnh.si.edu/panoramas/.](http://www.mnh.si.edu/panoramas/)) where they have successfully applied and implemented a panoramic virtual tour with graphical representation for navigation structure.

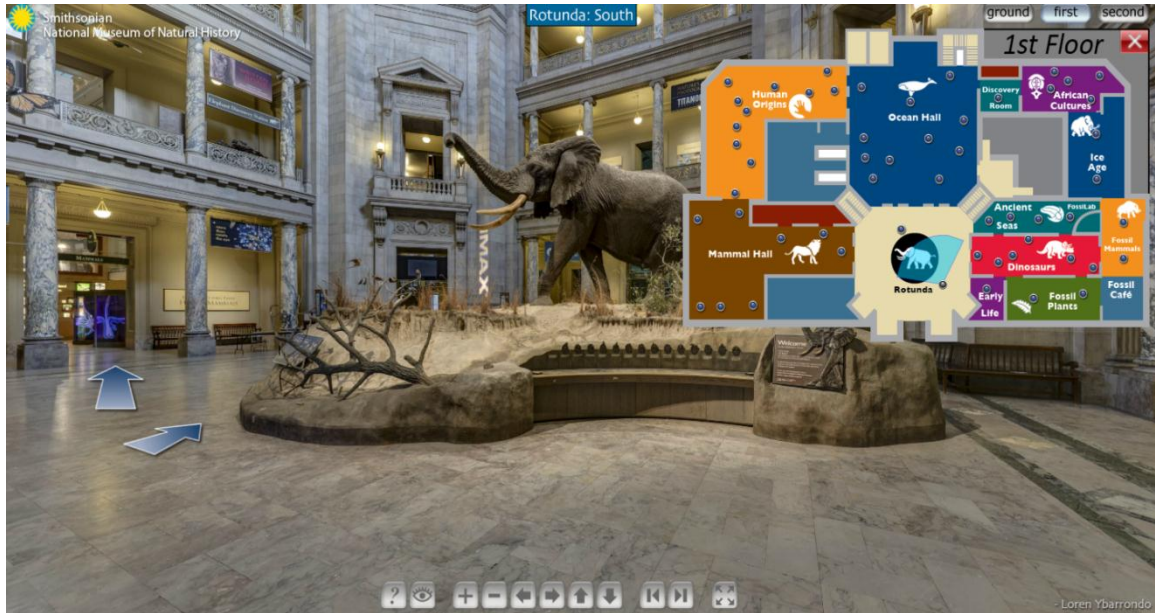


FIGURE 4.1: Smithsonian Virtual Tour's Interface

During the part 2, all the participants were asked to discover the website freely by themselves and identify the navigations tools provided within the website as much as possible. Similar to the part 1 of the study, after taking a virtual tour around the museum, the participant had to complete a given questionnaire to investigate their response with this type of museum and the level of how well the participants perceive the website. The questionnaire only consists of 9 questions, and most of questions focus mainly more on the degree of satisfaction (i.e. “I feel comfortable when using this graphical website”, “I found this website is very interesting and easy to use”, “I think this kind of website is very efficient”). All the questions are still rated on a 1-5 scale from “Strongly agree” to “Strong Disagree” and the participants would indicate their degree of agreement by placing a cross in the appropriate box. Besides, the author also asked some subjective questions so that the participants can freely express their idea about what the strengths and weaknesses and their perception on the navigation structures of this virtual museum.

4.1.2 Data analysis

As mentioned above, the collected data is divided into 2 parts which are going to be analyzed in these following sections.

4.1.2.1 Part I of Study 1:

For part I of the study, 3 selected website were given to the participants to investigate visitor's preference for website. The reasons why the author chose these 3 website are:

- For Muzium Negara website: As stated in the name of the museum, Muzium Negara is the national museum of Malaysia. Therefore, the author expected that the website of one of the biggest museums in Malaysia would look professional, well-organized and provides a proper information to the users.
- For Virtual Museum Melaka website: Since this project is about virtual museum concept, thus, the author had conduct a small research to find out whether this concept had been implemented in Malaysia or not. Surprisingly, only one result was found and that is the website of Virtual Museum Melaka. This study shown that the term of "virtual museum" is still quite unfamiliar in Malaysia.
- For Chengho Museum website: the author chose this website for this observation test because of the unique way that cultural heritages, artifacts and antiques in this museum were presented to the visitors through the use of a virtual map. The concept of Chengho Museum is similar to what the author is going to do with his project; hence, I decided to include this website in this study to investigate the reaction of participants toward this kind of navigation structure.

After a short briefing of 3 websites, the participants were asked to go through and explore themselves freely. The table below illustrates the results of questionnaire (the total score for each website) from the participants. For each questions in the questionnaire, a score was calculated for each website. The highest total score demonstrates which website is preferred among the 3 current website.

TABLE 4.1: Questionnaire’s Result Part I

Questions	Scale					Score for Website 1	Score for Website 2	Score for Website 3
	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree			
	5	4	3	2	1			
I thought I would like to use this website frequently	1	3	7	4	0	46	37	51
	0	0	9	4	2			
	0	8	5	2	0			
I found the website unnecessarily complex	2	4	3	5	1	46	42	40
	0	6	3	4	1			
	0	4	3	7	1			
I thought the website was easy to use	0	11	0	3	1	51	40	60
	1	4	1	7	2			
	4	7	4	0	0			
I found the various functions in this website were well integrated.	0	5	9	1	0	49	43	53
	0	2	9	4	0			
	1	8	4	2	0			
I thought there was too much inconsistency in this website	0	3	6	6	0	42	45	35
	1	4	4	6	0			
	0	1	3	11	0			
I would imagine that most people would learn to use this website very quickly.	0	7	4	2	2	46	48	54
	3	4	1	7	0			
	1	7	7	0	0			
I found the website is very cumbersome to use.	0	6	2	7	0	44	47	40
	0	6	5	4	0			
	0	4	2	9	0			
I felt very confident using the website	0	6	5	4	0	47	44	53
	0	6	2	7	0			
	1	8	4	2	0			
I needed to learn a lot about this website before I could effectively use it.	2	1	2	9	1	39	48	40
	3	3	3	6	0			
	0	3	4	8	0			
I could easily find the content that I want.	1	5	5	2	2	46	35	55
	0	3	2	7	3			
	1	9	4	1	0			
I thought it is easily for me to navigate where I am in the website	0	4	3	5	3	38	37	56
	0	3	4	5	3			
	1	11	1	2	0			
Total Score						494	466	537



FIGURE 4.2: Total Score for 3 Website

Looking at figure 4.2, we can easily see that the website 3 which is Chengho museum is the one that has the highest score: 537. Next to it, Muzium Negara is the second preferred website with 494 for total score from 11 questions which slightly less than Chengho museum. Lastly, the lowest total score belongs to virtual museum Melaka with only 466. Having the same result with the questionnaire, when a subjective question: “which websites do you like the most?” was given, 12 out of 15 responses from the participants are Chengho museum is the website that they prefer the most while only 3 participants chose Muzium Negara and no answer for Virtual Museum Melaka.

To make the analysis clearer, all the participants were required to state out the reasons why they choose that website as the most preferred one. For Chengho museum, a respondent emphasized that the reasons she was attracted to this website are “this website provides more photos with clear descriptions. Besides that, the gallery is arranged based on graphical location so that the users can easily navigate where they are in the museum”. Agreeing with that opinion, other participants, who also choose

Chengho museum as their first alternative, expressed that the most interesting factor in this museum website is the unique way they arranged the gallery through the use of a virtual floor map. By looking at it, they can see the flow of the story telling by the museum when they follow the navigation structure without encountered any problems. Some of the participants also highlighted that they prefer a website with more pictures and graphics rather than websites contains only texts and a few pictures like the case of Virtual Museum Melaka (remind that Virtual Museum Melaka is the website that have the lowest score based on the questionnaire). It indicates that by developing a museum website with more graphic features such as the floor map using in Chengho museum, ideally, it will attract more users to visit the website.

However, among the majority that chose Chengho as their preferred alternative, there are still 3 participants reckoned that Muzium Negara is a very good website to visit. The reasons are although Chengho museum provided a very interesting tools and more pictures included in the exhibition, the interface seem to be too simple compare with “an eye-catching”, more “professional” outlook of Muzium Negara. In addition, all the content and information in this website is placed properly and neatly through the use of drop-down menu so that the users can find specific information quickly. This comments show that besides graphic features, an user friendly interface is also an important factors that the author should take into consideration.

4.1.2.2 Part II of Study 1

TABLE 4.2: Questionnaire’s Result Part II

Questions	Score					Mean Value	%
	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree		
	5	4	3	2	1		
I think I would like to use this website frequently	4	9	2	0	0	4.13	82.7
I found this website is very interesting and easy to use	7	6	2	0	0	4.33	86.7
I found all the content that I want in this website	5	8	1	1	0	4.13	82.7
I feel comfortable when using this graphical website.	4	10	0	1	0	4.13	82.7
I feel very confident using the website	2	10	1	2	0	3.80	76.0
I would imagine that most people would learn to use this website very quickly.	1	10	3	1	0	3.73	74.7
I need to learn a lot about this website before I could effectively use it.	0	5	2	5	3	2.60	52.0
I think this kind of website is very efficient	4	10	1	0	0	4.20	84.0
I think the full screen mode is the best choice for this kind of museum.	11	4	1	0	0	4.93	98.7

As mentioned in the previous section, the purposes of the second part in this study are to enable the participants to interact with an implemented panoramic virtual museum and from then, gathering user’s requirements for the development of the project later. This table above illustrates the result from question 1 to 9 in the questionnaire taken from the participants for part II of the study. For each participant, they were required to indicate their degree of agreement on a 1-5 scale for each statement. From there, a mean value of each question will be calculated. The higher the mean value is, the higher the level of acceptance of general public for this type of museum (except for question 7). By using this following formula, we can easily calculate the mean value:

$$\text{Mean Value} = \frac{\text{overall total score for each scale}}{\text{total responses}}$$

For instance, with question number 1, there are 5 participants agree that they will come back to this website frequently for other purposes like entertaining or acquiring more knowledge. This yield a total score of $(4*5) = 20$. Repeating this step, I can calculate the total score for other scale: Agree scale: total score equal to $(9*4) = 36$; 6, 0 and 0 for neutral, disagree and strongly disagree scale respectively. Therefore, the mean value will be measured by: $(20+36+6+0+0)/15 = 4.13$. Similar to question 1, using the formula and the same method, I can easily calculate all the mean value for the rest of questionnaire. As among all the questions to investigate the level of enjoyment, the lowest mean value is 3.73 (question number 7 is an exception) and the highest one is 4.93. This calculation denotes that the participants were totally fascinated with this panoramic virtual tour. Therefore, there is a potential to attract more and more customers to museum website by applying this technique.

Many participants expressed that the museum enhances their feeling as they are visiting the real museum. They were presented to a clear and colorful display of the museum's view with high definition photo gallery. From their point of view, the participants can easily interact with the museum such as zoom in/out, or rotate the pictures to view the environment in three dimensions. However, one of the most important factors that contribute to the success of this museum website is the navigation. Many participants agreed that multiple options for choosing the destinations to visit enable the excitement in them while starting the virtual tour. For instance, the participants can easily locate their current position and move straightforward to the next section they want to visit thanks to the help of a virtual floor map and navigation arrows placed in the display. This was proven based on the result of 2 questions which were given to the participants to investigate how they perceive the navigation structures of the website. The first question is: "Did you recognize the use of provided navigation option?" and an overall result is shown in the table below.

TABLE 4.3: Recognition of Participants on Navigation Tools in Smithsonian’s Virtual Tour

	Not recognized	Recognized but not used	Seldom Used	Frequently used
Floor map	2	0	0	13
Navigation Arrow	0	2	3	10

Looking at the table, there are 13 over 15 participants said that they usually use the floor map option for navigating through sections of the museum. However, it is noticeable that some participants still complaint the “position of the map is not easy to see” since they have to click on the buttons to open it, and even when opened it, there are still 2 participants did not realize that the map is clickable. This issue suggests that the author should provide a short description/ guideline to the user to get used to before they start the tour. Conversely, when it comes to the other navigation option which is arrows located in the window, all the participants reckoned that they did recognized this type of navigation option in the website. Nevertheless, the number of participants preferred this option is slightly lower than those of floor map option, only 10 participants believed that they would use these navigation arrows frequently meanwhile 3 indicated they did realize but seldom used and the rest said they did not want to use it.

TABLE 4.4: Effectiveness Of Navigation Tools in Smithsonian’s Virtual Tour

	Unnecessary	Can be used but not really effective	Effective
Floor map	0	0	15
Navigation Arrow	0	3	12

For the second question, the participants were asked to rate the effectiveness of these 2 navigation option based on 3 level: “Unnecessary”, “Can be used but not really effective”, and “Effective”. From the result table above, the reader can easily find that

the floor map option is more preferred; therefore it is rated as more effective than the navigation arrows option. It is proven by 100% of participants rated it as “Effective” while this percentage is only 80% for the second option. Regarding to the opinion of one participant, the reason is due to with the floor map option, the users are easier to locate the current positions compare to the other options. It show a broader view of the museum, enables users to move to different sections rapidly , smoothly, effectively and efficiency. With the navigation arrows, the users still can walk through the museum easily, however, it may lead users to places that they do not want, or maybe repeated sections. Moreover, these arrows do not fully lead users to a completed round of the museum. According to Bastanlar, Y, in his research about user behavior in web-based interactive virtual tours, the navigation arrows are only effective for the user who prefers a sense of natural visit by passing the neighboring section [15]. From the results of the study, the author found that it would be better if I combine the advantages and benefits of both 2 navigation options, therefore providing to the users a completed tool to navigate.

Besides that, the participants also provided to the author some precious feedback to enhance the quality of the virtual museum. One of them is to limit the range of rotation due to the reason that rotating the view up and down may cause dizziness to users. Moreover, there are some complaints that they cannot find the information or description for those photos that show a detailed view for heritages or artifact to the users. The author would take into account all of these issues and consider them during the developing process of the project.

4.1.3 System's Activity Diagram

This below activity diagram illustrates a detailed to-be system that is developed based on the users' requirement gathering during the previous study and also on existing virtual museum application which is Smithsonian. The proceeding of the user-interaction system is developed in a simple way so that users at variety of ages, education background can easily use and interact with.

To start the virtual tour, users will click on the icon of virtual tour in the website and it will automatically open a new window for the user to start the tour. Initially, a panoramic photo of the started point will be loaded from the website's database. After the loading process, the users can start viewing the panoramic image for a certain section of the museums. With a panoramic image, there are varieties of features that help users interact with the virtual environment:

- **Rotate the image:** Users can rotate the view from right to left, up and down by using the provided buttons.
- **Zoom In/Out:** To view the artifacts, cultural heritages more clearly, the users can also use this feature of the website to zoom in and out for a particular point of the panoramic images.
- **View Popup Window:** For some certain parts of the museums (i.e. the areas that present attractive artifacts, etc...), the website will provide additional pop-up information to the users. While clicking on a special provided button, a new pop-up window where visitors can **view detailed images** in high quality of the artifacts and **hear the narration** that act like a real tour guide will be automatically opened.
- **Use Navigation Arrows/ Floor map:** In order to move to other section of the virtual museums, the visitors are offered two kinds of navigation tools. The first one is floor map which is an intelligent virtual map that provides a general view of the whole museums. The visitors can skip the sections that they do not want to visit and move straight forward to the places that they are keen on. The second

option is the navigation arrows which enables visitors to navigate section to section. When using these two navigation options, the users will be transferred to the next section and the process will start again from the loading process to viewing the panoramic image.

The virtual tour will only end when the website's users close the window.

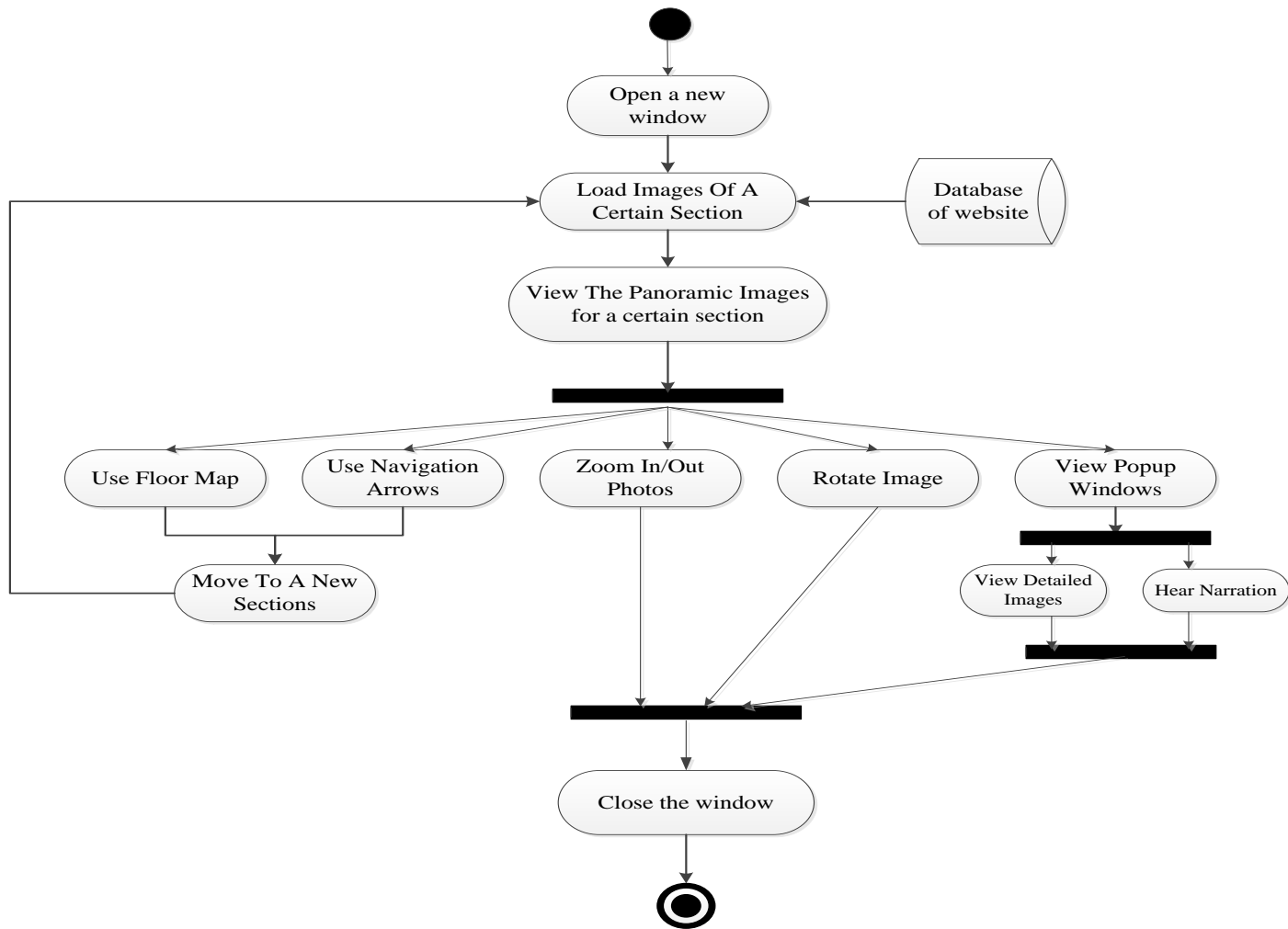


FIGURE 4.3: System's Activity Diagram

4.2. Prototype Development

4.2.1 Museum Visited



FIGURE 4.4: Pasir Salak Historical Complex Entrance

As it can be seen from the figure 4.5 above which show the entrance of the Pasir Salak Historical Complex, this museum is located in Kampung Gajah Town, Ipoh, Perak which formed by several traditional Malay old building alongside the Perak River. As its name has implied “Pasir Salak Historical Complex”, it is the memorial to the people in Perak and remarkable Pasir Salak history. This is also the place where the author will start developing the project. From UTP, it is not difficult to find the way to the museum since there are a lot of sign along the road and especially, there is a very big Durian monument at crossroad that will help people easily remember the way to Pasir Salak. In author’s case, luckily I can ask my senior to drive me there and it only takes us 40 minutes to reach the museum. However, the author mentioned that it would be

inconvenient for visitors to go to the museum if they would like to use the public transportation since there are a few bus from UTP to Kampung Gajah town and from the way back, it is kind of difficult to find public transportation to go back the town. The only choice is people have to call the taxi and it takes very long time to wait for the taxi to come. However, the author believes that this drawback will become one of the factors that support the development of this project.

Establishing in 1990, but only until 2004, the museum is opened officially to the public. It consists of both outdoor and indoor architectures which the author finds it is very interesting to discover. For outdoor architectures, when visitors come to Pasir Salak, they can easily find models of traditional old Malay houses, a watch tower, lela rentaka, a type of cannon used by old Malay, traditional harvest dance stage and many more. For the indoor, the most interesting thing that only can find in Pasir Salak Historical Complex is the Historical Time Tunnel which includes of many dioramas displaying the most important and remarkable events as well as flash points in the history of Malay and Malaysia. Besides that, in order to make the tunnel become more attractive, the museum has set a laser that detect when the visitors pass by, it will automatically activate the narrator and the sound play. The down stair of the building is the place exhibiting many of ancient antiquities and weapons used by old Malays together with video play that show more about the process to produce these weapons and the history of them. Nowadays, the museum is managed under the control of Administrative board of Perak museum. In a nutshell, the author found that this museum is a very interesting place for people not only foreigners but also Malaysians to visit and discover more about Malay history.

During the museum visit, it was an honor for the author to have an opportunity to cooperate with Mr. Mohd Fauzi Mohamad Razali, the assistant curator of Pasir Salak Historical Complex. Mr. Fauzi always shows himself as a supportive and cooperative person since the first time I came to the museum. As this project has been developed by another student, it does not take the author long time to explain to him what I am going to do to enhance the current developed website and what new features will be added in order to make the website look more attractive, useful and professional. Through the talk with Mr. Fauzi, the author found that currently there is no official website for the

museum. If visitors want to find any information about the museum, they have to go to the website of all museums in Perak and from there, look for Pasir Salak Historical Complex page. However, from the author's observation, this site is not very user-friendly, no updated information about the museum and sometime users cannot access to the page. Mr. Fauzi also mentioned that the Pasir Salak Historical Complex used to have an official website but due to several problems, they have to close it. Therefore, the author believes if the project is developed properly and successfully, it may become a way to attract more and more visitors to come to the museum. Furthermore, when I show Mr. Fauzi about the new concept of the museum (as showed below), he believed that this would be a great way to develop the website, even he also found himself that it is very interesting for users to interact more with the pictures and discover by themselves. Especially, Mr. Fauzi also very interested in the floor map tool which show the overview of all the session that visitor can visit in the museum. "I have never seen anything like this before. It is very interesting", he said excitedly.

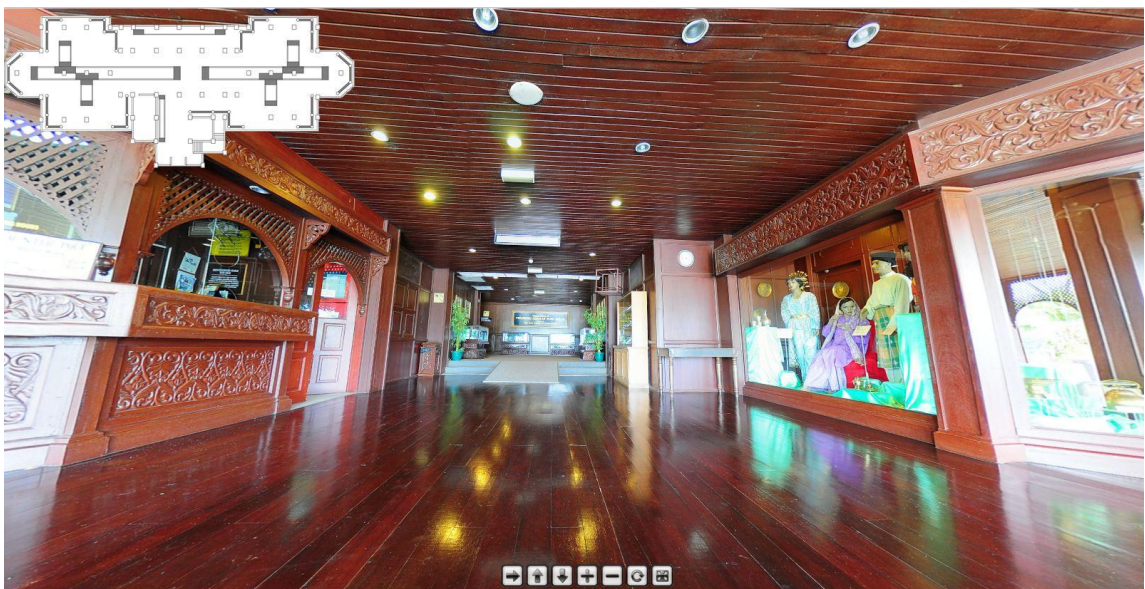


FIGURE 4.5: The concept of the virtual tour

However, during our discussion, the assistant curator mentioned that there are some places and items could not be shown in the website due to the afraid of copyright issues and the possibilities that fake items will be made by unknown parties. Thus, the scope of

this project was narrowed a lot. In the end, he concluded that “This idea of the project is very good since the main purpose is to help people know more about the museum and attract more visitors; however, everything has two side effect. If the project covers all the places in the museum, then people have no reason to go here directly since they can sit down in front of computer and access through Internet”. From his point of view and compare to the scope of this FYP project, I will only focus in two session of the museum which is the Historical Time Tunnel and Weapon session.

4.2.2 Challenges

During the development of the project, the author has faced several challenges. The most significant challenge occurred was the process to capture, stitch and generates 360x180 degree panoramic pictures due to the following problem:

1. Lack of equipment: the first and foremost rule while photographing panoramas is the users have to shoot all the images from exactly single viewpoint. In other words, the camera used to take the pictures should rotate around a center point called the optical center of the camera or also known as Entrance pupil of the lens. When two images were taken in 2 different viewpoints, the objects in the pictures might have different shape and therefore, during the stitching process, the software cannot recognize the similar point between them. As a result, a different will be visible in the overlap between two adjacent images [20], or sometime the stitching software cannot even stitch these images together to create the panoramas. This problem is called Parallax. To solve the problem of Parallax, normally, people will use equipment called panoramic head, a tool sticks to the tripod and help the camera to rotate 360 degree but still around a center point. However, due to the constraint of budget, the author cannot afford to buy a new panoramic head since its price is very expensive. To overcome this problem, the only one way is the author has to capture more images. The more images were taken, the higher the successful level of stitching images. For every panorama, the author has to take more than 15 images even I have used the fisheye lens which is a very wide lens while with a full frame camera, fisheye lens and the panoramic head, author only has to take 6 pictures. As a result, it takes the author a very long time to capture and stitch images.



FIGURE 4.6: Parallax Problem

2. The second problem is the lightness in the Historical Time Tunnel and the narrow space of the Weapon session. As the name has implied: Time Tunnel, there is no light inside the tunnel. The only source of light comes from dioramas in the wall. If author use flash of the camera, the brightness of each picture will be different. Once the pictures are not in line with each other, it will be very difficult for the stitching software to create the panoramas. To avoid it, author might need to use the Adobe Photoshop CS5 software to ensure all the pictures taken have the same brightness. However, this problem still can be sold by using a software but when it comes to the the second session of the project which is Weapon session, due to the narrow in space of the session, some place author really cannot create the panorama since the space is very small.

Besides, another challenge I have mentioned in the previous part is there are some sessions or items exhibited in the museum could not be shown in the website due to the concern about copyright issues. Hence, if author want to public these information, it would be required a lot of documentation and the permission from the director of Pasir Salak Historical Complex.

4.2.3 The process of converting and creating panoramas into Flash output

In this part of this report, author will describe the way how author create and convert panoramas into flash output. The process will be illustrated in these three simple steps:

- **Step 1: Taking images to create panoramas**

In this step, normally, a center point of the environment will be set and from that point, 10-15 pictures will be taken by using tripod until it covers the whole intended field of view with photos.



FIGURE 4.7: Images to create panorama

- **Step 2: Stitching the Images**

In this step, software called PTGui will be used to create panoramas. It will automatically rearrange these above images regardless of order and stitch them together by finding the similar point in each image called control points. A cylinder panoramic will be produced as the output. After generating the panorama, Adobe Photoshop CS5 software will be used to eliminate small faults of the images.



FIGURE 4.8: Panorama from the above pictures

- **Step 3: Converting into Flash output**

By using Pano2VR software, the author is able to easily convert the panoramas in JPEG format into Flash output to create interactive virtual tour. Besides, the software allows the author to build in many features for the virtual tour such as hotspots to link different panoramas into a complete tour, customize skin for the tour, create floor plan and other navigation tools, etc...

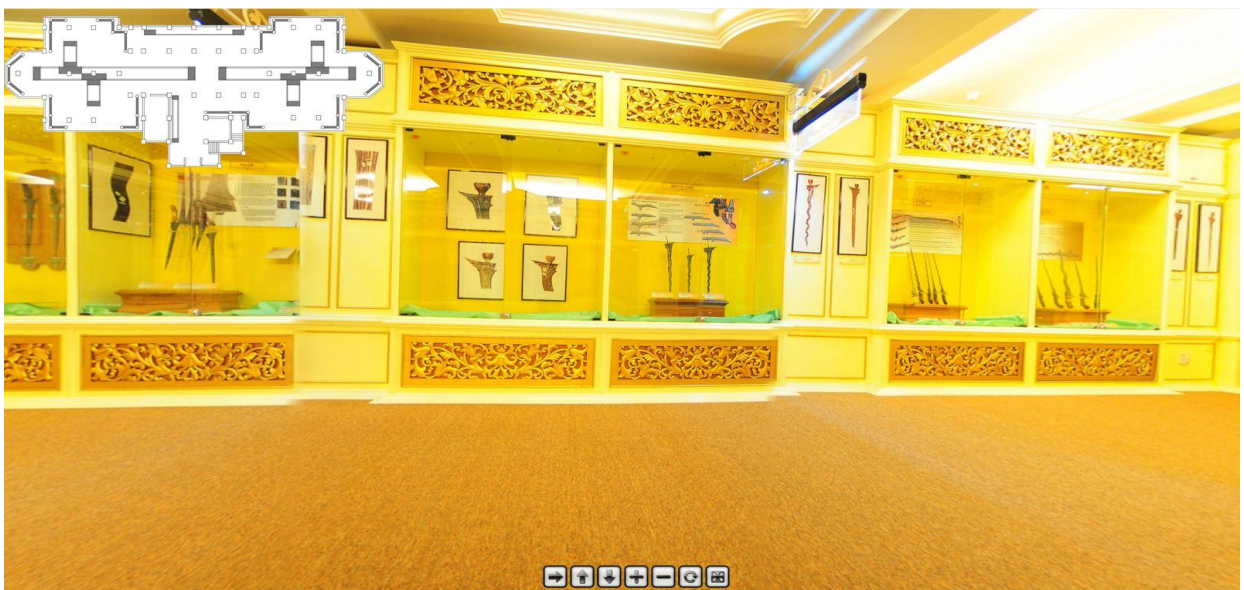


FIGURE 4.9: Flash output

4.2.4 Prototype

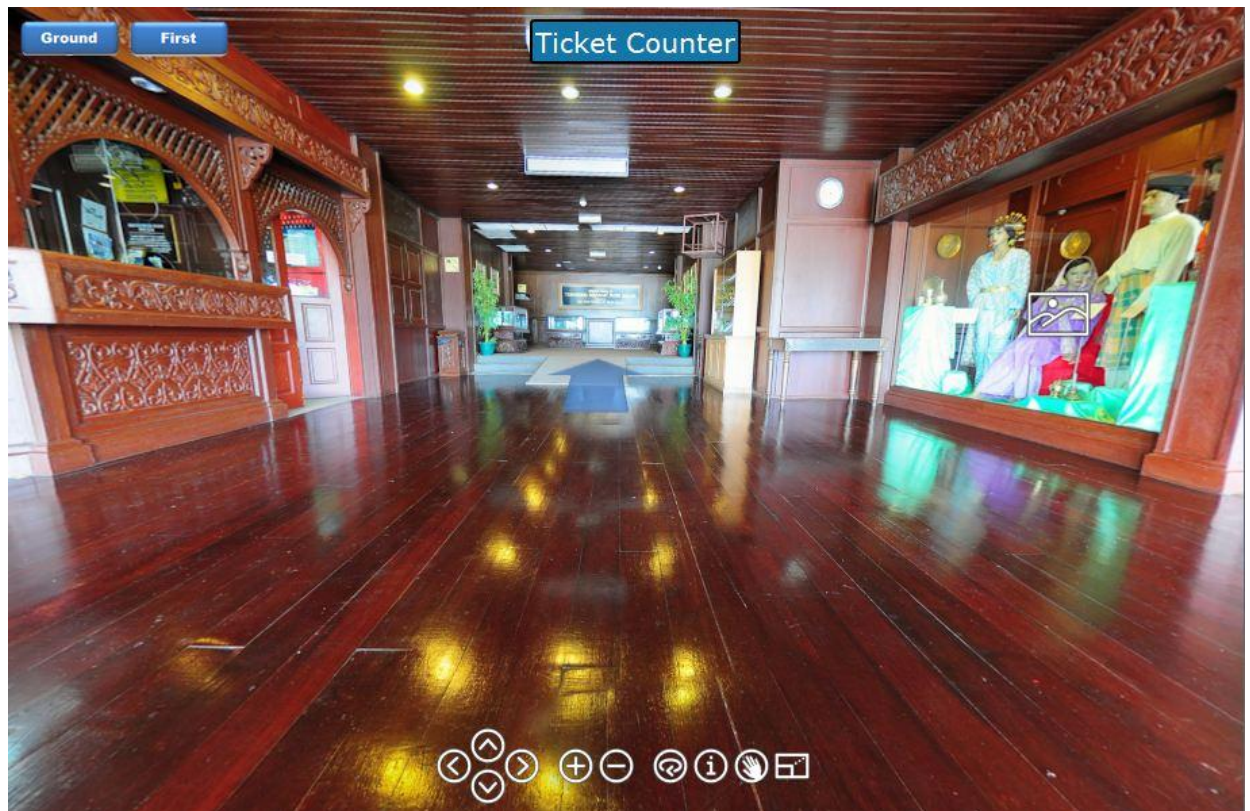


FIGURE 4.10: The Interface of the virtual museum

As can be seen from the figure above, it illustrates the design of Pasir Salak Historical Complex virtual museum's interface. For this part, the author will go through all the features of the virtual museum with detailed explanation.

In the upper left corner of the interface, there are two buttons labeled as "first" and "ground" which indicate the two sections in the ground and first floor of the museum. When users click on one of these two buttons, a designed floor maps will be shown to them. The floor map will provide an overview of all the spots that visitor can visit in the virtual museum as shown in these following figures:

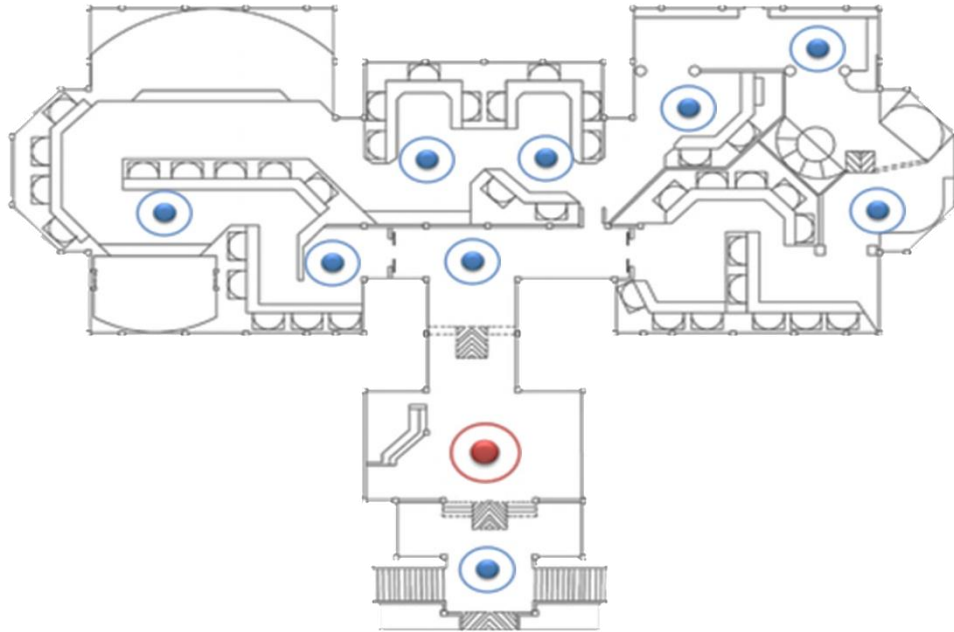


FIGURE 4.11: Floor map of Time Tunnel Section

From figure 4.11, it can be easily seen that there are two types of dot displayed in the floor map: the blue dots and the red dot. The red dot indicates the current place that the user viewing (means the current panoramic images which are displaying on the screen) and when users click on the red dot, nothing happens.

By contrast, the blue dots denote other places user can visit. When users click on these blue dots, the screen will load the panoramic image of that certain place and at that time, the red dot will be triggered and the blue dot will be replaced by the red dot to indicate the current position of the users. In addition, every time users put the mouse over these dots, a small textbox will be shown in order to let them know the status of that place.

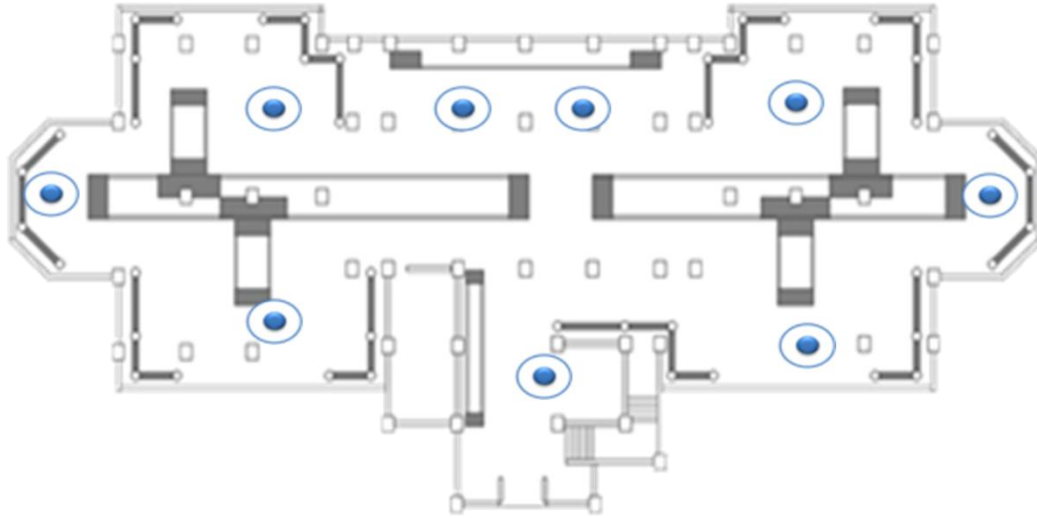


FIGURE 4.12: Floor map of Keris Section

In the middle of the interface, there is a blue textbox which will be used to label the status of the current place that the users are viewing. The idea of this textbox is from the previous part of the study (refer to section 2.3 in the report). In that part, Miller, E.-a website graphic designer- in one of his article, mentioned that it is a good idea to inform the audiences which location they are visiting in the website by highlighting the sections. The purpose of doing that is the designer already helped users know whether they are finding the right pattern or the right information that they need or not [12].

Another navigation tools that can be found in Pasir Salak virtual museum is navigation arrows. Similar to the mechanism of these blue dots on floor map that have been mentioned above, every time the users click on navigation arrow, they will be moved to the next panoramic section. However, different from the floor map tools which provide an overview of all places in the museum, when it comes to the navigation arrow tool, sense of direction will be the first things that users think about. In this virtual museum, the author intentionally designs arrows with different direction as shown in the following figure.












FIGURE 4.13: The navigation arrows used in the virtual museum

The reason is because the author wants to provide to the users the feeling like they are experiencing in an actual museum. They can know where they can turn left, turn right or go straight in the museum. That is also one of objectives that the author wants to achieve in this project.

In this virtual museum, the user also can found many different tools to interact with architectures and artifact displayed in the museum such as they can rotate to 360 degree, zoom in/out, tilt up and down, auto rotate and turn into full screen mode.

TABLE 4.5: Buttons used in the Virtual Museum

Buttons	Description
	Buttons that enables users to pan left/right
	Buttons that enables users to tilt up/down
	Buttons that enables users to zoom in/out
	Buttons that enables users to start/stop auto-rotation.
	Buttons that enables users to get extra information from the author
	Buttons that enables users to change control mode
	Buttons that enables users to change to full screen mode
	Buttons that enables the popup window to show the detailed images of the artifact or architecture shown in museum.
	Button that enables the user to hear the narration from popup window.

In order to provide more information about the architecture and artifacts shown in the museum, popup window was designed to perform this task. In a popup window, users can find a detailed picture together with the brief description about that object. Besides, narration is provided to users so that they can have multiple-options to interact with rather than only reading text and viewing images.



FIGURE 4.14: Popup window in virtual museum

4.3 Feedback from officers in charge of Perak Museums

After the prototype was completed, author contacted with the officer in the Pasir Salak museum, Mr. Mohd Fauzi, to settle a meeting with him. The purpose of the meeting is the author want to collect feedback and comments on the prototype and seek for more suggestion to improve the usability as well as the design of the prototype. Luckily, right after the author sent an email to Mr. Fauzi, he immediately reply that his boss is very interesting in this project and want to have a meeting with the author on Thursday, 28th March, 2013. The venue for the meeting is in Galeri Sultan Azlan Shah, Bukit Chadan , Kuala Kangsar, Perak.

Surprisingly, when author and his supervisor come to the gallery, everything had been settled. Mr Fauzi had provided a warm meeting room to welcome us and for project demonstration. The meeting was conducted right after our formal greeting to the officers in that Galerry. There are 3 officers in charge in Perak Museums involved in the project demonstration who are:

1. Ms. Nor Janati Ibrahim, Manager, Galeri Sultan Azlan Shah.
2. Mr. Mohd Salleh, officer, Galeri Sultan Azlan Shah.
3. Mr. Mohd Fauzi, Assitant curator, Komplek Sejarah Pasir Salak.

Before the project demonstration started, the author spent 5 minutes to introduce again about the idea as well as the objectives of the project. After that, the author explained on the design of the virtual museum. All three officers were very interested in the prototype; they concentrated in the interface of the virtual museum and wrote down several questions. After the explanation, the author asked Ms Nor Janati to make her own self-exploration. “I have never seen anything like this before. It is very attractive since I can interact with many objects in the museum”, she said after experiencing the virtual museum. Subsequently, the officers began giving the author questions focused on which software that author had used to develop this project, the duration to complete it and what challenges that author had faced. The author felt very happy since this project was gained a lot of attention from officers of museum.

Overall, the three officers were happy and satisfied with the prototype. They found the prototype very interesting as it includes attractive panoramic views of the Komplek Sejarah Pasir Salak's main attractions such as the Keris gallery and, provides interactive features that include options for either textual or audio descriptions of an artifact to be displayed. The prototype highlights adequate information as a "teaser" to those visiting the website to visit the actual museum in the future. One of the officers said "The website developed has about 30% information of the actual museum which is enough to encourage people to come to the museum. This is the thing that we are looking for to attract more customers." Besides that, when author mentioned about the navigation tools provided in the virtual museum, all three officers agreed that the navigation tools work very well and achieve the objective that the author had introduced since the first part which is to reduce loss of users' interest and disorientation in obtaining information.

Furthermore, after providing some precious comment and feedback on the prototype, Ms Janati also gave the author some suggestions that are necessary to be done to improve the prototype which are:

1. The word "dagger" should be changed to "keris and use it throughout the prototype.
2. Author have to correct some typos found in some parts of the prototype.

Besides, there are two suggestions which are considered necessary for future projects which are:

1. If possible, the author can provide a Malay version of the virtual museum for the prototype so that the range of user will be broader since some Malaysian do not know English can also use.
2. The author can find other way to improve the presentation of the content in the museum – e.g. content presentation does not necessarily replicate how it is being presented in the actual museum.

Author was really appreciated all the effort of Ms Janati as well as other officers in the meeting that day to spend time on the project demonstration and provide precious feedback. All the suggestion from the officers in charge will be carefully taken into account to improve the virtual museum in n near future.

4.4 Study 2

At the end of the project, a user testing was conducted with the participation of twelve (12) students from different departments in UTP. The purpose of this testing is to gauge the feedback, comments from potential users of this virtual museum and seek for any suggestions for further development later.

The testing was carried on 3 days from April 1st until April 3rd, 2013. The forms of the testing were printed and distributed by hand to the participants. The content of the testing consists of 3 parts which are the following:

1. Part I: A comparative study between the previously developed project and the current project was conducted. The purpose is to evaluate which version of virtual museum is preferred. If the current project is chosen, it means project's objectives have been achieved which is to improve the usability of the previously developed museum.
2. Part II: In this part, the author asks for feedback of users about the design of the virtual museum's interface and seeks for suggestions to improve the usability of the museum.
3. Part III: In this part, the author asks for feedback of users about the navigation of the virtual museum, whether it is sufficient enough and effective to the users or not, and seeks for suggestions to make it become more attractive and useful.

4.4.1 Part I

In part I, author decided to perform a comparative study between the previously developed museum and the current version to see which version of virtual museum is preferred. Users will have a chance to experience two developed versions of virtual museum without noticing which one is previously developed and which one is the current project of author to ensure that all evaluations from users are truth and fair. 2 version are labeled as version A (previously developed one) and version B (the current one)

Surprisingly, 100 percent of respondent expressed that they are satisfied with the features and design of version B and choose it as their preferences. Looking at these responses, author felt very happy and excited because the objective of this project has been achieved successfully. From their feedback, it can be seen that navigation is the most important factor that make the current version of the virtual museum different from the previous developed one. Some of responses from users can be found in the following table:

TABLE 4.6: Participants’ Response on the Virtual Museum

Respondent	Response
1	“I prefer version B, it looks more awesome and the features are better and well-coordinated than the first version which is version A”.
2	“It has better navigation and user interface design.”
3	“The navigation at version B is very clear. You can easily move to other locations in the museum compare to the other.”
4	“From my point of view, I prefer version B because it provides a better interface. In this version, I can rotate freely, right to left, up and down, thus it makes me feel more flexible compare to version A. Besides, I am also impressed with the floor map tools of the museum. It is such an useful tool to navigate where I am in the museum and help me move around easily.”
5	“I prefer version B because it has more interactive features and is easy to navigate. Besides, the symbol is visible and more meaningful.”
6	“For me, version B is better than version A since it has added more navigation tools. By using these useful tools, the museum has provided a sense of direction to users; make me feel more excited while exploring sections in the museum.”
7	“I like version B more because it has more functions and well-organized. In addition, it looks smoothly than version A.”

4.4.2 Part II

In part II of the study, a set of questionnaire included 4 rating question and 2 yes/no question will be given to users to answer. This part aims to gather user’s feedback on the design of the virtual museum’s interface and thus, seek for suggestions to make a better interaction design. For the first 4 rating question, similar to the study 1, a scale ranging from 1 (strongly disagree) to 5 (strongly agree) will be used to evaluate the satisfaction of potential users toward the interface of the museum. Detail for their responses can be illustrated in the following table:

TABLE 4.7: Questionnaire’s Result Part II of Study 2

Questions	Scale					Mean value
	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	
	5	4	3	2	1	
The virtual museum's interface design is attractive to the users.	7	5	0	0	0	4.6
The content in the virtual museum is well-organized	8	4	0	0	0	4.7
The virtual museum contains no feature that irritates me such as scrolling or blinking text	5	7	0	0	0	4.4
The virtual museum has a consistent feel and look	4	7	1	0	0	4.3

From results shown in the table, it is obvious that the current virtual museum has received positive responses from users. For all questions, the average score is always higher than 4. Based on table, the highest score received is 4.7 and the lowest is 4.3. Most of them felt very excited since there is no type of museum like that available in Malaysia. Some participants compared the features of this virtual museum with Google Street, a product of Google that also provides panoramic tour technique. “It looks awesome!”; “I feel like I am using another version of Google Street but for museum

only". These are two of some positive comments author had received at the end of the testing.

Beside positive feedback from the participants, author also received a lot of suggestions to improve not only the design of the virtual museum but also functionality that users can perform in the museum. From participants' point of view, they agreed that this virtual museum has all basic functions that a virtual museum should have, the content is well-organized and has a consistent feel and look; it is considered as a success of author in developing this virtual museum.

However, in question 6 where participants were asked to provide suggestion in order to make the museum better, some participants added that the museum still lacks of attractive features like allowing users walk step by step in virtual museum which can be found in Google Street or the ability to interact more with the artifacts displayed in the museum. One of participants suggested that if possible, an audio should be placed so that the users might feel more engaging. In addition, with the development of technology nowadays, touch technology found on many digital devices has become very popular. Therefore, it is a suggestion for author to apply this technology in the virtual museum in the future. Author is much appreciated the participants for their suggestion and all of these suggestions will be taken in to account for further development afterward.

For the last question in this part, the participants were asked to assess whether the design of this virtual museum makes sense (easy to understand and easy to learn how to use) Based on results of the questionnaire, 100 percent of participants said that they are satisfied with the design of the museum and have no difficulties while experiencing the virtual museums. Since all the tools are very obvious and clear, they do not need instructions or training before the testing but still can find out by themselves.

4.4.3 Part III

As the name of this project implied: “A Graphical representation for navigation status in a virtual tour”, navigation is the most important feature and also the main focus in this virtual museum. Therefore, in order to gather feedback from the participants on navigation developed in the Pasir Salak Historical Complex and also to determine the user satisfaction when navigating in the museum, a part in the questionnaire has been set aside. The result of this testing part can be summarized as following:

TABLE 4.8: Questionnaire’s Result Part III of Study 2

Questions	Scale					Mean value
	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	
	5	4	3	2	1	
This virtual museum provides sufficient navigation for me to get the desired information.	7	5	0	0	0	4.6
It is easy to move around at this virtual museum by using these provided navigation tools	6	5	1	0	0	4.4
I can easily know where I am at this virtual museum	8	4	0	0	0	4.7
Placement of navigation tools is easy to recognize	5	6	1	0	0	4.3

Based on the result of the questionnaire, it can be concluded that:

- ✓ With 3 navigation tools included: floor map, navigation arrow and a textbox in the middle of the interface, the virtual museum has provided sufficient navigation to user to get the desire information.
- ✓ Users did not get any difficulties to move around the museum with the help of these navigations.
- ✓ Placements of these navigation tools are obvious and clear enough so that it helps users to reduce the disorientation and confusing while experiencing the tour.

Since the participants were satisfied with the navigation in this virtual museum, there are a few suggestions only to improve the effectiveness of the navigation which are:

1. The floor map should be designed again to be more colorful and add some text to highlight the name of sections. It will help users feel more attractive and engaging.
2. A radar beam can be added to the current location to improve the sense of direction in the virtual museum (has been added in the latest version).

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

These days, with the advance of information technology, panoramic virtual museum websites have become a new way of interaction between museums and the general public, providing an effective medium to attract a huge number of audiences, besides the existence of traditional museums. During the duration of the project, author has successfully exercised the concept of panoramic virtual museums into practical. As a result, a new web-based virtual museum with sufficient navigation options based on the users' preferences has been constructed with a high level of interaction between museums and audiences. To conclude, after all study and development, this type of museum will act with no aims to replace the actual museum but as a complementary to promote widely the museum to general public.

5.2 Recommendation

At the end of FYP2, the project has been completed and all aforementioned objectives are achieved successfully. For further development, there are some suggestions that can be considered to improve the virtual museum in future:

1. A more advanced and more interactive virtual museum will be developed, which have more features for users to interact with the museum.
2. A Malay version for the Pasir Salak Historical Complex should also be considered to increase the number of users.
3. The quality of panoramic images should be enhanced since there are some faults with the current virtual museum in order to make the museum become more attractive.
4. A mobile application for the virtual museum will be developed.

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APPENDIX A- 2 SAMPLE FORMS OF STUDY 1

Questionnaire Form	
Name:	TRAN THI THU HANG
ID:	12961
Title:	Undergraduate student - UTP

Please complete the following questionnaire with specific regard to the above enquiry, by placing a CROSS in the appropriate box

Part 1:

Website 1: Museum Negara Malaysia

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I thought I would like to use this website frequently	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the website unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I thought the website was easy to use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the various functions in this website were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I thought there was too much inconsistency in this website	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I found the website is very cumbersome to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. I feel very confident using the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. I can easily find the content that I want.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I thought it is easily for me to navigate where I am in the website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Website 2: Virtual Museum Melaka.

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I think I would like to use this website frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. I found the website unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I thought the website was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. I found the various functions in this website were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I thought there was too much inconsistency in this website	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. I found the website is very cumbersome to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I feel very confident using the website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I can easily find the content that I want.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11. I thought it is easily for me to navigate where I am in the website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Website 3: Chengho Museum.

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I think I would like to use this website frequently	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the website unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. I thought the website was easy to use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the various functions in this website were well integrated	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I thought there was too much inconsistency in this website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I found the website is very cumbersome to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. I feel very confident using the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. I can easily find the content that I want.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I thought it is easily for me to navigate where I am in the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which websites do you like the most? Please state the reasons:

Chengho Museum

Because it shows where I am inside the museum with well-organised photos for exhibition. I can also see the flow of the story telling by the museum when I follow the navigation structure.

Part 2:

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I think I would like to use this website frequently	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found this website is very interesting and easy to use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found all the content that I want in this website	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I feel comfortable when using this graphical website.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I feel very confident using the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. I think this kind of website is very efficient.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I think the full screen mode is the best choice for this kind of museum.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you recognize the use of two navigation tools in Smithsonian's Virtual Tour ?

	Not Recognized	Recognized but Not Used	Seldom Used	Frequently used
Floor map				<input checked="" type="checkbox"/>
Navigation arrows				<input checked="" type="checkbox"/>

Please rate the effectiveness for each navigation tools from this museum website

	Unnecessary	Can be used but not really effective	Effective
Floor map			<input checked="" type="checkbox"/>
Navigation arrows			<input checked="" type="checkbox"/>

Please kindly provide your feedback about this type of museum website

I like all the features especially the quality of the photos. Weakness: the rolling up & down caused dizziness to viewer

Strength: navigation structure offers a feeling of real visiting of the museum. Multiple option for choosing destination enable the excitement. Plus I can identify the section I want to visit easily thanks to the navigation structure.

-Thank you very much-

Questionnaire Form

Name: ID:

Title:

Please complete the following questionnaire with specific regard to the above enquiry, by placing a CROSS in the appropriate box

Part 1:

Website 1: Museum Negara Malaysia

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I thought I would like to use this website frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. I found the website unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. I thought the website was easy to use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the various functions in this website were well integrated	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I thought there was too much inconsistency in this website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. I found the website is very cumbersome to use.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I feel very confident using the website	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. I can easily find the content that I want.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I thought it is easily for me to navigate where I am in the website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Website 2: Virtual Museum Melaka.

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I think I would like to use this website frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the website unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. I thought the website was easy to use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the various functions in this website were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I thought there was too much inconsistency in this website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I found the website is very cumbersome to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. I feel very confident using the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. I can easily find the content that I want.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I thought it is easily for me to navigate where I am in the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Website 3: Chengho Museum.

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I think I would like to use this website frequently	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the website unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. I thought the website was easy to use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the various functions in this website were well integrated	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I thought there was too much inconsistency in this website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I found the website is very cumbersome to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. I feel very confident using the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. I can easily find the content that I want.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I thought it is easily for me to navigate where I am in the website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which websites do you like the most? Please state the reasons:

Chengho Museum
Reasons
 - More photos provided with more descriptions
 gallery arranged based on graphical location
 → easy navigation.
 Easy to move between various junctions in
 the website

Part 2:

	strongly agree	agree	uncertain/ not applicable	disagree	strongly disagree
1. I think I would like to use this website frequently	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found this website is very interesting and easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found all the content that I want in this website	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I feel comfortable when using this graphical website.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I feel very confident using the website	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I need to learn a lot about this website before I could effectively use it.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I think this kind of website is very efficient.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I think the full screen mode is the best choice for this kind of museum.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you recognize the use of two navigation tools in Smithsonian's Virtual Tour ?

	Not Recognized	Recognized but Not Used	Seldom Used	Frequently used
Floor map				<input checked="" type="checkbox"/>
Navigation arrows			<input checked="" type="checkbox"/>	

Please rate the effectiveness for each navigation tools from this museum website

	Unnecessary	Can be used but not really effective	Effective
Floor map			<input checked="" type="checkbox"/>
Navigation arrows			<input checked="" type="checkbox"/>

APPENDIX B- 2 SAMPLE QUESTIONNAIRE FORMS OF STUDY 2.

QUESTIONNAIRE RELATED TO VIRTUAL MUSEUM TOUR

Name (Optional): Huyah Chu Hong

Programme: _____

Part I: COMPARATIVE STUDY BETWEEN TWO VIRTUAL MUSEUMS

Which version of virtual museum do you prefer?

a) Version A.

b) Version B.

Please kindly specify your reasons:

From my point of view, I prefer version B because it provides a
better user interface. In this version, I can rotate freely, right to
left, up and down, thus it makes me feel more flexible
compare to version A. Besides, I also very impressed with the floor
map of the museum. It is such an useful tool to navigate where
I am in the museum and easily help me move around easily

PART II: VIRTUAL MUSEUM'S INTERFACE

Scale: 1 2 3 4 5
 Strongly disagree Disagree Neutral Agree Strongly Agree

1. The virtual museum's interface design is attractive to the users. 1 2 3 4 5
2. The content in the virtual museum is well-organized. 1 2 3 4 5
3. The virtual museum contains no feature that irritates me such as scrolling or blinking text. 1 2 3 4 5
4. This virtual museum has a consistent feel and look. 1 2 3 4 5

5. Do you have any suggestion to improve the interface of the virtual museum?

a) Yes

b) No

If "Yes", please kindly specify it here.

6. Do you need think the design of the museum makes sense and it is easy to learn how to use if?

a) Yes

b) No

If "no", please mention certain specific areas where you are not satisfied

Buttons are small. Need to make larger

PART III: VIRTUAL MUSEUM'S NAVIGATION

1. This virtual museum provides sufficient navigation for me to get the desired information. 1 2 3 4 5

2. It is easy to move around at this virtual museum by using these provided navigation tools. 1 2 3 4 5

3. I can easily know where I am at this virtual museum. 1 2 3 4 5

4. Placement of navigation tools is easy to recognize. 1 2 3 4 5

5. Do you have any suggestion to improve navigation of the virtual museum?

a) Yes

b) No

If "Yes", please kindly specify it here.

- Should design again the floor map, make it more colorful.
- Can provide some text into the floor map to high light important places

****END OF QUESTIONNAIRE****

Thank you for your time and efforts

QUESTIONNAIRE RELATED TO VIRTUAL MUSEUM TOUR

Name (Optional): Nguyen Hoang Viet

Programme: _____

Part I: COMPARATIVE STUDY BETWEEN TWO VIRTUAL MUSEUMS

Which version of virtual museum do you prefer?

a) Version A.

b) Version B.

Please kindly specify your reasons:

Navigation added → clear view on direction.
For me, version B is better than version A since it has
added more navigation tools. By using these ~~useful~~ useful
tools, the museum has provided a sense of direction to
users, make me feel more excited while exploring
sections in the museum.

PART II: VIRTUAL MUSEUM'S INTERFACE

Scale: 1 2 3 4 5
 Strongly disagree Disagree Neutral Agree Strongly Agree

- 1. The virtual museum's interface design is attractive to the users. 1 2 3 4 5
- 2. The content in the virtual museum is well-organized. 1 2 3 4 5
- 3. The virtual museum contains no feature that irritates me such as scrolling or blinking text. 1 2 3 4 5
- 4. This virtual museum has a consistent feel and look. 1 2 3 4 5

5. Do you have any suggestion to improve the interface of the virtual museum?

a) Yes

b) No

If "Yes", please kindly specify it here.

6. Do you need think the design of the museum makes sense and it is easy to learn how to use if?

a) Yes

b) No

If "no", please mention certain specific areas where you are not satisfied

PART III: VIRTUAL MUSEUM'S NAVIGATION

1. This virtual museum provides sufficient navigation for me to get the desired information. 1 2 3 4 5
2. It is easy to move around at this virtual museum by using these provided navigation tools. 1 2 3 4 5
3. I can easily know where I am at this virtual museum. 1 2 3 4 5
4. Placement of navigation tools is easy to recognize. 1 2 3 4 5

5. Do you have any suggestion to improve navigation of the virtual museum?

- a) Yes
 b) No

If "Yes", please kindly specify it here.

An arrow can be added to current location to improve
on sense of direction.

****END OF QUESTIONNAIRE****

Thank you for your time and efforts