Implementation of Virtual Guide in UTP Virtual Mosque

By

Hazida binti Razali

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Information System)

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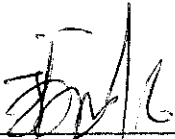# CERTIFICATION OF APPROVAL

Implementation of Virtual Guide in UTP Virtual Mosque

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A project dissertation submitted to the
Information System Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirement for the
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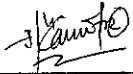(INFORMATION SYSTEM)

Approved by,

_____
(Hasiah Mohamed@Omar)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
December 2005

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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.

HAZIDA BINTI RAZALI

ABSTRACT

Ease of navigation and interaction is the most important element in the virtual environment besides the design and the architecture of the environment of building. This project is focusing more on the development of the virtual guide to aids user in exploring and navigating through the environment. The objectives of this development are to develop a virtual guide and interface, to help user while navigating through the virtual environment and to enhance the user interactivity through the navigation. To achieve the development target, research and analysis had been done to gather more useful information to complete this project followed by designing and development of the application in order to achieve the objective that had been set up earlier and lastly the completed application is evaluated a result had been obtained. From the evaluation, 80% of the respondent agreed that with the implementation of the virtual guide within the virtual mosque, it had helped them a lot in order to explore and understand the environment. For the future enhancement, it is recommended that the use of virtual guide should be explored further as an intelligent agent to make the guide to be functioned more effectively.

ACKNOWLEDGEMENT

Firstly, all my gratitude to Allah s.w.t that had given me the strength, wisdom and patient all the way in completing this project within the given time period.

This project will not be bale to be completed on time without the help and generosity of many people around me. Special thanks for my supervisor, Mrs. Hasiah Mohamed @ Omar that has been patient, understanding and helps me a lot through all the guidance and advice in doing this project.

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CHAPTER 1

1. INTRODUCTION

1.1 Background of Study

The term 'Virtual Reality' (VR) was initially coined by Jaron Lanier, founder of VPL Research (1989). Other related terms include 'Artificial Reality' (Myron Krueger, 1970s), 'Cyberspace' (William Gibson, 1984), and, more recently, 'Virtual Worlds' and 'Virtual Environments'(1990s). Other VR-related technologies combine virtual and real environments. As the technologies of virtual reality evolve, the applications of VR become unlimited. It is assumed that VR will reshape the interface between people and information technology by offering new ways for the communication of information, the visualization of processes, and the creative expression of ideas.

Today, 'Virtual Reality' is used in a variety of ways and often in a confusing and misleading manner. In immersive VR, the user becomes fully immersed in an artificial, three-dimensional world that is completely generated by a computer. Nowadays, the usability of this technology had been extended into other industries such as tourism, real-estate business and educational purposes.

With the existence and emergence of this VR technology, user will have the opportunity to get involved in the virtual environment and control the space exploration with the elements of user interactivity with the virtual environment without having to be in the exact place to understand the environment.

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The usage of VR in tourism industry in Malaysia had been implemented by one of the most leading tourism Web-site in Malaysia (http://www.virtualmalaysia.com), featuring some articles on background and lifestyle, tourism, and festivities in Malaysia. It also provides a comprehensive directory of restaurants, businesses, hotels, and more. This Web-site use QuickTime® Virtual Reality to give a general view of the featured hot tourism spot in available in Malaysia.

This project will be the enhancements form two previous Final Year Project completed by:

1. Mohammad Akbar bin Iklas, entitled *Exploring Virtual Environment Using Steroescoping Display Devices* (2004) and

2. Sharifah Intan Farhana Binti Syed Husain, entitled *Virtual Mosque Interior Walkthrough* (June 2005).

In (Akbar, 2004), he had came up with the architectural model of the currently under development, UTP mosque by using a few software such as 3D Studio Max 6, Amira and Open Inventor, and Microsoft Visual C++. Besides that, he also uses the Had Mounted Display (HMD) to add the feeling of an immersed 3D environment.

While (Sharifah ,2005) had enhanced the architecture model by adding the interior design of the mosque to provide a greater realism to the user of the application. The interior designs are focusing more into the Islamic art design. She also had improved certain walkthrough elements in the application such as the collision detection and sounds to make it more realistic.

As what had been mentioned in the report (Sharifah, 2005), she had made a recommendation to add a virtual guide in order to guiding the user for a walkthrough around the mosque as an amazing enhancement to do, and the users are able to follow the virtual guide and not getting lost. It will reduce the possibility of the user from getting lost as the mosque environment is quite big, and may not be understandable to the user. So, this project will mainly focus on the development of virtual guide that will give information to user and increase the level of interaction with users.

1.2 Problem Statement

1.2.1 Problem Identification

- Problem of Navigation Especially for the First Time User

  A novice user may find it difficult to navigate in the virtual environment. They will not have any clues of where to go and what to do in the given environment. This may significantly reduce their interest in exploring and navigating through the virtual environment.

- Unfamiliarity with the Environment

  For the user who might not really familiar with the Virtual Environment, they might have some difficulties to navigate through the previous applications, as they are not familiar enough to the virtual space presented to them. This also may lead to them getting lost in the space. In the application also, user will just experiencing the walkthrough feeling without being informed about the places within the mosque to improve the user understanding about the mosque itself.

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1.2.2 Significant of the Project

The target user of this project might be either the internal or external community of University Technology of Petronas (UTP). By having this applications, user may gain an experience exploring the mosque which is still under construction for the time being. After it had been completed with the basic architecture and Islamic artificial interior design, the addition of a virtual guide in guiding the user will be very beneficial as the user will be educated about the mosque environment and also enhance their feeling towards the interaction with the application.

Some other elements will be included into the applications to provide a more realism feeling towards the model. These elements also will be very useful to give an idea to the user about the usage of the spaces in the mosque that will reflected into the overall Islamic culture that being practiced by the Muslims especially when they are in mosque.

1.3 Objective and Scope of Study

The main aim of this project is to enhance the previous application by providing an agent to guide user while exploring through the architecture model.

The objectives of this project are:-

- To develop a virtual guide

  The presence of a virtual guide as a guidance for user to walkthrough the application can be very helpful, especially for the user that are not very familiar with the virtual navigation. Furthermore, this effort can educate the user about the ethics and practice that people do and don't in the real mosque.

- To help user while navigating through the virtual environment

  By having the virtual guide, it will help the user while navigate through the virtual environment. The guide will provide some general ideas about the application and what is provided in the application to help them explore the environment.

- To enhance the user interactivity through the navigation

  Rather then just walking through the environment without any direction given, the interaction with a virtual guide can be very exciting because user have a clearer view and information about the surrounding. The virtual guide also may able to give the user a pleasant journey when they are navigating through the virtual mosque, because with the featured of the guide, it will eliminate the tendency of user to be lost on the spaces and loose interest in the virtual world.

Scopes of study for this project are:-

- To provide an interactive virtual guide

  The virtual guide will be provided within the internal environment of the virtual UTP mosque. This virtual guide will functioned and inform user once the interaction happened, for example when user click on the guide to get some help in the virtual space. The virtual guide itself will not just explaining the places in the virtual mosque, but also give some overview about what people do at the place and also a few tips or trivia to the user.

1.3.1 The Relevancy of the Project

The relevancy of this project depends a lot on the usability and the effectiveness of the virtual environment to represent the actual environment to user through the computer.

With the additional of an guide and other objects, this application is ready to be used by the targeted user of this application. This project might be very useful especially for the visitor of UTP to show the advancement and the uniqueness of this university. As the real mosque is still under the development process, visitor can already feel and experienced the significant view of one of many splendid architecture around UTP campus.

1.3.2 Feasibility of the Project within the Scope and Time Frame

This project is targeted mainly for the benefits of the university, which enable to impress the visitors, staffs and students regarding the technology and good name of University Technology Petronas (UTP) and Petronas especially. However the scope of the enhancement of this project will focus only on the development of virtual guide that will improve the interactivity of the application.

The completion of this project should be ready by Week 14 and this will hopefully feasible for the project as it is only focused on the development of the virtual guide within the virtual environment.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Introduction

Virtual Reality is a way for human to visualize, manipulate and interact with computers and extremely complex data (Isdale, 2000). However, most of the application does not able to achieve this objective might be because of lacking in the information for user while navigating within the application. That is why, the presence of a virtual guide is very crucial to make it possible for the application to provide a proper visualization and interaction with user.

This chapter will covers some overview of the virtual reality background, the general problem of user navigation in virtual environment, what the suggestion of how to overcome this problem.

2.2 Virtual Reality Application

Virtual Reality defined as an artificial environment created with computer hardware and software and presented to the user in such a way that it appears and feels like a real environment. This virtual reality (VR) technology can provides the user with an opportunity to have experiences that would otherwise be impossible. User can smoothly and continuously interact while immersed in environments that would be inaccessible or impossible to experience. In these environments, users are free to roam and explore the virtual space.

One of the mostly used VR technology is a virtual building that are described as 'a formalized digital description of an existing or planned building which can be used to fully simulate and communicate the behavior of the real building in its expected contexts'.

In this project context, the virtual building that are going to be enhanced are the virtual UTP mosque, that are currently still under construction. By having this application, it could be very relevant for the university itself. UTP can show this project to visitors coming to the campus to show the uniqueness and specialties of the university. This project is a start for visitors to view a virtual UTP in the future (Sharifah, 2005).

Many 3D virtual environments, whether representing existing places (e.g., virtual cities) or imaginary ones, typically leave the user along and partially or totally unassisted in navigating the environment, discover points of interest and interact with objects (Chittaro, 2004). Leaving user unassisted can lead to a number of usability problems, ranging from navigation issues to difficulties in figuring out the information about the virtual environment.

2.3 The Needs for a Guide in Virtual Environment

Nowadays, virtual environments are becoming a widely used technology. Many recently developed virtual environments recreate real spaces with an impressive degree of realism. However, a lack of information for the user is frequently perceived, which make the user lose interest in these environments. Thus, the necessity of having a virtual guide had been recognized to help user to understand the environments (Ibanez, et al., 2003).

It also had been discussed by (Marsh & Smith, 2002), where they had addressed that the navigation in virtual environment can be difficult. One of the factors is the problem of user navigation within the virtual space. The major cause of user disorientation is lack of navigation cues in the environment.

A study was developed to test the effectiveness of guidelines in an attempt to reduce usability problems associated with navigation and exploration within virtual environments and to reduce user disorientation (Marsh & Wright, 2002). The study consisted of two groups where both are required to carry out a navigation task in a virtual environment; one with the design guidelines implemented and the other, in the same virtual environment without the guidelines. Eighteen paid volunteers recruited to took part in the study. These consisted of five females and thirteen males with ages ranging between eighteen and thirty-five. All of them had previous experience of computer games, describing themselves as nine novices and nine experienced users. Subjects are allocated study time slots and alternately placed in one of the two groups, with and without guideline.

The result shows that by having guideline for user in navigating through the space, ten users manage to not collided with the wall compared to eight without the guideline and only three user with guideline experienced disoriented with navigating compared to fifteen without the guideline. From the test, it is very important for a virtual reality application especially the one about virtual environment to have provide a guide for the user when navigating the environment.

The lack of proper navigation support may cause the users to experience the most well-known navigation problem that is 'disorientation'. As a result from this disorientation, users, especially the novice ones may become frustrated and abandoned in the space, miss out some interesting parts of the environment and complete the visit with the feeling of not having completely explored the environment and not acquire any knowledge from the visit.

According to (Clarebout et al., 2000), there are a few types of agent that can be embedded in the virtual environments such as follows:-

2.3.1 *Steve* – as a model

According to (Johnson et al., 2000), *Steve* is an acronym for Soar Training Expert for Virtual Environments. He demonstrates 'skills' involves in a specific tasks in a virtual environment. While *Steve* demonstrates parts of the task, he explains what he is actually doing. *Steve* takes the role of modeling. His support is directed towards the content of the task, the problem-solving processes and working in the environment. *Steve* also uses both verbal and non-verbal behavior to interact with user.

2.3.2 *PPPesona* – as a demonstrator

The *PPPesona* agent, is an animated agent for representing online instruction. (Andre et al., 1999) The agent guides the learner through web-based materials. By using gestures such as pointing the attention of students is drawn to particular elements in the presented information. *PPPesona* can be described as a demonstrator of information which always initiated support delivery.

2.3.3 *Jacob* – as an instructor and assistance

The agent *Jacob* provides instruction and assistance for user's task in virtual environment (e.g., tower of Hanoi). The user moves objects in a virtual environment and *Jacob* gives feedback while the user performs these activities and he also can demonstrate the task. *Jacob* interacts with user through text. He able to take the initiative to provide just-in-time support to the student, but student also may request support from him during task performance (Evers & Nijholt, 2000).

2.4 Virtual Agent

Virtual agents always come in a form of virtual human provided with an intelligent to take the user in the guided tour of the virtual environment (Larmore et al., 2002). The presence of the intelligent makes the agent able to learn and develop it knowledge from time to time. It also should be able to function autonomously.

In (Thalmann, 2001) he had stated that an autonomous Virtual Humans should be able to have a behavior, which means they must have a manner of conducting themselves. Typically, the Virtual Human should perceive the objects and the other Virtual Humans in the environment through virtual sensors: visual, tactile and auditory sensors.

Usually, virtual agent in the form of virtual human (also known as humanoid) may simply evolve in his environment or he may interact with this environment or even communicate with other actors within the same environment. The Virtual Human perceives his environment from a small window in which the environment is rendered from his point of view.
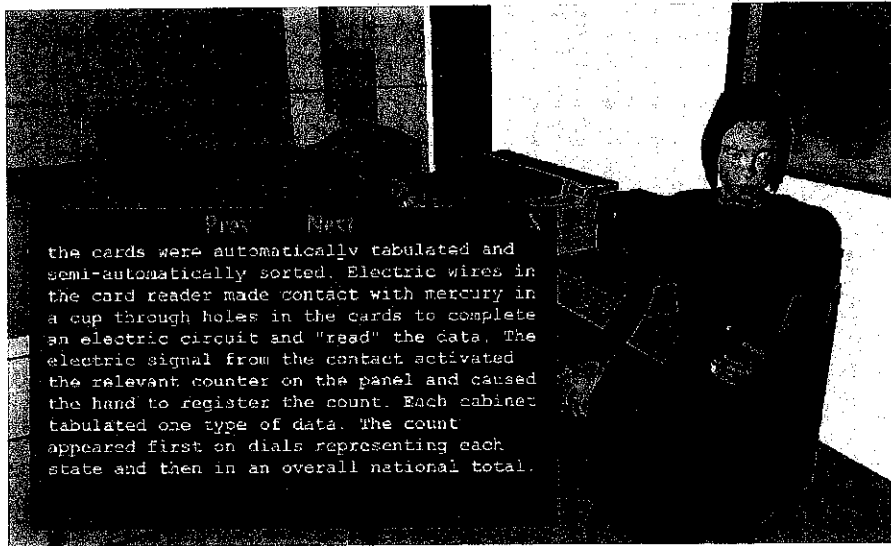
Figure 2.1 – Example of Virtual Human acting in the virtual environment in 3D Computer Science Museum

Several areas where autonomous virtual humans are essential are such as:-

2.4.1 Virtual people for Inhabited Virtual Environments.

Two types of real-time virtual humans may coexist in the same shared virtual environment: the guided ones and autonomous ones. Guided humans or avatars are useful to represent ourselves, the users or participants. Autonomous humans are able to act on their own. Based on the perceived information, the virtual human's behavioral mechanism will determine the actions it will perform.

2.4.2 Virtual substitutes.

A virtual substitute is an intelligent computer-generated agent able to act instead of the real person and on behalf of this person on the network. The virtual substitute has the voice of the real person and his or her appearance. He/she will appear on the screen of the workstation/TV, communicate with

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people, and have predefined behaviors planned by the owner to answer to the requests of the people.

2.4.3 Virtual medical assistance.

Nowadays, it seems very difficult to imagine an effective solution for chronic care without including the remote care of patients at home by a kind of Virtual Medical Doctor. The modeling of virtual patient with correspondence to medical images is also a key issue and a basis for tele-surgery.

2.5 Virtual Character

Virtual character can be described as another form of virtual agent but not necessarily in the form of human being. It can be other living character such as animals, insects or plants. However, these living characters should be able to animate and functioned as it is in the real world. The virtual character also should have the abilities to learn for specific assigned tasks like virtual human. The skill for the task can be developed and evolved through the experiences of performing the task. Other characteristics of this virtual character are same as virtual human.

2.6 Other forms of navigation aids

2.6.1 Using Landmarks

Design of real world environment. For example, in designing a building, an architects aims at reducing way finding problem for the people exploring the building by increasing visual access or including navigational cues. Landmarks can be used as distinctive environmental features functioning as reference points (Vinson, 1999). However, this kind of solutions can be

limitedly applied to 3D virtual environments that are virtual reconstructions of existing places, where the architecture of the environment cannot be modified.

2.6.2 Using Electronic Maps

Electronic maps of the environment that help users orient themselves (Darken & Sibert, 1996). These electronic maps adopt a third-person perspective, which can require a considerable cognitive mapping effort to be correctly interpreted.

2.6.3 Using 3D Maps

3D Maps, such as Worlds in Miniature (WIM) (Stoakley et al.,1995). A WIM is a three-dimensional small scale version of the 3D virtual environment, standing in front of the user, as if it were in the user's virtual hands. The user can directly manipulate both the WIM and the environment (changing something in one of the two will directly affects the other and vice versa).

2.6.4 Placing a constraints

Constrained navigation approaches that restrict user's freedom of movement. Placing constraints on user motion allows for a simplification of the effort needed to navigate the 3D virtual environment. For example, (Hanson & Wernert, 1999) present an approach where a user's navigation can be constrained to the movement of another user or of an automated guide.

2.7 Virtual Guide

Virtual guide is navigation aids that defined as a 3D object embodied in virtual environment to help user while navigating through the virtual space. Virtual guide will lead the user to the required places and preventing the user from being lost where the user has simplified follow the guide to visit the virtual environment. As stated by (Rickel & Johnson, 2000), showing the user where relevant objects are and how to go to them are likely to be more effective than trying to tell users where the objects are located.

Virtual guide can also be employed as a way to provide some basic information to the user during the visit. With respect to other forms of user guidance, an embodied agent can draw user's attention with the most common and natural methods, such as gaze and pointing gestures (Rickel and Lewis Johnson, 2000).

By having a virtual guide in the virtual environment, it may contribute to alleviate an additional problem, i.e., most virtual environments left user alone will look like a dead places, and make it less attractive to users. Virtual guide can make the virtual place become livelier, attractive and less intimating. Results of empirical studies show that embodied agent may have strong motivational impact to user, where user tend to experience presentations given by the guide as lively and engaging (Lester et at, 1997).

The table below will briefly show the differences between virtual agent, virtual character and virtual guide.

Table 2.1: Comparison of Virtual Agent, Virtual Character and Virtual Guide

VIRTUAL AGENT	VIRTUAL CHARACTER	VIRTUAL GUIDE
- in a form of human being - provided with intelligent - able to learn and develop knowledge - able to interact with its environment	- not necessarily in a form of human being - animated living character - able to learn specific task assigned to it - develop and evolve knowledge through experience	- in a form of any 3D object - not provided with intelligent - have predetermined and limited knowledge

2.8 The UTP Mosque Virtual Reality Project

In this project, a virtual guide will be develop in assisting user while navigating through the space and acquire information from the environment.

2.8.1 The virtual guide

The object that is going to be used in this application will be a sphere and named as 'VGuide'. VGuide in this application will only having a well-structured knowledge and will not evolve from time-to-time, unless the structured of the information is updated by the programmer. The VGuide will have a predetermined path to be followed according to the place that user had requested.

2.8.2 The Application

The application will be provided with an appropriate user interface to give a brief idea about what are provided within the application. The overall application will be placed in a different frame, so that user will not faced any disruption while navigating the virtual environment.

According to (Saretto,2000), the process of navigating throughout an environment can be considered to be composed into two tasks and two tactics. The tasks are *searching* (looking for a target) and *browsing* (see what are available within the environment).

The two tactics are *querying* (submitting a description of the object being sought to a search engine which will return relevant content or information) and *navigation* (moving oneself sequentially around an environment, deciding at each step where to go next based on the task and the parts of the environment seen so far). A combination of those tasks and tactics produces a navigation process. This navigation process will also be implemented in the application.

In the interface, there will be some selection of the places that can be navigated through the application. Beside that, the interface also will provide some information about the places within the virtual environment.

User will have the options either to browsing through the virtual environment by following the physical guide provided or by listening to the audio instruction that had been embedded into the application to give some directional sense and provide information for the user.

CHAPTER 3

3. METHODOLOGY

3.1 Procedure Identification

Through out the development of this application, a methodology had been developed to be used as a guideline for the project completion. The methodology is consists of three main phases which are *Research and Analysis* phase, *Design and Construction* phase and lastly, *Evaluation and Testing* phase. These main phases are described by the figure below.
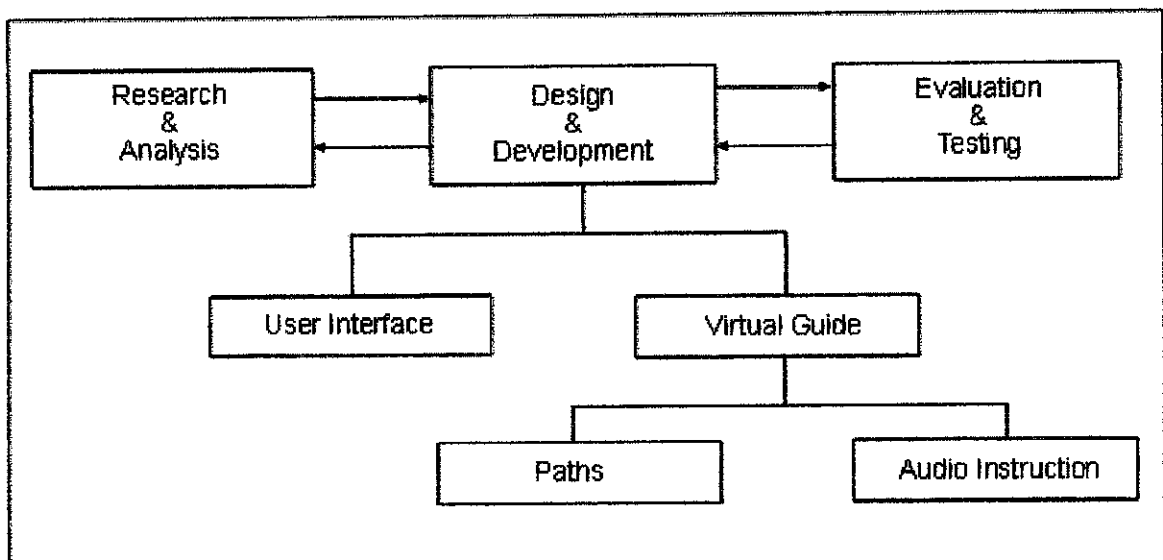

Figure 3.1: Methodology Framework

The project started with *Research and Analysis* phase which include the information gathering process and information analysis. The objective of this phase is to gather information needed to complete the project.

The second phase is the *Design and Development* phase. This phase is divided into two processes which are to design and develop the interface for the application and to design and develop the virtual guide that will be embedded into the virtual mosque application. The development of the virtual guide includes two main goals, that is the paths to be followed by the virtual guide and the audio instruction for the user.

The last phase is the *Evaluation and Testing* phase, where the product is evaluated and the results will be analyzed. The importance of this phase is to ensure that this project will achieve its development objectives.

3.2 Phase 1: Research and Analysis

Phase 1 is consists of two important stages which are information gathering and information analysis. Figure 3.2 shows the components of the Research and Analysis phase.
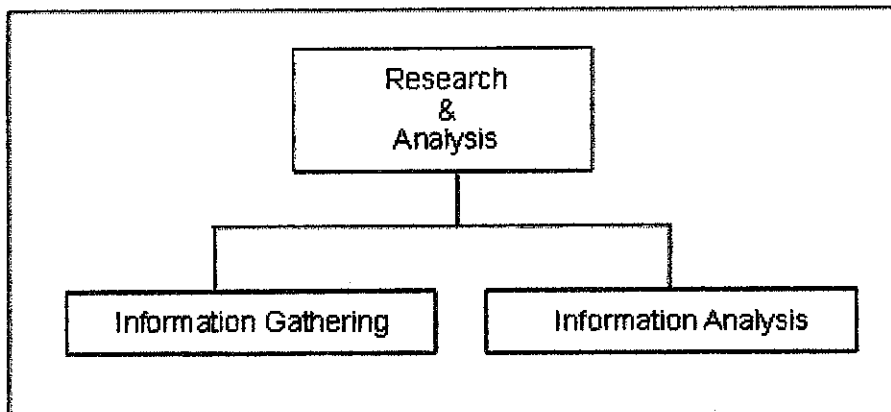

Figure 3.2: The Components of Research and Analysis Phase

In the information gathering stage, a research had been conducted to gather information about virtual environment, the navigation problem in virtual environment and the possible solution that can be used to overcome the problem. The information had been collected through journals and white papers available in the Internet. Beside that, the information is also collected through experience and observation on the existing virtual environment to figure out the exact navigation problem of the virtual mosque. The research and analysis stage is an ongoing process that will be done through out the development of this project.

Through the research, many researchers had highlighted the issue of navigation for example, many 3D virtual environments, whether representing existing places (e.g., virtual cities) or imaginary ones, typically leave the user along and partially or totally unassisted in navigating the environment, discover points of interest and interact with objects (Chittaro, 2004). One of the factors is the problem of user navigation within the virtual space. The major cause of user disorientation is lack of navigation cues in the environment (Marsh & Smith, 2002). This is how the objective of this project had been discovered and will be execute later in the development stage.

Once the information had been collected, the information will be analyzed to specify the specification of the application that will be develop later. It had been done after the information had been filtered and the information available will be used as aids for the design and development phase later. Besides that, the information also can help to figure out what are tools and equipments that will be used in the project.
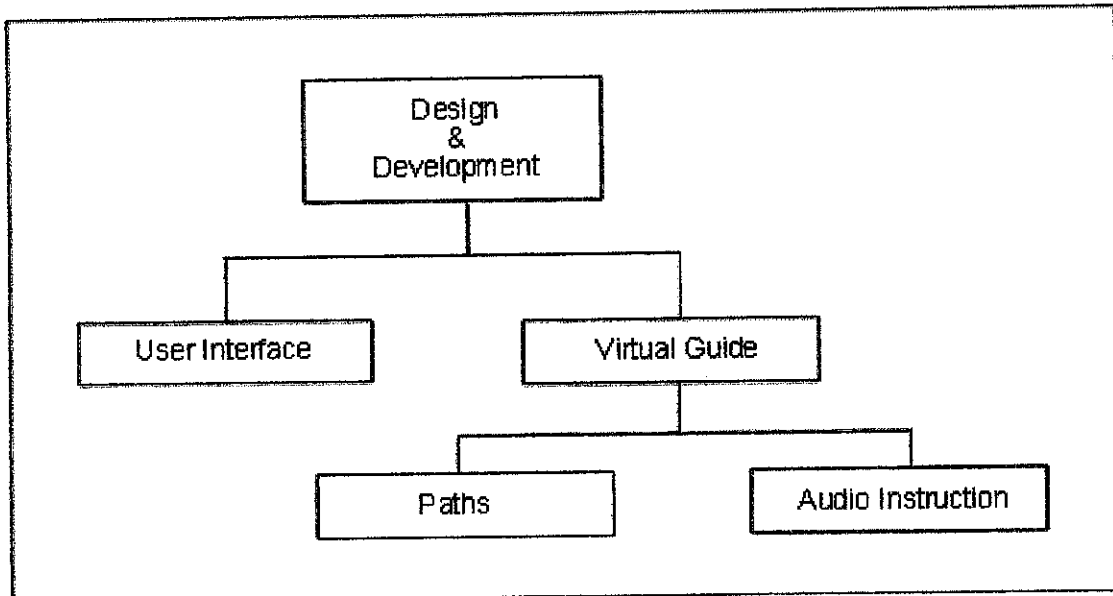
3.3 Phase 2: Design and Development

Figure 3.3: The Components of Design and Development Phase

Figure 3.3 shows the main components contains in the D*esign and Development* phase of the project.

3.3.1 User Interface

The design and development of the user interface in the application is to enhance the user understanding about the overall function contains in the virtual mosque application.

A rough design had been done, and the development of the user interface had been done by using HTML and JavaScript. It had been developed through the Macromedia© Dreamweaver software to make the development easier.

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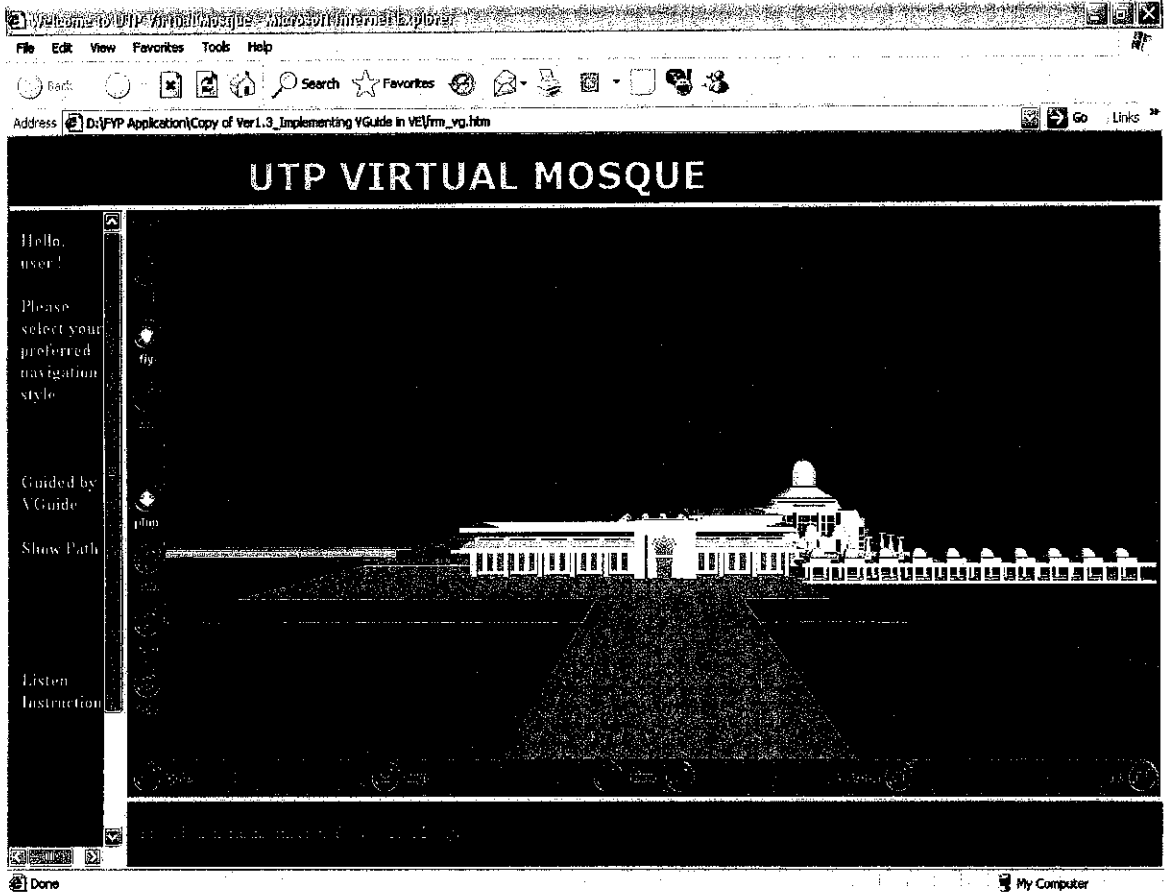Figure 3.4 shows the screen shoot of the interface that had been completed.

Figure 3.4: The Snapshot of the User Interface

The interface is using the common type of interface layout that had been used in other website. It contains four main frames which are the header, the menus, the VRML and information frame. The header frame shows the title for the application, while the information frame provide some useful information regarding the application for the users. The VRML frame is connected with the Cortona viewer to make it able to view through the frames in HTML page and lastly, the menu frame contains menu that available to be used by user.

There are two options that are provided for user to ease their navigation in the virtual environment. Users of the application can choose whether to navigate through the application by following the physical guide or by listening to the audio instruction provided in the application.

3.3.2 Virtual Guide

A physical guide had been embedded into the application with the aims of showing the selected path to user to help the user navigate through the virtual mosque. Figure 3.5 shows the comparison of the application with and without the guide. The left-side image shows the application without the implementation of virtual guide and the right-side image is showing the application with an embedded virtual guide.
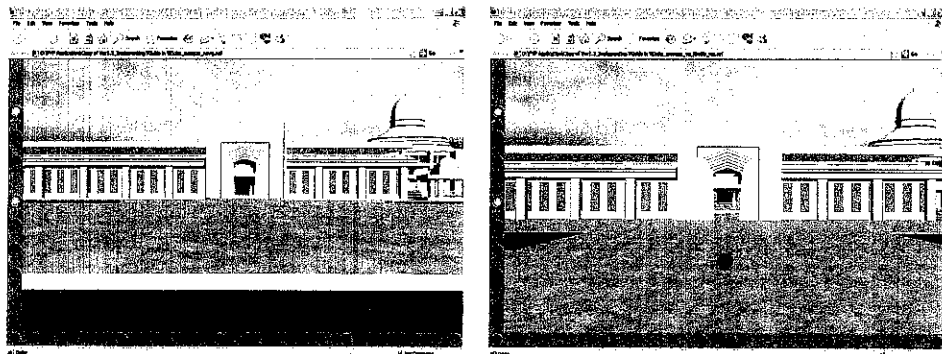

Figure 3.5: Comparison of the application with and without the guide

The predetermined path sets for the guide to move in the application had been done by using the *PositionInterpolator* nodes in the VRML programming. The function of PositionInterpolator is to animate objects, moving them along the path which had been specified through keyValue. In order to enable the interaction between the user of the application and the virtual guide, a ROUTE statement had been used through the *eventIn* and

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eventOut function. ROUTES are a simple way of defining a path   between

an event generated by a node and a node receiving an event.

Below is the fraction of the coding used in the application.

```
DEF vguide01 Transform {
        translation 45 2 -11.5
        children [
          Shape {
            appearance Appearance { material Material { diffuseColor 0 1 1 } }
            geometry Sphere { radius 0.125 }
          }
          DEF timer01 TimeSensor {
                  cycleInterval 20
                  loop FALSE
          }
          DEF position01 PositionInterpolator {
                  key [ 0 1 ]
                  keyValue [ 45 2 -11.5, -8 2.2 -11.5 ]
          }
          DEF ball_sensor01 TouchSensor { }
        ]
    }

# setting movement for p1
ROUTE timer01.fraction_changed TO position01.set_fraction
ROUTE position01.value_changed TO vguide01.set_translation
ROUTE ball_sensor01.touchTime TO timer01.set_startTime
```

3.3.3 Audio Instruction

The intention of providing the audio instruction in the application is to give another option to the user to use a guide to navigate within the virtual environment.

A sound clip had been added into the application by using the *Sound Nodes* into the VRML coding. Below is a fraction of the application that had been added with *Sound* node.

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```
DEF vguide01 Transform {
        translation 45 2 -11.5
        children [
          Shape {
            appearance Appearance { material Material { diffuseColor 0 1 1 }}
            geometry Sphere { radius 0.125 }
          }
          Sound { source DEF sound01 AudioClip { url"sounds/try01.wav"
                                                         loop TRUE }
          }
        ]
}
```

3.4 Phase 3: Evaluation & Testing

In the Evaluation phase, the processes are divided into two parts which are data gathering process and data analysis process.
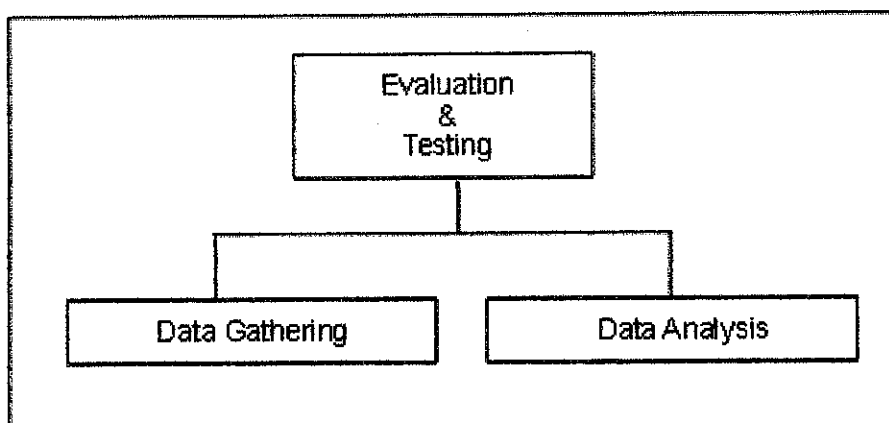

Figure 3.6: The Components of Evaluation and Testing Phase

3.4.1 Data Gathering Process

In this process the readily developed application will be evaluated. The objective of this process is to determine whether the implementation of virtual guide will improve the user navigation and interaction within the virtual mosque application. During this process, the evaluation will be done by a selected respondent and the evaluation will be based on the questionnaires given to them.

In order to conduct the evaluation for the project, twenty five (25) students had been selected to be the evaluator. A questionnaire had been given to each of the evaluator as a guideline for the evaluation. The questionnaire is included in Appendix A. All of the evaluators are novice users and not familiar with the virtual environment. It is because; the target user of this application is the first time user who never had experienced the virtual environment.

The developed application will be evaluated by the respondent. They are given some times to browse and navigate through the UTP virtual mosque, both with the embedded virtual guide and without the virtual guide. The times allocated are depends on the time needed by the evaluator to test the application.

3.4.2 Data Analysis Process

After the evaluation process, the data collected from the completed questionnaire will be analyzed. The purpose of analyzing the data collected is to see whether the application had achieved its development objective. The data are calculated the result will be represented into graphs. All the details of this process will be discusses more in Chapter 4.

3.5 Tools and Equipment

Tools and equipments are important in completing the project. The use of tools and equipment can help the process of development to be easier. Tools used to carry out this project are 3D modeling software while the equipments are the hardware that had been used such as desktop and its specification.

3.5.1 Software
VrmlPad 2.1

VrmlPad 2.1 is a product from ParallelGraphics is an authoring tools used for the development of VRML product or application. However, because it is just a trial version, the software has a few limitations such as cannot save files over 64K in size, cannot copy or cut selections over 32K in size to the clipboard, and debugging session is limited by 2 minutes only. To overcome this problem, the modification of the previous mosque application had been done through the Notepad and the VrmlPad is only used for the error checking purpose.

Cortona 4.2 VRML Client

Cortona VRML Client version 4.2 also from ParallelGraphics is an interactive VRML Viewer, which is the most ideal solution for viewing 3D models built through VRML. It works as a VRML plug-in for Internet browsers such as Internet Explorer and Netscape Navigator.

3.5.2 Equipment

Personal Computer

Personal computer is used to built and develop the whole application. The PC is running under Windows XP operating system with 512 MB of RAM and Intel Pentium® 4 CPU 3.00GHz.

Mouse

Mouse is used as navigation and interaction input device for this project.

CHAPTER 4

4. RESULT AND DISCUSSION

4.1 Introduction

The third phase in the development process of this project is the Evaluation and Testing Phase. This chapter will be focusing on the evaluation that had been done by the selected users and also some discussion from the result that will be analyzed.

4.2 Method and Procedure

4.2.1 Method

The method used for the evaluation part is through usability test and questionnaires. The usability test had been conducted where the user will experience the virtual mosque under the observation of the developer to evaluate how the user interacts with the application. The observation also needed to explain some additional information for the user regarding the application that they will be using. However, the result of the observation is only useful for the developer to discuss the result and provide am additional aids for the user to navigate the application.

A questionnaire will be given to each of the evaluator as a guideline for the evaluation. The questionnaire is formed into two main focuses, which are user interface, virtual guide and audio instruction. The purpose of this formation is to analyze the effective of each focus and whether the objectives of this project are fulfilled or not. The overall questionnaires had been designed to represent the negative opinion by the lowest score and the positive opinion by the highest score.

It had been divided into four main sections which are Section A for the original application without the virtual guide, Section B the evaluation on the user interface, Section C the evaluation on the implementation of virtual guide and lastly Section D; the evaluation on the implementation of audio instruction to aid users in the navigation process. The questionnaire is included in Appendix A.

4.2.2 Procedure

To start the evaluation part, a brief explanation will be given to the evaluator candidate to explain to them about the purpose of having the evaluation process and how it will help the developer to provide the features that might be needed by the users to enhance the navigation and interaction. After the briefing user will be given a chance to navigate through the virtual mosque application and have an experience of using such application. The time allocated for each of the evaluator is not determined and it depends on the evaluators to use their time to navigate through the virtual mosque as they need.

Firstly, the evaluator will be asked to experience the navigation without any guide provided for them. Then, user will try to use both of the navigation guide provided for them, which is by following the virtual guide and also by listening to the audio instruction. Once completed, the evaluator will be asked to answer the questionnaire given to them.

The data collected from the questionnaire will be calculated the result will be plotted into pie charts and histogram to give a better visualization and understanding to analyze the data further.

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4.2.3 Evaluators

In this phase, twenty five users had been selected to be the evaluator. All of the evaluators are novice users which are not familiar with the virtual environment and fifteen of them are not the regular user of personal computer. They had been chosen because the initial purpose of having the virtual guide in the application is to provide an aids for the user of the application which including the students of UTP itself and other external community.

4.3 Result

From the questionnaire distributed to the evaluators, an evaluation had been done, and Figure 4.1 and 4.2 shows the result collected from the survey for section A evaluating the original application without the virtual guide in terms of the ease of navigation and the tendency of getting lost. The lowest score means that, the users found that it is very hard to navigate through the application without having any navigation cues and the highest score indicates that user feel very easy to navigate.

For the first attribute which is the ease of navigation, overall result shows that 48 % of the evaluator feels that it is quite hard for them to navigate through the application (score given=2), and 44 % moderate regarding the matter (score given=3). Only 8 % of the evaluators score 4 with indicate easy for them to navigate. That means, nearly half of the evaluators, who are not familiar with the application experience difficulties while navigating the application provided and this is why the virtual guided is need within the environment.

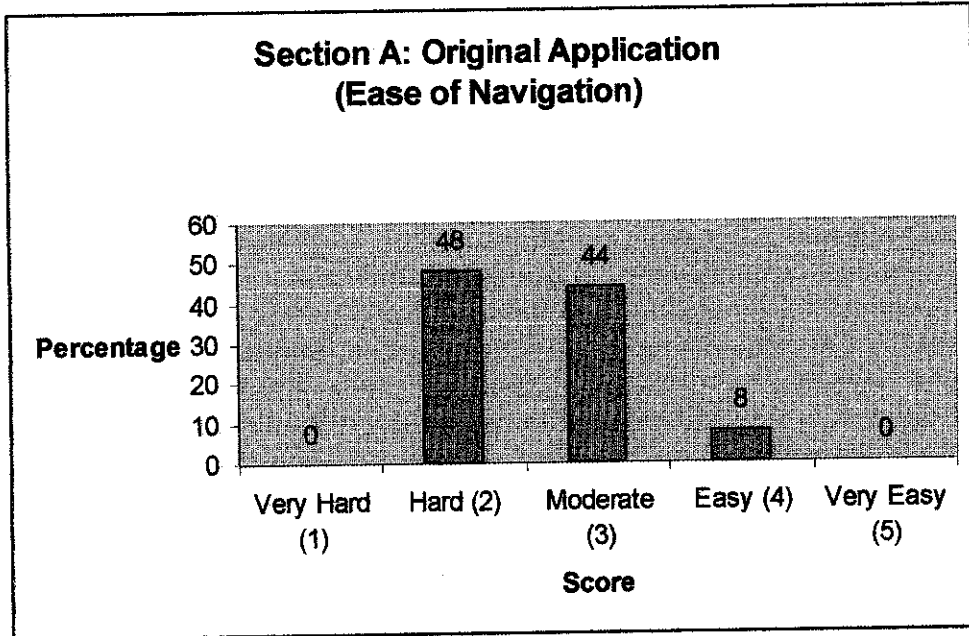**Section A: Original Application (Ease of Navigation)**

Figure 4.1: Result for Section A: Original Application - Ease of Navigation

Evaluation on the second attribute shows that 44 % of the evaluators feel that the tendency of getting lost in the environment is high (score given=4) and 8 % feel very hard. This also shows that, there are more than half of the evaluator having no idea about the environment and easy for them to be lost within the environment.
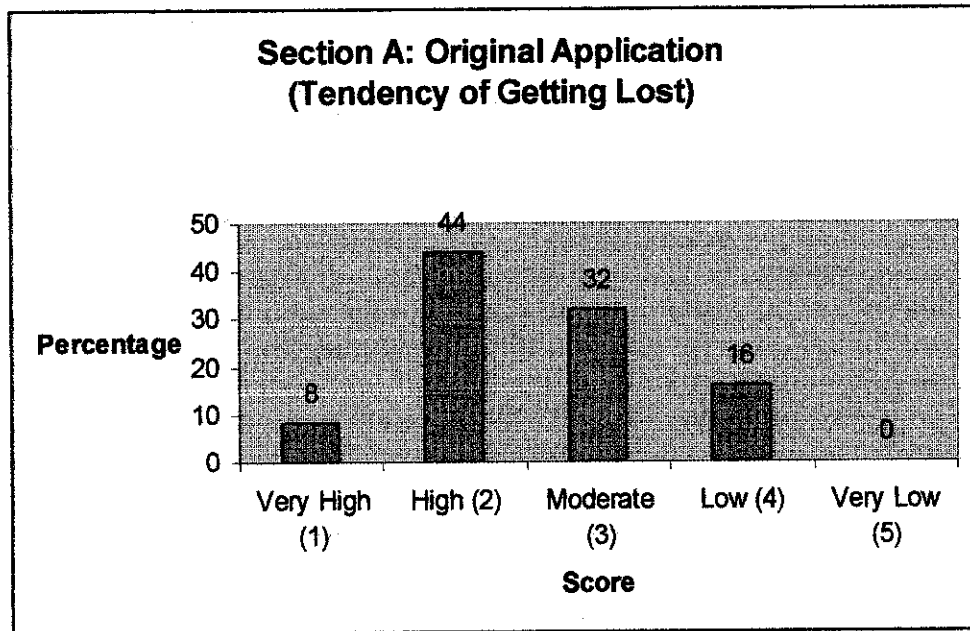
Figure 4.2: Result for Section A: Original Application - Tendency of Getting Lost

To show the effectiveness of having the virtual guide in the environment, the other three section of evaluation had been prepared to evaluate the application in terms of the implementation of user interface, virtual guide and audio instruction.
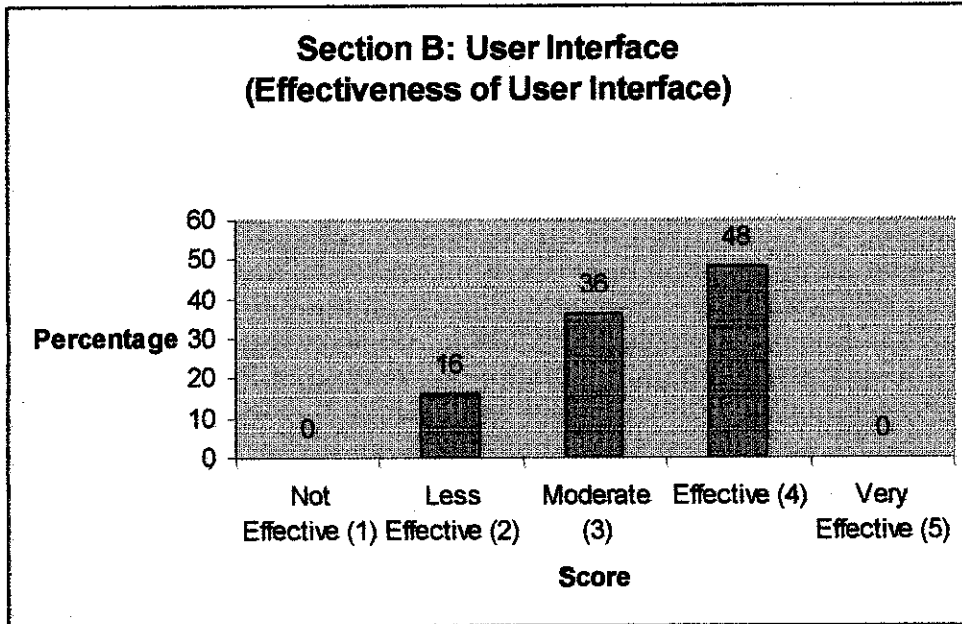
Figure 4.3: Result for Section B: User Interface - Effectiveness of User Interface

Section B in the questionnaires is focusing on the user interface. The attributes of the evaluation are the effectiveness of the user interface, the ease of interaction through the user interface and how much the user interface help user in their navigation. Figure 4.3 shows the results for first attributes which is the effectiveness of user interface provided in the application. The overall result shows that most users are happy with the implementation of the interface to aid their navigation in the application. It is because; 84 % of the evaluators score moderate and higher which is 36 % score moderate and 48 % score effective.

Section B: User Interface
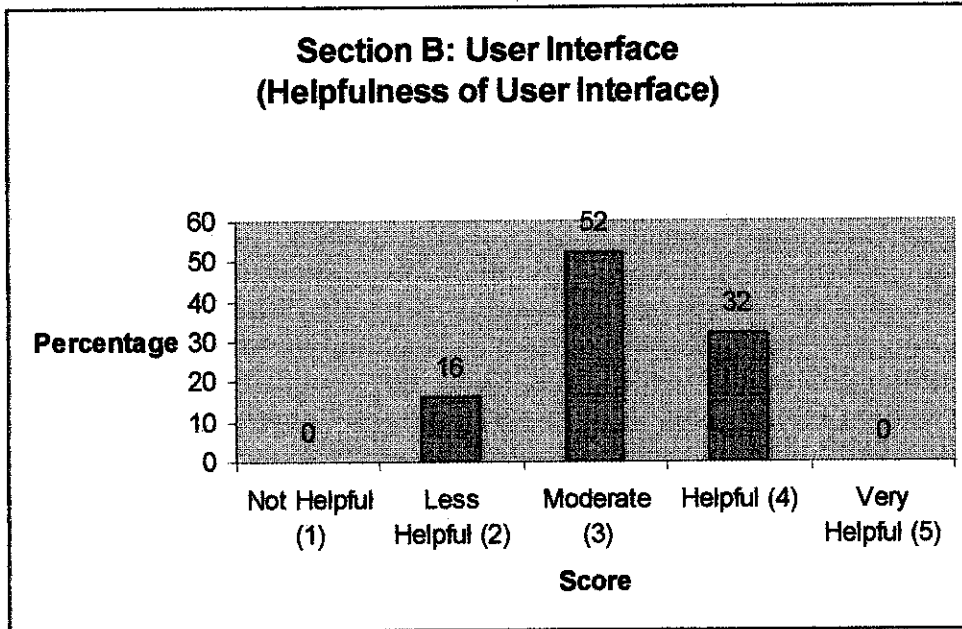**(Helpfulness of User Interface)**

Figure 4.4: Result for Section B: User Interface - Helpfulness of User Interface

For the second attribute (the helpfulness of user interface), most evaluators given a score of three which represent moderate between not very helpful and very helpful, but none of them give score for 1 which is not helpful and 5 for very helpful.

The evaluation results for section C: The implementations of virtual guide are as shown in Figure 4.5 to Figure 4.8. The attributes that had been evaluated in this section are the effectiveness of having the virtual guide, the ease of navigation, the ease of interaction and the tendency of user from getting lost in the environment.

The first attribute is about the effectiveness of having a virtual guide. Score shows that all of the evaluators score moderate and higher means 48 % score moderate (3), 44 % score effective (4) and 8 % score very effective (5).

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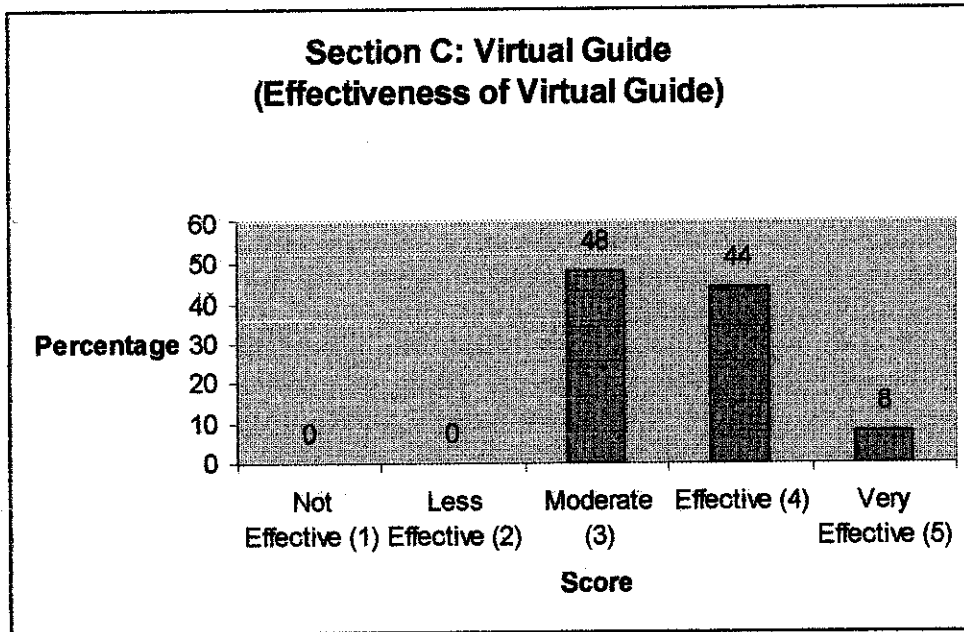**Section C: Virtual Guide**
(Effectiveness of Virtual Guide)

Figure 4.5: Result for Section C: Virtual Guide - Effectiveness of Virtual Guide

The result for second attributes also very promising where 68 % score 5 which indicate that they feel it is very easy for them to navigate through the application with the help of the virtual guide provided for them. From the rest of the evaluators, none of them give score lower than moderate which represent very hard to navigate through the environment.
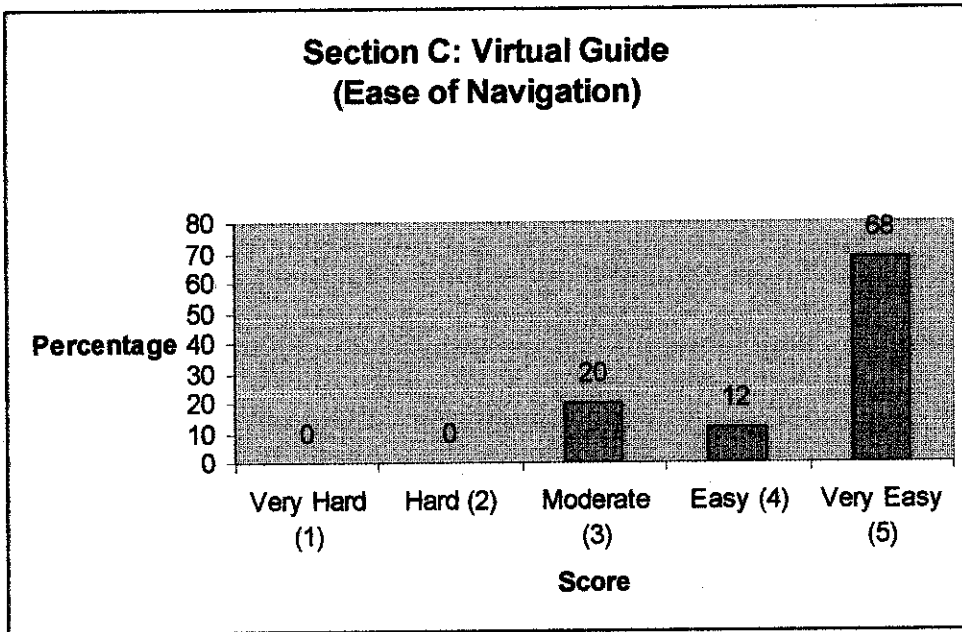
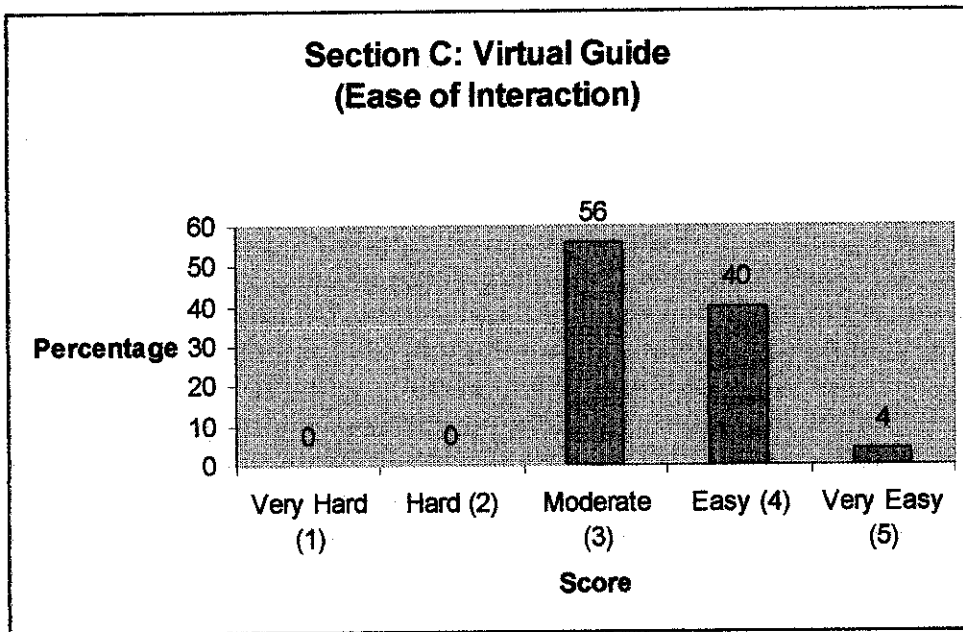Figure 4.6: Result for Section C: Virtual Guide - Ease of Navigation

Figure 4.7: Result for Section C: Virtual Guide - Ease of Interaction

The result for the third attributes which is about the ease of interaction with the guide shows that 100 % of the evaluators score moderate and higher which are 56 %

score 3 which indicate that they feel it is moderate for them to interact with the guide, 40 % score 4 and 4 % score 5. From the rest of the evaluators, none of them give score lower than moderate which represent a very hard for the user to interact with the guide implemented in the application.

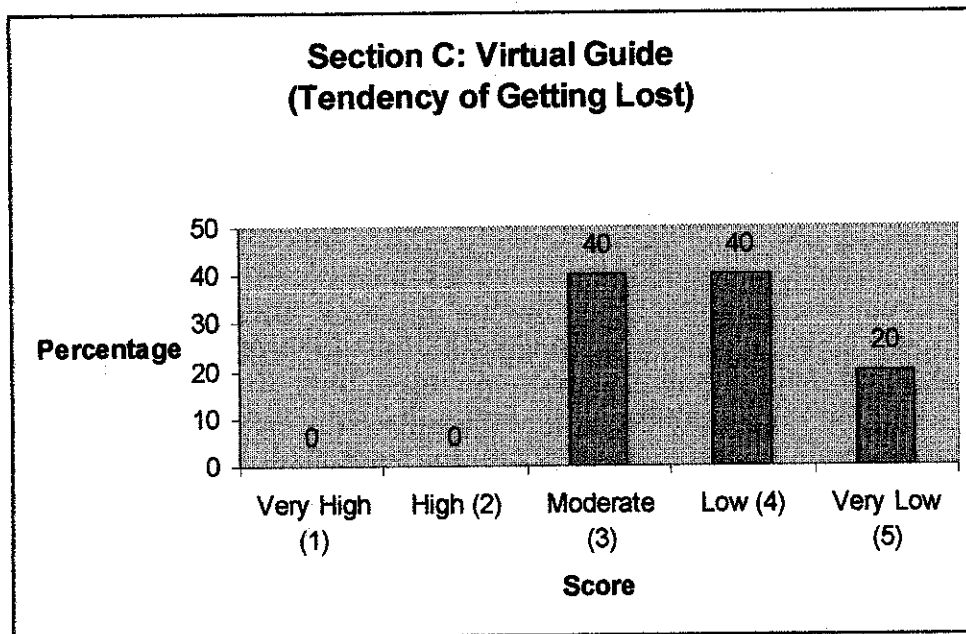**Section C: Virtual Guide (Tendency of Getting Lost)**

Figure 4.8: Result for Section C: Virtual Guide - Effectiveness of Virtual Guide

The last result for the last attribute which is about the tendency of getting lost in the environment shows that hundred percent of the evaluators score moderate and higher which are forty percent score 3 which indicate that tendency of getting lost is not quite high and not quite low while navigate through the environment, 40 % score 4 and 20 % score 1. It means that, none of them give score less than moderate which represent a very high tendency for the user to get lost in the virtual environment.

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The overall results for Section C had proved the effectiveness of implementing the virtual guide into the application and by no doubt, achieve its development objectives.

The last section in the evaluation is the evaluation on the Audio Instruction provided in the application. The attributes of the evaluation in terms of the audio instruction are more less same as the evaluation on the virtual guide which consists of the effectiveness of having the audio instruction, the ease of navigation using the audio instruction and the tendency of the user from getting lost within the environment. There are not many difference of the trend of result compared to the evaluation on the virtual guide which all of the attribute' average score are more than three. This shows that, by having the audio instruction, it had helped the user a lot in navigating through the environment and also in the same time understands the environment.
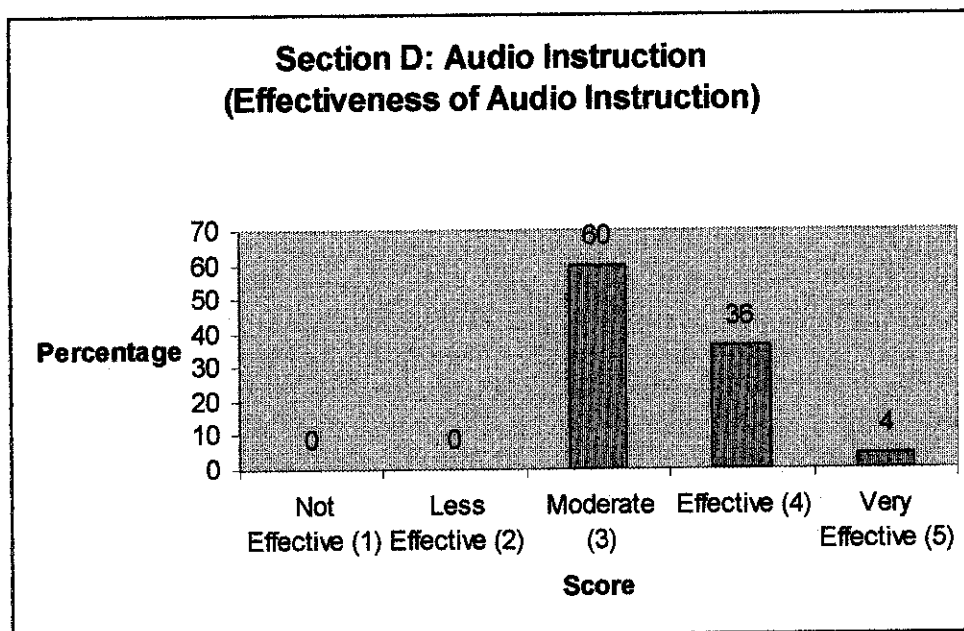

Figure 4.9: Result for Section D: Audio Instruction - Effectiveness of Audio Instruction

The evaluation on the effectiveness of having audio instruction shows that, all of the evaluator feels moderate and very effective to have audio instruction. Most of them score moderate and none of them score lower than moderate, which indicate not very effective.
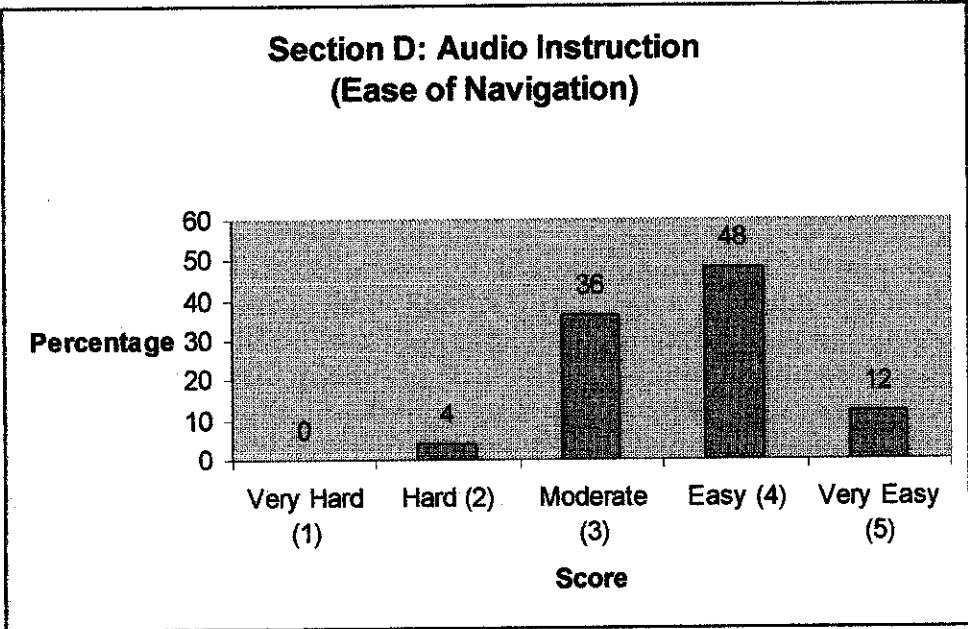

Figure 4.10: Result for Section D: Audio Instruction - Ease of Navigation

The result for the evaluation on the ease of navigation with the aid of audio instruction shows that only four percent of the respondents feel hard to navigate with the instruction, but most all of the evaluator feels moderate, easy and very easy to navigate through the application. Most of them score 4 for the evaluation which indicates easy to navigate.
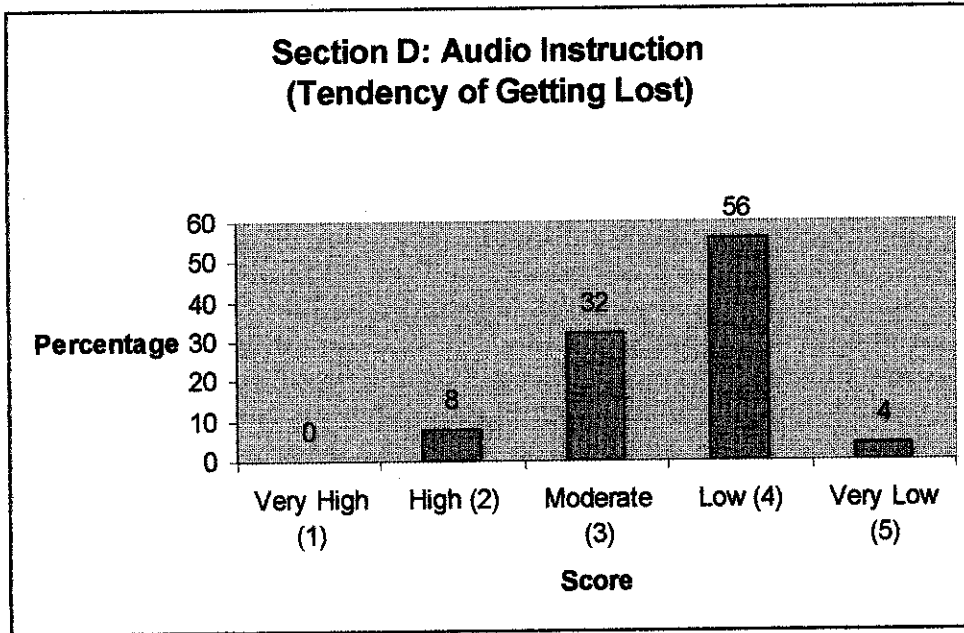
Figure 4.11: Result for Section D: Audio Instruction - Tendency of Getting Lost

The last attribute for audio instruction is regarding the tendency of getting lost, shows that only 8 % of the respondents experienced a high tendency of getting lost within the environment while listening to the audio instruction. Most all of the evaluator feels moderate, low and very low tendency of getting lost. Most of them score 4 for the tendency of getting lost in the environment is low.

4.4 Discussion

To draw out the effectiveness of having the virtual guide, a comparison had been made according to the user responds. The comparison done is in terms of the ease of navigation and the tendency of user getting lost in the virtual environment. The results for the comparison are as in the Figure 4.12 and Figure 4.13.

For the comparison in terms of the ease of navigation, the result shows an obvious difference in user response on the implementation of virtual guide and audio instruction compared to the application without any navigation cues. Most of the user agreed that the implementation of a guide in the application will help them a lot in their navigation. It shows through the score of most of the respondent which are more than moderate that indicate in is easier for them to navigate through the application after the implementation of virtual guide and also audio instruction.
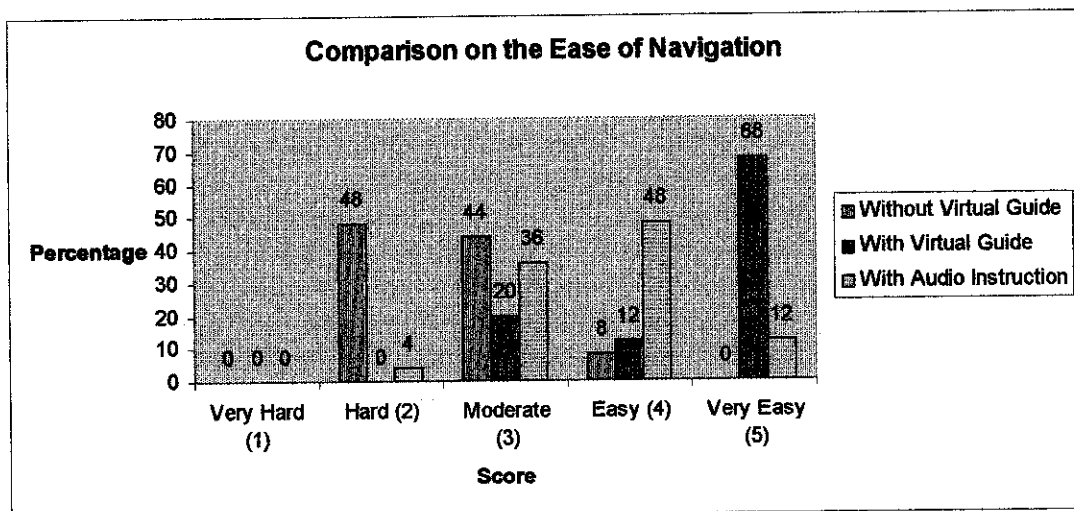

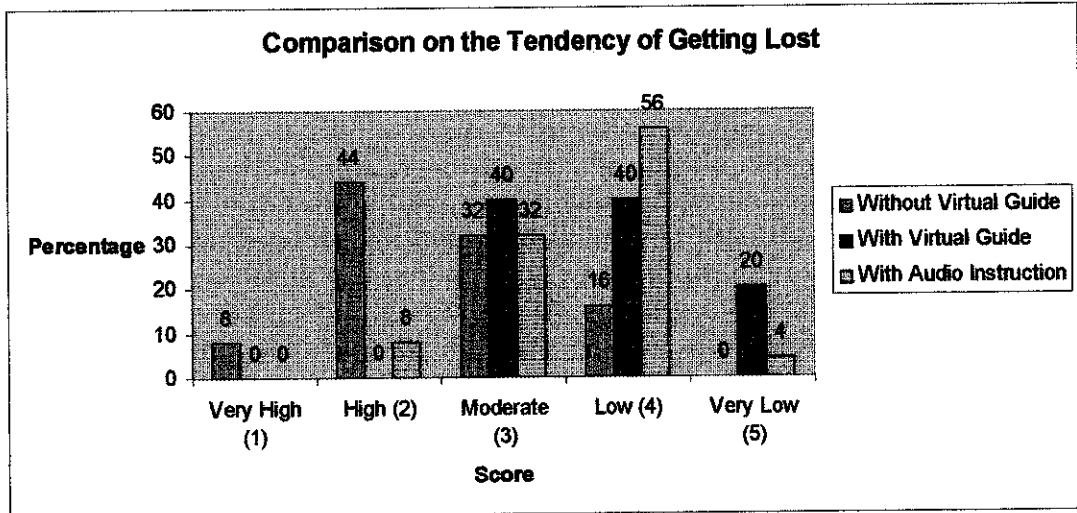Figure 4.12: The comparison on the ease of navigation

Figure 4.13: The comparison on the tendency of getting lost

For the comparison in terms of the tendency of getting lost, the result shows an obvious difference in user response on the implementation of virtual guide and audio instruction compared to the application without any navigation cues. Most of the user agreed that the implementation of a guide in the application will help them a lot in their navigation by reducing the tendency of getting lost within the virtual environment given to them. It shows through the score of most of the respondent which are less than moderate which indicates that there is a lower tendency for the user to feel and get lost within the environment after the implementation of virtual guide and also audio instruction.

4.5 Conclusion

From all the discussion regarding the result and evaluation, it is clearly shows that the navigation aids provided to user, either it is on the form of a physical guide or through an audio instruction, may give a different navigation experience to user. By having the guide, user will be easily navigate to the exact place that they intended to go and the audio instruction provide the user with not only with the direction, by also some information that might be useful for the user in order to understand the virtual environment,.

CHAPTER 5

5. RESULT AND DISCUSSION

5.1 Project Summary

UTP mosque is one of the main attractions in the UTP campus in Bandar Seri Iskandar, Tronoh, Perak. The design of the mosque carries out the beauties of Islam and the high technologies achieved by UTP, especially Petronas. As it had been officially open to be use now, everyone can benefits it and enjoys the significant construction of the building. However, for the people who are geographically far from UTP, the availability of the virtual mosque can be very exciting, as they can enjoy the feels and views as they are in the real mosque.

This project is focus mainly on the development of the virtual guide to help user while navigating through the virtual mosque. The virtual guide is useful for the user, especially for the first time user, as it will provide the navigation cues to the user and avoid them from getting lost in the environment.

A guide had been embedded into the application. User may choose either to follow the paths used by the guide to go to the specific place or they also might have an option to listen to the audio instruction provided in the application to help their navigation.

Generally, this project had been able to achieve its initial development objective as what had been stated earlier. It had been proved through the evaluation and testing process that had been carried out in the Evaluation Phase.

Along the development process, many new things had been learnt. As Virtual Reality course is not offered to an IS student, it had give a great opportunity to learn this knowledge about virtual reality and gain experience with it.

5.2 Problem Encountered

Through out the completion if this project, a few problem had been faced. The main problem is the time constraint where only a limited time provided to complete this application and the whole project. Because of this, only a few paths were able to be completed and the guides only have a limited function.

Another main problem is to specify the coordination of the application. Because of this coordination process, the development process had been delayed for a quite long time, to figure out the coordination. It had affected the rest of the application development such as, to locate the guide at the appropriate location in the application, and also to set up the paths to be followed by the virtual guide.

5.3 Limitation

This application however has its own limitation. One of the most obvious limitation is the virtual mosque is not totally represent the actual UTP mosque. This is happened because this project is an enhancement from two other previous FYP project, and this semester project is only focusing on the navigation aids, not the physical development of the mosque. It is suggested that a new physical virtual mosque should be develop, and combined all the three projects by using the techniques discovered through the second and third enhancement which are the texture mapping for the interior of the mosque and also the navigation guide for user in the virtual mosque.

Another limitation of this project is the guide provided is having its own pre-determined paths, and it is very limited. For future enhancement, as the new physical virtual UTP mosque had been developed, more paths should be provided to help user in their navigation process and it should provided the more detail parts of the mosque.

5.4 Conclusion

As a conclusion, the overall development of this project had achieved the development objectives by implement the virtual guide into the existing virtual mosque application. It also had been proved that, by having the virtual guide in the environment, it had helped the user a lot in navigating and browsing through the virtual mosque. This project was intended to help user to further their understanding on the ease of navigation using virtual guide for exploration, interaction and navigation.

5.5 Future Enhancement

There are many opportunity for this project to be enhanced and improved. The scope can be broadening into many different fields area, especially an Artificial Intelligent (AI). By having the AI element in the application, the guide can be made as an intelligent guide, which may improves the application a lot, especially in terms of interaction. Besides that, an intelligent guide also will acquire its own knowledge and might be able to learn and increase their level of knowledge from time to time.

Another suggestion is, to change the virtual guide to be more lifelike feature. This will make the guide to be more presentable and easily notice by the user. Behavior also can be added into the virtual guide according to what is resembles. Beside be

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able to guide user more effectively, it also may enhance the interaction with the user of the application.

This project also can be enhanced by utilize the other type of input devices for virtual reality such as the data gloves which enable user to touch, feel and move the objects within the virtual environment. It also can be customized to be able to interact with other virtual reality device, for example HMD.

Another suggestion to improve the interactivity and navigation is to provide a map into the virtual environment. The map will be displayed the entire floor plan of the mosque and indicate the current location of the user while navigating through the environment. Besides working as a navigation cues to user, it will also increase the user understanding towards the environment.

In terms of then virtual environment, the enhancement that can be made are by adding a lifelike feature into the environment, to make it more livelier to user, and avoid them to feel stranded alone in the virtual environment. It also may increase the level of realism. The lifelike features are such as flying birds, humans and trees.

REFERENCES

[1] Tim Marsh and Shamus P. Smith,2002, *Evaluating guidelines for reducing user disorientation when navigating in virtual environments*, Department of Computer Science, The University of York

[2] Tim Marsh and Shamus P. Smith, 2002, *Guiding user navigation in virtual environments using awareness of virtual off-screen space*, Department of Computer Science, The University of York

[3] Luca Chittaro., Lucio Ieronutti, Roberto Ranon, 2004, *Navigating 3D Virtual Environments by Following Embodied Agents: a Proposal and its Informal Evaluation on a Virtual Museum Application*, HCI Lab, University of Udine, Italy

[4] Tinsley A. Galyean, *Guided Navigation of Virtual Environments*, MIT Media Lab, Cambridge

[5] W. Lewis Johnson, Jeff Rickel, Randy Stiles, Allen Munro, 1998, *Integrating Pedagogical Agents into Virtual Environments*

[6] T. Panayiotopoulos, , N. Zacharis, S. Vosinakis, *Intelligent Guidance in a Virtual University*, Department of Computer Science, University of Piraeus, Greece

[7] J. Ibanez, R. Aylett, R. Ruiz-Rodarte, 2003, *Storytelling in virtual environments from a virtual guide perspective*

[8]   Robert Larmore, Matthew Knaus, Sergiu Dascalu, Frederick C. Harris Jr.,
        2002, *Virtual Environment for On-Campus Orientation*, Department of
        Computer Science and Engineering, University of Nevada, Reno, USA

[9]   Daniel K. Schneider, Sylvere Martin-Michiellot, 1998, *VRML Primer and
        Tutorial*, Faculte de Psychologie et des sciences de l'education, University of
        Geneva

[10]   Daniel Thalmann, 2001, *Interacting with Humanoids*, Computer Graphics
        Lab, EPFL, Lausanne, Switzerland

[11]   Soraia Raupp Musse, Marcelo Kallmann and Daniel Thalmann, *Level of
        Autonomy for Virtual Human Agents*, Computer Graphics Lab. Swiss
        Federal Institute of Technology

[12]   Takeo Igarashi, Rieko Kadobayashi, Kenji Mase, Hidehiko Tanaka, *Path
        Drawing for 3D Walkthrough*, Dept. of Info. Engineering, University. of
        Tokyo

[13]   Daniel Thalmann, *Virtual Humans in Virtual Environments: A New View of
        Multimedia Applications*, Computer Graphics Lab (LIG), Swiss Federal
        Institute of Technology

[14]   Melisa binti Muhamed, 2003, *Exploring Virtual Gallery Using Virtual
        Character*, Degree in Information Technology Final Year Project Report,
        University Technology of Petronas, Perak, Malaysia

[15]   Sharifah Intan Farhana binti Syed Husain, 2004, *Virtual Mosque Interior Walkthrough*, Degree in Information Technology Final Year Project Report, University Technology of Petronas, Perak, Malaysia

APPENDIX A

Evaluation Form

Have you ever experienced using the Virtual Environment application such as this?

(Please tick your answer)

☐ Yes   ☐ No

Please rank your answer for each question.

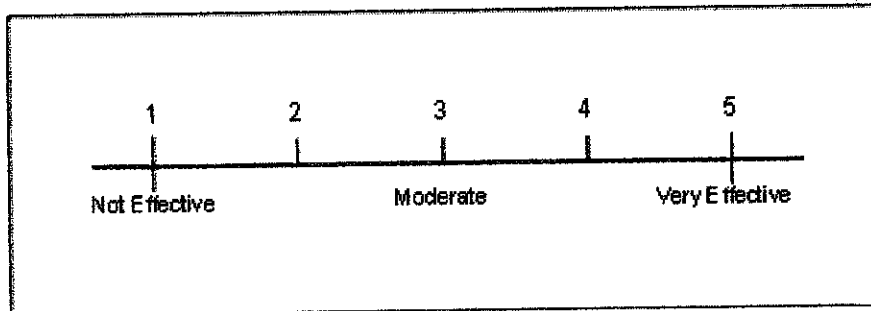### Section A: Original Application

1. The ease of navigation

2. Tendency of getting lost

Section B: User Interface

1. The effective of the user interface

```
        1          2          3          4          5

    ─────┼──────────┼──────────┼──────────┼──────────┼─────
      Not Effective           Moderate          Very Effective
```

2. Is the user interface helpful?

```
        1          2          3          4          5

    ─────┼──────────┼──────────┼──────────┼──────────┼─────
      Not Helpful             Moderate          Very Helpful
```
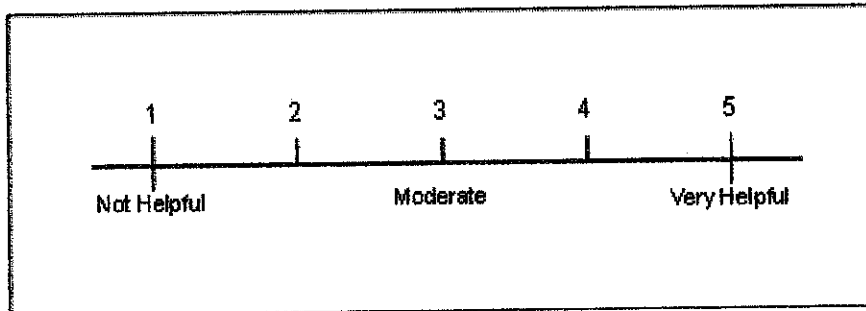
Section C: Virtual Guide

1. The effective of virtual guide

```
        1          2          3          4          5

    ─────┼──────────┼──────────┼──────────┼──────────┼─────
      Not Effective           Moderate          Very Effective
```

2. The ease of navigation

```
        1         2         3         4         5
        |         |         |         |         |
    Very Hard           Moderate          Very Easy
```

3. The ease of interaction

```
        1         2         3         4         5
        |         |         |         |         |
    Very Hard           Moderate          Very Easy
```

4. Tendency of getting lost

```
        1         2         3         4         5
        |         |         |         |         |
    Very High           Moderate          Very Low
```
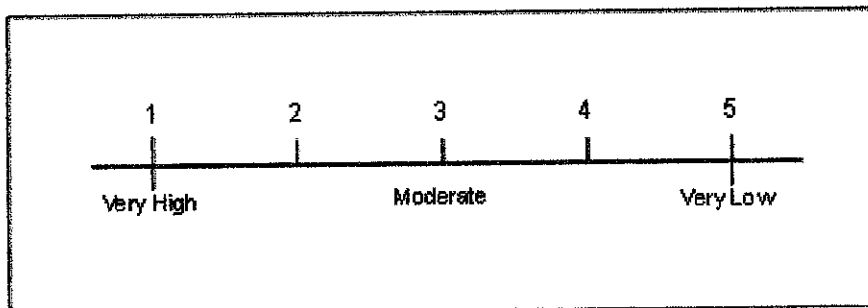
Section D: Audio Instruction

1. The effective of audio instruction

1	2	3	4	5
Not Effective		Moderate		Very Effective

2. The ease of navigation

1	2	3	4	5
Very Hard		Moderate		Very Easy

3. Tendency of getting lost

1	2	3	4	5
Very High		Moderate		Very Low
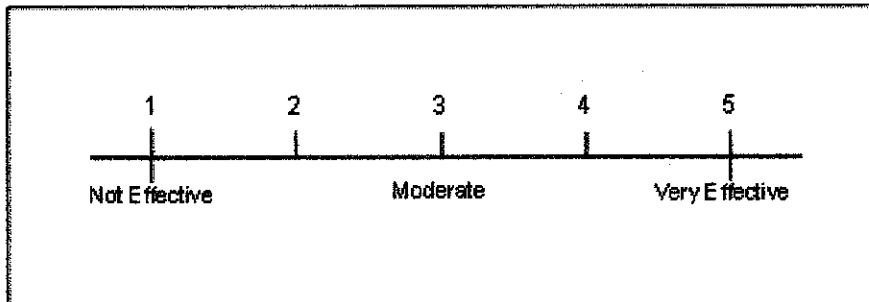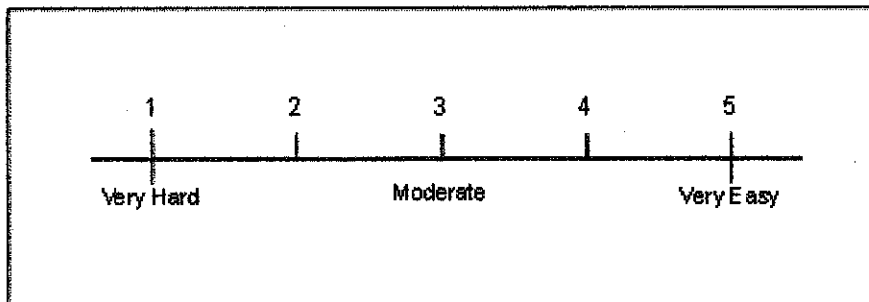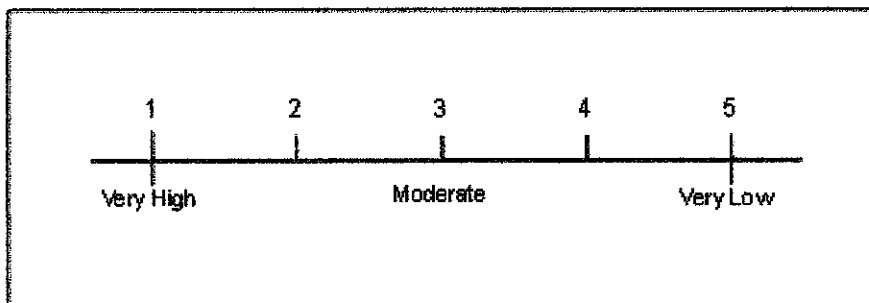
APPENDIX B

Source code for the path setting and guide interaction

```
DEF vguide01 Transform {
        translation 45 2 -11.5
        children [
          Shape {
            appearance Appearance { material Material { diffuseColor 0 1 1 } }
            geometry Sphere { radius 0.125 }
          }
          DEF timer01 TimeSensor {
              cycleInterval 20
              loop FALSE
          }
          DEF position01 PositionInterpolator {
              key [ 0 1 ]
              keyValue [ 45 2 -11.5, -8 2.2 -11.5 ]
          }
          DEF ball_sensor01 TouchSensor { }
        ]
    }

# setting movement for p1
ROUTE timer01.fraction_changed TO position01.set_fraction
ROUTE position01.value_changed TO vguide01.set_translation
ROUTE ball_sensor01.touchTime TO timer01.set_startTime
```

Source code for the implementation of audio instruction

```
DEF vguide01 Transform {
        translation 45 2 -11.5
        children [
          Shape {
            appearance Appearance { material Material { diffuseColor 0 1 1 }}
            geometry Sphere { radius 0.125 }
          }
          Sound { source DEF sound01 AudioClip { url"sounds/intro.wav"
                                                loop TRUE }
          }
        ]
}
```

APPENDIX C