ABSTRACT

The name of this project is Human Avatar in Virtual Environment. This system consists of two subsystem, the interface for this system and the controls. Interface function as an introductory page and provides navigation buttons that will guide user to interact with it. This control is part that involved in human control and how it should act with environment.

The Internet had become an important medium of communication today. Since then, the world had seen the evolution of information representation. We had made the journey form ID ((in the days of DOS) to 2D and now we are crossing the threshold into an inevitable world where 3D graphics on the computer serve as our interface and our medium of choice for data communication. The use of 3D on the Web allows virtually infinite amount of interactivity. The most important achievement of 3D technology is the making of 3D simulation, which provides interaction with the user in 3D graphic that look exactly like real. The Human Avatar applies the concept of simulation by creating 3D objects like object in the real world. It emphasizes on the user interactivity where user can interact with the simulation and learn through 3D environment.

The Human Avatar concerns the use of simulation as a mean of learning something and shows to the user what they can see in real world. Creating 3D graphics of the environment. In another word, a realistic-looking process is presented on the computer screen. This report provides an overview of the project development. It is also contains the introduction to the conception of the project, the scope and boundaries covered by the simulation, the phases of the system analysis and development processes and the system design. Its also contains the system implementation, testing and evaluation.

ACKNOWLEGEMENT

This thesis has been prepared through a lot of efforts and support by those who really care for me. Without the innovative thinking and support of many people, this thesis would not exist.

Firstly, I would like to thank my supervisor, Encik Taha that had guided me along this project development. Encik Taha had been so dedicated and patience in giving me advices and consultation at any time and providing me with the details. His encouragement and kindness in helping me through out the project is deeply appreciated.

Secondly, to Ms. Mas Idayu Md. Sabri who gave me a lot of suggestions and opinion during the project development, thank a lot for the ideas. Her ideas really helping me on behalf to finished this project.

Also not forget to all my course mates that played important roles in giving a hand and information. Without them, I think it is the major factor that might stop me to finish this project. Although they busy with their own work but they still giving their time to helping me when I faced with problems. Thanks a lot guys.

Lastly, a great appreciation to my family for their supports especially to my sister for let me use her computer. Although they are far away from me, they always asking me about this project and giving full support.

CONTENTS

1.0 INTRODUCTION

1.1 Introduction

Avatar in Virtual Environment is a system where user can control a virtually made human inside the virtual space. The main system is how to implement a human behavior in virtual reality itself. How "human " walk, run, jump, touch objects in a virtual environment.

This project target is how to create a virtual human which able to interact with objects in its world, by using some scripting to make the movement easier, 'deflector' or wall to prevent the virtual human from run out from its course and pictures for mapping to make the "world" more realistic.

Avatar in VR takes this opportunity to develop a virtual space where provides different approach for communication. This virtual space is actually a sample of a scene which is going to be created later. Users may "feel" the scene and walk through the virtual world by themselves.

1.2 Virtual Reality Defined

Virtual Reality or VR is a computer system that can gives users the feel in the illusion of a computer-generated (CG) world and let the user to navigate through the world at will. In short, it's like converting real object to 3D-based object. Furthermore, it has no limitation in creating object that is impossible to build in a real world. Nowadays, VR extensive growth applies to:

- Movies (Final Fantasy, Transformer, Ice Ages)
- 3D games (Command & Conquer, FIFA 2003, Unreal Tournament)
- Simulation (Driving School, Army for battle strategy, Aeronautics)
- Education (Real-Time learning)

Some of the benefits from Virtual Reality are:-

- Safety – A simulation like a journey through space without a needs to go to space reduce risks of losing life.
- Precision- Viewing organs or molecules in every side of perspective made user quick to understand.
- Economy- Driving simulation for beginner before through the real drive.
- Entertain- Helps students to enjoy and learn faster.

1.3 Project Objectives

1. To model out the the human avatar. In this case, the virtual human itself. It then can be use to be a model to navigate through the virtual world.
2. Model must inherit at least basic abilities in real human.
3. Model can interact with other entities such as door, or window.

1.4 Project Plan

The main plan of the project is to create a human avatar in the world of 3D graphic. The virtual environment later then will be created for bringing up the feels in the user towards realism in terms of feel like being there.

1.5 Target User

For this kind of project, my target user would be for user in age around 12 and above. It is so even though it can be maneuvers easily by all user, because due to the concept of my avatar system which normally will interest the teen on trying the system out.

For users, it is easy for them to use the system because with user friendly interface and with minimal of complex instructions will attract them to it.

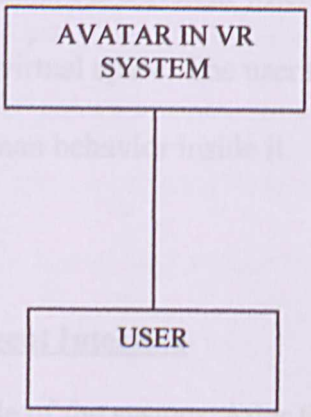


Figure 1.1: The target users of the Avatar system

1.5.2 User

All user are allowed to use the Avatar in VR to:

- Navigate through the system.
- Interact with object and other entities.
- Take tour inside the sceneries created.
- Do some action in the virtual world in terms of human behavior.

1.6 Project Scopes

The avatar in virtual environment is a system where user can use it to interact in the world which created inside the virtual space. The user then can navigate through the system while doing some basic human behavior inside it.

1.6.1 Avatar in Virtual Environment Interface

The system first load the title of the system. After the loading is done, user then will be directly brought to the start point inside the 3d space. The user is represents as a model which is created for navigate, interact, and do some actions while the user controlling the model.

i) Main menu by pressing some hotkey button. Eg: Esc

ii) Help on how to navigate when user is inside the system

This module facilitates the visitors with various type of actions of human behavior. The actions are:

i) walk

ii) run

iii) see objects, the house itself

iv) descending, ascending stair

v) turn on/off switches

vi) interact with objects

The main part is to designed Avatar in VR in such a way that the virtual space is identical to real environment. Every part of the building in the virtual space contains the characteristic of he actual object in terms of location, size, shape, and mainly its color. Extra information will be shown to users for further action like clicking on an object. For example, if users are near to the switch, and by pressing certain keys, user can turn the switch on.

1.7 Project Schedule

ID	Task Name	Duration	2003 Mar	Apr	May	June	Jul	Aug	Sep	Oct
1	Planning	2W								
2	Analysis	2W								
3	Requirement	1W								
4	System Design	1W								
5	Program Design	1W								
6	Documentation	2W								
7	Coding	16W								
8	Testing	6W								
9	Documentation	1W								
10	Presentation	1W								

Figure 1.2: Time schedule for the project

CHAPTER 2: LITERATURE REVIEW

2.1 Computer Graphics

Computer Graphics, two and three-dimensional images created by computers that are used for scientific research, artistic pursuits, and in industries to design, test, and market products. Computer graphics have made computers easier to use. Graphical User Interface (GUIs) and multimedia systems such as the World Wide Web (WWW), the system of interconnected worldwide computer resources, enable computer users to select pictures to execute orders, eliminating the need to memorize complex commands.

2.1.2 Creating Three-Dimensional objects

Many uses of computer graphics, such as computer animation, computer-aided design and manufacturing (CAD/CAM), video games, and specific visualization of data such as magnetic resonance images or internal organs, require drawing three-dimensional (3D) objects on the computer screen. In this project, several techniques are used which is provided by the 3D applications. There are *Non-Uniform Rational B-Splines* (NURBS) and *editable mesh*. In objects and character creation, these techniques are involved.

2.1.2.1 NURBS

Non-uniform Rational B-splines or NURBS is a technique to build normally complex structure which usually organic-shape objects. Organic-shape object is actually combination of non-symmetrical and symmetrical objects which created by using curves. As an example, a box is a symmetrical object but plants are not.

2.1.2.2 Editable Mesh

Creating human or any character are much perfect using this technique. It means that the creation of objects would be much precise and looks more real. It is so because the ability to manipulate vertices of the object. Vertices means the point on the surface of the object. This techniques also can be use to create other objects. Symmetrical objects like a box or door are far better using Editable mesh rather than NURBS. However, even though that this techniques would create sharp model of objects for characters, it is unwise because of lots of polygon usage and hard to do. So, this technique would be only used for creating symmetrical object.

2.1.3 Modeling

In this section, explanation of how the human object and the others objects were modeled are shown. The first step in a rendering pipeline is the creation of 3D object, is represented either as a series of curved surfaces or as polygons, usually triangles. The points on the surface of the object, called vertices, are represented in the computer by their spatial coordinates. Other characteristic of the model, such as the color of each vertex and the direction perpendicular to the surface at each vertex, called the normal, also must be specified. Since polygons do not create smooth surfaces, detailed models require an extremely large number of polygons to create an image that looks natural.

Another technique used to create smooth surfaces relies on a parametric surface, a two-dimensional (2D) surface existing in three dimensions. For example, a world globe can be considered a 2D surface with latitude and longitude coordinates representing it in three dimensions. More complex surfaces, such as knots, can be specified in a similar manner.

2.1.4 Mapping

Several techniques were used to add realistic details to models which created in this project with simple shapes. The most common method is texture mapping, which maps or applies an image to an object's surface like wallpaper. For example, a human hand pattern could be applied to a rendered sphere. In this process only the object's shape, features of the texture, such as hand and finger lines, and color of the hand, affect the way the object looks in the lighting; the sphere still appears smooth.

Another technique, called bump mapping, provides a more realistic view by creating highlights to make the surface appear more complex. In the example of the human hand texture, bump mapping might provide shadowing in the hand and finger lines and highlights upon some hand surfaces. Bump mapping does not affect the look of the image's silhouette, which remains the same as the basic shape of the model. Displacement mapping address this problem by physically offsetting the actual surface according to a displacement map. For example, the hand texture applied to the sphere would extend to the sphere's silhouette, giving it an uneven texture.

2.2 Animation

This project involved non-controllable animation only in automatic tour and after user activated some action which provided in the virtual world. An explanation on this section are enclosed. Computer Animation, creation of the illusion of motion by viewing a succession of computer-generated still images. Animation are required in automatic tour as an early information to all places inside the virtual house and as for actions that activated by the user, they can see how the virtual human in the virtual world can act like a real human. Animation would add some realism to the user while they watch it. Computers were first used to control the movements of the artwork and the camera.

Animation not only limited to non-controllable model viewing. As for human movement which controlled by the user also called animation. In this case, human avatar that is created in the project in controllable. User can move the virtual human freely to all spaces within the virtual world which is provided. Computer animation can be used to create special effects and to simulate images that would be impossible to show with non-animation techniques, such as a spacecraft flying by the planet Saturn. Computer animation can also produces images from scientific data, and it has been used to visualize large quantities of data in the study of interactions in complex systems, such as fluid dynamics, particle collisions, and the development of severe storms. Computer animation has also been used in legal cases to reconstruct accidents.

2.2.1 Camera Stands and Editing

There's two type of camera that would be used in the Human Avatar project. There are first-person view camera and third-person view camera.

Special characteristics or real cameras such as fish-eye lenses and lens flare, can be simulated by the virtual camera. This ability to control a virtual camera, combined with powerful digital video editing, enables the animator to complete the film entirely in a computer-generated environment.

2.2.1.1 First-person view camera

The first person view camera would be placed inside the virtual human's eyes. From there, users can see how they going to see objects and its environment in the real would. The virtual human created using the normal human height with the normal eyesight. Therefore, the user would know how is it really the size of the house in the real world.

2.2.1.2 Third-person view camera

The third-person view camera is placed from the virtual human within range 1 to 3 meters and high around 30 to 50 centimeters from the human head. This view would make navigation much easier to the user because they could see the virtual human and control it around the house easily.

2.2.2 Avatar (Human Avatar)

To create a virtual "Human" in world of 3D needs real knowledge in 3D animation. Without any knowledge in animation could fatal the objective of the project. The needs of knowledge on how to create human object and then to create its bone for easier action later is absolute.

In real-time 3D, this "human" must be able to do the basic movement like real human do. The behavior such as jump, run, walk, see, touch, ascending or descending stairs are the basic movement. This virtual human must be able to interact with its environment such as objects that was created in the virtual world.

In this project, the virtual human is created using editable mesh. It starts from a simple object of a box. Some basic techniques are used such as extruding object, welding vertices and smoothing to create the virtual human. Most of the time were spend on creating bones and controller for the virtual human.

Bones were created for the virtual human because to safe much time and work to animate the virtual human. These bones functions which are created are nearly same as real human bones, to move. After completion of bones, controller are placed to some important bone's joint. Controllers are needed to reduce useless work on human repetition movements. It means like if a human is walking, one single movement of right and left leg is taken by the controller. Then the controller can repeats the movement again and again to make the virtual human keep on walking. Without controller, animation can be a nightmare.

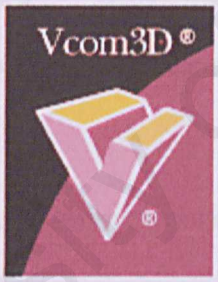
2.3 Previous Projects

Nowadays, there are many projects previously done by the same techniques and published through the Internet. Here's two projects have been studied:

I) VCOM3D

II) Smart City

2.3.1 VCOM3D (*www.vcom3d.com)*



Vcom3D is a company which helps deaf children to learn from an early age. Normally deaf student can reach the capability to read started from grade 4. This situation is so slow to compare with normal children which surrounded with speeches from the beginning of their birth.

Vcom3D provide a simulation-based e-Learning to these special kids to help them reach comprehension in same level with normal kids have. Authors will have a user-friendly graphical interface to create interactive simulations in which characters interact with and move through their environments to demonstrate tasks and to play roles.

Simulation-based e-Learning is in demand because of its impact on comprehension and retention. Researchers at multiple institutions (including Carnegie Mellon and University of Indiana) have found that a one-on-one learning experience results in a 2-sigma increase in learner performance. Adding a virtual mentor to e-learning content approximates this experience. According to Brandon-Hall, the e-Learning industry recognizes that compelling and engaging simulation, using an animated mentor, increases comprehension and retention significantly.

Vcom3D developed a text-based animation language with low bandwidth and small footprint. Next, all Vcom3D characters are designed to use the same library of gestures and actions, so that characters and animations may easily be reused when creating content. Vcom3D has eliminated these problems to everything is easy for their parents or guardian; key barriers are content development cost, bandwidth or CD-ROM footprint requirements, and advanced technical skill level required for authoring content.

Vcom3D's current focus is on applications that equalize education, training and employment opportunities for the Deaf and Hard of Hearing. While this focus continues, the opportunity to create the standard for all 3D content on the Web is just on the horizon. Ultimately, Vcom3D, Inc. technologies and products will bridge the comprehension gap for all audiences in every situation imaginable – from hospital waiting rooms to airport security to training sales reps worldwide – with one changeable tool that works for every audience.

2.3.2 SmartCity (*www.smartcity.com*)

Smart City is a computer visualization tool that creates a virtual with avatar-based environment. Users can view through this virtual world, walk inside the cities, and even interact with other users in form of virtual-human.

Smart City is an integrated decision support system and data management for 3D virtual lifestyle and landscape design. It try to bring human to another version of life by recreates our self with own define virtual human characteristic. Here, users can reach

something that is impossible to do in real world by represent them as a part of the illusion world.

Smart City would be the bridge for a far better communication between the virtual environment and the designers, decision makers, or even other ordinary people around the world. In this project, its initial implementation is to convert real world objects and stuff to virtual and to make user feels like living inside the virtual world. For this purpose an application name Archiew 3d are used to create the models and the building architectures. It will be converted to VRML format automatically.

2.4 Advantages and Disadvantages

In this section, advantages and disadvantages of the project are enclosed to compared with previous project.

Project	VHS Advantages	VHS Disadvantages
SMART CITY	Smart City can't make offline tour due to the interactivity with other user but this project can achieve it.	Interactivity with other user. Means that user can interact with other user that log in to the virtual world.
	Doesn't need to download a large size software to view the file.	Still need to download viewer plugin.
V-COM 3D	This project will not cost user. V-Com3D is a pay-site company.	Cannot support one-to-one communication which mean user can interact with administrator or with higher level user.
	Supports downloadable program for usage of offline tour.	Still need to download viewer plugin.

2.5 Proposed Tools

These are several tools that are proposed in this project development. In this section all tools only will be described to its features. Deep explanation on these tools will be given in the next chapter. Below are these listed proposed tools:-

1) Adobe Photoshop 7
2) 3D studio Max 5
3) Maya 4.5
4) Cortona VRML Client
5) Spazz 3D
6) Cosmoplayer
7) VRMLPad 2.0

2.5.1 Features

Each of these tools has its own features. Therefore, thorough analysis is required to choose which features are needed in this project. More explanation on these tools will be discussed in Chapter 4.

2.5.1.1 Adobe Photoshop 7 Features

Tool type: Graphic Editing Tool

- Special effects, layer effect, liquify tools and many more.
- Freely Customize tools and easy interface.
- High resolution and small size image published.
- Supported almost all type of image formats.

2.5.1.2 3D Studio Max Features

Tool Type: 3D Authoring Tool

- Global illumination with exposure control, photometric lights & new shaders
- Now includes **reactor**® – premiere dynamics software integrated with **3ds max**
- Export to real-time 3D environments with Render-to-Texture, Normal Maps, and Light Maps

- Support for Vertex Color Baking of Radiosity solutions
- New intuitive Curve and Dope Sheet Editor, Draw Curves, and Soft Key Selections
- Enhanced animation capabilities with a new Set Key system to streamline pose-to-pose animation
- Perfect control over mapping coordinates with a new UVW Unwrap modifier
- Unmatched polygonal modeling
- 5th-generation **backburner**™ network rendering & management utility for management of **3ds max** and **combustion**®

2.5.1.3 Maya 4.5 Features

Tool type: 3D Authoring Tool

- Innovative user interaction techniques.
- Smoothest possible workflow
- Advanced digital content production.
- Unique hierarchical editing capability
- New polygonal architecture
- New auto-projection and relaxation tools

2.5.1.4 Cortona VRML Client Features

Tool Type: VRML Viewer

- Fast and highly interactive viewer.
- Free plug-in for standard HTML browser
- Work with office application such as Ms Word.
- Complete support for VRML97

2.5.1.5 Spazz 3D Features

Tool type: 3D Web Authoring and Animation Tool.

- Boolean operation, NURBS deformations, and Magic Cookie Wizard.
- Infinite adaptive Undo/Redo system
- Own browser to view file.
- Supported Realtime and Non-Realtime animation.

2.5.1.6 Cosmo Player Features

Tool type: VRML Viewer

- Fast and highly interactive viewer.
- Free plug-in for standard HTML browser
- Work with office application such as Ms Word.
- Complete support for VRML97
- Supported Java and Javascript.

2.5.1.7 VRMLPad 2.0 Features

Tool type: VRML Authoring Tool

- Codetips for Quick Viewing
- Fast and easy usage of interface.
- Script data monitor state.
- Script procedures adding.

CHAPTER 3: Methodology

3.1 Techniques used

Several techniques have been studied to collect and analyze the system information needed. These techniques include:

- Brainstorming
- Questionnaires
- Interviews

3.1.1 Brainstorming

At the early stage, based on experience, brainstorming is the perfect action to gather information. It is done to catch the exact point and concept of creating the project. The idea to create this system is actually from the buy-selling house business. To create and show buyers an early view of their dream house in virtual before they decide to buy it without the need to go to see the real house.

Many ideas are gathered and finally little by little it started to have a form of how the project should be presented and finally lead to the scope of the project.

Gather as many as possible information on development tools. Based on the functionality, abilities, and compatibilities, we tried to find the best suited tools for this project development.

3.1.2 Internet

The Internet is the most precious place to find infinite sources on project development. Latest information can be obtained in here. Furthermore, gathering information through the Internet reduce the cost of using conventional method.

Many avatar based projects done by some commercial companies through the Internet, providing very useful information.

3.1.3 Questionnaire

Questionnaire is done by listing all basic needs questions related to the implementation of the project. These questionnaire's target mainly to the student for starting research, then by proceed to public.

Distribution of questionnaires to many type of people could show what is the overall needs in the program development. These data are calculated and a statistic information is generate.

Even though Questionnaire is quite conventional and costly, but it provides very useful information and accurate data.

3.2 Process Modeling

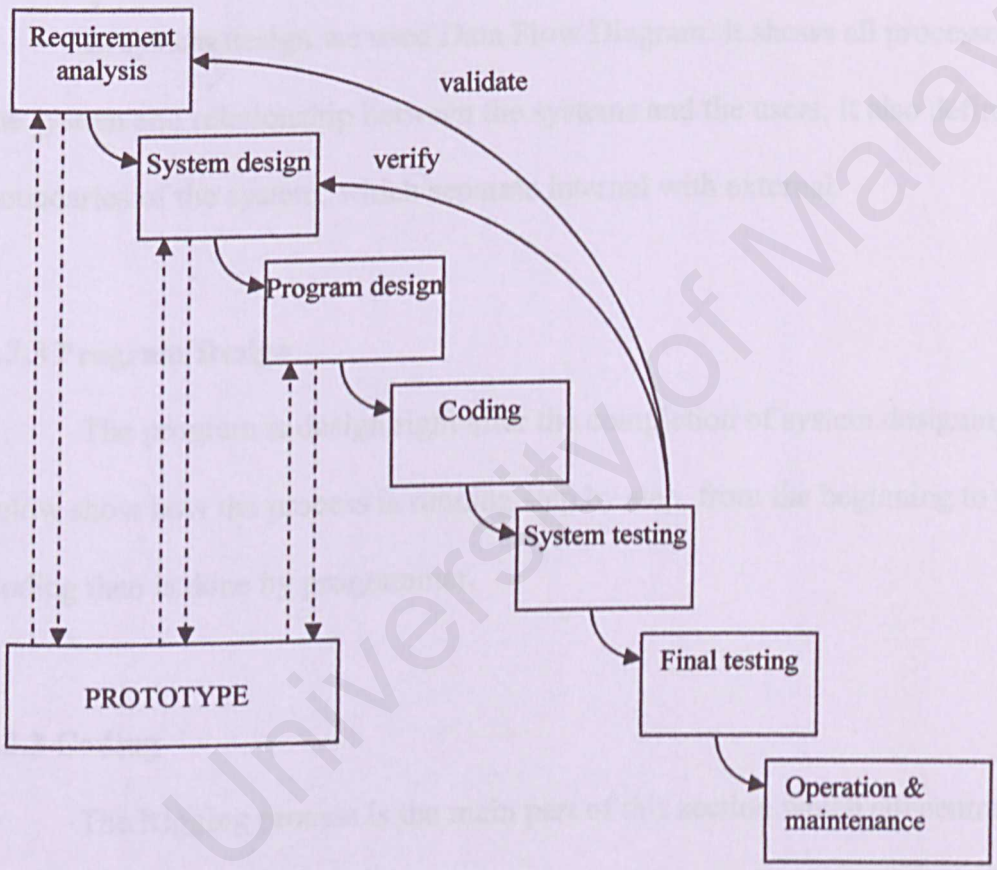


Figure 3.1: The Waterfall Model of Prototype

At an early stage, the needs of defining a process development is absolute, which describe how the development process is organized. In this process Waterfall model is used.

3.2.1 Requirement analysis

At the beginning stage, the requirements of the system are identified. All this requirement will go through proper analysis to make sure it's properly defined. Then these analysis will be jot down to form a report of System Requirement Statement.

3.2.2 System Design

In system design we used Data Flow Diagram. It shows all processes take part in the system and relationship between the systems and the users. It also defined the boundaries of the system, which separate internal with external.

3.2.3 Program Design

The program is design right after the completion of system designing. Flow Chart below show how the process is running step by step, from the beginning to the end. Coding then is done by programmer.

3.2.3 Coding

The Rigging process is the main part of this section which concentrates on creating the human movement, "walls", interaction, as well as mapping to its environment.

3.2.5 System Testing & Final Testing

After its design is finished, system is being tested. Testing divide into two; System Testing and Final Testing. In System Testing; unit, integration, and system is tested. In Final Testing, all in System Testing and to all subsystem are tested.

3.2.6 Operation and Maintenance

Lastly, to maintain or develop the system, Training program is required to show the way of controlling the system. Proper maintenance help project owner to maintain system easily.

CHAPTER 4: System Analysis & Requirement

4.1 Development Software and Tools

In this section, we'll see that several software been studied. Each has its own functions and compatibility. All this software are studied to analyst the best development kit that are going to be used for the project. This software divided into two group:-

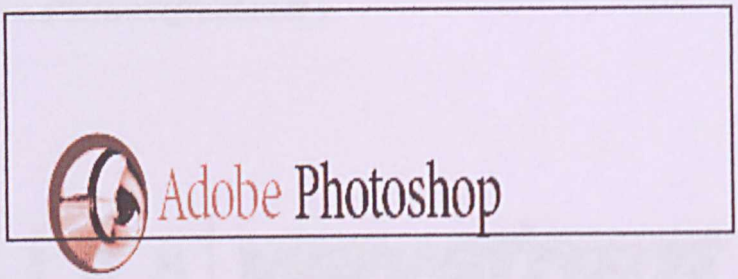
i) Tools for creating objects and its environment for Avatar in VR.

ii) Platform (Operating System).

4.1.1 Tools for Avatar in VR Development

In Chapter 2, All these tool's feature has been studied. Now, an extra explanation will be given to add more understanding to each of software.

4.1.1.1 Adobe Photoshop 7 (*http://www.adobe.com*)



The Adobe Photoshop 7 is a well known graphic tool in most of animators and art designers and known as the most powerful graphic editing tools. It has many capabilities such as special effects, layer effects, liquify tools and many more to create very good quality images.

4.1.1.2 3D Studio Max 5 (*www.discreet.com*)

3Ds max ™ is well known 3D modeling, rendering, and animation software to most professional 3D animators. Many features has been added since its first version released in 1996 and has gained more than 97 industry awards.

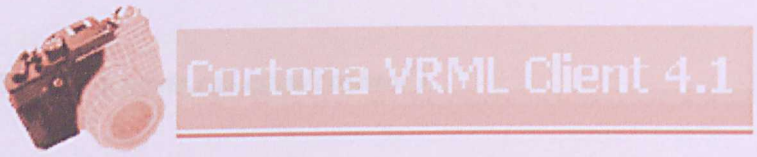
4.1.1.3 Maya 4.5 (*www.aliaswavefront.com*)

Alias | wavefront

MAYA

Maya is the most powerful and advanced solution for the creation of digital content and 3D animation on the market today. All Maya features are perfectly integrated into a single environment that is completely customizable and optimized for maximum productivity. Innovative user interaction techniques in Maya deliver the smoothest possible workflow. Maya is for the advanced digital content creator who truly wants to work with the ultimate creative tool for maximum creative possibilities. This program is for advanced digital content production in video, film, broadcast, games, and location-based entertainment.

4.1.1.4 Cortona VRML Client V4.1 (*www.parallelgraphics.com*)



Cortona® VRML Client is a fast and highly interactive Web3D viewer that is ideal for viewing 3D models on the Web. A set of optimized 3D renderers guaranties the best visual quality on both PCs with the latest video-cards and those with more basic video card capabilities. Cortona is a free plug-in for standard HTML browsers like Internet Explorer ™.

4.1.1.5 Spazz3D (*www.spazz3d.com*)

Spazz3D™ is a 3D Authoring and animation Tool for web-based program. It is an easiest way to create an avatar-type system without much knowledge of VRML itself. Animation such as real-time or non-realtime can be done using this same product.

Its functions has similiarity with 3D program tools but it's in compact version and specially for web authoring and animation. Boolean operations, nurbs deformations, and Magic Cookie Wizard fastened the work.

4.1.1.6 Cosmo Player (*www.cai.com/cosmo/*)

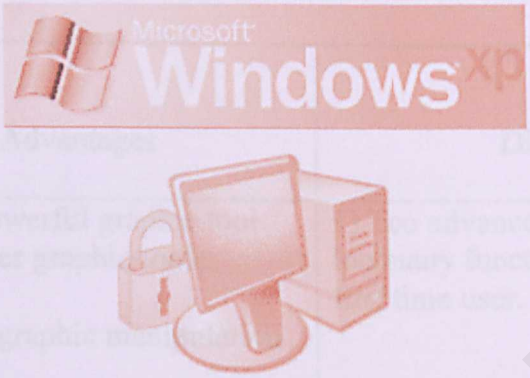
Cosmo Player is a high-performance, cross-platform VRML browser for Internet browsers. It is developed by Silicon Graphics Incorporation. It is designed for fast and quality viewing of 3D world. Cosmo Player included several basic functions for users to explore the virtual world such as rotate, zoom, and pan. As for navigation purpose, it gives users choice of viewing and action inside the virtual world.

4.1.1.7 VRMLPad 2.0 (*www.parallelgraphics.com*)

VRMLPad 2.0 mainly pointed to VRML scripting. This version includes integrated script debugger. It enable user easily control the script with easy and friendly user interface. It can monitor each script written in the editor. It also allows user to insert anchors and external prototypes. It provides AutoComplete function and dynamic error detection. It runs the operations and resources. Besides, it is able to preview the VRML, scene, and contains a publishing wizard.

4.2 Platform

4.2.1 Microsoft Windows XP Professional



Windows XP delivers a host of great features, including improved reliability and security, along with great experiences in real-time communications, mobile support, home networking, digital photos, digital video, and digital music. The new Windows Catalog will showcase thousands of products that make the Windows XP experiences even better, and Windows XP is also driving new standards in software and hardware quality.

4.3 Advantages And Disadvantages

This section will show advantages and disadvantages of all proposed tools. Below is the table that show all of those:-

Tools	Advantages	Disadvantages
Adobe Photoshop 7	1) Most powerful graphic tool among other graphic tools. 2) Lots of graphic manipulation tool. 3) Support many type of image formats.	1) Too advance to use by beginner. Has too many functions that will confuse first time user.
3D Studio Max 5	1) Support conversion to VRML type format. 2) Very easy to learn because of nice and good implementation on GUI.	1) Not too many help on each icons and functions.
Maya 4.5	1) Very nice in character modeling with excellent graphics rendering.	1) Not a user-friendly type of Tools 2) Only suitable for Advance user or professionals. 3) Very hard to learn.
Cortona VRML Client	1) Easy to use. With a very easy graphical user interface.	1) Need to install first.
Spazz3D	1) Create beautiful project especially for creation of building.	1) Only best on OpenGL type of project. 2) Not suitable for character modeling.
VRMLPad 2.0	1) Easy interface 2) Monitor each word of script.	1) Must know how to scriping VRML. Not really helpful on explanation of each script.

4.4 System Requirement Statement

4.4.1 Preconditions and Assumptions

- The Building is created must be exactly the same or at least nearly same but objects in the building may not exactly the same with the real world.
- The VHS system may be used for multi user

4.4.2 Functional Requirement

- User can move inside the 3D space freely
- User can do basic human movements while they were there.
- User also can interact with object there which are set to interact with.
- Hotkeys to make the navigation is much easier.

4.5 Other Requirement

4.5.1 Interface and Reporting Requirement

- The Avtar in VR system should work on a Windows system.

- The system should return to the previous section if error occurs.

4.5.2 Non-functional Requirements

- **Reliability** – Process errors must be avoided before the error could occurs on output.
- **Availibility and Manageability** – The program should not stop and must be available all the time, and anywhere.
- **Security** – All information used in the system must be legal. Authorized users only may change or modify the system. Login and Password included in the system. Validation control is needed to ensure the safety of the data.
- **Usability** – Guideline and help are needed to train user how to use the program.
- **Flexibility** – System shall be able to have update in incoming future.

4.6 Software Analysis

Based on the comparisons made above on the tools information that has been gathered, the following are justification of the software to be used in the Virtual Home.

1) Microsoft Windows XP Professional (Platform)
2) 3D Studio Max 5 (3D Authoring Tool)
3) Cosmo Player (VRML Viewer)
4) VRMLPad 2.0 (VRML Editor)

4.6.1 Microsoft Windows XP Professional

This latest Microsoft operating system has better functions, fast, lots of compatible software, compared from other OS. 3ds max can't run under Windows 98 and have problems with Windows 2000. It's more reliable and up to date.

4.6.1.1 Reliability

The best part of Windows Xp is its ability to prevent any errors from occurs. Even though error still occur, it will stop the program's process while not disturbing any other running process. It also have repairing system to return the system to normal again.

4.6.1.2 Mobility

Mobile computing is simpler and more efficient with Windows XP Professional. Means that users can work anywhere, anytime and much more saving time while increasing productivity. Latest mobile OS using Windowx Palm XP much more efficient and easy-to-use than other OS. Even an O2 PDA using Windows XP as is Platform.

4.6.1.3 Manageability

Windows XP Professional is easier to deploy, manage and support. Centralized management utilities, troubleshooting tools, and support for self-healing applications all make it simpler for all users to manage their computers. Furthermore it's cheaper than other OS.

4.6.1.4 Performance

With 128mb of ram, Windows 2000 Professional was 36 percent faster than Windows 95 and 30 percent faster than Windows 98. But it's not enough for Windows XP Professional which 15 percent more faster than Windows 2000 Professional. Now, the XP is talking.

4.6.1.5 Security

Windows XP Professional Provides very tight security features to protect sensitive data. Now it has wireless networking capabilities by adding support for the IEEE 802.1x security protocol. Accessing to the Internet will never be this easier with Windows XP Professional.

4.6.1.6 Internet

The familiar user interface of Windows 98 and the capabilities of Internet Explorer 6, makes using the Internet and the local desktop a unified user experience. This user interface with integrated search capabilities, makes information search much more easier.

4.6.1.7 Usability

Windows XP Professional is a combination of Windows 2000 and Windows 98. Using Windows 2000's power and security while using traditional ease of use of Windows 98.

4.6.1.8 Hardware

Windows XP Professional lets you take advantage of new hardware devices, such as those with universal serial bus 2.0 (USB), IEEE 1394 (FireWire), IEEE 802.1X, and BlueTooth. It also support for existing hardware makes Windows XP Professional ideal for home-use, and large company as well.

4.6.2 3D Studio Max 5

It's ability to convert its file into VRML files makes its the choice of tools as the development tool. Its friendly user interface gives user flexibility and reliability.

Its user friendly interface and its choices of users level interface made this product became the most 3D tool of choice among 200,000 Windows® 3D animator. It provide CG (Computer-Generated) professionals with advanced tools for character animation, game development, advertising, visual effects, and movies.

Many new features has been added in this version. Because of this, there might be more 3D animators to join the track with Discreet™.

4.6.2.1 Architecture

- Grow and Shrink Selections
- Support for shaded faces with Soft Selection
- Repeat Last Operation
- Constrain Translation to Edges and Faces
- Quickslice

- Remove Vertex, Edges
- Insert Vertex
- Improved Cut tool
- Extrude Edges
- Connect Edges
- Loop Select
- Ring Select
- Outline Polygons
- Extrude Along Spline
- Hinge From Edge
- Flip Polygons
- Remove Unused Map Vertices.

4.6.3 Cosmo Player

This Browser is needed to view the VRML format. This Viewer has not much different with Cortona VRML Viewer. So randomly, Cosmo player is being choose to be the viewer.

Cosmo Player included several basic functions for users to explore the virtual world such as rotate, zoom, and pan. As for navigation purpose, it gives users choice of viewing and action inside the virtual world.

Cosmo Player made experience in a world of 3D much fun and exciting. Users can experience data visualizations or in CAD model. It supports all VRML 2.0 codes.

4.6.4 VRMLPad 2.0

VRMLPad 2.0 is a powerful text editor for VRML programming. Features include; Dynamic error detection, Syntax highlighting, Advanced find and replace command, syntax tip, and auto-indent. VRMLPad allows users to preview the scene, organize and optimize in publishing. This tools is chooses because there's no other VRML tools that can be find easily in the Internet. Furthermore, it's better to have the tools rather than using Notepad to handle the script.

- Control the execution of your script, including pausing execution, running to a cursor, or a breakpoint location, or stepping through code.
- Monitor the state of script data, including the current call stack; variables, arrays, and objects that are available in the current context; evaluate expressions containing this data.
- Modify the values of variables, arrays, and objects in the script during a debugging session.
- Add new procedures to the script during a debugging session.
- Examine and modify on the fly data items in the script using the Quick Watch window.
- Use CodeTips for quick viewing of variables' values in the script.

CHAPTER 5: Avatar System Design

5.1 System Design

The process in this step is focusing on how the systems work when users enter the main interface of Avatar in VR system. and how the program can help user navigate through the system.

There is a flow charts have been drawn to explain the program design. Figure 4.5 explains the program design of the avatar system.

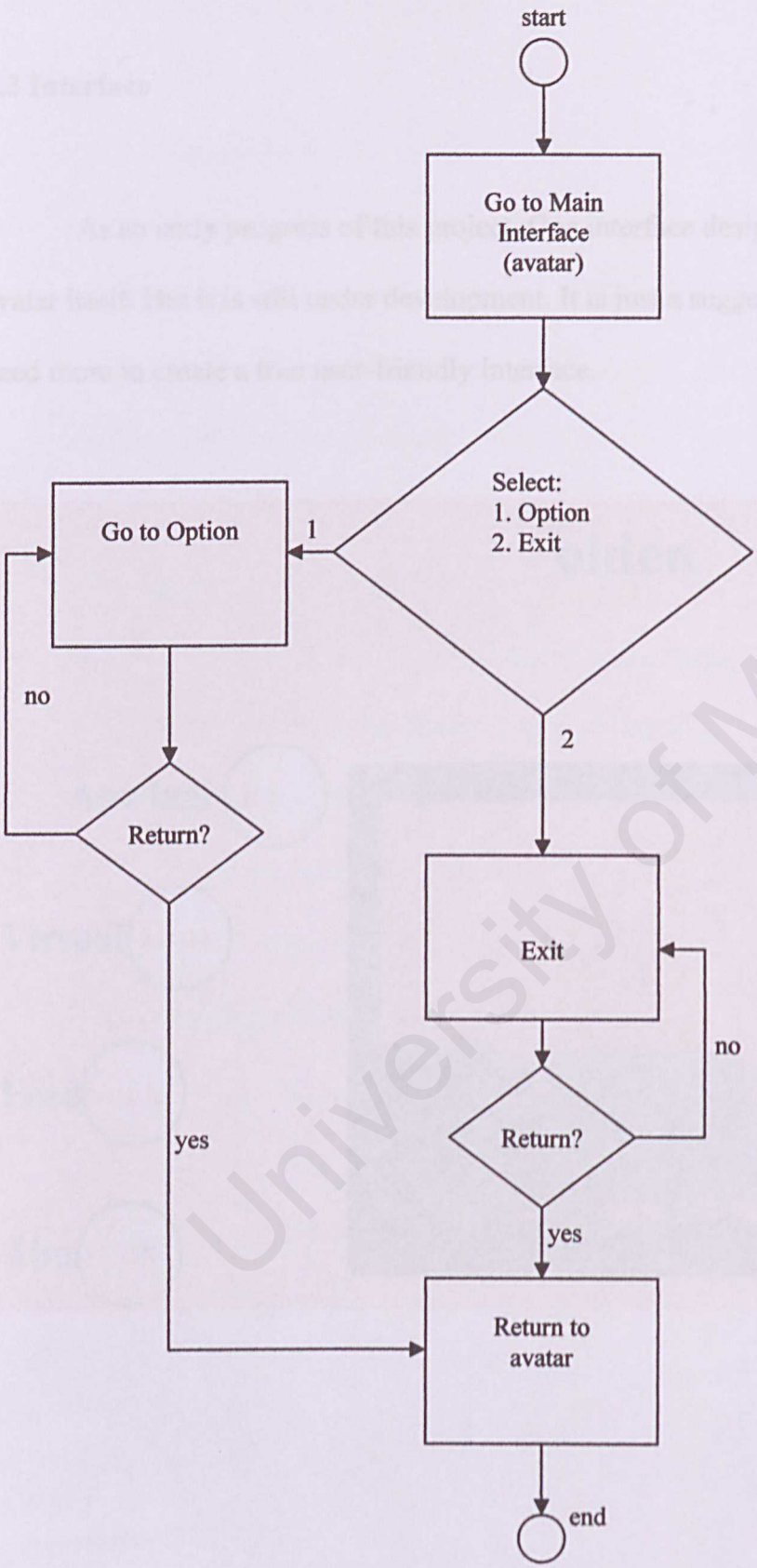
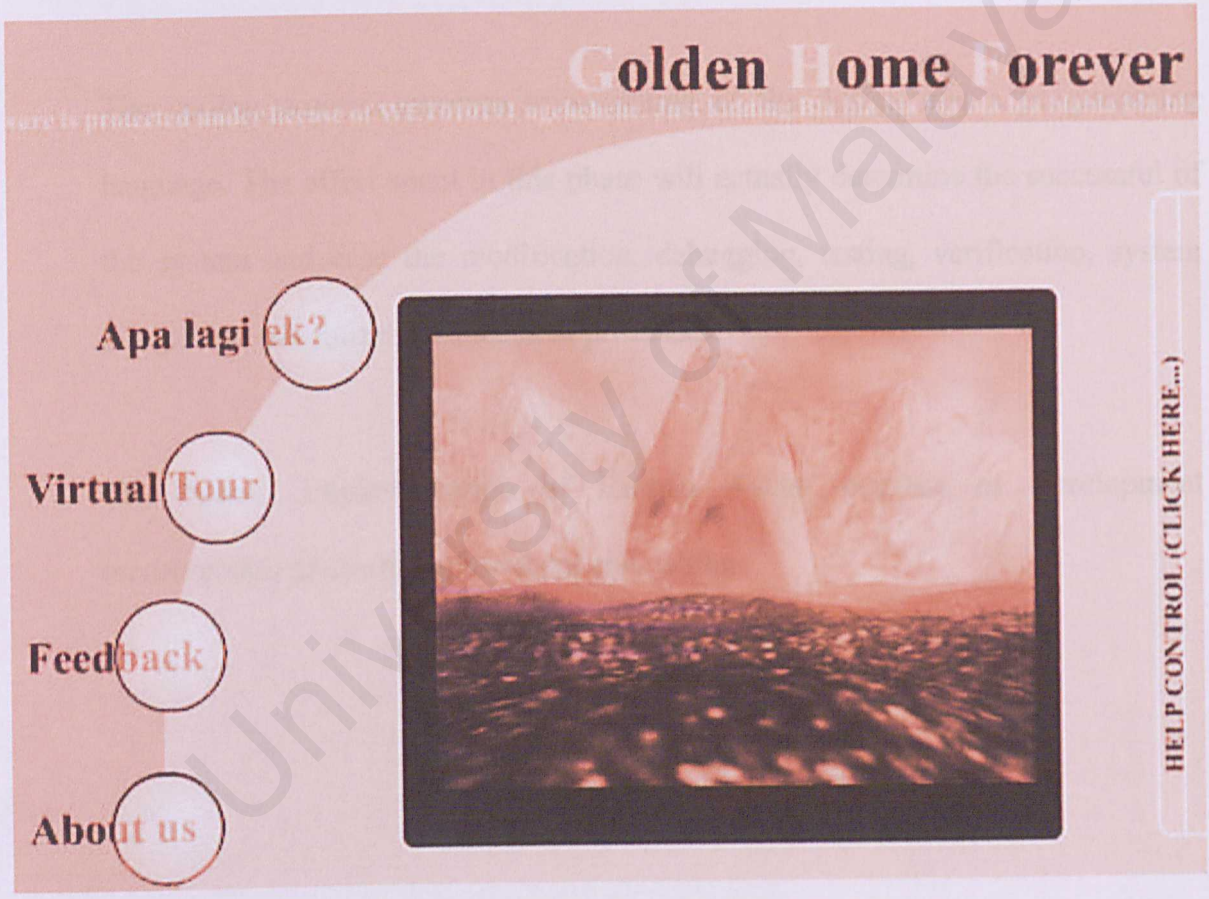


Figure 5.5: The Flow Chart of VHUI System

5.3 Interface

As an early progress of this project, One interface design has been done. It is for avatar itself. But it is still under development. It is just a suggested interface and might need more to create a true user-friendly interface.



6.0 SYSTEM IMPLEMENTATION

6.1 Overview

System implementation is an important phase that involved the implementation of development and coding phase especially when involves a project developed by a team of people where integration of system works by different of people takes a huge effort.

The coding process involves transforming of the design into a programming language. The effort spent in this phase will actually determine the successful of the system and ease the modification, debugging, testing, verification, system integration and future enhancement processes.

The system implementation of Human Avatar consists of development environment, platform environment and coding.

6.2 Development Environment

Development environment plays an important role in determining the speed and stability of the system. The correct selected environment will ensure the smoothness and reliability simulation performance.

6.2.1 Actual Hardware Used

Below are the hardwares that had been used to develop the system;

- Athlon XP 1800+ processor – 1.533 GHz
- 512 Mb RAM
- Nvidia GForce4 Ti 4200 Display Card - 128 Mb
- SVGA Color Monitor

6.2.2 Actual Software Used

Below are the softwares that had been used to develop the system;

- Operating System

  Microsoft Windows XP Professional

- Software tool

  3D Game Studio A5 System

- Programming Language

  C++

6.3 Platform's Development

Platform's development for this system includes setting up the development environment and the WDL character rigging into the machine. The installation of 3DSMAX is essential to support the modeling development for simulation engine.

6.3.1 Setting Development Environment

- Install the operating system

  Microsoft Windows XP Professional

- Install the Software tool

  3D Game Studio A5 system

  3DSMAX v5, v6

- Install MED

  Model Editor for skinning and rigging process

6.3.2 3DSMAX 3DS to MDL process

3DSMAX is a cross-platform standard for 3D rendering and 3D modeling. 3DSMAX v5 or V6 would only run under Windows me, 2000, and XP.

There are several files required to be include within 3DSMAX plugin folder. These file are crucial for converting 3DS model into readable version for 3D Game Studio A5 system which is known as WDL.

Below are the steps that should be taken in order to install 3DS->MDL plugin into the machine;

Step 1 : Get plugin from 3DGS site.

- Download plugins from various URL from the internet such as from;

  http://www.3dgs.com/

Step 2 : Installing plugin

- To install plugin, decompress the archive by using WinZip then the following files will be extracted;

  3dstomdl.dlo

  3dstomdl.dlc

  readme.txt

The next step is to move the files into the appropriate directories so 3DSMAX v5 can find them for linking.

- Place the 3dstomdl.dlo file into the *c:/3dsmax5/plugins* directory
- Place the 3dstomdl.dlc file into the c:/3dsmax5/plugins directory
- Readme.txt is an instruction similarly as above instruction.

To create a 3DS file for 3D Game Stuido program using the plugins;

- Select "New" from the "File" menu
- Create an entity/model.
- Create bone system and attach to the model.
- Select "export" the file with desired name.
- Choose type of export. It will be WDL file format.
- Click ok and the model will be automatically converted into WDL file format.

Below figure shows modeling was done using 3DSMAX.

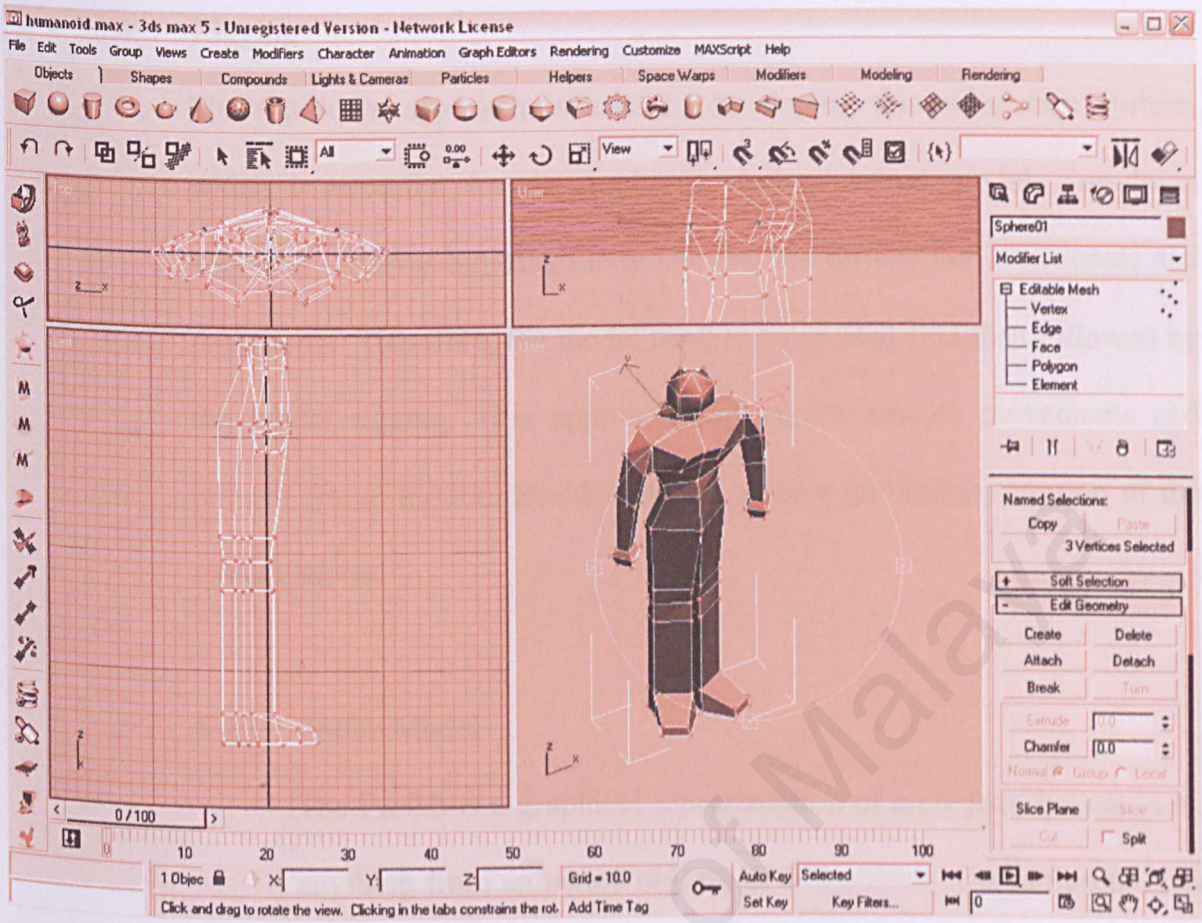


figure 6.0 Modeling Process in creation of a virtual human

6.4 Rigging

The top-down approach is used in developing this simulation system, which is essential for developing a well-structured model. Top-down approach involves building the model that are refined into functionals and animatable. Therefore, the model need to be created first then followed by the model rigging. This approach will ensure smooth movements and prevent freeze motion. Besides, it also gives a preliminary version of the system sooner.

6.4.1 Prefab Model

The Prefab is a graphical representation of an object that could be anything from animated objects or still objects. Certain prefab has its own behavior. This can be used as a reference when rigging session is in progress and to learn the exact behavior for as for this project, human behavior.

Figure 6.1, 6.2, 6.3 and 6.4 shows the different act of model post created which is referred from an existing prefab.

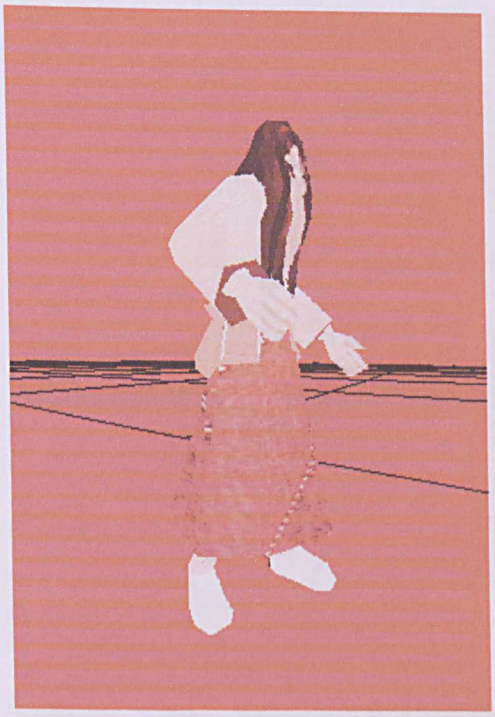


Figure 6.1 : Model was rigged into "stand" position.

Figure 6.2 : Model was rigged into "walk" position.

Figure 6.3 : Model was rigged into "run" position.

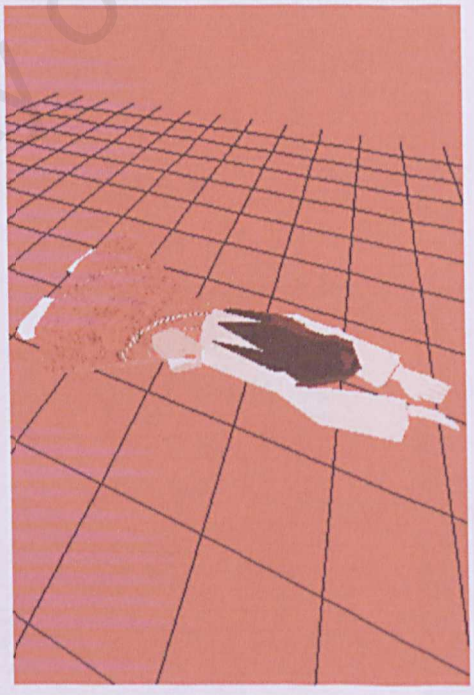


Figure 6.4 : Model was rigged into "swim" position.

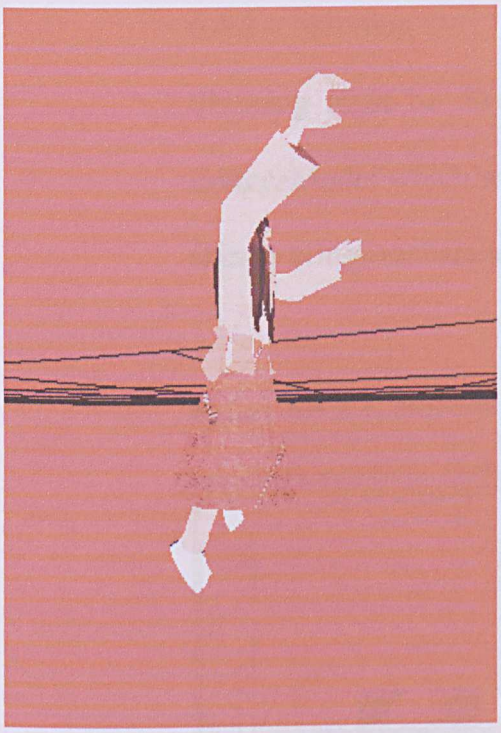


Figure 6.5 : Model was rigged into "jump" position.

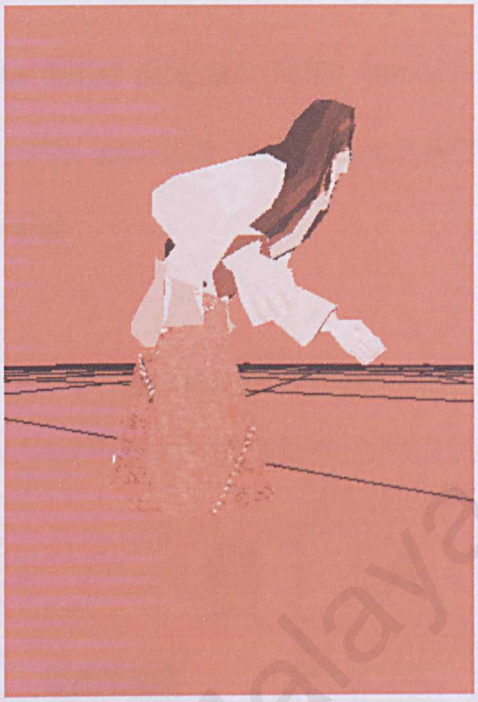


Figure 6.6 : Model was rigged into "crouch" position.

6.4.2 Skinning

Skinning must be done in the MED program. MED stands for Model Editor. Model which was converted into MDL model format will be given skin to brings realism to the model.

Figure 6.4.2.1, and 6.4.2.2 shows how skinning were made

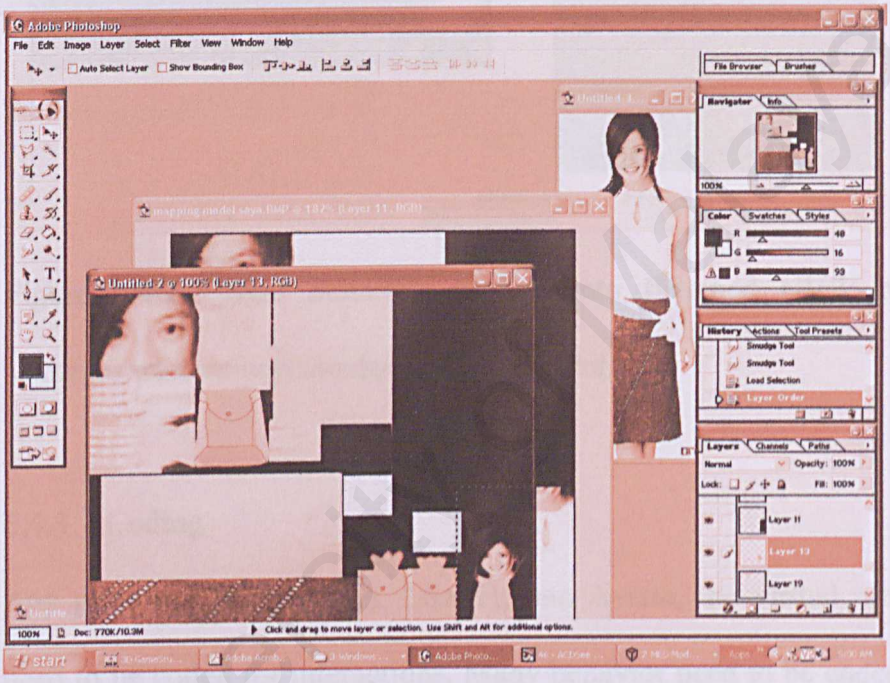


Figure 6.4.2.1 Skin materials was taken from a picture or combination of several pictures

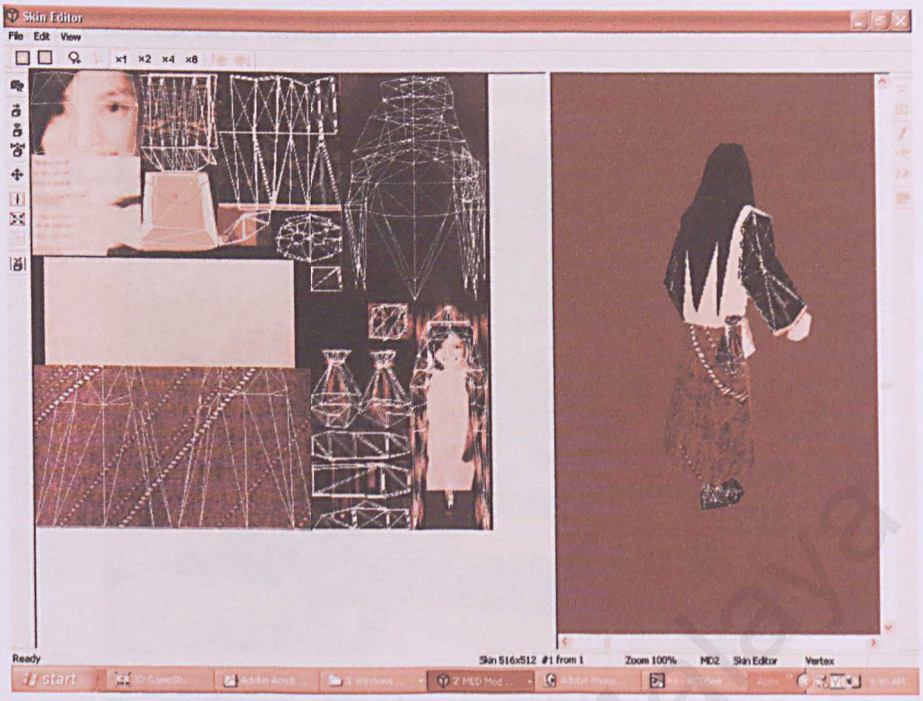


Figure 6.4.2.2 Skin materials applied into flattened UVW mapping. Vertexes were re-coordinates to fit the model.

6.4.3 Coding

Any programs need coding. Like Human Avatar, the virtual model also need to be coded for interactions. Many behavior need to be coded for the avatar to works. Each different movement means coding is required. Below shows every aspect of movement of the human avatar which include coding.

6.4.3.1 Interaction (door)

Figure 6.4.3.1.1 User interact with door

```
action pintu
{
while (1) {
play_entsound(my,open_snd,66);
while (my.pan < 90) {
my.pan += 3*time;
wait(1);
}
waitt(16);
play_entsound(my,close_snd,66);
while (my.pan > 0) {
my.pan -= 3*time;
```

```
wait(1);
}
waitt(16);
}
}
```

6.4.3.2 Avatar movements and camera setting

Many type of views for camera

Figure 6.4.3.2.1 First person

Figure 6.4.3.2.2 3rd Person

Figure 6.4.3.2.3 Perspective

Figure 6.4.3.2.4 Side

Avatar Movements

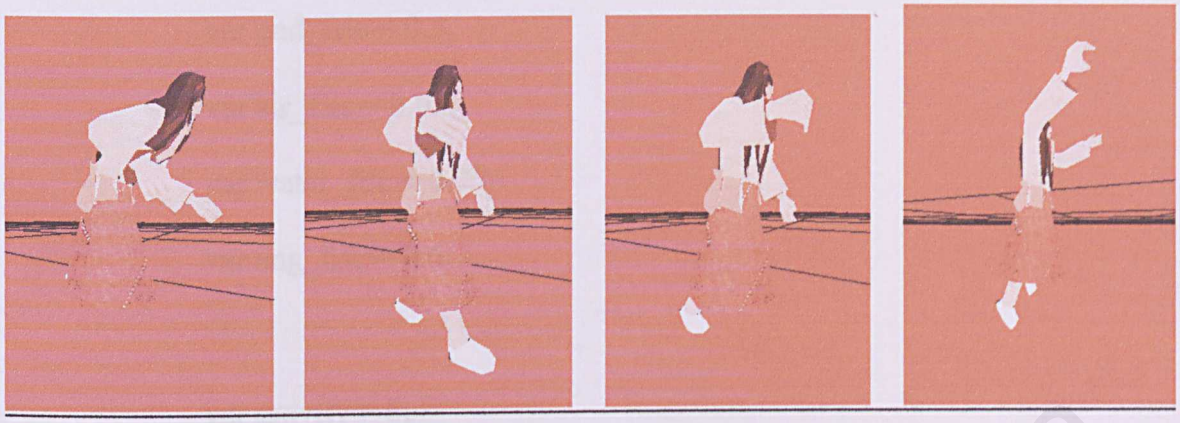


Figure 6.4.3.2.5 Human Avatar movements

```
IFNDEF MOVE_DEFS;
SOUND  thud,<tap.wav>;
SOUND  robo_thud,<tap.wav>;
SOUND  splash,<splash.wav>;
DEFINE shadowsprite,<shadow.pcx>;
DEFINE shadowflat,<shadflat.pcx>;
DEFINE DEFAULT_WALK,13.040;
DEFINE DEFAULT_RUN,5.060;
ENDIF;


////////////////////////////////////////////////////////////////
var movement_scale = 1.00;
var actor_scale = 1.00;
```

```
var gnd_fric = 0.5;

var air_fric = 0.03;

var water_fric = 0.75;

var ang_fric = 0.6;


var gravity = 6;

var elasticity = 0.1;


var slopefac = 2;


var strength[3] = 5,4,75;

var astrength[3] = 7,5,2;


var jump_height = 50;

var fall_time = 6;

var duck_height = 25;


var power_max = 1;



// values set in scan_floor
```

```
var on_passable_;
var in_passable_;
var in_solid_;


//////////////////////////////////////////////////////////////////
DEFINE _WALKFRAMES,SKILL1;
DEFINE _RUNFRAMES,SKILL2;
DEFINE _ATTACKFRAMES,SKILL3;
DEFINE _DIEFRAMES,SKILL4;

DEFINE _FORCE,SKILL5;
DEFINE _ENTFORCE,SKILL5;
DEFINE _BANKING,SKILL6;
DEFINE _PENDOLINO,SKILL6;
DEFINE _HITMODE,SKILL6;
DEFINE _MOVEMODE,SKILL7;
DEFINE _FIREMODE,SKILL8;


DEFINE __FALL,FLAG1;
```

```
DEFINE __WHEELS,FLAG2;

DEFINE __SLOPES,FLAG3;

DEFINE __JUMP,FLAG4;

DEFINE __BOB,FLAG5;

DEFINE __STRAFE,FLAG6;

DEFINE __TRIGGER,FLAG7;


DEFINE __DUCK, FLAG8;


DEFINE __SOUND,FLAG8;

////////////////////////////////////////////////////////////////

DEFINE _HEALTH,SKILL9;

DEFINE _ARMOR,SKILL10;


DEFINE _SPEED,SKILL11;

DEFINE _SPEED_X,SKILL11;

DEFINE _SPEED_Y,SKILL12;

DEFINE _POWER,SKILL12;

DEFINE _SPEED_Z,SKILL13;

DEFINE _ASPEED,SKILL14;

DEFINE _ASPEED_PAN,SKILL14;

DEFINE _ASPEED_TILT,SKILL15;
```

```
DEFINE _ASPEED_ROLL,SKILL16;

DEFINE _TARGET_X,SKILL17;
DEFINE _TARGET_Y,SKILL18;
DEFINE _TARGET_Z,SKILL19;
DEFINE _TARGET_PAN,SKILL20;
DEFINE _TARGET_TILT,SKILL21;
DEFINE _TARGET_ROLL,SKILL22;

//Entity for user
DEFINE _FORCE_X,SKILL17;
DEFINE _FORCE_Y,SKILL18;
DEFINE _FORCE_Z,SKILL19;
DEFINE _AFORCE_PAN,SKILL20;
DEFINE _AFORCE_TILT,SKILL21;
DEFINE _AFORCE_ROLL,SKILL22;

DEFINE _WALKSOUND,SKILL23;
DEFINE _SIGNAL,SKILL24;
DEFINE _COUNTER,SKILL25;
DEFINE _STATE,SKILL26;

DEFINE _ANIMDIST,SKILL28;
```

```
DEFINE _TYPE,SKILL30;

DEFINE _FALLTIME,SKILL31;


// Vector Variationss

// Force Vars

var force[3];

var absforce[3];

var aforce[3];


//Distance Variations

var abspeed[3] = 0,0,0;

var dist[3];

var absdist[3];


//Camera Variations

var person_3rd= 0;


var eye_height_up = 0.8;

var eye_height_swim = 0.7;

var eye_height_duck = 0.8;
```

```
//Mics Variations
var p[3];
var friction;
var limit[3];
var covered_dist;
var anim_dist;

var head_angle[3] = 0,0,0;
var headwave = 0;
var walkwave = 0;
var my_dist;
var player_dist;
var scan_sector;
var my_height;
var my_height_passable;
var my_floornormal[3];
var my_floorspeed[3];
var temp_cdist[3] = 120,0,0;

var vecFrom[3];
var vecTo[3];
```

```
var temp2[3];


entity* player;  entity*          temp_ent;

action* carry;


DEFINE _MODE_WALKING,1;

DEFINE _MODE_DRIVING,2;

DEFINE _MODE_SWIMMING,3;

DEFINE _MODE_DIVING,4;

DEFINE _MODE_WADING,5;

DEFINE _MODE_HELICOPTER,6;

DEFINE _MODE_ROCKETEER,7;

DEFINE _MODE_DUCKING,8;

DEFINE _MODE_JUMPING,9;

DEFINE _MODE_CRAWLING,10;

DEFINE _MODE_TRANSITION,14;

DEFINE _MODE_STILL,15;

DEFINE _SOUND_WALKER,1;

DEFINE _SOUND_ROBOT,2;


DEFINE _TYPE_PLAYER,1;

DEFINE _TYPE_ACTOR,2;
```

```
DEFINE _TYPE_FOE,3;

DEFINE _TYPE_DOOR,10;

DEFINE _TYPE_GATE,11;

DEFINE _TYPE_ELEVATOR,12;

DEFINE _TYPE_HEALTH,23;

DEFINE _FOG_UNDERWATER,2;

SOUND beep_sound,<beep.wav>;

//SYNONYM debugsyn { TYPE ENTITY; }

////////////////////////////////////////////////////////////////

function _setback()

{

if(EVENT_TYPE == EVENT_BLOCK) { MY.ENABLE_BLOCK =

OFF; }

if(EVENT_TYPE == EVENT_ENTITY) { MY.ENABLE_ENTITY =

OFF; }

if(EVENT_TYPE == EVENT_STUCK) { MY.ENABLE_STUCK = OFF;

}

if(EVENT_TYPE == EVENT_PUSH) { MY.ENABLE_PUSH = OFF; }
```

```
if(EVENT_TYPE == EVENT_IMPACT) { MY.ENABLE_IMPACT =
OFF; }

if(EVENT_TYPE == EVENT_DETECT) { MY.ENABLE_DETECT =
OFF; }
if(EVENT_TYPE == EVENT_SCAN) { MY.ENABLE_SCAN = OFF; }
if(EVENT_TYPE == EVENT_SHOOT) { MY.ENABLE_SHOOT =
OFF; }
if(EVENT_TYPE == EVENT_TRIGGER) { MY.ENABLE_TRIGGER =
OFF; }

if(EVENT_TYPE == EVENT_TOUCH) { MY.ENABLE_TOUCH =
OFF; }
if(EVENT_TYPE == EVENT_RELEASE) { MY.ENABLE_RELEASE =
OFF; }
if(EVENT_TYPE == EVENT_CLICK) { MY.ENABLE_CLICK = OFF;
}
}
```

changed to function

```
function _beep() { BEEP; }

// foot sound
function _play_walksound()
{
if((ME == player) && (person_3rd == 0)) { return; }
if(MY._WALKSOUND == _SOUND_WALKER) {
play_entsound(ME,thud,60); }
if(MY._WALKSOUND == _SOUND_ROBOT) {
play_entsound(ME,robo_thud,60); }
}

function _test_arrow()
{
MY.PASSABLE = ON;
MY.SCALE_X = 0.5;
MY.SCALE_Y = 0.5;
waitt(128);
remove(ME);
}
```

include <move.wdl>;

include <camera.wdl>;

include <animate.wdl>;

include <input.wdl>;

6.4.3.4 A5 Engine

A5 engine is the most important part in this system. The engine was developed based on popular games engine such as Doom. Extra New script. Below is the coding for each rules and position update;

- Tesisku.WDL (all definition/ main file program)

```
path "C:\\PROGRAM FILES\\GSTUDIO\\template";
include <movement.wdl>;
include <messages.wdl>;
include <menu.wdl>;
include <doors.wdl>;
////////////////////////////////////////////////////////////////////////
```

// Resolusi Enjin

```
var video_mode = 6;        // screen size 640x480
```

```
var video_depth = 16; // 16 bit colour D3D mode

//////////////////////////////////////////////////////////////

// Strings and filenames
// change this string to your own starting mission message.
string mission_str = "Selamat datang ke Ruang Maya 'Human Avatar' Tekan
[F1] untuk bantuan.";
string level_str = <tesisku.WMB>;

//////////////////////////////////////////////////////////////

// Skrin Permulaan Enjin
bmap splashmap = <logo.bmp>;
panel splashscreen {
    bmap = splashmap;
    flags = refresh,d3d;
}

//////////////////////////////////////////////////////////////////////

// Pergerakan angkasa
bmap horizon_map = <horizon.pcx>;
```

```
function init_environment()
{
    scene_map = horizon_map;    // Gambar latar
    scene_nofilter = on;

    sky_speed.x = 1;
    sky_speed.y = 1.5;
    cloud_speed.x = 3;
    cloud_speed.y = 4.5;

    sky_scale = 0.5;
    sky_curve = 1;

    scene_field = 60;           // ulangan petaan ke atas angkasa
    scene_angle.tilt = -10;

    sky_clip = scene_angle.tilt;
}

//////////////////////////////////////////////////////////

function main()
{
```

```
//    warn_level = 2;          // keluarkan amaran ralat
      tex_share = on;          // entiti petaan dikongsi

// resolusi paparan
      splashscreen.pos_x = (screen_size.x - bmap_width(splashmap))/2;
      splashscreen.pos_y = (screen_size.y - bmap_height(splashmap))/2;
      splashscreen.visible = on;
      wait(3);


      init_environment();
      level_load(level_str);
      freeze_mode = 1;

      waitt(16);
      splashscreen.visible = off;
      bmap_purge(splashmap);      // keluarkan skrin splash dari video utama

      load_status();
      msg_show(mission_str,10);

//ifdef CAPS_FLARE;
```

```
// lensflare_start();
//endif;

// set kaku
    freeze_mode = 0;

}
```

6.4.4 A5 Engine Implementation

A5 Enginr is used to provide a graphical representation that shows the behavior of virtual human in this simulation. A5 Engine requires certain calls to its libraries to be able to set up the basic graphical functions required by this system.

```
WINDOW WINSTART
{
    TITLE           "Human Avatar";
    SIZE            480,320;
    MODE            IMAGE;      //STANDARD;
    BG_COLOR        RGB(240,240,240);
    FRAME                   FTYP1,0,0,480,320;
    BUTTON_START,SYS_DEFAULT,"Start",400,288,72,24;
```

```
    BUTTON
    BUTTON_QUIT,SYS_DEFAULT,"Abort",400,288,72,24;
    TEXT_STDOUT     "Arial",RGB(0,0,0),10,10,460,280;
}

WINDOW WINEND
{
    TITLE           "Finished";
    SIZE            540,320;
    MODE            STANDARD;
    BG_COLOR        RGB(0,0,0);
    TEXT_STDOUT     "",RGB(255,40,40),10,20,520,270;

    SET FONT        "",RGB(0,255,255);
    TEXT            "Sebarang butang untuk keluar",10,270;
}*/
```

6.5 Conclusion

System implementation begins with modeling the model and its environment. Then rigging process were made to ensure the smoothness of the object. Rigging phase is the most part which really makes lots of effort to be put into. Due to the limited knowledge and skill, the interaction entities are set to minimum but the main objective are still be achieved.

7.0 SYSTEM TESTING

7.1 Overview

System testing should be well conducted before the system is delivered to the end-user. Testing is done throughout the whole system development process, which means that the testing were made within the process of development itself and it could be anytime. All the system written or modified application program as well as procedural manuals, hardware and system interfaces are tested thoroughly.

7.2 Objectives

System testing are mean to be first problem detection that might be occurred during the implementation. It is vital because if the system testing was not made frequently, later when the final testing has lot of things to be corrected if any problems occurs.

There must be reasons why system testing must be made during the development process.

- Finding errors and faults
- Ensuring the functionality of the system
- Correcting errors which found in the system

7.3 Unit and Integration Testing

This phase test on whether the system could fulfill all requirements. In Avatar in Virtual Environment, the successful of rigging processes and setting movement and interactions are really important for the entire system development.

7.4 Conclusion

Testing is one of the important steps while developing a system. Performance and smooth running simulation is considered during this process. Unit, module, integration and system testing has been carried. All these testing will lead to a quality and stable system deliverable for users.

8.0 SYSTEM EVALUATION

8.1 Overview

A lot of researches and studies have been carried out during the planning and development phase of human avatar. Although there were some problems encountered during the coding process but taking them as a good motivation to learn more about this A4 engine environment seems to be a really wise decision.

As a fresh starter with A4 Engine, Human Avatar has not much functionality to be offered to the user. With developer's limited knowledges and experiences, this system offering some basic function through basic and straight forward coding methods.

In the other hands, this system still have a highly potential to be further enhanced to become more interesting and more functionality in the future. Perhaps, this small effort has created a good opportunity for any individual to enhance this system, which is demanding a quit good of programming skills and a lot creativity.

8.2 Problems Encountered

While developing Human Avatar System, there were several problems had been encountered by the developer. The arise problems has been listed as below;

- Learning new programming language – A4 engine gaming C++
- Complicated installation of environtment editor and model editor
- Applying human mesh into coding
- Limited sources and references

8.3 System Strengths

Below are the strengths and advantages of Human Avatar system;

8.3.1 Minimal Hardware Requirements

Since the human mesh has been modeled using a basic and simple polygon, thus rendering process while performing the simulation is not giving a huge impact to the smooth performance even with the minimal hardware requirement.

8.3.2 Entity Controls

Human Avatar provides the user with in scene controls user interfaces. This interface allowed the user to control the sounds, volume, exiting VR and restart VR. This control also provides the camera views for user the had many views in virtual environment.

8.3.3 Camera View Selection

There are three types of camera view that can be selected by user. First view is the 3rd person view where the user can watch the human performing the basic behavior. Secondly, follow 1st person view where a still camera was created to focus and follow the human movement. The third view is 3rd person free view where the user can see 3rd person view freely and rotate the camera.

8.4 System Constraints

Below are the constraints and limitations of Avatar in Virtual Environment;

8.4.1 Poor Interface

The system really has poor interface. It was created with simple and attractive way. But all functions were run successfully.

8.4.2 Simple Avatar Model Design

Due to the difficulties on creating human avatar and lack of knowledge in 3D environment scheme, it is hard to create human with perfect in every aspects. The human model was from simple cube and then being extruded up until human shape were made.

8.5 Future Enhancement

For the future enhancement, there are still several enhancement which still can be made in order to brings out much better system. This enhancements may set the final part of completion of the virtual reality.

Due to the time constraint and lack of knowledge, certain features are not be able to be inserted as well within the project. Below are the enhancements which are mean to be done within the system for future development.

- Add movie trailer within the system.
- Enhanced model for avatar.
- Advanced skinning for prefabs.
- Adding more interaction within the simulation and extra information for learning purpose.
- Interact with other user in the simulation world

8.6 Conclusion

As the conclusion, all objectives was achieved in the development of Human Avatar in Virtual Reality. Interaction and simulation stated has successfully achieved.

Human Avatar In VR has described the concept of human behavior, which is referred to a human-behave-like-motion. The model is based on the simulating the human basic's behavior such as walking, standing, running, jumping, swimming and much more for basic movements.

REFERENCES

1.. Neil Blevins (2001) *Complex Shader using procedural [online],* Available from: http://www. 3dlinks.com
[Accessed July 3th, 2003]

2. Nawyecky (2000) *Mixing procedural textures [online],* Available from: http://www. nawyecky.com/tutorials.htm
[Accessed July 3rd, 2003]

3. Rory Hallman (2000) *Volume Clouds [online],* Available from: http://www. cyberthrill.com
[Accessed July 10th, 2003]

4. Julio Juarez (2003) *Photorealistic texturing with photoshop and max [online],* http://trainingvids.phpwebhosting.com/riddlaz/Tutorials/LeafProject/
[Accessed Aug 19th, 2003]

5. Platinum Pictures Multimedia (2003) *Brick Wall [online],* http://trainingvids.phpwebhosting.com/riddlaz/Tutorials/LeafProject/ [Accessed Aug 19th, 2003]

6. Aaron R.Ross (2000) *Cloning and the Xform Modifier [online],* Available from: http://www. 3dlinks.com
[Accessed July 10th, 2003]

7. Richard Osborne, (1999) *Advanced Applications of the Surface Modifier* [online], Available from: http://www.3dlinks.com
[Accessed July 10th, 2003]

8. Comet Michael.B, (1999) *Modeling with Meshsmooth [online],* Available from: http://www.3dlinks.com
[Accessed July 11th, 2003]

9. Aaron R.Ross (2000) *Boolean Compound Objects [online],* Available from: http://www. 3dlinks.com
[Accessed July 11th, 2003]

10. Webmaster, (2002) *Introduction to C++ [online],* Available from: http://www.acm.org/crossroads/xrds1-1/
[Accessed July 11th, 2003]

11. Olli Pekka., (1999) *Clothing [online],* Available from: http://www.3dlinks.com/jbirn/index.html
[Accessed July 22nd , 2003]

12. Nikola Drincic, (2002) *Character Sad Mike [online],* Available from: http://www.3dluvs.com/
[Accessed July 22nd , 2003]

13. Michael Roger, (2000) *Modeling Joan of Ark [online],* Available from: http://www.mr2k.3dvf.com
[Accessed July 1st , 2003]

14. Jerry Sandefur., (2003) Applying Multiple Texture to a single object *[online],* Available from: http://digitalmedianet.com
[Accessed July 10th , 2003]

15. Nikola Drincic., (2003) *Making of Shark: Texturing [online],* Available from: http://www.3dlinks.com
[Accessed July 1st , 2003]

16. Platinum Picture Multimedia., (2001) *A simple Orb [online],* Available from:

http://www.3dcafe.com

[Accessed July 27th , 2003]

17. Neil Blevins., (2001) *Metal and Reflections [online],* Available from:

http://www.3dcafe.com

[Accessed July 27th , 2003]

APPENDIX A [USER MANUAL]

2.0 Introduction

Avatar in Virtual Environment is a system which simulate human behavior inside the vast space of virtual environment. It's target are to bring the human to the next level of technology which simulates the real world into virtual. It can be used as a relaxation or learning.

3.0 About This Manual

This user manual will provide guidance to execute and interact with this system. It also will show you the system interface within the system itself.

4.0 Hardware Requirements

Below is the minimum requirement for Human Avtar in 3D Environment;

- Pentium III processor – 500 MHz
- 128 Mb RAM
- Graphic Card - 16 Mb (support OpenGL acceleration)
- SVGA Color Monitor

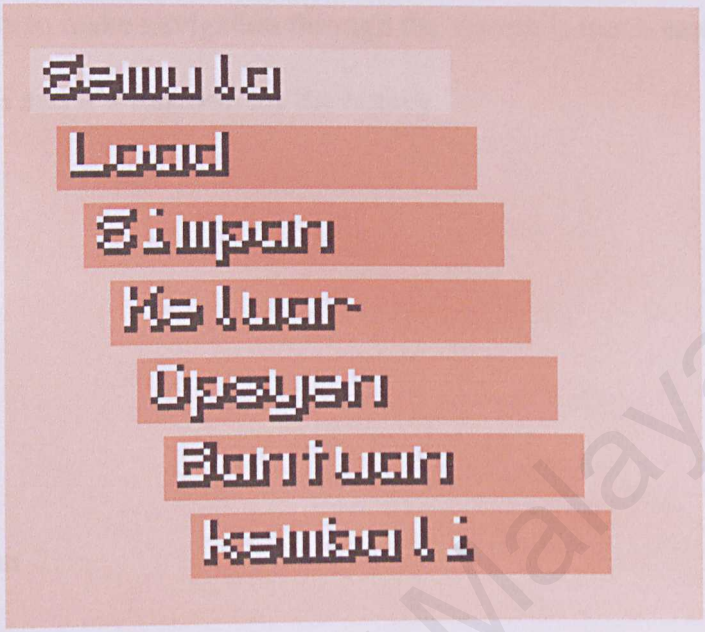
Higher specification than stated above will improve the smoothness and stability of the simulation for your viewing pleasure.

5.0 System Interface

Below are the user interface for Avatar in Virtual Reality system. Inside the system are the menu located on top-left screen that provide basic function for enhancement and options.

Avatar In Virtual Environment interface

6.0 Menu Control



GLUI Controls

Definitions:

1) Semula: Start the simulation from the beginning
2) Load: Load save state which if were made
3) Simpan: save state were user wish to.
4) Keluar: Exit from the system
5) Opsyen: option for volume, music.
6) Bantuan: Help on hotkeys.
7) Kembali: return to simulation

7.0 Hot Keys and Controls

Hotkeys are use to make navigation through the system is much easier for user.

Here's the keys and it's function for the hotkey.

Esc - Menu

F1 – Help

F2 – Save

F3 – Load

F5 – Resolution

F6 – Snapshot

F7 – Choose camera view

F12 – Sound/music

F10 – Exit

Controls name itself has define the function. It's the control keys for virtual human.

Up arrow – Move forward

Down arrow – Move Backward

Left arrow - Turn Left

Right arrow – Turn Right

Hold arrow key + Shift – Run

Num7 – Jump

Num1 – Crouch

Num9 – Look up

Num3 – Look Down

4.6.4 VRMLPad 2.0

VRMLPad 2.0 is a powerful text editor for VRML programming. Features include; Dynamic error detection, Syntax highlighting, Advanced find and replace command, syntax tip, and auto-indent. VRMLPad allows users to preview the scene, organize and optimize in publishing. This tools is chooses because there's no other VRML tools that can be find easily in the Internet. Furthermore, it's better to have the tools rather than using Notepad to handle the script.

- Control the execution of your script, including pausing execution, running to a cursor, or a breakpoint location, or stepping through code.
- Monitor the state of script data, including the current call stack; variables, arrays, and objects that are available in the current context; evaluate expressions containing this data.
- Modify the values of variables, arrays, and objects in the script during a debugging session.
- Add new procedures to the script during a debugging session.
- Examine and modify on the fly data items in the script using the Quick Watch window.
- Use CodeTips for quick viewing of variables' values in the script.