THE HUMAN SKELETAL MULTIMEDIA SYSTEM

Name: Norhayati Suzari

Matrics Number: WET990127

Supervisor: Cik Nurul Fazmidar Mohd Nor

Moderator: Mr Ibrahim Abu Bakr

CONTENTS

LIST OF FIGURES

INTRODUCTION

ACKNOWLEDGEMENT

First of all I would like to thanks Allah for giving me the strength and patience to do this project development and everything else in my life. All my effort on this project development are for His glory and not my own.

Next I would like to extend my sincere appreciation and immense gratitude to Cik Nurul Fazmidar Mohd Nor for taking me under her wing and guide me through the journey. I feel blessed to have her as my mentor for her guidance and tutelage on the concept of this project development has been invaluable and irreplaceable. Without her encouragement, guidance, support and patience, I would not have the confidence to express my opinions, ideas, and suggestions to the responsibility in hand.

My next heartfelt thanks goes to my moderator, Mr Ibrahim Abu Bakr for his patience and positive criticism which enabled me worked out my flaws in my work and help me to produce better achievements and improve my judgement in the real working.

Last but not least, I would like to express my heartfelt appreciation to all my friends who been with me through thick and thin especially to Miss Shazlina Ahmad, thank you very much for lend me your hand, your voice and for always been there for me. Also to Amy, Nani,Zasya,Sam, Chot and Kak Fizah. Special gratitude should be given to my company in lab Pn. Soh, the lab assistant, she makes me think that I'm not freezing alone.

And not to forget to all the kind and generous people in the Internet whom sharing their thought, notes and tips ~ thanks a lot for spreading the knowledge to the others.

Thank You So Much

And this thesis is dedicated to the loving memory of my late father,

Suzari B Mohd Seron

ABSTRACT

This project named The Human Skeletal Multimedia System, is a medical web site that applying virtual reality in it presentation. This is an effort to integrate between medicine mystery and computing technology. Within this web site users will be able to explore beneath human muscular and skin, which is human skeletal system. This educational revealing knowledge will be delivered by multimedia interactive elements such as 3D graphics, animation and sounds.

As to ensure that this project will fulfill users need to the fullest I have made a literal observation on the current web sites together with interview sessions with target users. Throughout this processes I can estimate users expectation towards the system and perhaps some manipulation from the current system in order to develop a better system.

To create an attractive and smooth 3D web site I decided to use the latest creative multimedia software that is 3D Studio Max and VRML (Virtual Reality Modeling Language) as the medium to present my 3D world to users. I also include sound effects to this web site to add the realism of the virtual world.

As for now, that's what I can assume and promised to users about this project. Hopefully, it will contribute to the growth of computer graphic technology and our local medical website.

1.1: Introduction to the project

Most people would agree that computer graphics are anything but simple. There are many points that must be learned when studying 3D graphics and associated technologies. Often it is found that for every new topic learned, branching points and topics are discovered that must be studied. With that in mind, however, there are some basic concepts to 3D graphics, and the hardware associated with it, that will allow for a general understanding of the technology. This article will explore some of the key points of graphics hardware and rendering technology, hopefully allowing for a general understanding of some of the technology.

For today a revolutionized technology that has captured the eyes of the public especially web developers to create an imaginary world that has been plaguing our modern society today formally known as virtual reality is VRML. VRML stands for ``Virtual Reality Modeling Language''. It allows to specify dynamic 3D scenes through which users can navigate with the help of a VRML browser. VRML scenes can be distributed over the World-Wide Web and browsed with special VRML browsers, most of which are plug-ins for Netscape or Internet Explorer. VRML is well integrated with the WWW, e.g. VRML scenes can be connected with other VRML scenes (as well as other WWW formats) via URLS.

The previous standard was VRML 1 and allowed to specify static scenes only. Forget about it! The current standard is VRML 97, which in its draft phase was known as VRML 2. The VRML 97 Specification contains many changes to the VRML 1 language. It adds audio, interactive objects, behavior and scripting among other things. In this sense, VRML 97 is far more complex than VRML 1. A future version (or layer of VRML) will add ``multi-user shared experience'', i.e. some kind of standardized interactive multi-user technology.

The Virtual Reality Modeling Language (VRML) can been seen as a 3-D visual extension of the WWW. People can navigate through 3-D space and click on objects representing URLs (including other VRML worlds). Often, VRML is pronounced like ``Vermal", not ``V-R-M-L".

As Mark Pesce in his book VRML, *'Browsing and Building Cyberspace'* points out, the WWW had two fundamental dimensions: *connectivity* (the http protocol) and *interface* (i.e. the rendering of content, especially HTML and embedded URLS). VRML inserts itself seamlessly in the Web's connectivity. VRML browsers can access other VRML files via an URL. They can access any other format that then is passed to another application (e.g. an HTML browser or a HTML window). On the other hand HTML browsers can be configured to fire up VRML helper applications (or plug-ins). HTTP servers, finally, can be configured to tell the client that a VRML (*.wrl) document is transferred. [1]

From here challenges are presented with the idea of creating parallel worlds of our own global society to create virtuality. Let's face it, people are intrigued with the capablilty to create worlds that is preserved as a true presentation of reality. Hollywood is doing it, creating movies that initiates virtual worlds like "The Matrix" and "Final Fantasy". In Malaysia however, this technology is surprisingly not emphasized which would lead our unreadiness to embrace the latest technology.

By proposing this project, it had given me a gateway to explore new frontiers of multimedia elements and the proposal will focus on the steps that I have chosen to create my own 3D world, "The Human Skeletal Multimedia System".

1.2: Objective

Health websites were an alternative for medical students and doctors to get more information about related issue for medical purposes. Especially for undergraduate doctors, it is a must to remember every details of the particular issue.

I think it would be helpful if there's a website that can provide fully information about a specific issue together with an elements that can make them easier to digest every single data it contained. In my website, beside the full information of human skeleton system that I offered I'm also provide my website's guest with a multimedia elements that hopefully can wipe away their boredom while trying to catch up with the information written in that page.

Furthermore the existence of this web site will add the variety to the currents medical web site. This new approach born from the inquisitive feeling of the web designer to provide more effective and optimums information to the user.

The new approach of 3 dimensional is the latest technology invented by the web designer. The main point of creating this kind of web site is to attract user intention to hook up on the system. With the quick development of information technology and design, I'll be very proud to contribute in building a simple web-based system about the human skeletal system with the help of creative multimedia application that is 3D Studio Max and also the new technology of web language that is VRML.

This system contains a chain of information that has to be well organizing so user will easily to archive the data. Therefore, I have been really careful to prevent from the data redundancy. Then, a systematic information can be delivered.

1.3: Project Motivation

As a multimedia student, it is a big shame not to know how to use the multimedia authoring tools. In fact, as a university graduate, people will not just expect me to know how to use multimedia-authoring tools, but also be able to deal with development of softwares high level programming and scripting.

3D Studio Max is the most commonly used software for creating very attractive 3D website. While VRML is an internet 3D language that has born from the evolution of computer graphic technology. Even though, our local web sites are not familiar with this approach, but I believe this new out look will quickly change user's point of view towards interactive and attractive web sites. If people can be impressed with 2D animated web site, there will be no doubt that they will extremely interested to hook up on 3D web site that have fully multimedia elements.

Many of the soft wares that I use to develop this web site are the latest creative soft wares that can be considered as a knowledge-in-demand in the future. Therefore, they have high market value. Perhaps, this knowledge will be a credit for me when I'm looking for a job after I'd graduated.

Well, to build a 3D project like this, it requires a full commitment and never ending exploration on a new software that seems so difficult to me at first. But I know, this is the best opportunity I ever get in a way to enhance and polish my skills in design.

Beside my carrier development as I explained above, I decided to do this project because of the wide range of it's target groups. Human skeletal system is a part of human anatomy that is an essential reading material for all age. Learning about yourself is like a general knowledge for everybody.

As a whole, the proposed project, "The Human Skeletal Multimedia System" was developed for all levels of society, above the age of 15. So far in the online market, I've yet to found an anatomy system that is fully interactive with the users.

1.4: SCOPE OF THE PROJECT

As the general view of this web site's contents, I would say that it's covered as low as what high school students learn in their biology subject up to what medical students learn in their anatomy subject for human skeletal system.

This web site provides an attractive 3D model that can be navigated and it will show the nearest actual looks of the 206 bones that form our skeletal system. It provides the bone description and functions, and also a trial session for users to see how all those bones are functioning.

The target users for this web site are high school, pre-university and medical students, doctors and public users aged around 25 to 50. As a high school and pre-university students only learn human skeletal system for schooling purposes and some of them have no intentions to learn more than what have written in their school syllabus, I like to say that my main target users is medical students. They have to get a clear view on this system because soon they will apply this knowledge on the real human.

Public users learn about this topic because they feel that it is essential for people to know how their body's work. It is like a general knowledge. While doctors are surfing into this web site just to recalled what they have learnt in schooling time.

The availability of this web site is the only constraint to archive these valuable contents. This is because; this web site could only be reached through Internet access.

1.5: SYSTEM DEVELOPMENT CHART

As the times to develop this project are limited, I have to carefully estimate the period for every development stage. This step is basically crucial because with only slight mistake it will ruin the whole development process.

I have divided the development process into two stages; there are basic studies on project, writing proposal and project implementation.

Below is the system development chart:

a) Prepare Proposal

1. Preliminary investigation on the topic
2. Survey and interviewing
3. Assemble all data collection
4. Specify system requirements
5. Specify system design
6. Writing proposal

b) System Implementation:

1. Assemble all data
   - ✓ Assemble all the specific data about human skeletal system
   - ✓ List out all the images and 3D models that have to build.
2. Building 3D model part by part of the human skeletal system.
3. Integrate all the models to form fully 3D skeletal system.
4. Create interface
   - ✓ Create virtual reality interface
   - ✓ Import 3D models into VRML
   - ✓ Building connections between pages.
5. Testing
   - ✓ Error detection
   - ✓ Fixing the errors
6. Bring system online

System development chart

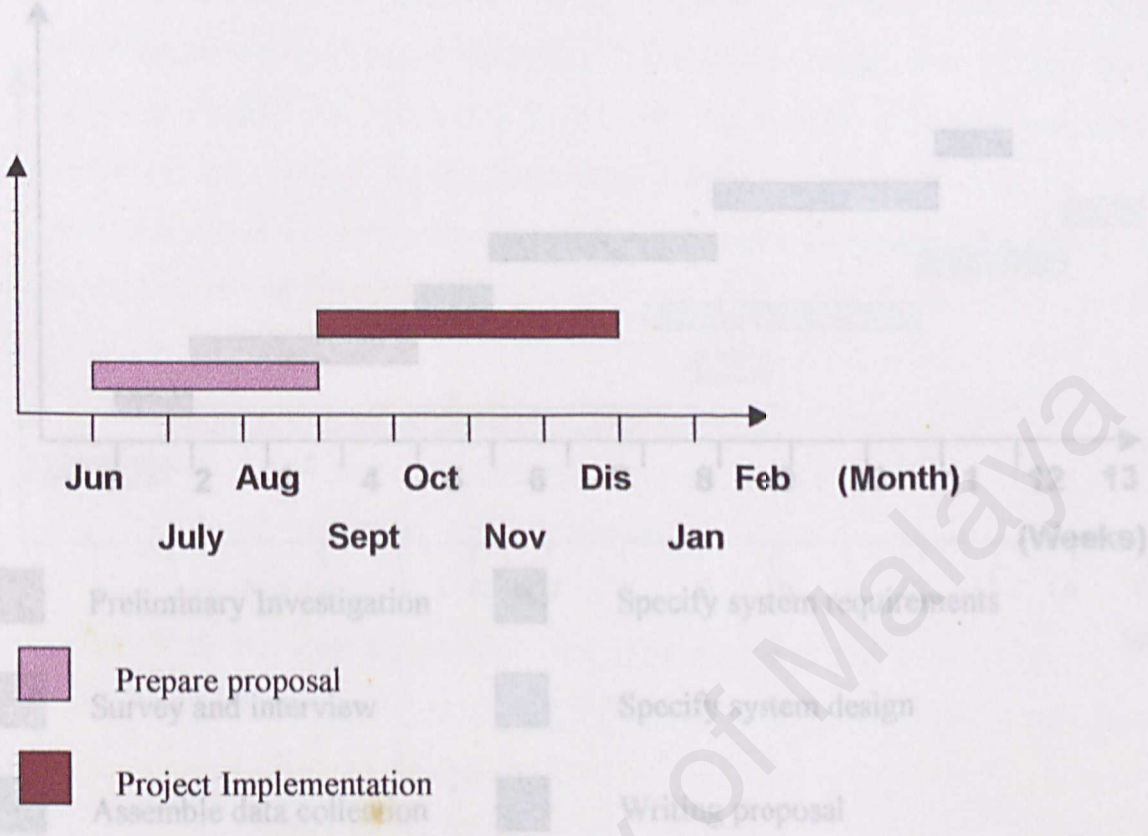


Figure 1.1: System Development chart

Proposal time line

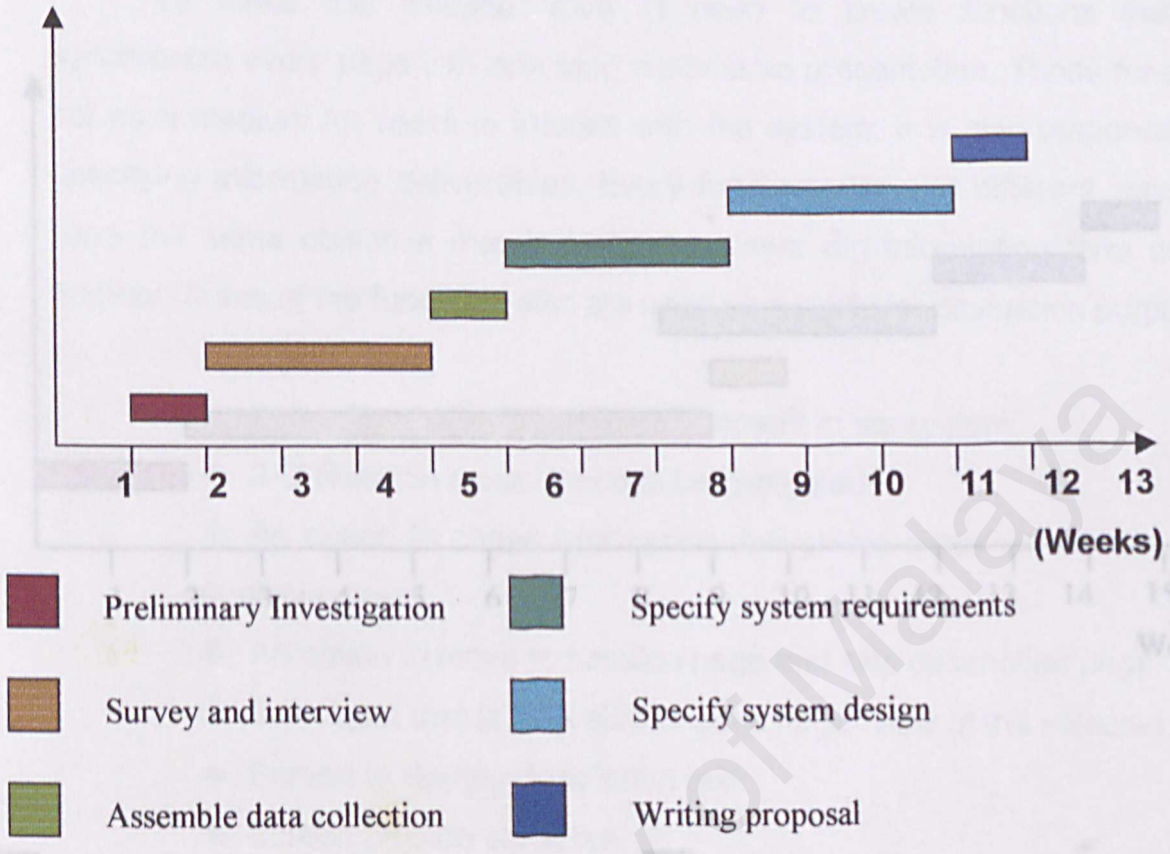


Figure 1.2: Proposal time line

System implementation chart

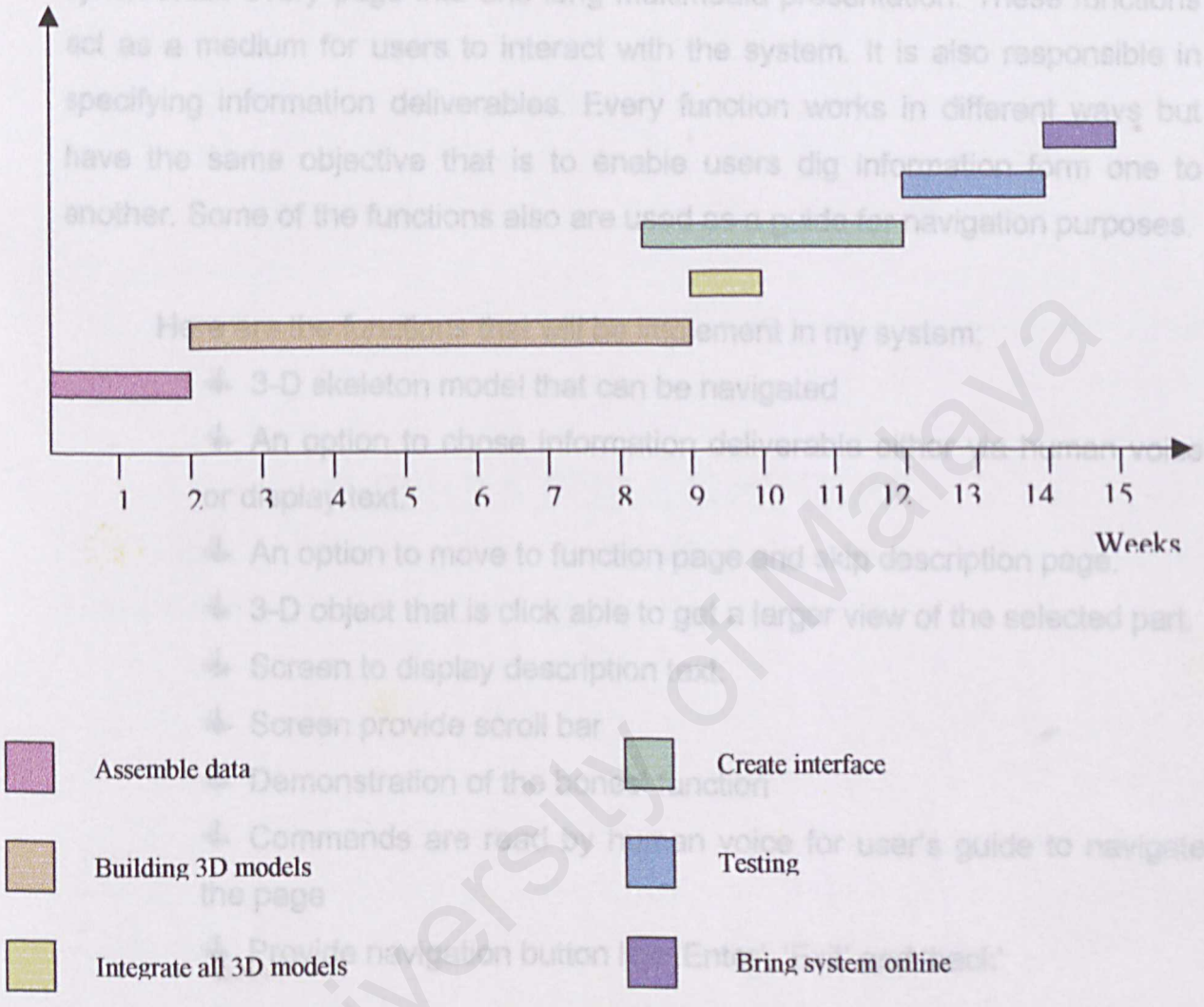


Figure 1.3: System Implementation chart

1.6: BRIEF ON SYSTEM FUNCTION

To make this website 'alive', I need to create functions that will synchronize every page into one long multimedia presentation. These functions act as a medium for users to interact with the system. It is also responsible in specifying information deliverables. Every function works in different ways but have the same objective that is to enable users dig information form one to another. Some of the functions also are used as a guide for navigation purposes.

Here are the functions that will be implement in my system:

- 3-D skeleton model that can be navigated
- An option to chose information deliverable either via human voice or display text.
- An option to move to function page and skip description page.
- 3-D object that is click able to get a larger view of the selected part.
- Screen to display description text.
- Screen provide scroll bar
- Demonstration of the bones' function
- Commands are read by human voice for user's guide to navigate the page
- Provide navigation button like 'Enter', 'Exit' and 'back'

LITERATURE REVIEW

2.1: The Objective of doing Literature Review

Literature review is an analysis from the observation on current system that available online. This process is literally importance because I can get the overview looks of my system. It's not that I will develop a twin system, but it can give the rough idea on my system that will be building and how it will look like.

I do an observation on some of the medical website that focused on human skeleton system and anatomy. I'd tried every functions and features the web sites offered and put myself as a user that seeking information about human skeleton system. I also tried making myself easy on the system.

As a result, I got to correspond with the good and the mess of the system also some web sites with poor contents. Later in this chapter I will lay out all the analysis from my research and observation.

In order to give users the full satisfaction, I got to know their needs. With all this requirements, I can estimate their expectation on the web site. My goal is to make users feel that they have been to the coolest web site that provide them with all the specifications needed. As an alternative to this effort I chose an interview as a way to communicate with users about their requirements and expectations. Through this I started assemble all the data and organize them in the systematic flow.

In short, doing system analysis will give me an opportunity in designing a systematic system without have any important data been left out.

2.1: Medical Web Site in general

In the growth of computer technology and human inquisitive, there will be a lot of new ways in achieving people imaginative scene. These including the idea of learning process. People are constantly exposed to the different medium of information deliverable including the Internet services.

As an alternative and perhaps also as trial purposes, people started using World Wide Web (www) to share their knowledge with others. These is because WWW offers a wide range of users and it is borderless.

Medical field was also involved in using the latest technology in sending information via Internet. Web site is the place to throw in all the information that need to be spread among medical expert and public users.

Medical web site was divided into several sub divisions such as health, disease, treatment and also human anatomy system. And as we knew human skeletal system is a part of the anatomy system.

The idea of searching a particular subject in the Internet is that, if we can have a thought about it, then there must someone else have think the same. And that is also a reasonable thought on how people can build a web site to be put onto the Internet. Spreading thought and knowledge.

The development of medical web site is merely depending on the help of creative software or language. It mobiles from static page to dynamic data, from drawing 2D image to more realistic 3D image in creating virtual reality web site.

At this time being, online learning seems to become as a reliable alternative for medical students in understand their studies. However to bring the imagination to reality it needs a lot of courage, creativity and hard working.

2.3: Analysis on the existing medical web site (focused on human skeletal system)

2.3.1: www.stemnet.nf.ca/CITE/skeletal.htm

This web site has a simple yet attractive interface. In the first page, users are welcomed with a fully 3D model of human skeleton. Then there was a list of the pages contained in that web site, together with the contents description. These help users in trying to choose which page that he/she wants to go. Unfortunately there was a redundancy in the chapter contents.

This web site provides users with bone description, anatomical position and its function. It divided the contents into junior reader (only a brief explanation over the 206 bones and its anatomical position) and senior reader (more detailed and specific). The language presentation is easy to understand and informal, it's ideal for students level.

As for the interactivities level in this web site, I would say, poor. Because there is less chance for users and web page to interact with each other. And the linking was pretty bad, there are many broken links in this web site that will make users fade up to explore more on this web site.

Overall it is a good web site with the richness of data but it has less of interactivity with users and also some linking problem. Perhaps if the problem can be solved, I think this we site is suitable for medical students to lay on.

2.3.2: *www.bionim.com*

Firstly, I would like to comment about the contents of this web site. It covers only about name and anatomical position of the bones. It is specially build for users to remember the name and the structure of the skeletal system and did not offer for more description or explanation about any specific bone.

However this web site has a very nice and beautiful 3D model of human skeleton. The mix of colors and depth make the skeleton looks quite impressive. The information on the interface was arranged systematically and users can have a list of models that will represent larger view of the 3D image and show users the bone structured.

For the page interactivity, this web site offers more interaction between user and web page. Beside the interaction between users and the information given, this web site also provides a quiz slot. It will give a 3D model of any human skeletal part and ask users to name every bone of the selected skeletal part consists. Then after several trial, users can get the answer from the answers' button.

Overall I would say that this web site is attractive and obviously that they try to make an effective communication between users and the web page. However, the contents of this page about human skeletal system are too little. And this web site is not focused only on human skeletal but for the whole anatomy system.

2.3.3: *http://sprojects.mmip.mcgill.ca/anatomy3D/*

The name of this project is **3D Anatomy for Students.** It's been develop by four undergraduate students in the purpose of helping medical students understand complex 3D anatomical relationship. And this project is still under development process. However it has been present to the users for a quick view.

This web site looks very intelligent in delivering the information about human skeletal system. And this web site is specially built to help users learning about human anatomy system with the help of creative multimedia elements.

I have seen the sample of the models in 3D and also the models' function. It can't be click but it can be rendered using user's mouse. For every one circulation you can see the changes of this model. As an example - a skull. At first just can see the transparent edge that separate the bones with each other, after one circulation a platform of the skull will appear, then followed by the nerve system, facial muscular and lastly human skin that give a look and face to the 3D model. To see how the looks change is pretty impressive.

The contents of this web site cover the whole anatomy system this includes the human skeletal system with the detailed description and functionality. It is special dedicated to the person that masters in this complex field with a hope that it will able to help them in any ways.

Sample of the user interface for 3D Anatomy for Students.

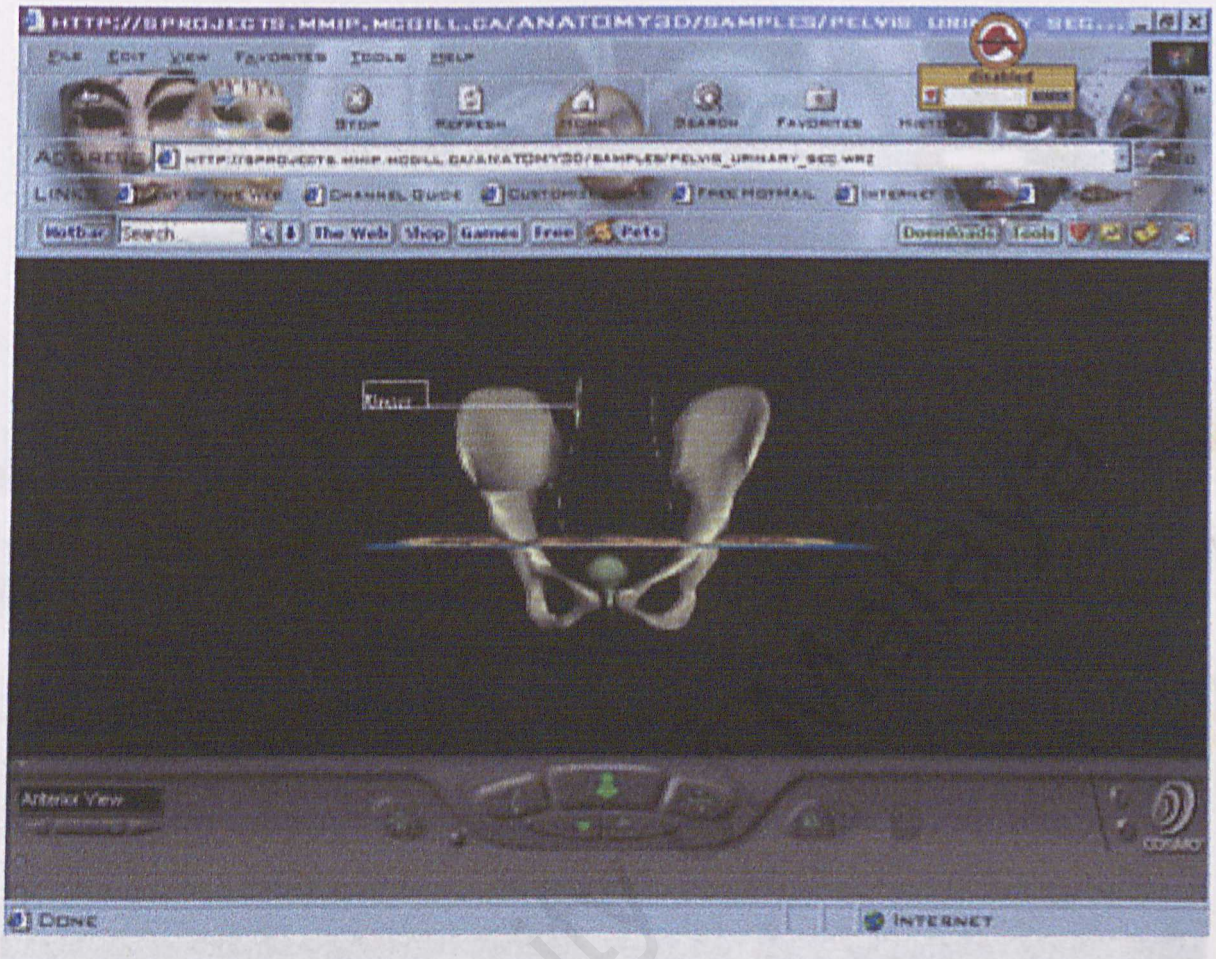


Figure 2.1: Pelvis 3D image at the anterior view

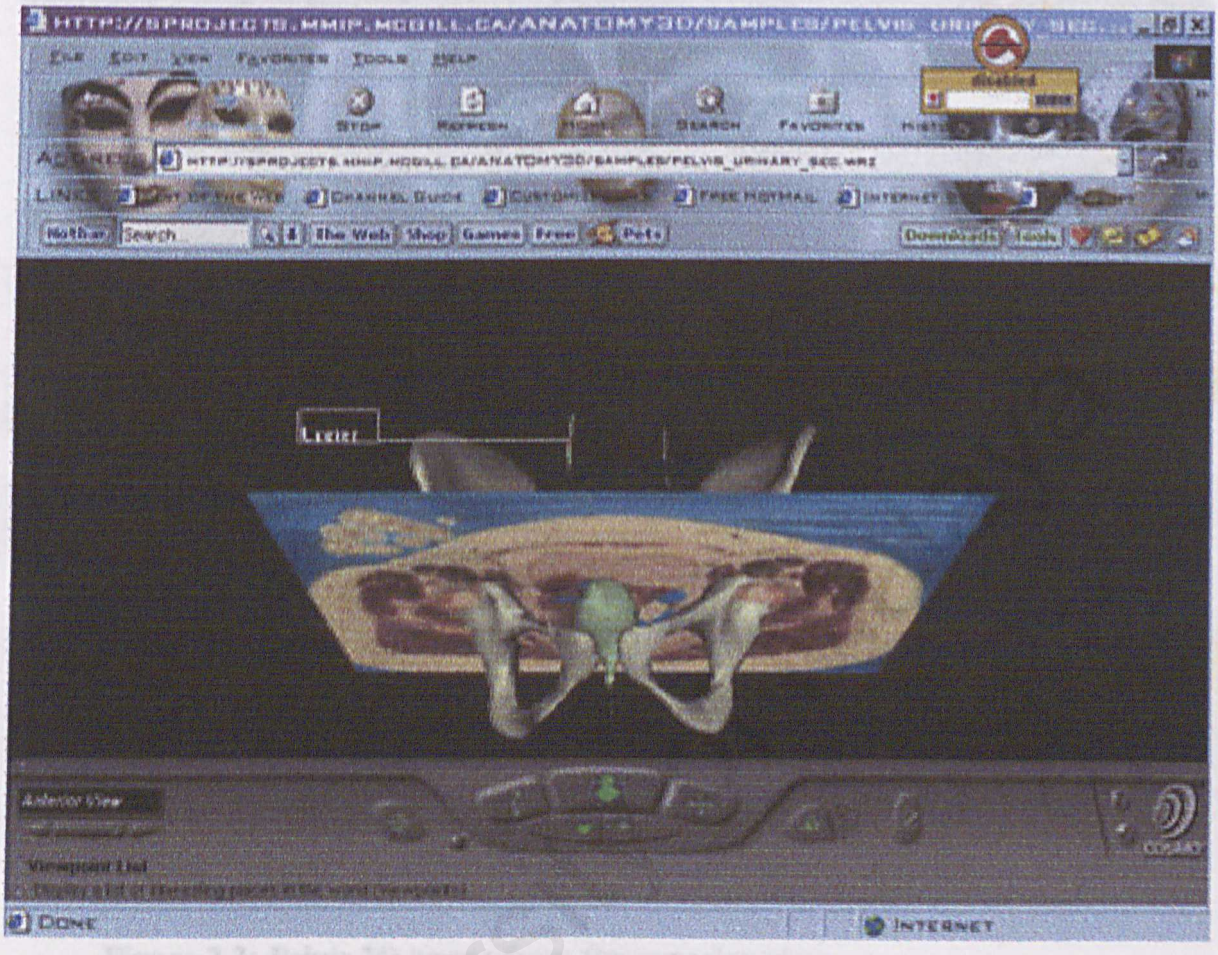


Figure 2.2: Pelvis 3d image is moving up to give user the superior view

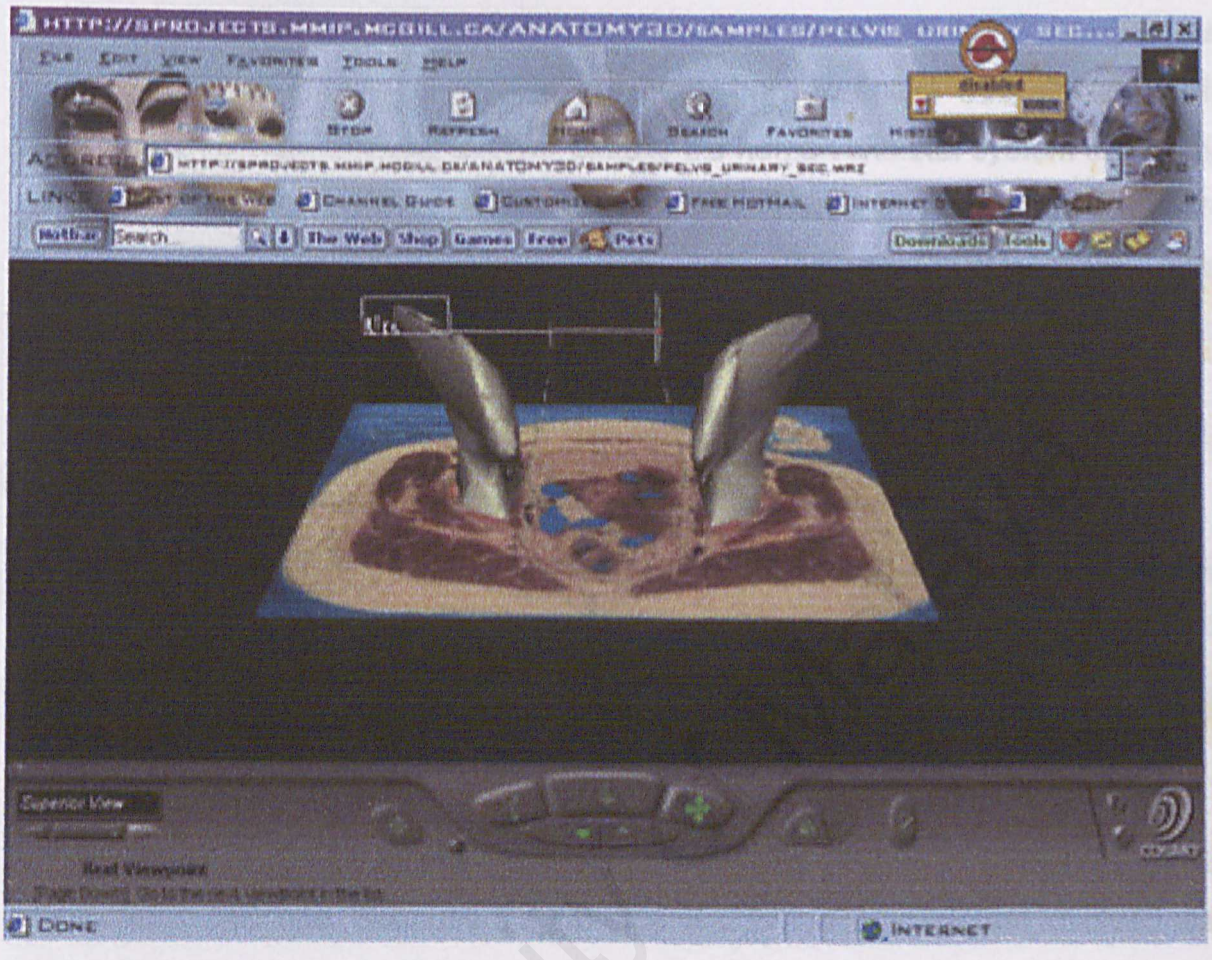


Figure 2.3: Pelvis 3D image from the superior view

2.4: System comparison

Three of them I picked from a hundreds of human anatomy web site that available online. I have to say that it's pretty hard to find a web site that only focused on human skeletal system, usually the human skeletal system comes as a part of division in human anatomy web site. That's why I took an example system from human anatomy web site. Among those three only *www.stemnet.nf.ca/CITE/skeletal.htm* that is specialized in human skeletal system.

If we talked about the outlook of every web site I could say that the two last web site have a better out look from the first web site. Even though the interface also attractive but it was too simple to be compared with other web site, in addition it's using an informal language presentation that was more suitable for students. All of them provide users with 3D models of skeletal system.

Interactivity is one of the important components in the creation of multimedia web site. Because it's the only way to make users feel involved with the information presentation and also catch their intention to surf more. From three of the web site bionim web site seems to offer more interaction between users and the web page. 3D Anatomy for Student web site also offer a much more interactivity, but somehow it is still under construction and we cannot take the sample as the guarantee product. However if they really implement all those interactivity elements, that will be a very interactive web site.

The contents of the web site is the most important part, because that is why their surfing onto this web site at the first place. To evaluate the contents quality I don't find it is relevant because it depending on the objective of the web site. Like the first web site that I analyzed, it only contained the anatomical position of the bones. This is because the author objective is to help user to be

easily remember the structure of the skeletal system. While the rest have a plenty of information about the single bone because of their target for the users' information requirements.

2.5: The benefits that was obtained from the web site

As we can see the role of the online system is to simplify our job. We don't have to buy expensive books to seek information about human skeletal system. Furthermore, if we see from the information availability aspect, it is much easy for us to get the information through the Internet. We just have to log on and type the URL or if we're not sure with the URL, we can always use search engine to crawl over the web.

This kind of web site is specially dedicated to medical students. Because they are in the user group that really in need to surf onto this web site. They can have a close looks at the structured, the complex anatomical relationship, bone descriptions and functions, and also a reference for the further information that didn't been include in that web site. Students can take fully advantage from this web site if they know how to manipulate the information and features given through the system.

And lastly for the person that do not involved in medical field can also get a benefits from this system. The contents are suitable as reading material for all people. It is a general knowledge that could be useful in the future, because we never know what we will get in the coming days. Maybe if they know what forms a bone and how to keep it healthy and strong, they can start earlier in the right diet to prevent from ostheopherosis.

2.6: Summary

The human skeletal multimedia system is not widely used yet because many developers only interested in providing users with the whole anatomy system. There are not many web sites that will cover perfectly complete on human skeletal system. Most of the web site that focused on the human skeletal system did not having multimedia elements as it accessories.

From the observation that I did I can summarized that human skeletal web sites are still lack of performance. In my opinion, to creating a good web site there should be an equal integration between the user interface designs, interactivity and the contents. When users feel satisfy with the information deliverable and the system design that means the developer has achieved the goal to fill the users needs. What is more satisfying for developer than for having a web site that successfully make all the user's requirements met.

Because of the dynamic growth of the computer graphic technology and the high inquisitive of human, I believed that we would have the perfect human skeletal multimedia system for the next generation.

SYSTEM ANALYSIS

3.1: System Methodology

V-MODEL

The v–model framework is a structured testing approach that can be used with any project management or system development methodology. The deliverables of every stage of the v-model need to be verified and validated to ensure that they are complete and correct. Work proceeds to the next stage in the v-model when all projects deliverables in a stage have met all the verification and validation requirements.

The process of verification and validation is an attempt to catch as many errors as possible within the development life cycle, otherwise know as "stage containment". Each successive stage of testing ensures that the specifications defined in the deliverable of the corresponding stage have been implemented. This is achieved by the early development of test requirements. [2]

In short, I can say that verification is a process to check that deliverable is complete (contains all requires information, follow standard). While validation is a to check that deliverables satisfy requirements specified in the early stage. And lastly, testing is to ensure that the specification is properly assembled and implemented.

As we can see from the v-model diagram, my system will undergo three testing stages. They are application test, system integrated testing and acceptance testing. The goal of application testing is to deliver an application functionally defined set of system components that satisfy all design requirements. That is, by which all the pieces of the unit testing functionality are stung together to complete the assembly test process.

While system integrated testing is to confirm that the working applications or group of components, can be fully integrated to satisfy functional, technical and quality requirements. Stress testing is another element that may be performed during the cycle.[3]

Users will do user acceptance testing usually of course, but in this case I do the acceptance testing by myself regarding to the users need that I have compiled earlier. The goal of this stage is to confirm that the system will function within the business environment and deliver all user requirements within that environment.

Here I specify three advantages of v-model to my system:

- ✓ It emphasizes quality from the initial requirements stage through the final testing stage.
- ✓ It focuses on testing throughout the development life cycle, early development of test requirements and early detection errors.
- ✓ Each major deliverable in the development process is assessed, verified, validated and tested.
- ✓ It is suitable to manage short time project implementation.

V-MODEL

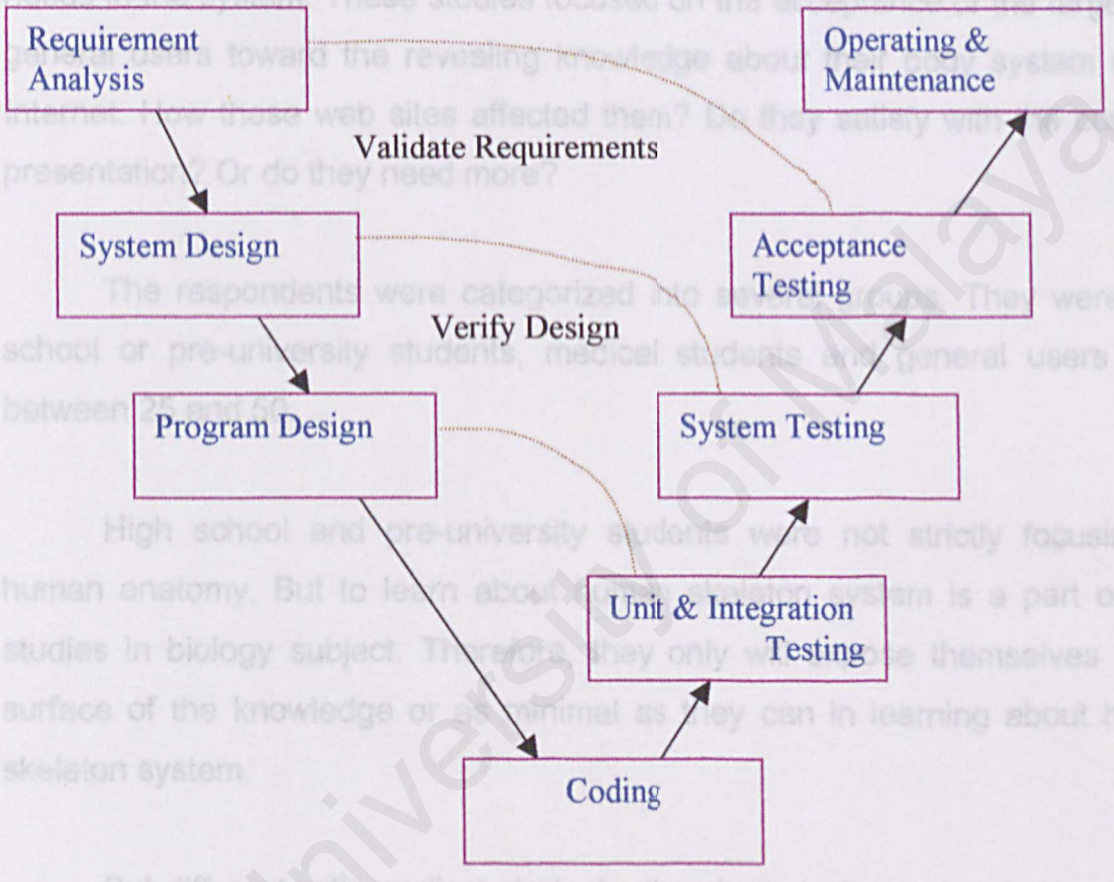


Figure 3.1: V-Model Diagram

3.2: Studies on current system via interview

3.2.1: *Target Groups*

The purpose of this studies is to get public opinion on current medical website that available online. It also used as an alternative to assemble users needs in the system. These studies focused on the acceptance of the target and general users toward the revealing knowledge about their body system in the Internet. How these web sites affected them? Do they satisfy with the contents presentation? Or do they need more?

The respondents were categorized into several groups. They were high school or pre-university students, medical students and general users aged between 25 and 50.

High school and pre-university students were not strictly focusing on human anatomy. But to learn about human skeleton system is a part of their studies in biology subject. Therefore, they only will expose themselves to the surface of the knowledge or as minimal as they can in learning about human skeleton system.

But different with medical students, they have to learn closely to every bit of the bones. Because, soon they will need to use that knowledge upon a real human. This is where the visual effects come as an important element in the web site. The effects will make them easier in remembering every data and indirectly will tackle them to hook up onto this web site. I need to know the information requirements of this target group in order to help them getting the fullest advantage from this web site.

The third respondent group is public users aged between 25 and 50. Some of them are teachers, lecturers, lawyers, programmers and executive officers. Most of them learn about human skeleton as a general knowledge. However, some of them use the knowledge as an extra material in their working tasks.

3.2.2: *Interview*

I have conduct an interview with the target users in order to get their opinions towards the current system and also their expectation upon a new approach of medical web site. Throughout this interview I can assemble all the information that need to be put into the web site. So from the combination of observation and users' target interviewing I can get the final view of the system that need to be build.

Basically, interviews are pre-planned question and answer dialogues between two people. I do five steps in preplanning the interviews. And they are:

1. Read background material
2. Establish interviewing objectives
3. Decide who to interview
4. Prepare the interviewee
5. Decide the question types and answers

There are a few other ways in gathering information from users. But I choose to interview them because I can get a lot more specific information. I'm dealing with users' needs and opinions, so I think there is no other best way of doing it but interviewing. [4]

Read background material

This is a homework that I did before the interviewing session. I study my respondent's background and specify their intention to the system. I list down questions that are relevant to their knowledge and try to avoid from giving them a leading questions.

Establish interviewing objectives

As I mentioned before, I do an interviewing sessions is to get a complete answer to my questions. During the interview if I'm not clear with the answer (that is important to the studies) I can straight away asking for an explanation.

I have to consider all of their opinions because they are the voice of their needs. Of course I won't take all the opinions, they have to be filter out. But, to have a multiple views upon a single point is really .....

Decide whom to interview

The interviewees should be my target users. I have several group of target users, so I take 5 persons to represent the opinion of every groups. Even though it will look like inadequate of representative for every group, but I think it will be a reasonable amount for interviews that will be conduct by one person. Therefore, I only chose interviewees that are really familiar with the system and able to give their thoughtful opinions towards the system.

Prepare the interviewee

Usually I will meet the person I want to interview and discuss about the interview session that will be held. I will make sure that the session won't be a burden to them. All I need is their co-operation and not the resentment. If I can't meet them, I'll call or send an email. This will show them my commitment to the interview sessions.

Decide on question types and structure.

Basically there are two types of questions; they are either open-ended question or closed question. Open-ended questions give interviewees option for responding. They are open. They can say anything. This kind of questions will put them in ease and providing a richness of details. Closed-question is an alternative to open-ended question. This kind of question gives interviewees a limited response. I use the combination of both.

Open-ended question will give me an extra information while closed-question always be used as a confirmation. I also do probe or follow-up of the question when the interviewee gave me a brief and unclear answer to my question.

I begin my question with detailed or closed-questions before I expand the topic with open-ended question. This is called pyramid structure because I need to warm up my interviewee with the topic before let them spit their opinion on my open-ended questions.

3.2.3: *Research Analysis*

This research involved 15 respondents with 10 of them are students and the rest from career group. All of them are familiar with the human skeleton system web site and the online learning as new approach of studying.

Here is the statistic of their answers from the interview sessions that I've conduct.

The first question is just to ensure that they have been to the human skeletal web site and the purposes of their surfing. Because 10 of them are students, so the purpose of surf onto the web site is to learn. While one out of 15 said that sometimes his job requires him to know about other issue like human skeletal system. While others like to hook up onto the web site just to dig for more general knowledge.

Half of the students agree that online learning is suitable and can be as an effective alternative for students to study on human skeletal system. While the other half think that learning via Internet sometimes didn't meet the goal of learning. This is because of the lack of required information and the availability of the data. One of them said that she couldn't stand to be in front of computer too long because of the eyes strain.

There are three problems they commonly face when surf to the Internet;

- Lack of detail information that is important
- Slow loading when it involved graphics or movie clip
- Interactivity problem while they are trying to figure out what they should do in the web site page.

All of them have experienced the slow loading data, 4 out of 15 that are all medical students said that many of the web site didn't provide the appropriate information. While 9 of them agreed that sometimes don't have a clue on how to navigate from one page to another.

For the multimedia statistic analysis please refer to the bar chart (number).

When I asked about the characteristics of the human skeletal web site, I figure out five main characters that they think should be best to be put in the web site. They are;

- Clear instruction on how to handle the web site page.
- Fill every page with appropriate data and important data shouldn't be miss out.
- Provide two ways of communication between user and web page. This refers to the interactivity of the web site.
- Include additional elements to make the process of learning more interesting.
- Provide clear images and it is best to have a skeleton model that offer fully view of it's bone.

Lastly is about the feedback from them to the author of the web site. And 8 out of 15 send an email to the author when they face a problem with the web site. As the result from their feedback, 5 from 8 said they got an auto reply, and then followed by the solution in short time. While the rest comment that they received the auto reply but without the follow up solution.

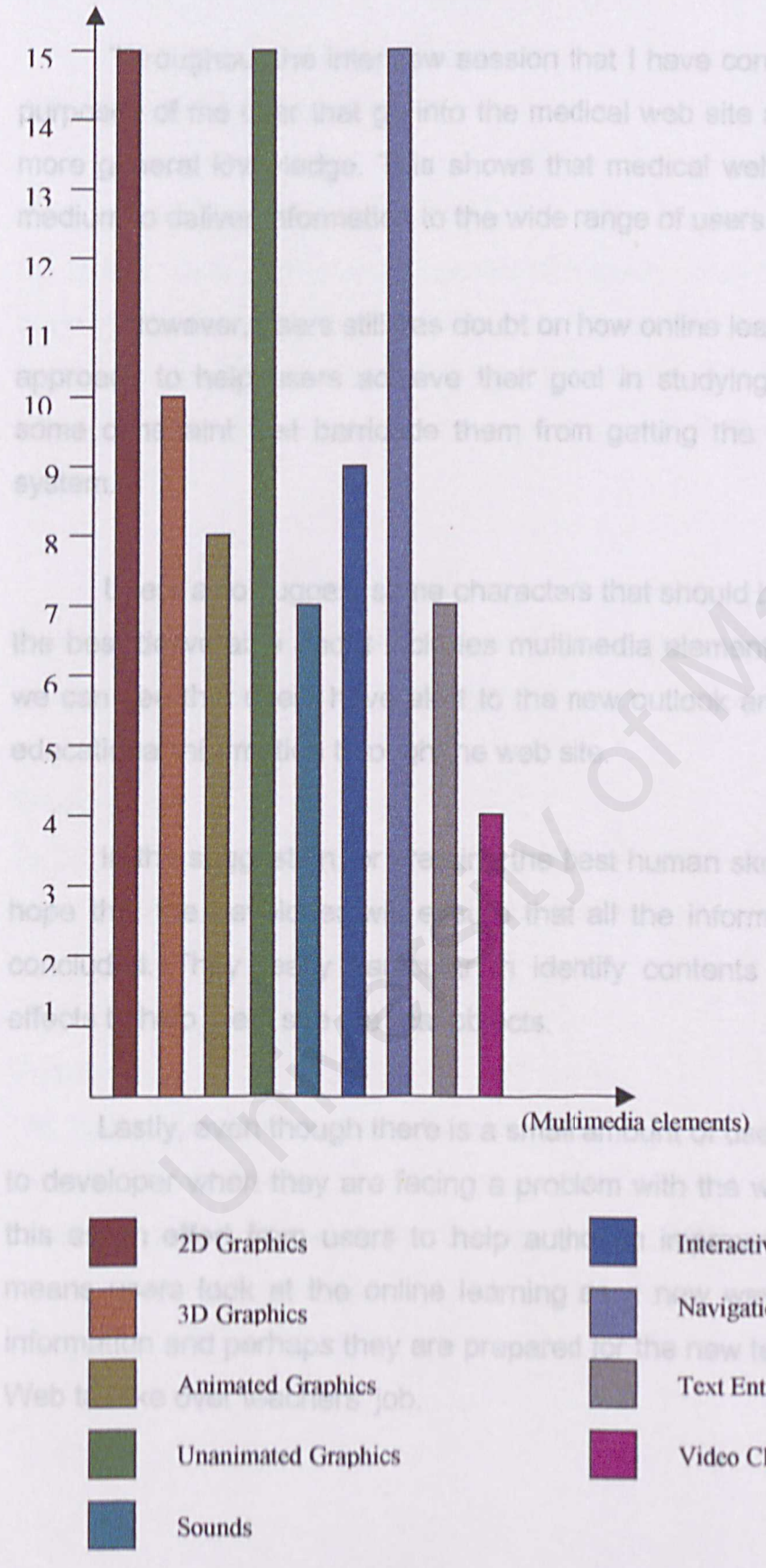


Figure 3.2: Number of users that find specified multimedia elements in current human skeletal web site

3.2.4: *Summary*

Throughout the interview session that I have conduct, I can say the main purposes of the user that go into the medical web site are for learning and gain more general knowledge. This shows that medical web site has potential as a medium to deliver information to the wide range of users.

However, users still has doubt on how online learning can be an effective approach to help users achieve their goal in studying because there are still some constraint that barricade them from getting the fullest advantage of the system.

Users also suggest some characters that should be put into the system for the best deliverable and it includes multimedia elements and interactivity. Here we can see that users have alert to the new outlook and features in presenting educational information through the web site.

In the suggestion for creating the best human skeletal web site, they also hope that the developer will ensure that all the information needed has been concluded. They really particular in identify contents and also an additional effects to help them see the real objects.

Lastly, even though there is a small amount of users that do send an email to developer when they are facing a problem with the web site, but we can see this as an effort from users to help author in improving their work. That also means users look at the online learning as a new way to deliver and receive information and perhaps they are prepared for the new technology in World Wide Web to take over teachers' job.

3.3: Contents

This web site will cover 206 bones of the human skeleton comprise strong, light tubes, rods and plates. Together with these bones' function that support the body, guard vital organs, act as levers for locomotion, store certain minerals, and (in bone marrow) make blood. Bones are linked by joints – some fixed fibrous, others mobile, with ligaments uniting bone ends buffered by shock absorbent cartilage.

The skeletal system has two great subdivisions, a (vital) axial skeleton of skull, vertebrae, and ribs; and an appendicle skeleton of limbs bones.
Here is a brief specification for every sub division of the skeleton. [5]

Skull

Its 22 bones feature eight in the cranium (a rigid shell guarding the brain) and fourteen facial bones, including a movable mandible (lower jaw) and a maxilla (upper jaw), with sockets for teeth.

Vertebrae

The backbone's 33 vertebrae from the curved weight-bearing column sheathing the spinal cord. There are seven cervical (neck), twelve thoracic (chest), and five lumbar (lower back) vertebrae. Below these movable bones lie the sacrum (five fused load-bearing vertebrae) and coccyx (four fused vertebrae forming a vestigial tail).

Rib Cage

The rib cage or chest has twelve pairs of flat bones curving forward from the thoracic vertebrae. True ribs (the top seven pair) join the sternum (breast bone) at the front of the chest. False ribs (pair 8-10) join the seventh pair. Floating ribs (pair 11-12) end short. Ribs and breast bone shield vital organs and aid breathing by moving up and down.

Shoulder girdles

These anchor arm to the skeleton. There are two scapulae (shoulder blades) hung at the back of the chest and two clavicles (collarbones) holding shoulder clear of it.

Arms

Each has a humerus (upper arm bone), radius and ulna (forearm bones), and 27 bones of the hand: carpals, metacarpals and phalanges.

Lower limbs

These transmit weight from the trunk to the ground. Two hip bones (each of three fused bones) flank the sacrum, and all form of bony basin – the pelvis. This is joined by each femur (thigh bone) which leads to the tibia (shin bone) and fibula of the leg proper. Below this come the talus (ankle bone), and the tarsal, metatarsal, an phalangeal bones of the foot.

3.4: System requirements

3.4.1: *Functional requirements*

Without functions web site will only contains a static page, which can't be, navigate or like a book's page that can't be leaf through. That's why functions are so important in the development of a web site. The functions ability is been determine in program design stage.

As a web site with a multimedia concept I supposed that users would expect an interactive web page. These means that I have to provide many functions in order to make a two-way communication between my users and the system I built. That is what we called interactive. Here I will explain every function that I use to satisfy users' need.

- 3-D skeleton model that can be navigate

  As we know 3D image can be seen in 3 dimensions. So, in my web site I create an image that can fully be seen just with moving a mouse. The image will move in opposite direction of the mouse movement.

- Dual deliverable method

  The Human Skeletal Multimedia System web site offers two ways in delivering information. Users can choose either reading text that displays on the text screen or listen to the reading text via human voice. If they choose to execute audio player I also can help them to catch up with the missed data with a playback device that is 'REPEAT' button.

- An option to chose between description page or function page

  This web site only contains three pages that is introduction, description page and function page. So, the second page is for bone description. But, if users want to jump onto the next page they can use 'FUNCTION' button to bring them to the new page. They don't have to wait until the end of description page.

- Interactive 3D model

  3D model that I used in this web site is an interactive object. Every part of the model has been specified to certain function. It will either give user a larger view or a description of the selected part. And when user mouse over the object it will display the name of the bone.

- Text Screen

  In the description page, there is an option to read the information on the text screen. All the description data will be display in that screen and it also provide users a scroll bar to read a long description which over the limit size of the screen.

- Demonstration

  Demonstration is a segment to show users the functional part of human skeletal system. It will play a synchronize scene of the bone's function. 'REPEAT' button is for users to playback the demonstration.

- Trial session

  Trial session is a segment to build a direct interaction between users and the system. This is another way to see how is the bone functioning. Users need to click at the bone and try to move it by dragging the cursor. If they move it to the right way it will follow the mouse movement otherwise it will not moving.

- Reading commands

  When users enter the web page for the first time, an audio speech will be played to guide users through the web site. Like always users can use 'REPEAT' button to playback the audio speech.

- Navigation button

  Basic navigation buttons like 'ENTER', 'BACK' and 'EXIT' are also provided in this page.

- Feedback button

  Feedback button is for user to give an author their word of criticisms or compliments.

3.4.2: *Non-functional requirements*

These requirements are constraints on the services or functions offered by the system. They include timing constraints, constraints on the development process, standards and so on.

- Robustness

It refers to the time the system is able to restart after an unexpected error of failure.

- Reliability

The system should reliable and should not cause unnecessary downtime of the overall environment. At this point, it sets out the acceptable failure rate.

- Response time

A reasonable interval time should be taken while retrieving the desired information such as a larger view of 3D model, audio file for bone description and demonstration show. Users should not be kept waiting for a long time for the outcome.

- User friendliness

The interactivity of the interface determined the friendliness of the web site. User must feel like they are involved and a part from the system, so interaction must exist between user and interface.

- Expandability

The system is able to enhance including adding new features, functionality, volumes of product in the future time.

3.4.3: *Software Requirements*

My web site is using a virtual reality approach, that is an environment where people can see things in three-dimensional. I'm using this approach because I want to create a new outlook of medical web site that is with an addition of realism in its deliverable.

In market nowadays, there are a few software that I can use to produce such web site, but I have decided to try VRML. It is a 3D Internet language that has been used widely by a web designer in order to build a virtual reality environment in their works.

Meanwhile, as the time to build this system is limited I have to simplify my task in developing the system. Even though VRML is able to create a smooth 3D model of human skeletal system, but it will take a while to finish this keen work. Therefore, I seek help from 3D studio max. It is a 3D model builder that capable in building a very beautiful and realistic 3d objects. It also provides features to animate these models.

To make this web site more attractive and interactive I used an audio system to manipulate a situation in this web site. Sounds creating and editing process will be handle by Soundforge. Soundforge offers a variety of method in making the recording process as good as in the studio recording.

Lastly is Microsoft SQL Server as software for my database. I'm using Windows NT as the platform that will make my personal computer as a client, server and database. Below I will give specific information about all the software that I will use.

3.4.3.1: VRML

VRML (Virtual Reality Modeling Language) is a file format for describing interactive 3D objects and worlds. VRML is designed to be used in Internet, intranet and local clients system. VRML is intended to be a universal interchange format for integrated 3D graphics and multimedia. VRML may be used in a variety of application areas such as engineering and scientific visualization; multimedia presentations, entertainment and educational titles web pages and shared virtual worlds.

I used VRML to interpret my graphic user interface into a language that can be understood by the browser because of its characteristics. There are:

- Author ability:

  Enable the development of computer programs capable of creating, editing, and maintaining VRML files, as well as automatic translation program for converting other commonly 3D file format into VRML file.

- Compos ability:

  Provide the ability to use and combine dynamic 3D objects within a VRML world and this allow re-usability.

- Extensibility:

  Provide the ability to add new object types not explicitly defined in VRML.

- Be capable of implementation:

  Capable of implementation on a wide range of system.

- Performance:

  Emphasize scalable, interactive performance on a wide variety of computing platform.

- Scalability:

  Enable arbitrarily large dynamic 3D worlds.

Compared to other 3D language I prefer VRML because its capability of representing static and animated dynamic 3D and multimedia objects with hyperlinks to other media such as text, sounds, movies and images. VRML browsers as well as authoring tools for the creation of VRML files are widely available for many different platforms. [7]

VRML support an extensibility model that allows dynamic 3D objects to be defined allowing application communities to develop interoperable extensions to the base standard. There are mapping between VRML objects and commonly used 3D application programmer interface (API) features.

Apparently VRML needs some additional equipment to support its functionality in creating a virtual reality web site. They are text editor, file translator, compressor and VRML viewer.

VRMLPad

I need a text editor to write the VRML coding and I chose to use VRMLPad. It has a capability in simplify my task as a new beginner in writing VRML code. VRMLPad is a professional editor for VRML programming. Key time saving features include powerful editorial abilities and visual support for the scene tree and resource operations. [8]

It provides Smart Auto-Complete, dynamic error detection, syntax highlighting, advance find and replace, visual support for the scene tree operations, ability to preview VRML scene and publishing wizard.

Crossroad

Because of the 3D models are been built using 3D Studio Max, the file format is different with the file format of VRML. Therefore, I need a translator to change the file format of 3D objects into a format that will be understood by the VRML. [9]

Cosmo Player

This will be explain in the hardware requirement under browser specification.

3.4.3.2: Sound Forge

Sound Forge is Sonic Foundry's award-winning two-track digital audio editor. Sound Forge includes a powerful set of audio processes, tools, and effects for manipulating audio. This one-of-a-kind application is perfect for audio editing, audio recording, effects processing and media encoding. I can create, record, and edit audio files with a combination of Sound Forge with any Windows-compatible sound card. The clean and familiar Windows interface makes editing a breeze. It also has built-in support for video and CD burning and can save to a number of audio and video file formats, including WAV, WMA, RM, AVI, and MP3. [10]

As a beginner in web development and design I need a powerful software to help me simplify my task. That's why I'm using Sound Forge. It provides many features that are very useful in creating and editing audio files. Here are some of the features:

- Powerful editing features — Sound Forge provides a combination of over 35 audio effects and processes with more than 200 presets. It includes dozens of editing features including: Cut, Paste, Move, Delete, Mute, Reverse, Crossfade, Trim, Normalize, Fade, Pan, Resample, Enhance, Insert Silence, and more.
- Amazing effects—Sound Forge includes 20 DirectX Audio Plug-Ins, including XFX™1, XFX™2, XFX™3, and Acoustic Mirror™, which can be used for acoustic simulation and microphone modeling. The entire arsenal of effects includes Amplitude Modulation, Chorus, Delay, Distortion, Flange, Gapper, Noise Gate, Pitch Bend, Reverb, Vibrato, Time Compression, Wave Hammer™ and more. Sound Forge also includes three Eqs—Graphic, Parametric, and

Paragraphic and supports DirectX Plug-Ins from third party applications.

- Support for many file formats—Sound Forge supports a wide range of audio formats, including 12 import formats and 17 export formats, such as WAV, Windows Media™ Audio, RealAudio® and MP3.

3.5: Hardware Requirements

Component	Description
Platform	Windows NT 4.0 or greater
Memory	256 Mb RAM
Processor	Intel III 600MHz
Monitor	24 bit, 15" VGA
Sound Card	Sound Blaster
Display Card	GeForce 3 MX 128 bit
Browser	Internet Explorer and Cosmo Player

Table 3.3: Hardware specification for developer

Component	Description
Platform	Windows NT 4.0 or greater
Memory	128 Mb RAM
Processor	Intel II 400MHz
Monitor	24 bit, 15" VGA
Sound Card	Sound Blaster
Display Card	GeForce 3 MX 128 bit
Browser	Internet Explorer and Cosmo Player

Figure 3.4: Minimal hardware specification for user

3.5.1: Platform

Before I chose a platform, I have to clarify that it must be compatibles and able to support many application in one time. Because of the limitation of time line to develop this system, the platform that I choose is based of my familiarity in usage. That is why I decided to chose operating system from Microsoft that is Windows NT 4.0 instead of other platform like UNIX or MAC.

Here I specify some features in Windows NT that help me in building this system:

- ✓ The Microsoft Windows 95 operating system user interface has been integrated into Microsoft Windows NT Server 4.0
- ✓ Network Monitor - A network diagnostic tool, the Network Monitor examines network traffic to and from the server at the packet-level. It can capture network traffic so I can analyze it later.
- ✓ Windows NT Diagnostic Tool – Windows NT Server 4.0 includes a diagnostic program that for examining the system. It contains information on device driver, network usage and system resources, such as IRQ, DMA, and IO address. This information is presented in a graphical tool that can be run on a remote Windows NT-based system.
- ✓ Internet Server – The combination of Windows NT Server 4.0 and its built-in Web server, Microsoft Internet Information Server 4.0 (IIS), delivers up to 52 percent better Web server performance with Active Server Pages (Microsoft Test Result).[12]

3.5.2: Memory

RAM (Random Access Memory) is the place in a computer where the operating system, application programs, and data in current use are kept so that they can be quickly reached by the computer's processor. RAM is much faster to read from and write to than the other kinds of storage in computer, the hard disk, floppy disk and CD-ROM. However the data in RAM stays there as long as the computer is running. When it was turned off, RAM loses its data. When the computers on again, the operating system and other files are once again loaded into RAM, usually from the computer's hard disk. [13]

In my hardware specification I have to use a huge RAM because of the large amount of data that u I use in one time, regarding to the 3D graphics. If RAM fills up, the processor needs to continually go to the hard disk to overlay old data in RAM with new, slowing down the computer's operation. Unlike the hard disk, which can become completely full of data so that it won't accept any more, RAM never runs out of memory. It keeps operating, but much more slowly.

3.5.3: Monitor

Monitor is a computer display and related part package in a physical unit that is separate from other part of the computer. Meanwhile, display is a computer output surface and projecting mechanism that shows text and often graphic images to the computer user. [14]

Display can be characterized according to:

- Color capability – verified through the display mode that determined how many bits used to describe color and how many colors can be displayed. In order to get the best view of this project interface, I used 24-bit bit-depth (number of bits used to describe a pixel) that is operate in SuperVGA (Visual Graphic Array) and can display up to 16,777,216 colors.

- Sharpness and view ability – the actual sharpness of any particular overall display image is measured in dots-per-inch. It is determined by a combination of screen resolution and the physical screen size. The same resolution spread out over a larger screen offers reduced sharpness. On the other hand, high-resolution settings on a smaller surface will product a sharper image, but text readability will become more difficult. In this project I always come to the common use resolution that is 800 x 600 pixels with 15-inch.

- The size of the screen – the display screen width relative to height, known as the aspect ratio, is generally standardized at 4 to 3 (usually indicate as "4:3"). The size of my screen is 15-inch.

3.5.4: Browser

A browser is an application program that provides a way to look at any interact with all the information on the World Wide Web the word 'browser' seems to have originated prior to the web as a generic term for user interfaces that let you browse (navigate through and read) text files online.

Technically a web browser is a client program that uses the Hypertext Transfer Protocol (HTTP) to make request of Web Server throughout the Internet on the behalf of browser user. To develop this project I need two different browser, they are Internet browser and VRML viewer.

As an Internet browser I like to say that prefer to use Microsoft Internet Explorer. This browser comes with Microsoft Windows Operating System and can also been download from Microsoft web site. And Internet Explorer also provides several features that will give a better performance to my web site than other Internet browser.

Here are the features:

- Its flexibility to experience the web the way we want.
- Image toolbar: allows my users to quickly and easily save and print pictures from my web page. When users point to pictures (images) on web pages, the image toolbar appears giving instant access to My Picture folder.
- Provides user interface for locating and playing media within the browser window. Users can play the audio file without opening a separate window; they can also control the audio volume.
- If pictures are too large to display in browser window, the new automatic picture-resizing feature resizes the picture so they fit within the dimensions of the browser window.

While for VRML viewer I use Cosmo Player. This viewer will interpret the VRML coding to a graphical 3D images that can be seen by users in the interface. This Netscape and internet Explorer 4.0 compatible plug-in is compliant with the VRML 2.0(version that I used to develop this system) specification. One of the most popular browsers.

This browser brings high quality, high-performance 3D experiences to the web. It will set a new standard of interaction to my high-impact animated web site. Here are some features of Cosmo Player:

- Support Microsoft Direct 3D
- Support up to 8 simultaneous 3D scenes on the same HTML page.
- Support COM implementation of the EAI (External Authoring Interface).

3.5.5: Sound card

A sound card (also referred to as an audio card) is a peripheral device that attaches to the ISA or PCI slot on a motherboard to enable the computer to input, process, and deliver sound. The sound card four main functions are: as a synthesizer (generating sounds), as a MIDI interface, analog-to-digital conversion (used, for example, in recording sound from microphone), and digital-to-analog conversion (used, for example, to reproduce sound for a speaker).

My computer use Sound Blaster sound card because it have 3D capabilities enabled by processor on the card that use mathematical formulas to create greater depth, complexity, and realism of sound.

SYSTEM DESIGN

4.1: Objective of doing System Design

Information system design is defined as those tasks that focus on the specification of a detailed computer-based solution. It is also called physical data. Hence, it addresses the data, processes and interface building blocks from the system designer's perspective. Which in this case, I'm the system designer, system analyst and programmer of the project.

There are many strategies to perform system design, but in this chapter I'm focusing more on the interface because it is a web-based system. Within system design approach, I can create an interface based on the earlier clarification of the interface concept and data flow.

First thing that I will do in system design is to define the general concept of this web site. This is important because concept will indirectly tell users the quality of the web design that has been build by the designer. Then it will follow by the data flow organization. All the assembled data will be divided into several specific segments and they will be arranging in a systematic flow.

Lastly I have to create the interface, which is responsible in delivering all the data to users with all the specified functions. Through system design stage, I can create the right and suitable interface that contained all the information needed. This will organize the processes of decorating an interactive and attractive web site.

In short, a beautiful user interface can be presented without missing any important data. The main part that supposed to be seen by users of this site is an attractive 3D model of human skeletal system that contained functions that will present the systematic flow of information about skeletal system.

4.2: Concept of the Interface

When I decided to build this system, I have kept in mind that my system should be simple yet informative. So do the interfaces. VRML (Virtual Reality Modeling Language) is the language that commonly uses to create a virtual reality environment. But what is virtual reality?

Virtual reality is the simulation of a real or imagined environment that can be experienced visually in the three dimensions of width, height and depth, and that may additionally provide an interactive experienced visually in full real-time motion with sound and possibly with tactile and other forms of feedback.

The simplest form of virtual reality is the 3-D image that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zoom in and zoom out. Most of these images require installing plug-in for your browser.

As the images become larger and interactive controls more complex, the perception of "reality" increases. More sophisticated efforts involve such approaches as wrap around display screens, actual rooms augmented with wearable computers, and hap tics joystick devices that let you feel the display images.

The virtual reality can be divided into:

- The simulation of real environments such as the interior of x building or a spaceship often with the purpose of training or education.
- The development of an imagined environment, typically for a game or educational adventure. This is what been applied in my web site.

The popular products for creating virtual reality effects on personal computers include Bryce, Extreme 3D, Ray Dream Studio, TrueSpace, 3D Studio Max and Visual Reality. But I used VRML because it allows me to specify images and the rules for their display and interaction using textual language statements.

4.3: Sample of the interface

Basically this web site only contains three main interfaces. Fewer interfaces will save time consuming especially for the downloading process. Furthermore user will not confuse with the system functional and it will be easy for them to seeking multiple information in one page.

Here I will show the basic outlook of my interface.

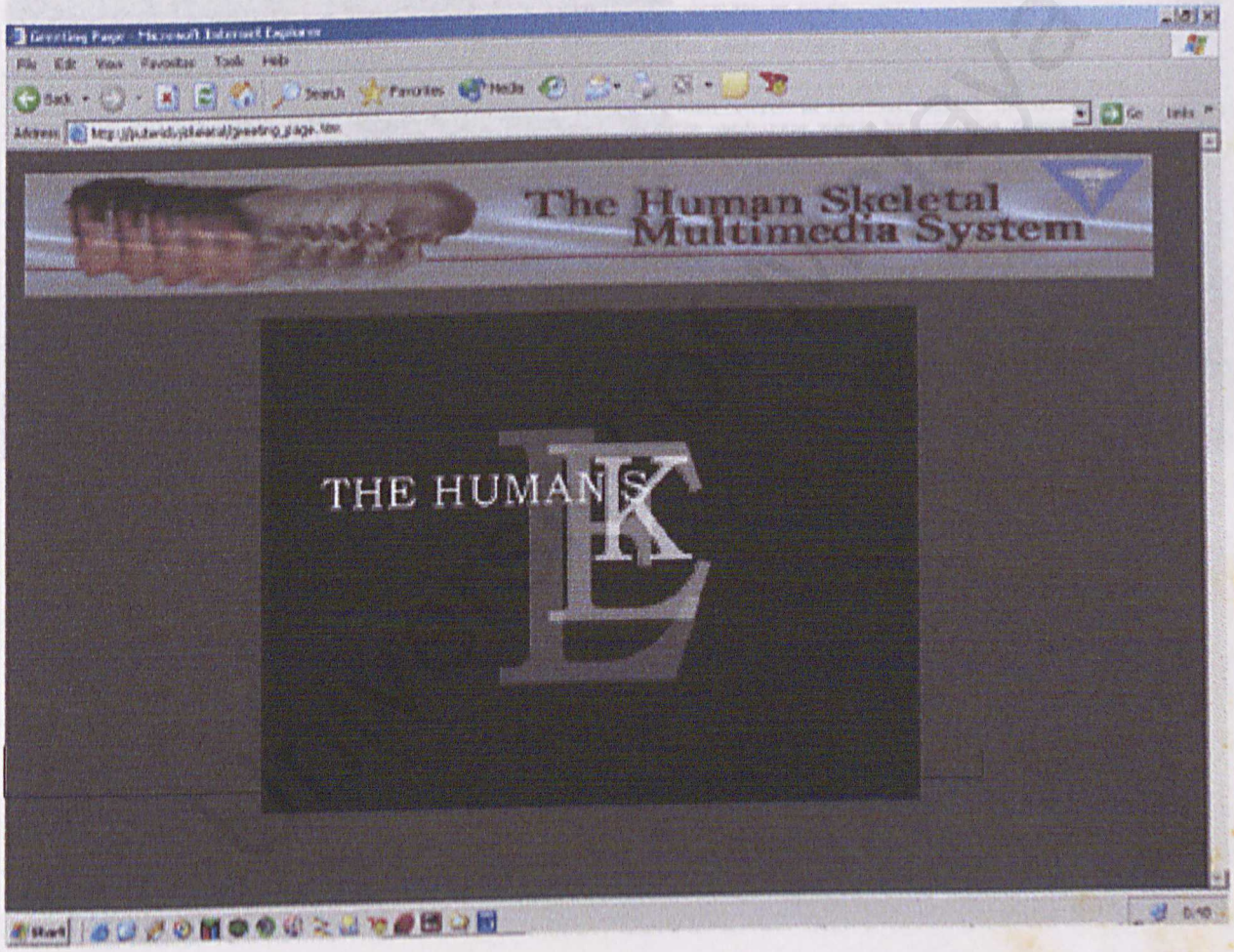


Figure 4.1: Introduction page

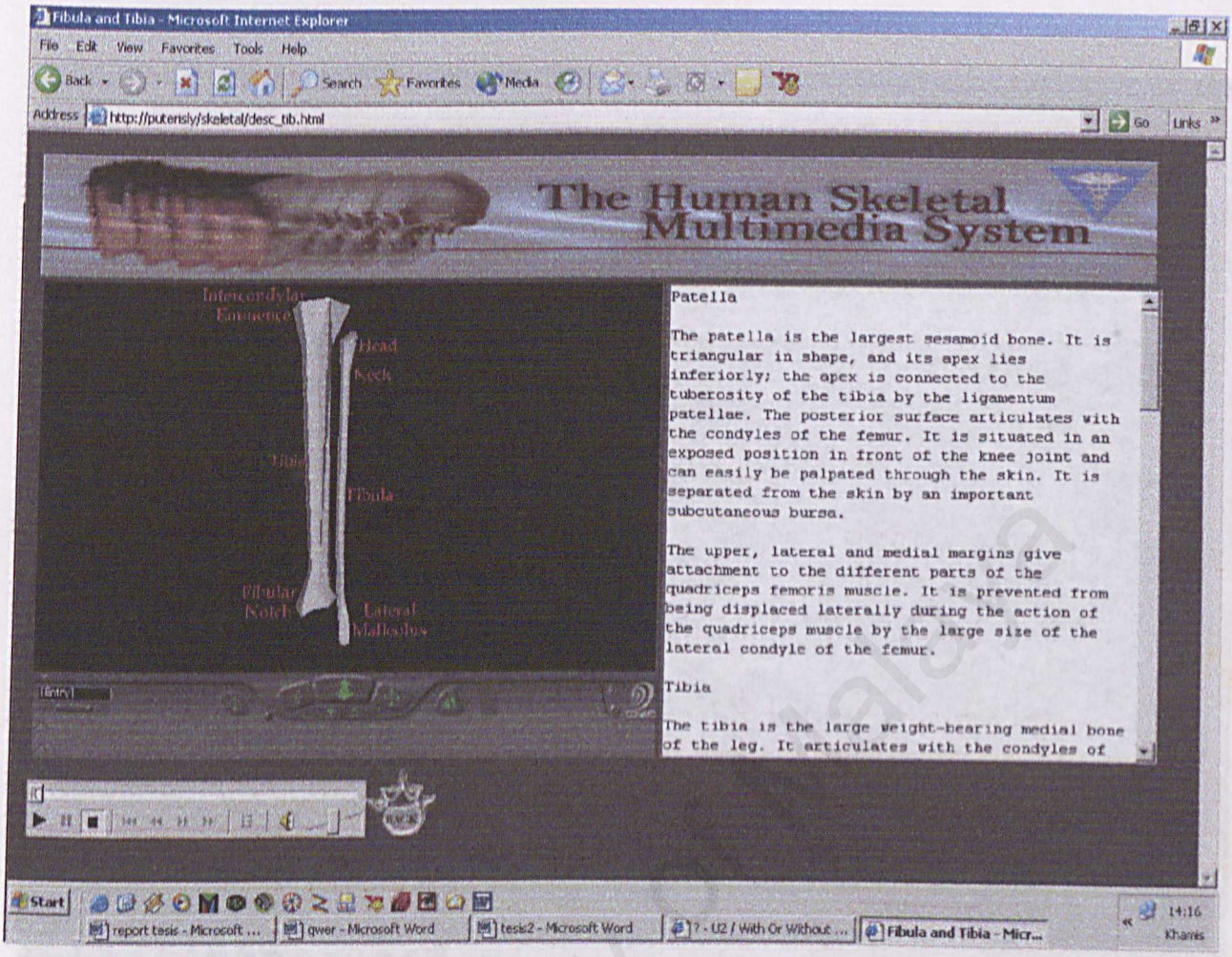


Figure 4.2: Bone description's page

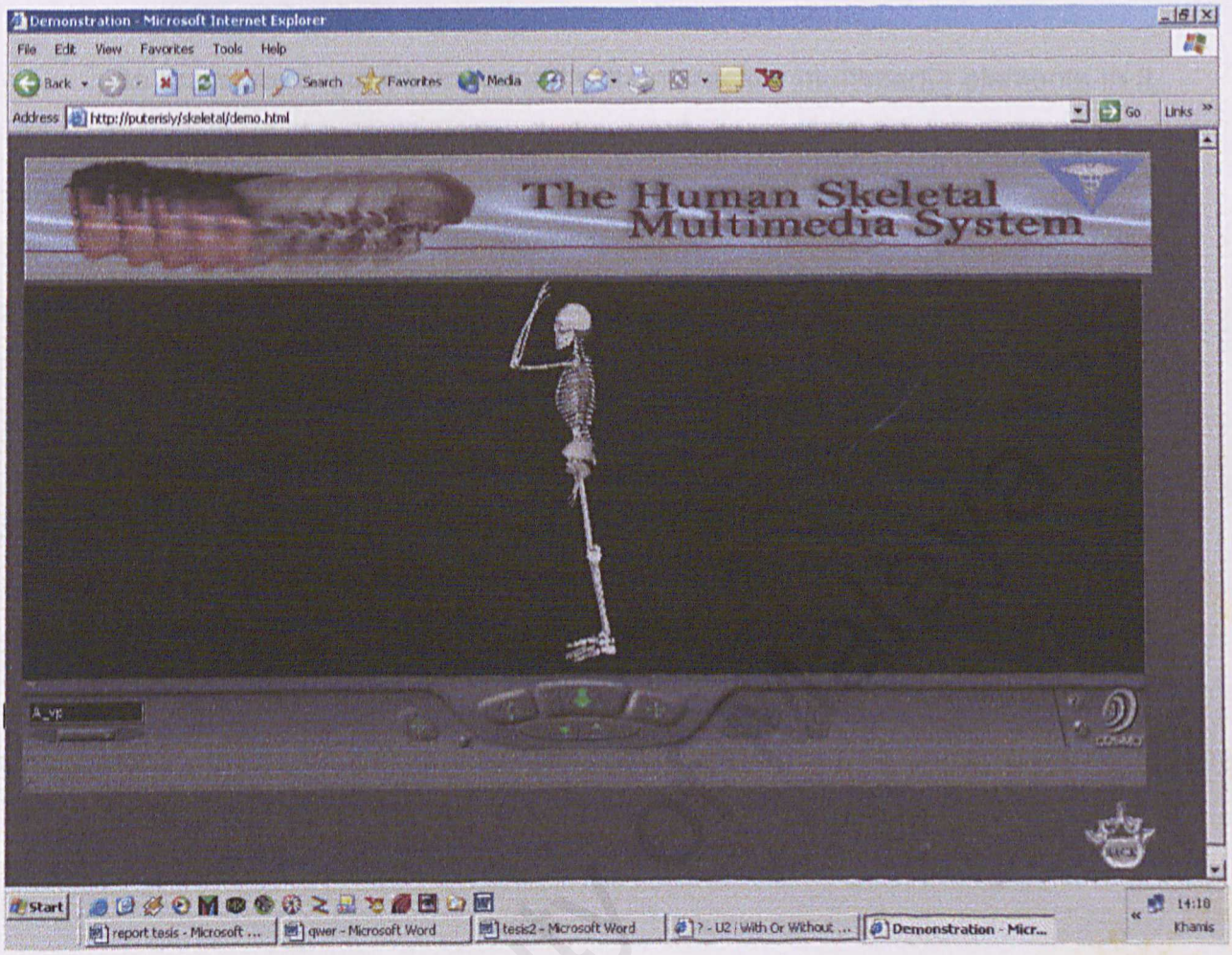


Figure 4.3: Bone function's page

4.4: Multimedia Elements

As the system will be presented with interactive multimedia elements in it, so I will explain what is multimedia all about. What transform a plain page into an interactive and desirable site.

Actually, multimedia is more than one concurrent presentation medium (for example, on CD-ROM or a Web site). Although still images are a different medium than text, multimedia is typically used to mean the combination of text, sound, and/or motion video. Some people might say that the addition of animated images (for example the animated GIF on the Web) produces multimedia, but it has typically meant one of the following:

- Text and sounds
- Text, sound, and still or animated graphic images
- Text, sound, and video images
- Video and sound

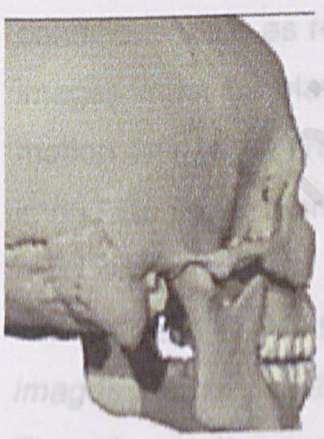
In live situations, the use of a speaker or actors and "props" together with sound, images, and motion video. Multimedia can arguably be distinguished from traditional motion pictures or movies both by the scale of the production (multimedia is usually smaller and less expensive) and by the possibility of audience interactivity or involvement (in which case, it is usually called interactive multimedia). Interactive elements can include: voice command, mouse manipulation, text entry, touches screen, video capture of the user, or live participation (in live presentation).

4.4.1: 3D Images

In computers, 3-D (three dimensions or three dimensional) describes an image that provides the perception of depth. When 3-D images are made interactive so that users feel involved with the scene, the experience is called virtual reality. Usually virtual reality environment needs a special plug in viewer for Web browser to view and interact with 3-D images. Virtual reality experiences may also require additional equipment.

3-D image creation can be viewed as a three-phase process of: tessellation, geometry, and rendering. In the first phase, models are created of individual objects using linked points that are made into a number of individual polygons (tiles). In the next stage, the polygons are transformed in various ways and lighting effects are applied. In the third stage, the transformed images are rendered into objects with very fine detail.

Below is the example of 3-d image that been rendered.



Skull from the right side

Skull view from in front

Skull view from left side

4.4.2: Animation

Images convey a lot of information because the human visual system is the sophisticated information processor. It follows, then, that moving images have the potential to convey much more information. When animation is recorded for later viewing, it is typically presented in film or video formats by recording a series of still images. This is possible because the eye-brain assembles a sequence of images and interprets them as a continuous motion.

The receptors in the eyes continually sample light in the environment. The only limitation on motion detection is the reaction time of those sensors and on certain mechanical limitation such as blinking and tracking. If an object moves fast enough, then the receptors in the eye will not be able to respond fast enough for the brain to distinguish a sharply defined, individual detail; motion blur results.

In either film or video, a sequence of images is recorded which can be played back at rates fats enough to fool the eyes into interpreting them as continuous motion. Of course, in order to save resources, this rate is kept as low as possible while still maintaining the persistence of motion. Under some viewing conditions such as rooms lighting and viewing distance, the rate at which single images must be played back in order to maintain the perception of continuous motion fails to be created. The object appears as a rapid sequence of the static images to the eye-brain.

There are actually two rates that are of concern. One is *the number of images per second* that are displayed in the viewing process (called *display rate*). The other is *the number of different images occur per second* (called *sampling rate*).

To 'animate' is literally 'to give life to'. 'Animating' is moving something that can't move itself. Animation adds to graphics the dimension of time, which vastly increases the amount of information that can be transmitted. In order to animate something, I have to be able to specify, either directly or indirectly, how the 'thing' is to move through time and space. The basic problem is to select or design animation tools which are expressive enough for me to specify what I want to specify while at the same time are powerful or automatic enough that I don't have to specify the details that I'm not interested in.

4.4.3: Sound

Sound is any audible vibration in an elastic medium. In a fluid, such as air, sound is propagated as a longitudinal wave. Regions of alternating high and low pressure travel away from the sound source, at the speed dependent upon the elastic properties of the medium. The perception of sound is called hearing.

With today's desktop computers, multi track audio recording can be done without the use of tape recorders, mixing consoles, and outboard signal processors. Hardware devices facilitate the input of several simultaneous audio signals, while software programs can record these signals to the computer's hard disc. Editing and signal processing can be performed with a degree of precision and fidelity unobtainable with analog technologies. Digital audio tracks can be either individually routed via hardware to a traditional mixing console, or mixed internally using software like SoundForge that I use in developing this web site.

4.5: Interactivity

In computer, interactivity is the sensory dialog that occurs between a human being (or possibly another live creature) and a computer program (program that run without intermediate user involvement are not interactive: they're usually called batch or backgrounds program).

On World Wide Web, we're not only interact with the browser but also with the pages that the browser brings to you. Hypertext or the words and picture links you can connect to are the most common form of interactivity while using the web (which can be thought as a giant, interconnected application program).

In addition to hypertext, web offers other possibilities for interactivity. Any kind of user input, including typing commands or clicking the mouse, is a form of inputs. Displays image and text, printouts, motion video sequences, and sounds are output forms of interactivity.

Here I will list out all the interactivity elements that been offered through this web site:

- 3D models of fully skeletal system that can be navigate.
- 3D models that are click able to give user a larger view of the selected part.
- These 3D models also can link user to the further information on the selected part.
- Text screen that has a scroll bar
- An audio button that will give user an option to chose information deliverable via human voice.
- 'REPEAT' button to enable user to playback the audio file and also a movie clip for the bone function's to see how demonstration.

- 'DEMO' button for users to see a demonstration of bone basic functions.
- Basic navigation button such as 'ENTER', 'EXIT' and 'BACK' are also provided

4.6: System structure

The internal structure of an information system is considered important to produce a system that is easy to understand, modify, test and maintained. It revolves around of the trappings of each function, the input that is needed to trigger a reaction or process and the output that represents the outcome or the needed results of the process. The human skeletal multimedia system architecture is provided for the convenience of the reader's of this proposal in order to elaborate on how data within the system is stored, transferred and manipulated: It is deliver in Relationship Flow Chart

1.Relationship Flow Chart (RFC)

An RFC simply and concisely illustrates relationship between various data objects (rectangles). It is a method to show the data flow from one interface to another. It contains the web page output, the processes involved, the choices that users have and the cycle of the repeated data.

As a web-based system that dealing with a graphic user interface, I think flow chart is an appropriate way to see how the data flow and also the system handling. Here we can see the conditions and choices that users have while they're dealing with the system. Firstly, a data dictionary appears at the beginning of this section. The data dictionary defines all symbols used in the RFC.

Data Dictionary

To describe the transactions of input and output that would occur in this system, the best approach used is representation of pictorial and graphical symbols to describe the flow of data and functionality that was recognized in the analysis and requirements. The following are the symbols that would be used in the diagrams in this section:

Relationship Flow Chart

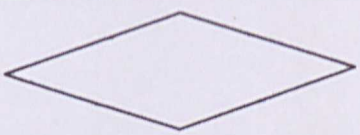
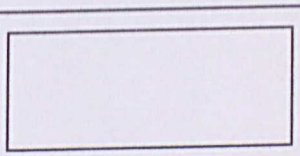
Symbol Representation	Symbol Description
	An indicator to show the flow of each process.
	Describes the conditions used to launch an activity or process.
	Represents the activities/process involved.

Figure 4.1 illustrates the data dictionary of the relationship flow chart

Advantages of the Data Flow and Flow Chart Approach

The data flow approach has four chief advantages over narrative explainations of the way data moves through the system. The advantages are:

1. Freedom from committing to the technical implementation of the system too early.
2. Further understanding of the interrelatedness of systems and subsystems.
3. Communicating current system knowledge to users through data flow chart.
4. Analysis of a proposed system to determine if the necessary data and processes have been defined.

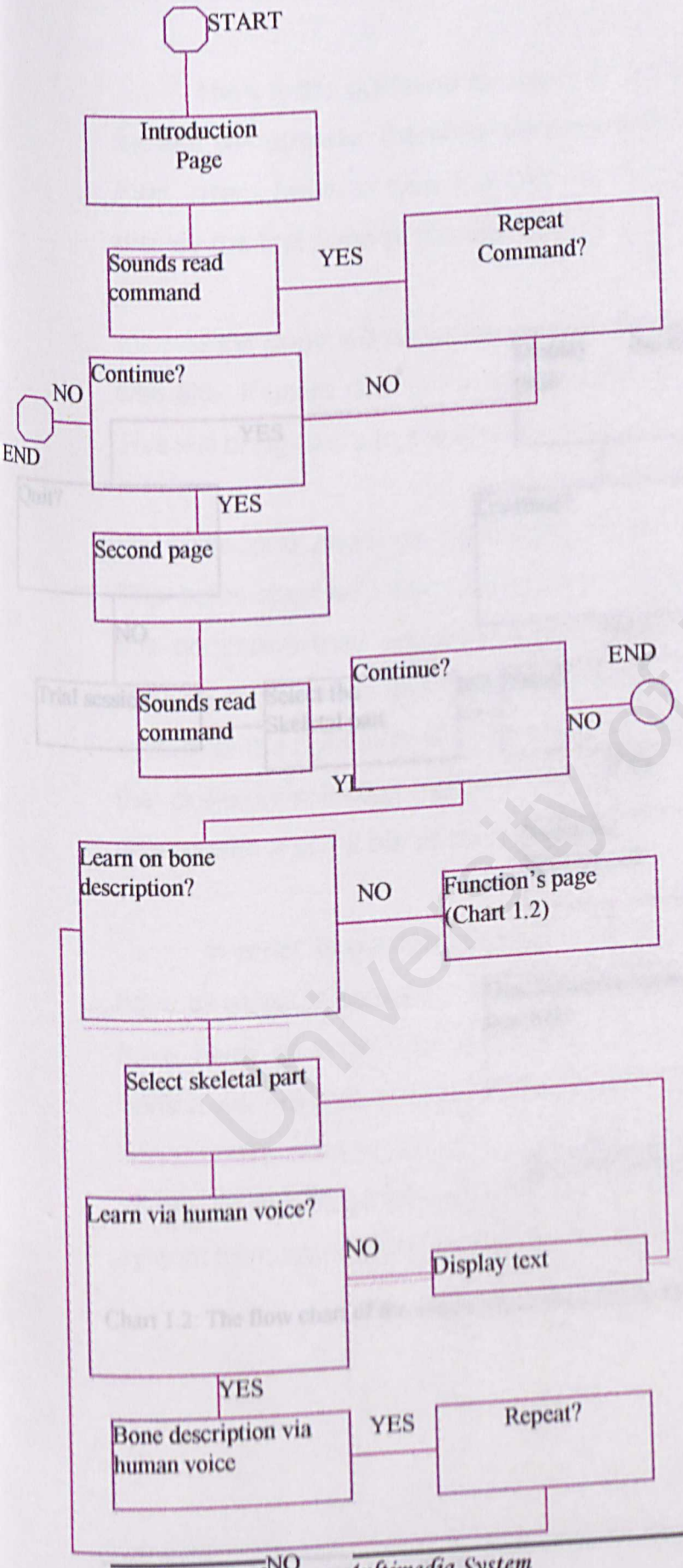


Figure 4.1: The flow chart of the system that accessed bone description's page

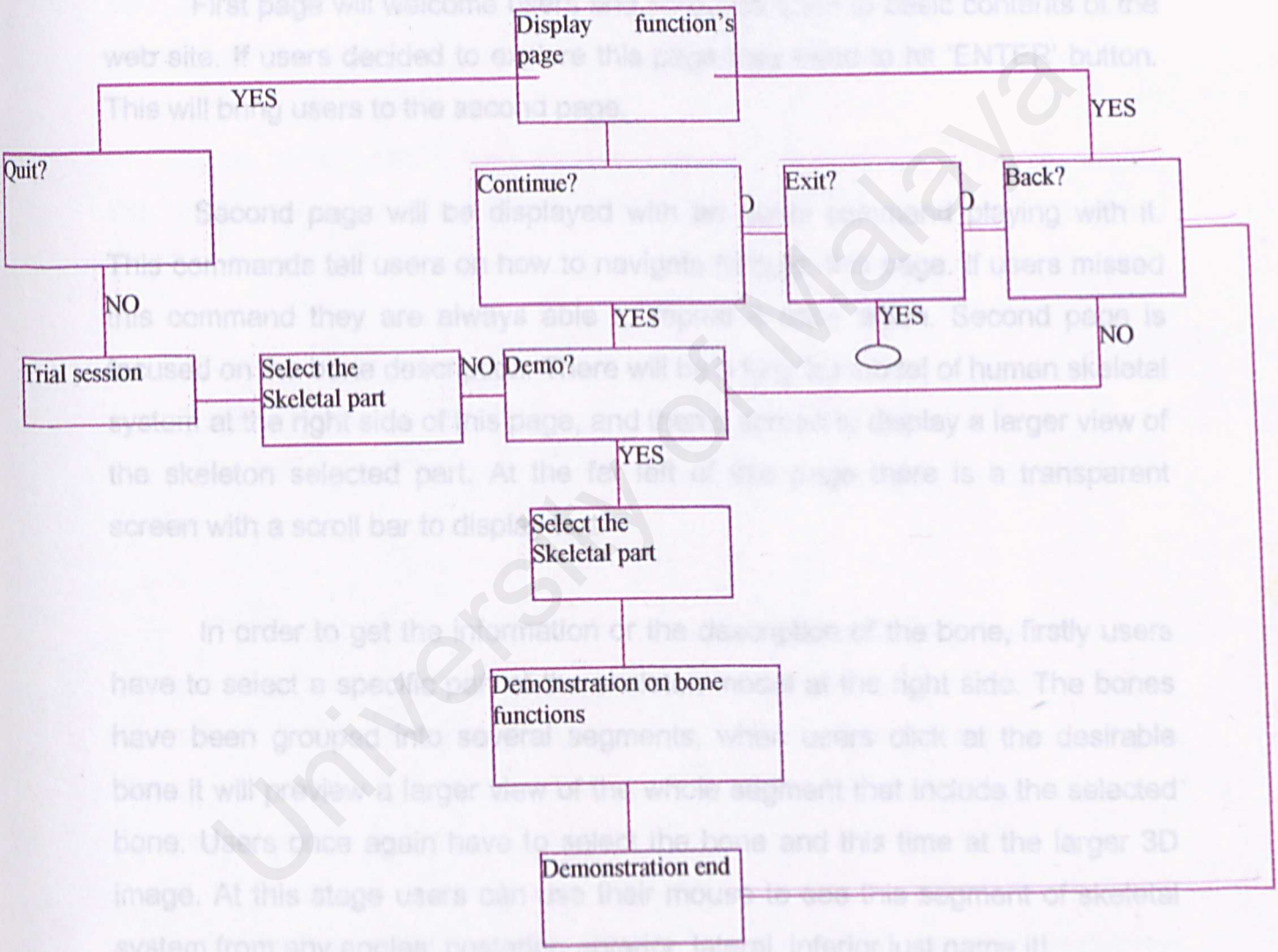


Chart 1.2: The flow chart of the system that covered bone function's page

4.7: System Handling

Here is the guideline for users to use this system. I will explain on how this system will operate, therefore user know how to navigate through this web site. First, users have to type the URL of my web site; browser will be notified to display the first page of the web site.

First page will welcome users and introduce them to basic contents of the web site. If users decided to explore this page they need to hit 'ENTER' button. This will bring users to the second page.

Second page will be displayed with an audio command playing with it. This commands tell users on how to navigate through this page. If users missed this command they are always able to repeat it once again. Second page is focused on the bone description. There will be a fully 3D model of human skeletal system at the right side of this page, and then a screen to display a larger view of the skeleton selected part. At the far left of this page there is a transparent screen with a scroll bar to display text.

In order to get the information or the description of the bone, firstly users have to select a specific part of the skeleton model at the right side. The bones have been grouped into several segments, when users click at the desirable bone it will preview a larger view of the whole segment that include the selected bone. Users once again have to select the bone and this time at the larger 3D image. At this stage users can use their mouse to see this segment of skeletal system from any angles; posterior, anterior, lateral, inferior just name it!

After users have click at the bone, the description of the selected bone will be displayed at the left screen. If there is a long description about the bone, users can use the scroll bar to see the whole text. As I claimed this system as an interactive web site, so I offer another method in delivering the description. That is with a help from audio file that will read the whole description. In case users have missed out any information, they can always repeat the audio description by hitting the 'REPEAT' button. To catch a new description of other part they just have to repeat the same steps begin with select any part from fully 3D human skeletal system.

Now, let say users have finished with the description or want to jump to the function's page they can use 'FUNCTION' button. When they hit the button they'll be moved to the next page that will serve them with skeleton's functions.

Function's page will come out just like the description page. It will be (iringi) with a human voice telling users what to do and if there is a ambiguity on how to operate with this page they can repeat the command by hitting 'REPEAT' button.

This page has the same interface like the description page but without the transparent screen to display text. This is because no text will be used as an information method in this page. Two ways in explaining about the functions are through demonstration or trial session. First users have to select which way they're preferred.

Say that they chose 'DEMO' button, it will give them a demonstration on how the bone is functioning. Demonstration would not involved users along the presentation; users just can see the movies about bone functions. And if they would like to see it once again, like always, just hit the 'REPEAT' button.

Now we go to more interactive segment that is trial session. Here, users participation is a must! Firstly they have to click at 'TRIAL' button, this will activated the 3D models icon that been display beside the demonstration screen. Then, they got to select the specific icon that will represent the actual 3D model at the demonstration screen. Now they can start their testing program. Actually this program is to see how those joints (a part that bonds the bones together) are functioning. Users can try to move the bone by click at the selected bone then hold while drag it to the desirable way. If they move it to the right way as how it was able to move, depends on it function, then it will follow the cursor movement. If not, it just will stand static. To try other part, users only have to choose them at the icon group.

If users want to quit or exit from this page, they got to go to the previous page because only that page contains 'EXIT' button. 'BACK' button will bring them to the previous page. From this page (description's page) users can made their decision either still want to continue the exploration or just leave the online multimedia show.

1.7: Expected Outcome and Conclusion

Same as any of project developer, my goal is to develop a system that will fulfill users need. Before I develop this system I have made a survey to see users' requirements for system like this.

Most of them require a web site that provides a richness of important data and have interesting features to entertain them while they're trying to digest every single information written.

My system is built definitely based on users' requirements. This web site will serve its users with a vivid visualization of human skeletal system, which are interactive. And these models are standing and displaying in a virtual reality environment page. Users will be guided on how to navigate through this page via human voice that will read the commands.

The contents of this web site covered about bone descriptions and functions of joints that bond the bones to each other. And the information is delivered through two methods, which are text display and audio playing. Users can chose either way.

In order to make people learn more about human skeletal system, in the program design I have fixed a program that will only go to the more interactive page by digging more information on the subject.

Users must experience a virtual reality web site that will teach them about human skeletal system. Beside medical static data users also can be entertain with dynamic growth of computer graphic technology.

What I can summarized from the expected outcome are:

1. This system using new approach of delivering information that is via virtual reality world.
2. The main purpose of this system is to help medical students understand the complex structure of human skeletal system.
3. The goal that developer has to achieve through this project is to deliver an information like been required by the users with a complimentary elements in order to give them an opportunity to take a fully advantage from this system.
4. This system covers about the human skeletal structure and functions with a help of creative multimedia elements. It has an equal integration of three aspects that are user interface design, contents and interactivity.
5. This system hopefully can contribute to the development of computer graphic technology in local scene.

SYSTEM IMPLEMENTATION

5.1 : INTRODUCTION

Mainly this website focused more on the end user side, that is the interface. It is important to carefully distributed the information into the interface and integrate it with the suitable multimedia elements.

As a whole this website contains 5 layers and they are greeting page, introduction to bones page, linking page, description page and demonstration page.

Beside designing the interface, every functionality included in the website had to be planned wisely to prevent system from being a mess.

Here I will explain the implementation process layer by layer, starting with greeting page.

5.1.1: Greeting Page

Mainly, the entire pages are developed using html. But in every page I embed a flash or VRML file. Like the greeting page I embed a flash movie to welcomed users to the website. I don't like a static page so I create a simple animation using flash to make the page looks alive. The movies merged two scenes because one of the scene I create using a third party software of flash that is Swish. I also include sounds to add realism to the web page. Here is the flash animation stage where I create the animation.

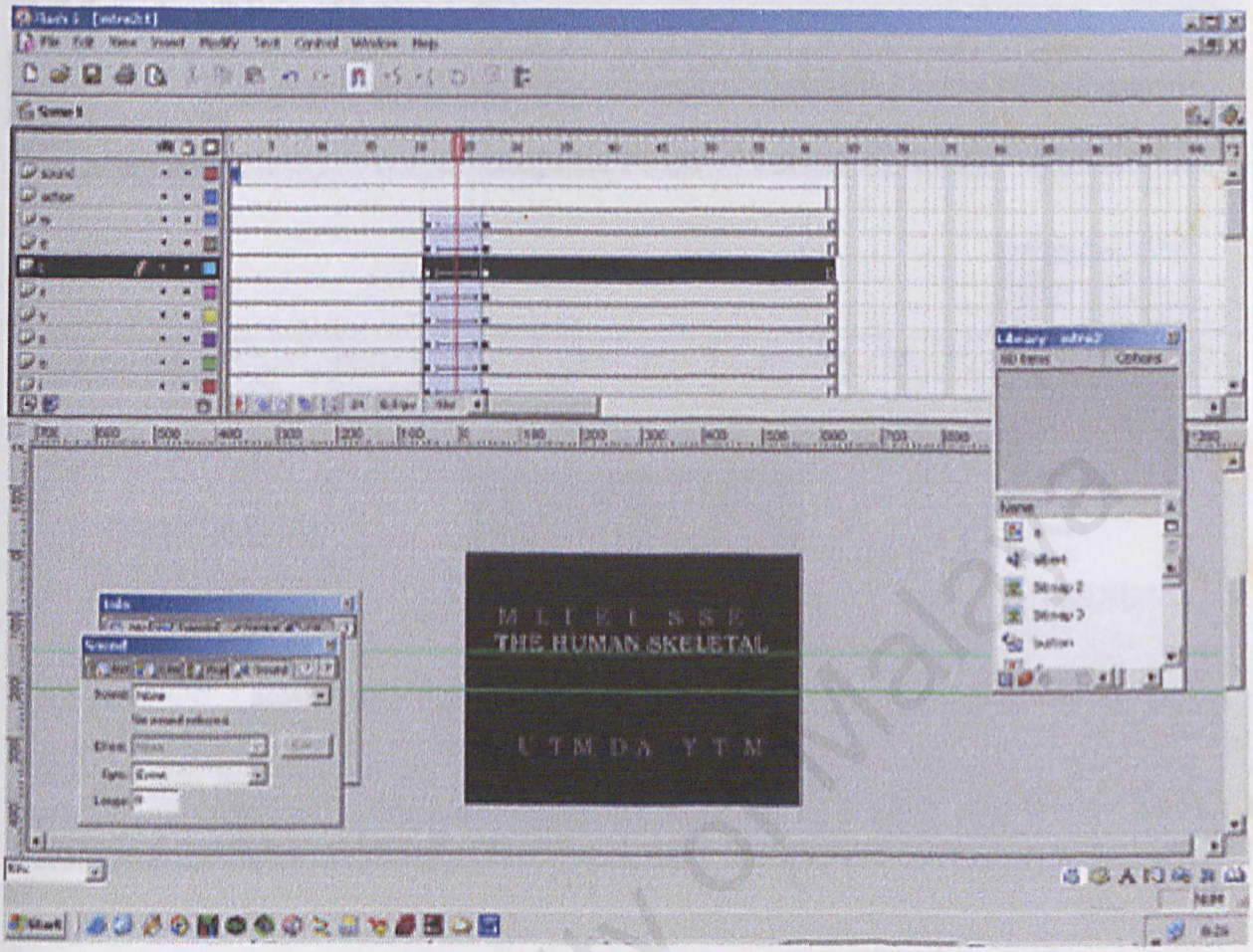


Figure 5.1: First scene presenting words ' The Human Skeletal Multimedia System'

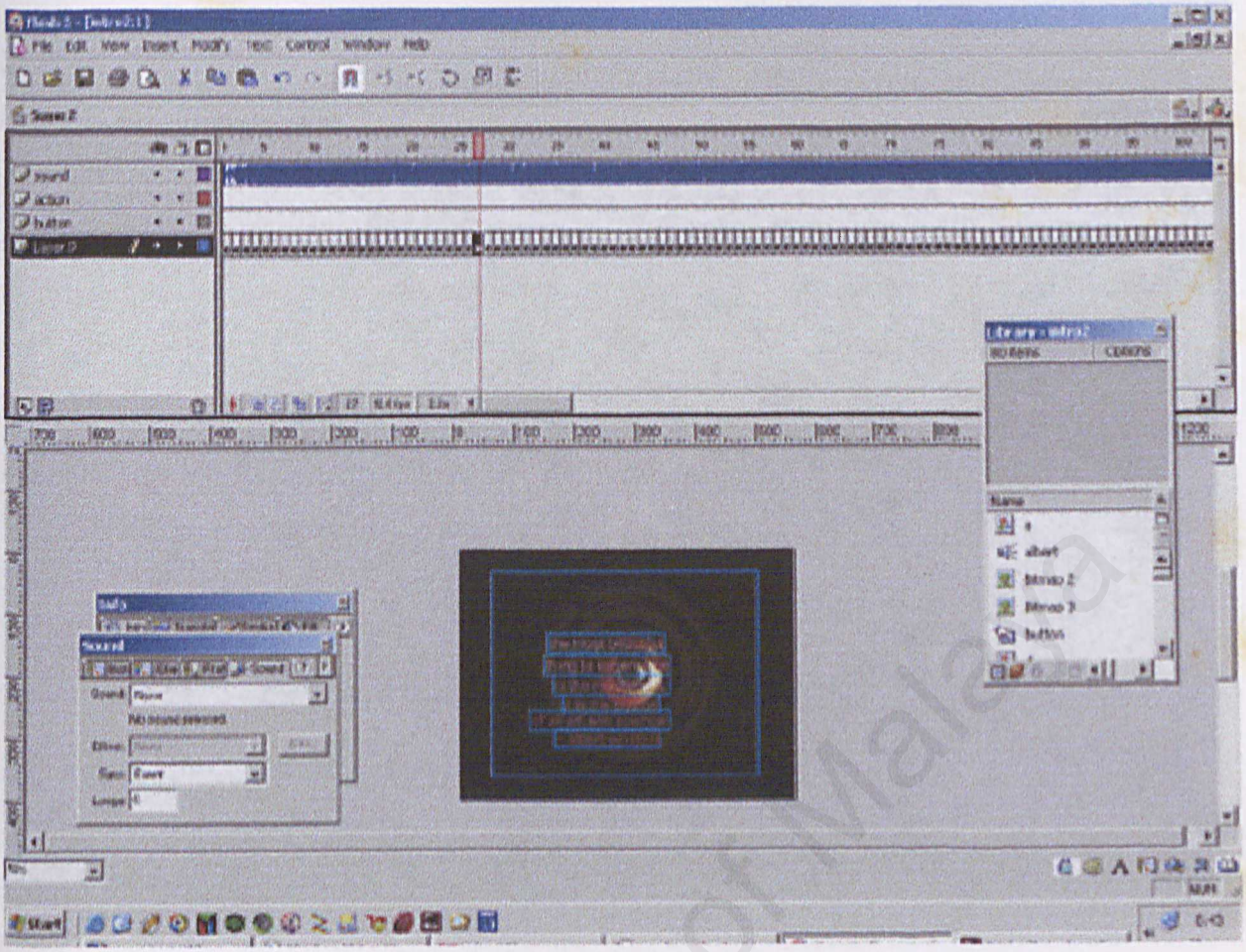


Figure 5.2: Second scenes that shows a quote from Albert Einstein and eyes that will bring user to the second page.

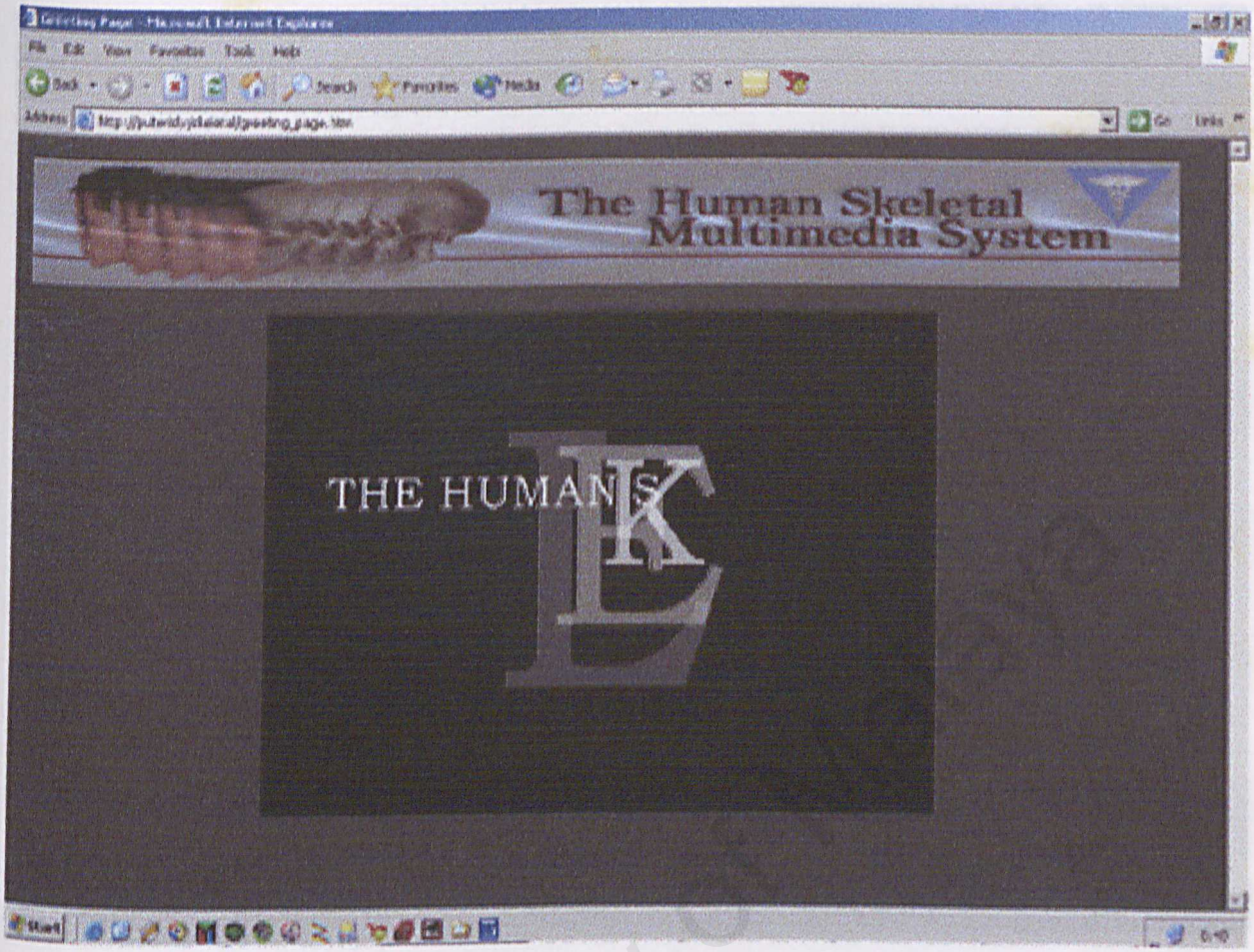


Figure 5.3: The first scene of the flash movie

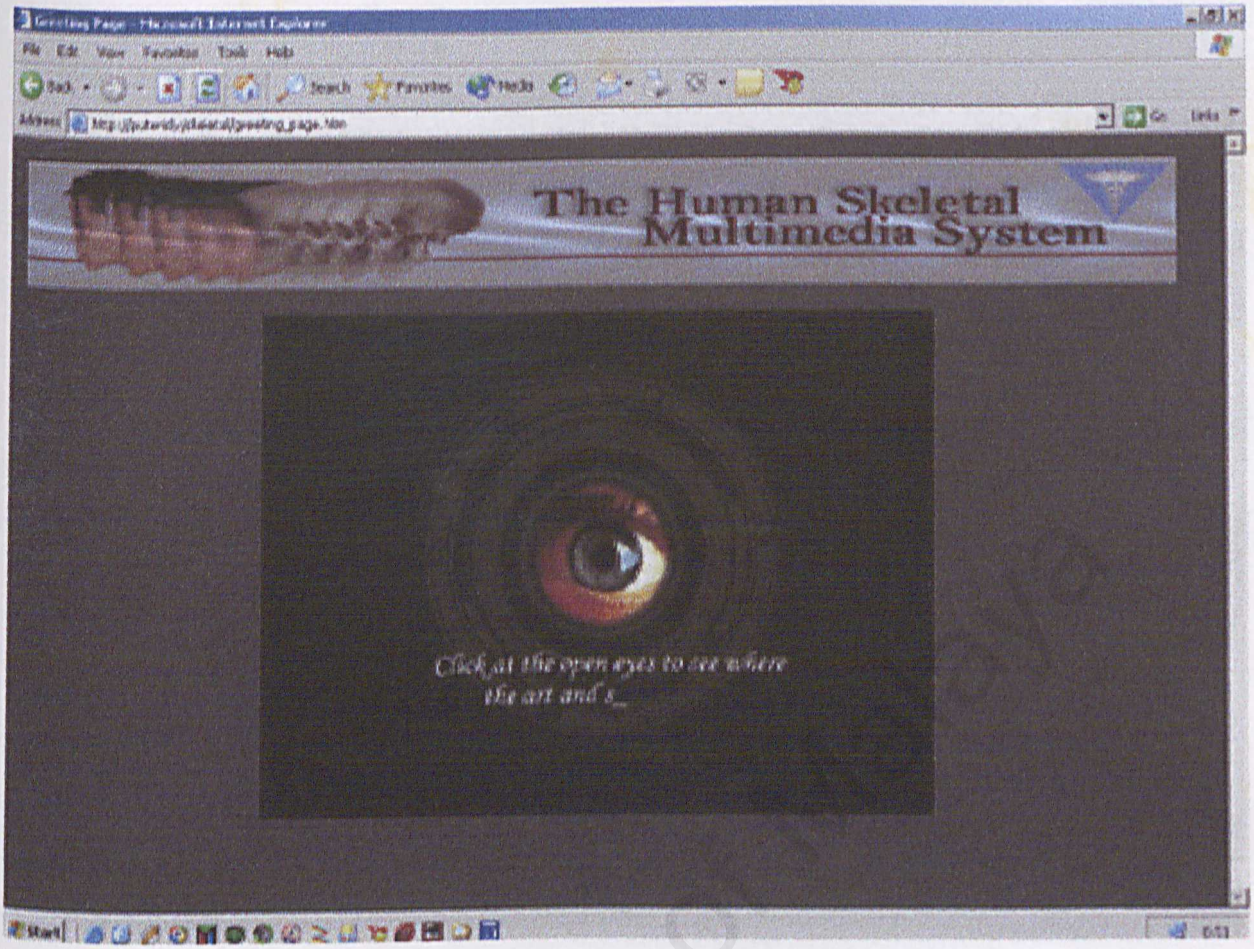


Figure 5.4: The second scene of the flash movie

5.1.2: Introduction to bones

This page also contains flash movie, basically it is a 4 minutes movie that presented the types of bones and its characteristics. It includes sounds and at the end of this movie there is a 3d model that render and click able when it stops. A command via human voice will tell what to do to go to the next page.

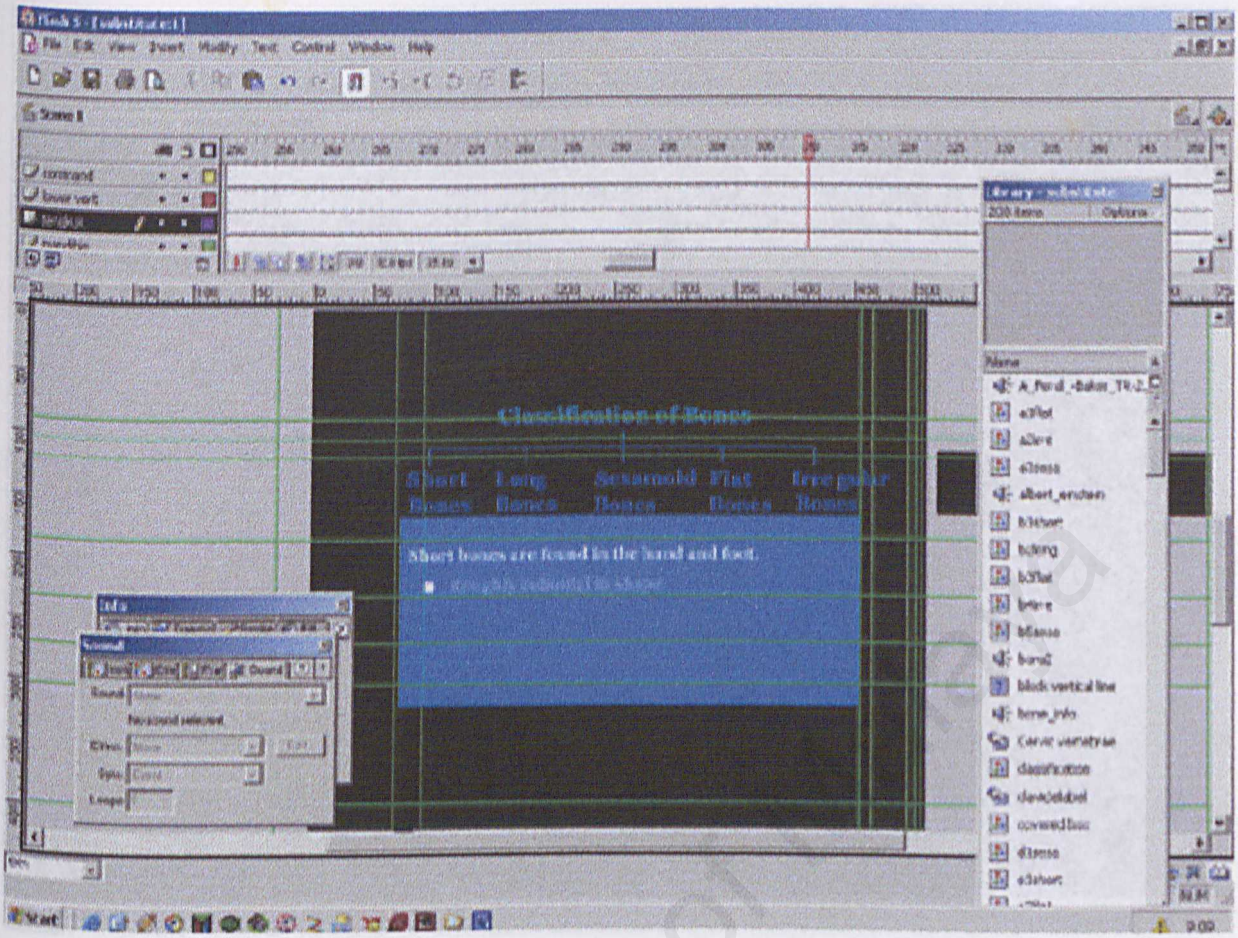


Figure 5.5: Flash movie stage where I create the scene.

The green lines act as a ruler so it makes thing easier to coordinate. This animation is 12 frame rate per second so one frame is 1/12 x 60 seconds. In order to synchronize it with the sound, I must first clarified the audio files duration and then calculate the total of frames that will fix the sounds duration.

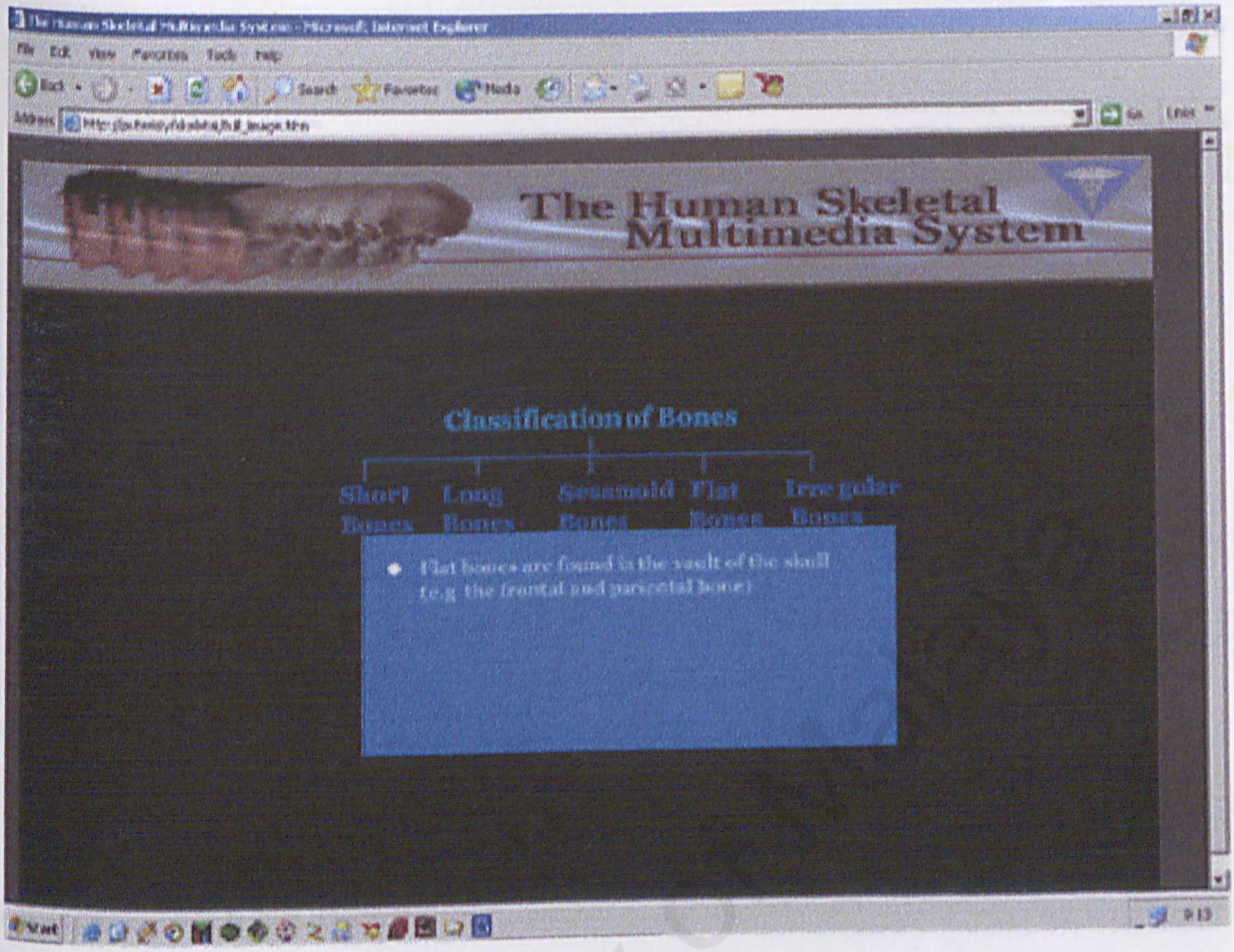


Figure 5.6: This is the interface of the Introduction to bone interface.

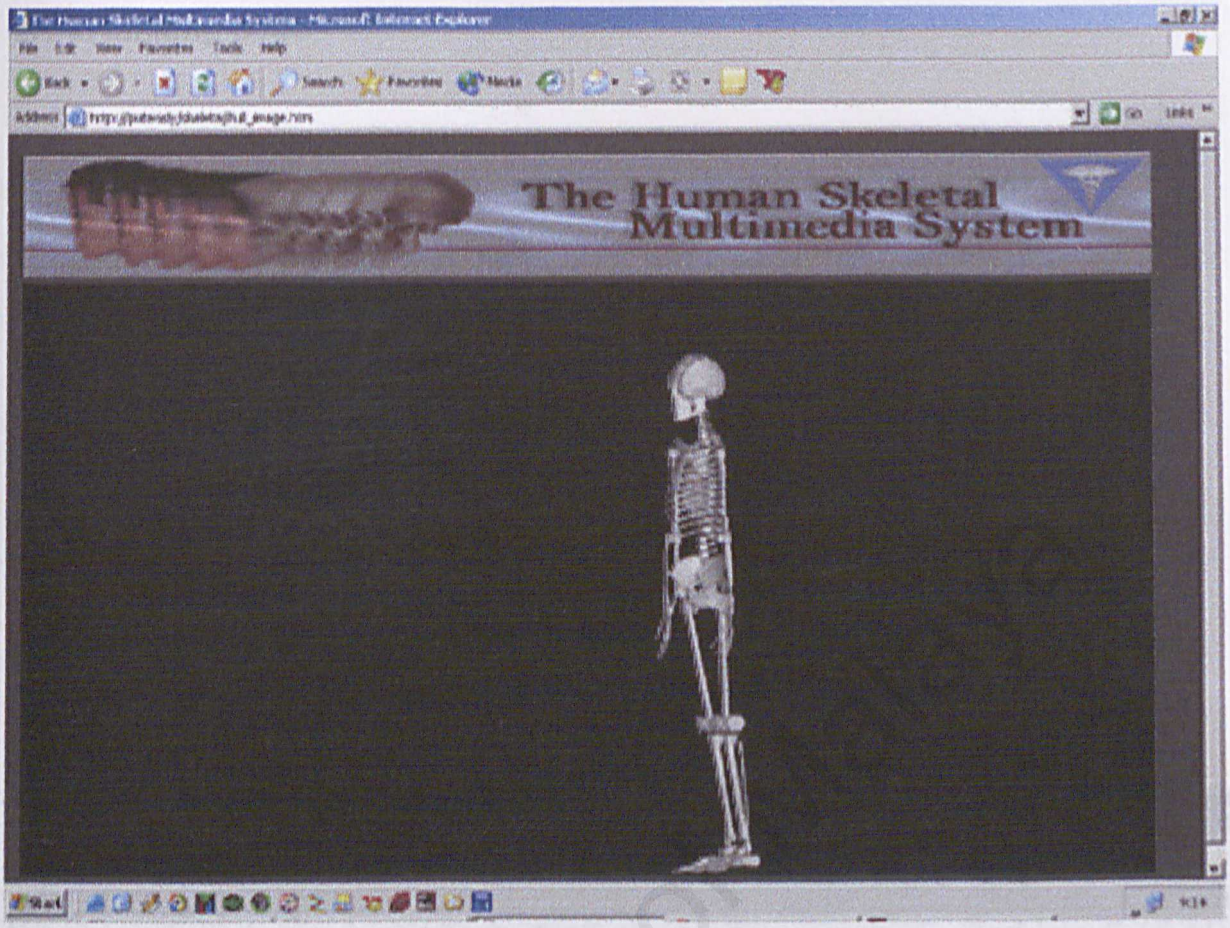


Figure 5.7: And this is the last scene of the movie where the 3d images are rendering and it will be click able when it stops.

5.1.3: Linking page

Linking page is an alternative for user to skip an introduction page and jump right to the linking page where they can chose any part of the skeleton they want for description. It just contains a 3D model of the human skeletal system that will render and click able when it stops. I do this page using flash. I can't import 3D files in either VRML97 format (.wrl) or 3D Studio Max format (.max), so I imported a series of jpeg files for the animation scene into flash. That is how user get the 3D model rendered in my flash movie. And beside the skeleton I put a button to go to the demonstration page.

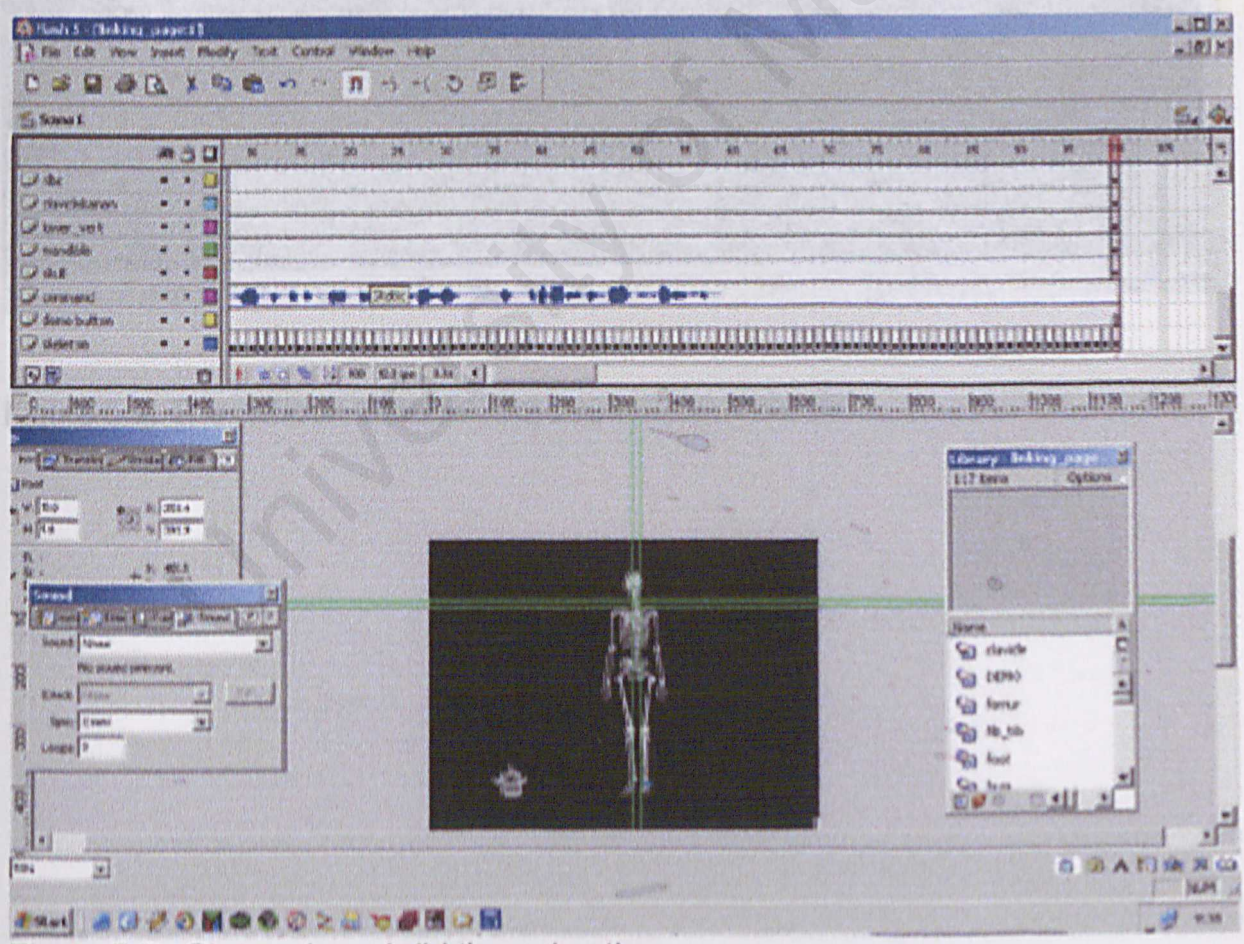


Figure 5.8: Stage where I did the animation

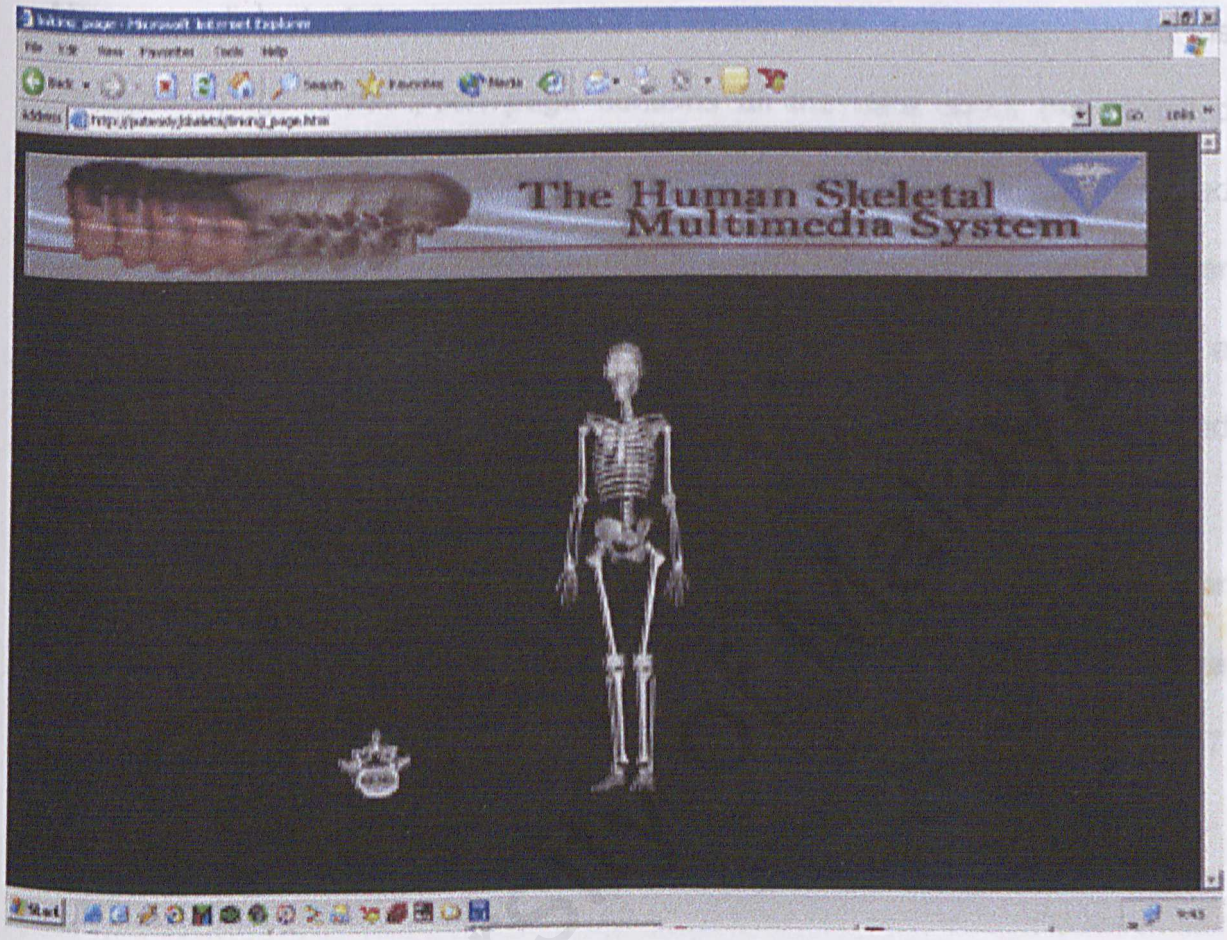


Figure 5.9: The outlook of my linking page in the web site.

5.1.4: Description page

After user clicked at the desired bone in *linking page* it will bring user to the description page. Description page contains all the data about the specified bones. The information is delivered using text and verbal info (the text was read by a human voice). Here I embedded the 3d model viewed by any VRML viewer that user has in their computer. Usually the VRML viewer allowed user to have a look around the model. The can lift it up, lift it down, twisting, turning it around and so on. I also provide user with the control panel for playing the audio files.

I labeled the bones using Spazz3D and the interface layout with Dreamweaver and all the 2D graphics is created and edited using Photoshop. Because of the 3D model was built using 3d Studio Max, I have to convert it first to VRML97 format then import it into Spazz3D for labeling and animating.

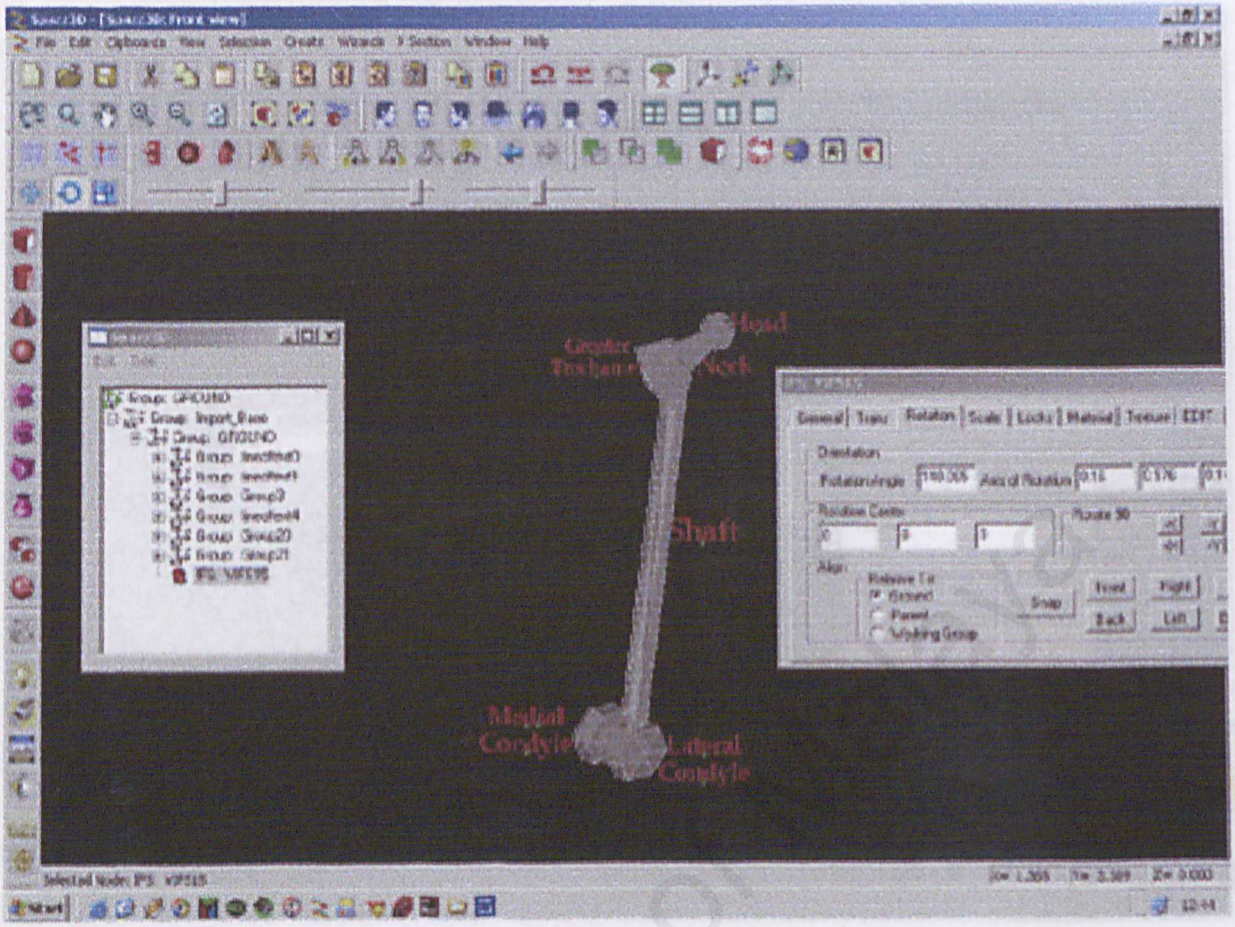


Figure 5.10: Spazz3D software that I used to label the bone.

There is a tree window that stated all the components used in the stage. And also a panel that showed the attributes of the components such as scale and coordinates.

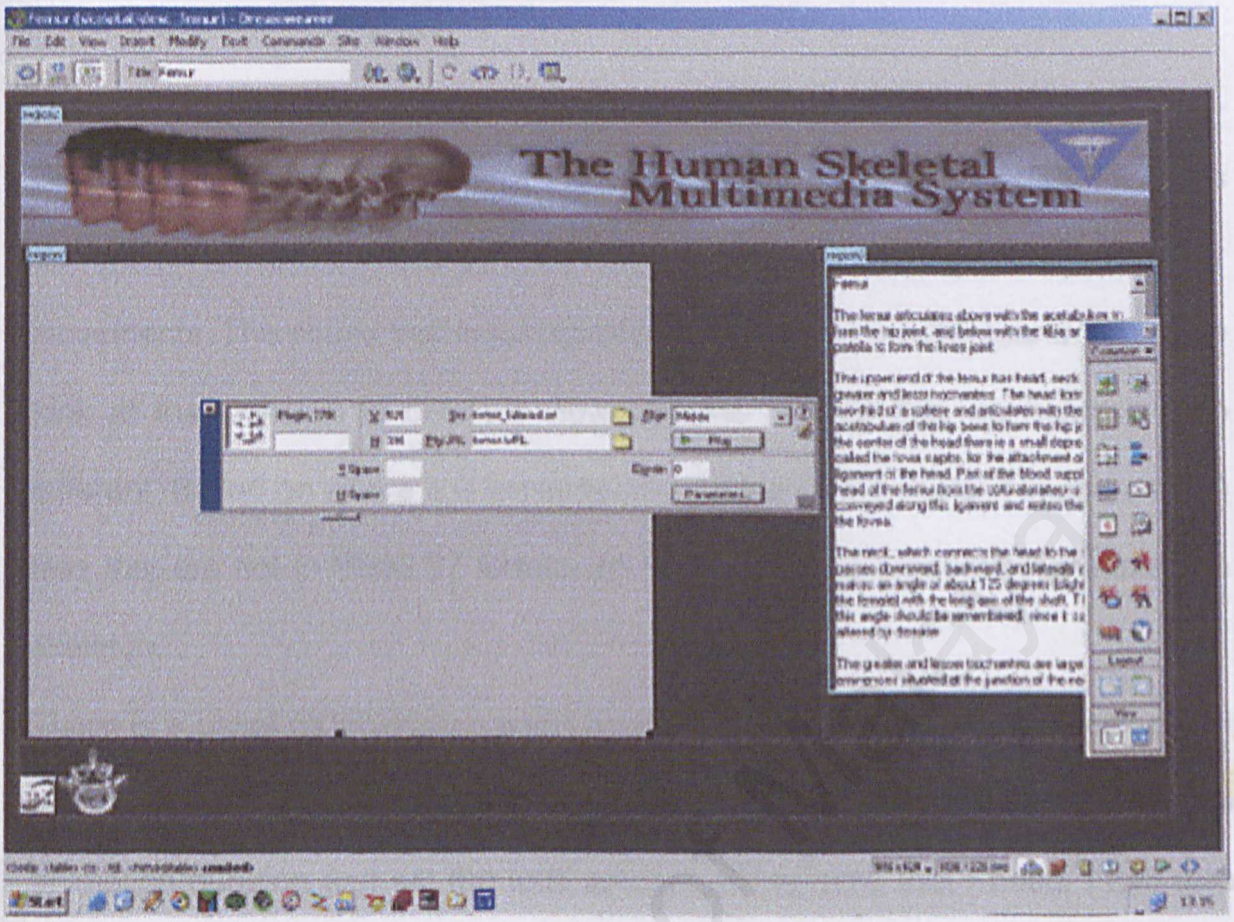


Figure 5.11; The layout of the interface can be seen in Dreamweaver stage. Coordination of the interface has to carefully arrange.

5.1.5: Demonstration page

Demonstration page showed how the entire system of the skeleton performed a movement. It is accompany with an audio files that explain about every movements. The sound that imported into the animation is a 3D sound. When we look at the skeleton in different view port the sounds that we heard is also different. Based on where it is implemented. Like above, I couldn't import any 3D files that are not in VRML97 format, so I did the same process to animate this skeleton.

There is a panel for animation and I have to add node; which is a specified part that I want to animate in the whole skeletal system. The next thing to do is set the animation duration and set the total amount of keyframe that I need. I can also set the frame rate for this animation so I could estimate how long does it takes to make one movement. Every transformation involved 3 axis and I have to considered several views to make sure that there is no part of bone that detached from the skeletal system.

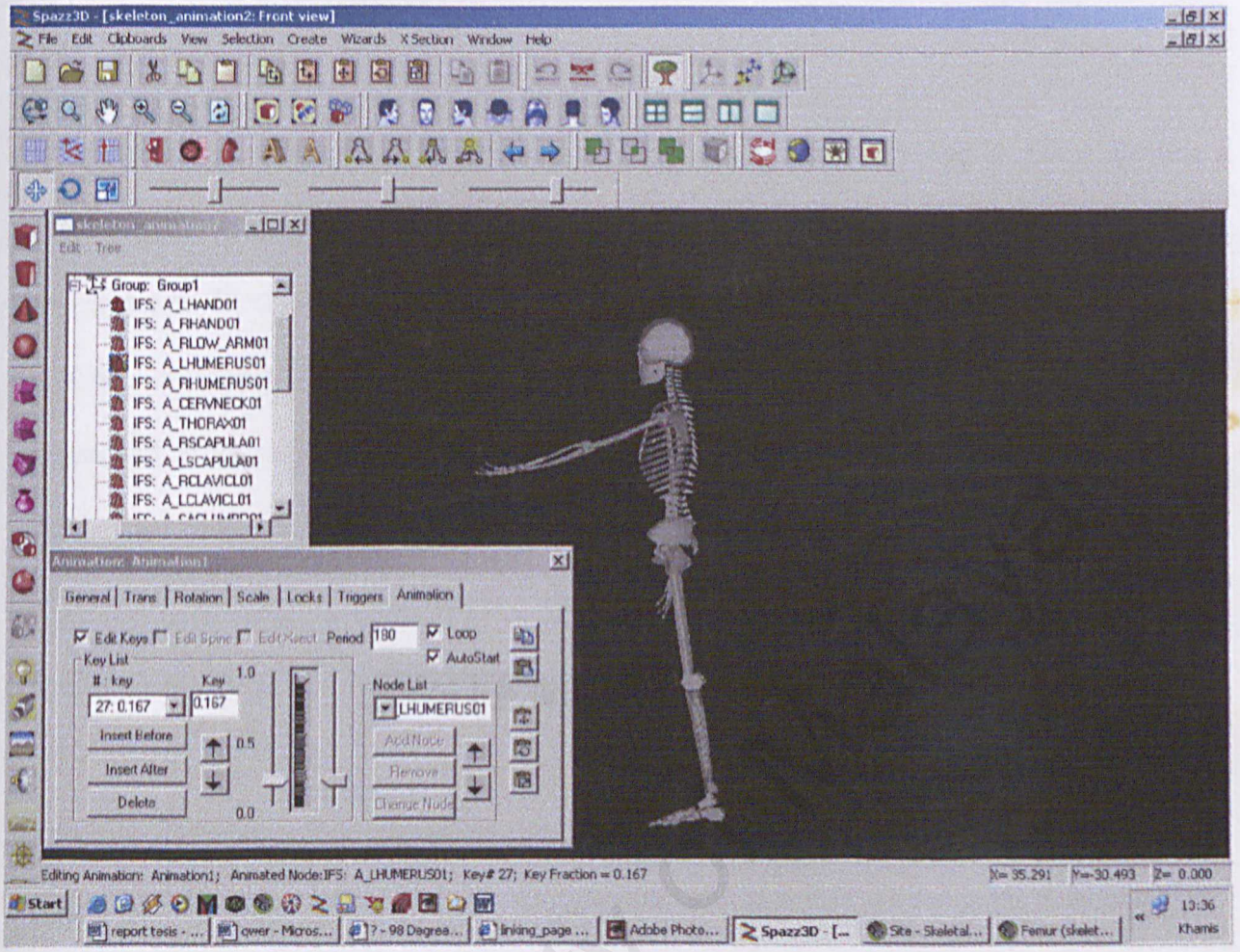


Figure 5.12: This is the animation in Spazz3D stage. I have to set it in the edit key mode to start creating animation.

SYSTEM TESTING

6.0: INTRODUCTION

In developing a system, testing usually involves several stages. First, each program component is tested on its own, isolated from the other components in the system. Such, testing, known as module testing, component testing or unit testing, verifies that the component functions properly with the types of input expected from studying the component's design. Unit testing is done in a controlled environment whenever possible, so the test team can feed a predetermined set of data to the component being tested and observe what output actions and data are produced.

When collections of components have been unit tested, the next step is ensuring that the interfaces among the components are defined and handled properly. Integration testing is the process of verifying that the system components work together as described in the system and program design specifications.

Once we are sure that information is passed among components is accordance with the design, we test the system to assure that it has a desired functionality. A function test evaluates the system to determine if the functions described by the requirements specification are actually performed by the integrated system. The result is a functioning system.

Recall that the requirements were documented in two-ways: first in the user's terminology and again as a set of software and hardware requirements I could use. The function test compares the system with the remainder of these software and hardware requirements. When the test is performed successfully in user's working environment, it yields a validated system.

When the performance test is complete, I am certain that the system functions according to my understanding of the system description.

An acceptance test, is where the system was checked against the user's requirements description. Upon completion of acceptance testing, the accepted testing is installed in the environment in which it will be used; a final installation test is run to make sure that the system is still function like it should.

6.1: UNIT TESTING

In this level test, usually programmer will examine the code of the module or unit. But in my system, I don't need to do any amendment directly to the scripting. Because of the complexity of the scripting that involves VRML (Virtual Reality Modeling Language) I decided to use an authoring tool to help me create the desired modules. Among the main tools that I used are 3D Studio Max, Spazz3d, Soundforge, Macromedia Dreamweaver and Macromedia Flash.

I divided the system into several units like 3D files, flash files, .wav files and an integrated file for each page that combined those files. All the models of the bones are created using 3D Studio Max with a reference to an anatomy books and pictures of bones in the internet. I have to ensure the measurement is accurate and the scale is consistent for every bone. This is important in the merging process, where all the bones will be connected to each other to form the fully human skeletal system. . I'll make sure that the model looks as close as it can be to the real bone. However, with a limited time and experience I should be satisfied with the final result of the bones even though it does not reach my expectation.

As for the flash animation, it also requires an accurate duration of the movement and the other imported files that will be used to add up the effects. Usually an audio file (.wav) will be imported into flash to add the realism and make it more

interesting. But, the command problem that will occur in this process is the insynchronization between animation and sounds.

3D animation that I embedded in the website is created using Spazz3D. Actually the model was made using 3D Studio Max before it been converted into vrml97 format (.wrl). Then it will be imported into Spazz3D , where the animation process will take place. 3D animation is a lot difficult compared to the 2D animation. It has three axis that should be taken care of whenever I want to make any transformation. So, I have to considered several views of the scene before move on to the new keyframe to start new movement. Without a keen look for the scene, there is a possibility that user will find a detachment between parts of the bones.

Verbal information is included in the website in case user preferred to listen to the information instead of reading. In order to achieve the objective of the project, that is to create a user friendly web site, I embed an audio player controller. It will enable user to have a fully control over the verbal information. Here, I have to make sure that the entire .wav file is using the same tone and rhythms, and this can be done with the help of SoundForge.

6.2: INTEGRATION TESTING

When I was satisfied that the individual components are working correctly and meet the objectives, I combine them into a working system. This integration is planned and coordinated so that when a failure occurs, we have some idea of what caused it. I used Bottom-up integration strategy to check why and how components are combined to test the working system. This strategy affects not only the integration timing but also the thoroughness of the system. The system is viewed as a hierarchy of components, where each component belongs to a layer of the design.

One popular approach that I used for merging components to test a system is called bottom-up-testing. Within this method, each component at the lowest level of the system hierarchy is tested individually first. Then, the next components to be tested are those that call the previously tested ones. This approach is followed repeatedly until all components are included in the testing. This method is useful when many of the low-level components are general-purpose utility routines that are invoked often by others.

Here is a diagram to show the bottom-up integration testing method that I used in my web site.

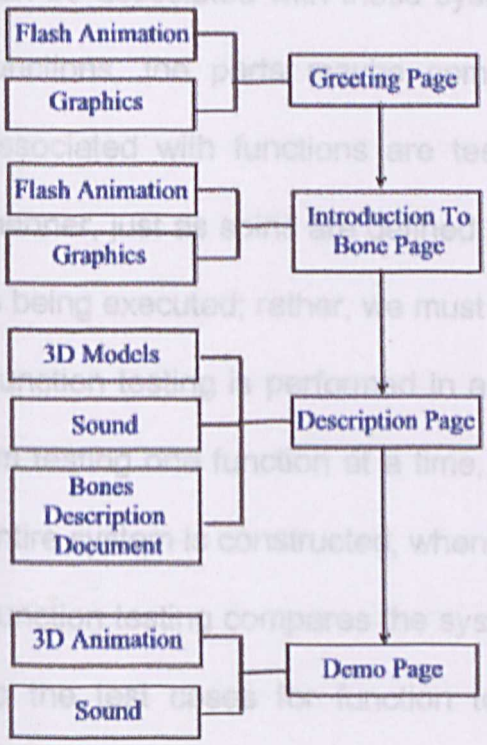


Figure 6.1 : Bottom-up strategy in integration testing in my system.

6.2: FUNCTION TESTING

Function testing is based on the system's functional requirements. Each function can be associated with those system components that accomplish it. For some functions, the parts maybe comprise the entire system, the set of actions associated with functions are tested. Functions may be defined in a nested manner, just as spins are defined in levels. We need not know which component is being executed; rather, we must know what the system is supposed to do.

Function testing is performed in a carefully controlled situation. Moreover, since I'm testing one function at a time, testing function can actually begin before the entire system is constructed, when it need be.

Function testing compares the system's actual performance with it requirements, so the test cases for function testing are developed from the requirements document.

Below are the functions in my website that have to be tested;

1. Navigation button
2. 3D models that should be click able by users.
3. 3d models can be viewed in the plug-in screen (VRML viewer) in its best performance.
4. Scroll bar
5. Embedded audio player control panel.
6. Animation running smoothly in the plug-in screen.
7. Flash movie contains the appropriate information and the animation is synchronizes with the sound.

6.3: PERFORMANCE TESTING

Once I have determined that the system performs the functions required by the requirements, I turn to the way in which those functions are performed. Thus, the functional addresses the functional requirements, and performance testing addresses the nonfunctional requirements.

System performance against the performance objectives set by users (as I surveyed before the system was proposed). For example, function testing may have demonstrated how the skeletal system performed a movement. Performance testing, on the other hand, examines how well the animation was presented, is it animated smoothly? Is the movement synchronizing with the explanations presented using audio streaming?

So, briefly, here are the issues that I considered when I'm doing performance testing.

- How long does it takes for a page to download my 3d models.
- The information that presented using flash movie is well organized and the duration for every point is long enough that users do not have just a glance on them.
- Is the 3D animation running smoothly or does the sound will conflict with the animation?
- Analyzed the system and specified the computer configuration that will best viewed the system

6.4: ACCEPTANCE TESTING

When the function and performance testing are complete, I am convinced that the system meets all the requirements specified during the initial stages of software development. The next step is to assure that the system meets the user requirements.

Since I don't have a real 'user' that will evaluate the system I made, so, I put myself as a user. I will make sure the friendliness of the system, which is the interface, is in the maximum level.

Contains check is performed to assure the richness of data that I promised to the users are available in the web site. I clarified the data included in the website with the requirements documentation that I made before the system was built.

6.5: INSTALLATION TESTING

The final round of testing involves installing the system at the user sites. As I'm using an Windows 98 operating system that included IIS in its system, I can make my computer as a server. All I need to do is throw in all my files in a folder in the server's folder. Then I address the path of the folder (that contains all my files) with the folder name.

To view my web page all I need to do is open the browser and type the folder name followed by the first page's file name.

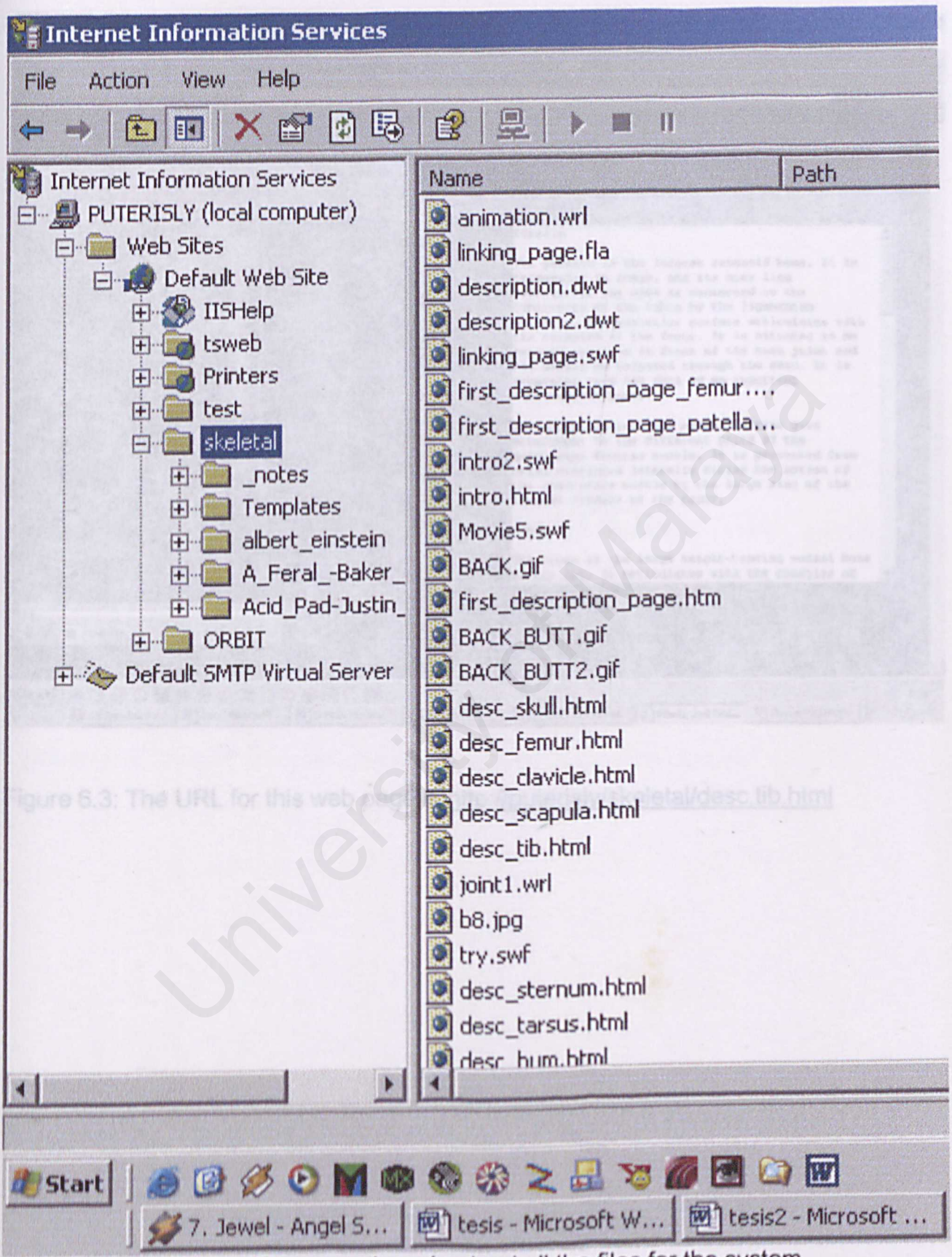


Figure 6.2: This is the IIS server where I upload all the files for the system.

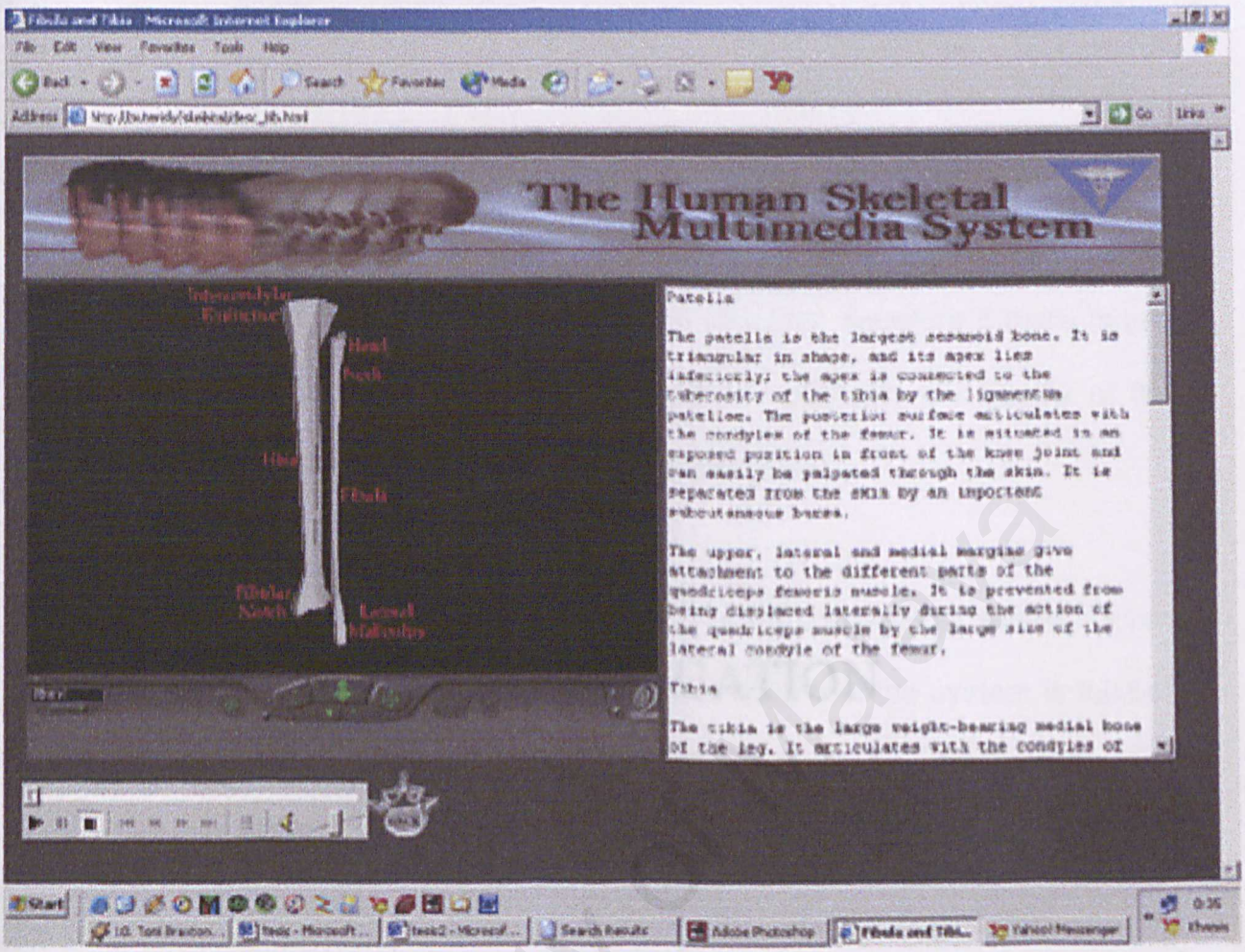


Figure 6.3: The URL for this web page is http://puterisly/skeletal/desc.tib.html

SYSTEM EVALUATION

7.0: INTRODUCTION

The evaluation process is where the whole project is analyzed from the implementation process until the presentation of the final product. It is important for me to know the level of each development process, therefore if there is any enhancement that should be done later on, I can evaluate the quality of the system. This will prevent the regression of the old system.

It is also important to know an opinion from users toward the system. Even though I have do an acceptance testing to make sure that the system is fulfilled the system requirement, however sometimes maybe I can do a little amendment to improve the quality of the system as long as it won't bring a major different from the proposed system. I had a several opinion from a public users on my system and some of them are good and can be apply to the system.

7.1: PROBLEM ENCOUNTERS AND SOLUTIONS

Developing this system gave me an experience on handling a large number of tasks in hand. I have to carefully manage the task and be responsible for every consequence occurred along the way. With a minimal experience there must be a few problems that should be overcome wisely.

7.1.1: Lack of experience

To develop this system I used many new softwares that I never touch or heard of it before. They are 3D Studio Max, Spazz3D and SoundForge.

3D Studio Max offers a lot of simplicity in creating a complex 3D model. However, the software its own is a complex authoring tool and it requires a lot of understanding and practice. With a limitation of time and the pressure to finish modeled the skeleton as soon as possible maybe the main reason for the model to look quite plain.

As for *Spazz3D* I used it for animating the skeleton, as it is easier to create it than using 3D Studio Max. Spazz3D is a VRML authoring tool and it implements every feature that VRML offers. However there is still a lot of confusion to use the software. But worse come to worst, I am not able to create a link between the skeleton page with other page in the web site. Thus, I have to find another alternative to make the model interactive with users. Spazz3D also don't have any controller over the audio files.

The tutorial given was incomplete and there is only a few tutorial and tips in using Spazz3D.

Sound Forge is a new software that is powerful and really help in editing audio files. However, this is my first time using Sound Forge and it takes time to figure out the right way handling the entire button on its interface. More over, there is a jargon that officially used in sound that I am not familiar with.

7.1.2: Hardware limitation

The software I used is varying, and sometimes there is incompatibility between them. For example, to animate 3d model that I create in 3D Studio Max it has to be converted into VRML97 format before import into Spazz3D.

And to develop a project like this it requires a fast processor, as it has to process a 3D object and with several software running in one time. Slow processor will delay the designing process and sometimes the computer will hang.

7.1.3: Heavy load of data

This website revealed the inner part of human body that is human skeletal system. Working with anatomy system is never going to be easy with a lot

of details and medic term that I don't understand. Assembling and arranging the data according to the specified part is very challenging.

7.1.4: Solution

Solution is like a magic that amazed myself or a cure of disease that released me from a great pressure and depression. Whenever the problems occurred I will always referred to book, internet or friends. The simplest way of course the direct explanation or guide from friends but it happened that sometimes they know too little. Then, it makes me had to dig it up from internet and books.

Usually for my limitation of mastery and experience in 3D Studio Max, I will search for tips in the internet. There are a lot of tips that suit the requirements but some have to be modified.

A few of the problems can't be solved; it needs new approach to handle it. For example, I can't make a link from the skeleton model page to the other page using Spazz3D. Without this feature, user can't navigate through the other page because it was in the main page. As a solution I made up an animation by flash that imported 3d skeleton. Actually it is not a real 3D image, it just a series of static image (.jpeg) in a series.

In order to handle a bundle of data with medic terms I have to refer to many anatomy books. Because of my unfamiliarity with the medic terms I used the text-

to-speech machine that is available in the internet for the right pronunciation. This is important because I have to record the description of the bone.

7.2: EVALUATION BY END USERS

After I have finished developing the system I was looking forward for an opinion from users. I showed the website to some of my friends and listen for their comments about the system. Most of them like my works, and quite impressive with the 3d model and the animation.

The interface is user friendly and they have no problem navigating through the web site. The information deliverable is well presented using two methods that are text and verbal info. Some of them preferred someone reading the text.

They also like the 3D animation because usually there's only 2D animation that available in net. Furthermore, it is pretty entertaining to see the skeleton moving his body like a dancing man.

I also pick a few comments from users on how to make the system looks better and more interactive. I really appreciate their suggestion and I even do an amendment to the website due to their comments. It is such a waste to ignore a good advice.

7.3: SYSTEM CONSTRAINT

No system can be called as a perfect system, which is why Microsoft has a several versions of Windows. It's no different with my system; there are a few constraints that limit the flexibility of the system.

The entire 3D images are simulated using VRML, so it requires a VRML viewer. There are a lot of VRML viewers that available in the internet and can be free downloaded. It just users have to make sure that they have VRML viewer to see my 3D skeleton.

This webpage is best viewed in 1024 x 768 pixels resolution. So if the users have less than the required resolution they will need to scroll the page up and down. This will affect the looks of the interface design because users can't have the full view of this page.

It also requires a high speed of processor and virtual memory because it will take a while for the system to download the page that contained 3d model. It also will probably caused the insynchronization between the animation and sounds.

7.4: FUTURE ENHANCEMENT

Overall I am satisfied with the system and I think this is the best final product that I can come out with. But, if I have an extra time I would like to make it more interactive with users, especially at the demonstration page. At this time being, users can only watch the skeleton performed its movement and listen to the explanations read via human voice.

Users don't have a control over the animation at all. So, I hope that I can create a control panel for the demo page. Thus, there will be a dual communication between users and the system.

I also think of putting a lot more extra information about the bones. Maybe link it to a new page that has radio button contains a link for certain issue of the bones. Therefore, users can get the more details description on each part of the skeleton.

7.5: KNOWLEDGE AND EXPERIENCE GAINED

Throughout this project I learned about design concept, new software that available in the internet in trial version that I used to help me creating the web page. I am also learned the important concept of spreading the knowledge in the internet to others. There are a lot of nice computer genius share and teach beginners with tips and forum in the internet. It is a pleasure misery where the total stranger give a hand to a totally another stranger in a name of contributing to the growth of computer technology. This is like a virtual welfare and investment to the future technology.

As the contain is about the human skeletal system which is totally different from the subject I learned in IT school of course in taught me a lot about human skeletal anatomy and indirectly the human anatomy system. It makes me wonder how the doctors remember all parts of human body; in and out.

I also learned the main concept of developing 3d model and have been well trained with the whole hard works that I commit in developing this project. It's not easy to build something that seems so simple and beautiful There is always the complexity in every simplicity.

APPENDIX

USER MANUAL

Hardware requirement

Component	Description
Platform	Windows NT 4.0 or greater
Memory	128 Mb RAM
Processor	Intel II 400MHz
Monitor	24 bit, 15" VGA
Sound Card	Sound Blaster
Display Card	GeForce 3 MX 128 bit
Browser	Internet Explorer and Cosmo Player
Best viewed resolution	1024 x 768 pixels

Figure 3.4: Minimal hardware specification for user

How to navigate through the page

1. To make it available online, put all the files in a folder in the IIS or PWS of the computer. Clarify the URL of the page with the folder path. Enable the server.
2. Make sure that you have VRML viewer installed in the computer otherwise you can't see any 3d image. To download the vrml viewer you can go to this website www.cosmoware.com.
3. Open internet browser and type the URL specified earlier followed by this file ../greeting_page.htm. This will open the first page of the website.

4. From the first page a text of command will appear to ask you to click at the open eyes and then it will bring you to the Introduction to the bones page.
5. Introduction of the bones is a flash movie page, so you need to wait until the end of the show. At the end of the show, a read command will ask you to wait until the 3d model finish rendering and then you can click at any part of the skeleton to seek for further description of the bone. This will bring you to the description page of the bones.
6. At the description page you will find a 3d image of the skeleton in vrml viewer screen. Next to the model is a text describe on the selected bone. If you want to hear the audio files just click button play at the audio control panel at the bottom of the page. Beside the audio control panel is a button to go to the linking page.
7. Linking page is a last scene of Introduction to bone page. It has a fully human skeletal system model and is click able at any part of its body. This will bring you to the description page of the selected bone.
8. Beside the full human skeletal system model in the linking page, there is a vertebrae button written on it 'DEMO'. If you click at this button it will bring you to the demonstration page. Here is where the 3D animation took part. You can see how the skeleton performed a move and it is accompany with an explanation read via human voice. Unfortunately, you don't have any control over this animation.

9. To go back to the linking page you just have to click vertebrae button written 'BACK' at the surface and it will bring you back to the linking page.

CODING

Coding for 3D skeleton

Name of the bone : Radius/Ulna

Medium for simulation : Virtual reality Modeling Language

Software used to create it : 3D Studio Max

```
#VRML V2.0 utf8
WorldInfo {
 title "Spazz3D"
 info [
  "This VRML World was created with Spazz3D, a VRML 97 authoring tool"
  "www.spazz3d.com"
 ]
}
DEF dad_GROUND Transform {
 children [
  DEF GROUND Group {
   children [
    DEF dad_Import_Base Transform {
     translation 9.636 -5.766 -17.073
     scale 1.2 1.2 1.2
     children [
      DEF Import_Base Group {
```

```
# Produced by 3D Studio MAX VRML97 exporter, Version 3.01, Revision 0 MAX
File: lengan_bawah.max, Date: Thu Jan 03 12:44:22 2002
      children [
       DEF dad_VIFS03 Transform {
        translation -0.01413 -0.7471 -0.2837
        rotation 0.986 0.164 0.013 0.159
        children [
         DEF VIFS03 Shape {
          appearance Appearance {
           material DEF material0_mat Material {
            ambientIntensity 0.160
            shininess 0.066
            diffuseColor 0.8 0.8 0.8
            emissiveColor 0.0 0.0 0.0
            specularColor 0.0 0.0 0.0
           }
          }
          geometry IndexedFaceSet {
           solid TRUE
           creaseAngle 0.524
           coord Coordinate {
            point [
             -9.50000 11.02000 1.96200
```

-10.58000 1.07600 2.17200

-10.53000 2.54800 2.17200

-11.08000 -0.14730 2.34200

-11.37000 0.55260 2.36200

-11.29000 -0.32730 2.33200

-10.97000 -0.12730 2.34200

-10.65000 -0.04735 2.35200

-10.39000 -0.08735 2.34200

-10.53000 -0.06735 2.35200

-10.21000 -0.12730 2.34200

-10.03000 0.65260 2.37200

-10.10000 -0.19730 2.34200

-9.95000 -0.30740 2.34200

-9.96000 -0.16730 2.25200

-9.97000 -0.02735 1.93200

-9.97000 -0.08735 2.08200

-9.97000 -0.11730 1.74200

-9.97000 -0.10730 1.76200

-9.96000 -0.16730 1.62200

-10.03000 0.65260 1.55200

-9.95000 -0.29730 1.52200

-10.65000 -0.02735 1.52200

-10.77000 -0.06735 1.52200

-9.93000 -0.21740 1.83200

-9.89000 -0.05735 1.77200

-9.93000 -0.21740 1.80200

-9.93000 -0.21740 1.59200

-9.83000 -0.26730 1.93200

-9.22000 1.70300 1.30200

-9.68000 -0.34740 1.91200

-9.57000 -0.41730 1.82200

-9.58000 -0.41730 1.58200

-9.22000 1.64300 1.05200

-9.57000 -0.41730 1.79200

-9.58000 -0.41730 1.55200

-9.72000 -0.33730 1.39200

-9.39000 1.61300 0.94240

-9.60000 -0.40740 1.52200

-9.85000 -0.23740 1.49200

-9.93000 -0.21740 1.55200

-9.60000 1.69300 1.09200

-9.76000 -0.32730 1.40200

-9.59000 1.77300 1.33200

-9.93000 -0.24730 1.56200

-9.76000 -0.31730 1.68200

-9.18000 4.01300 1.03200

-9.03000 4.12300 0.91240

-9.05000 5.41300 0.79240

-9.28000 3.79300 1.13200

-9.07000 6.03300 0.50240

-9.04000 4.16300 0.63240

-9.07000 6.14300 0.45240

-9.05000 5.83300 0.59240

-9.05000 5.65300 0.68240

-9.21000 4.03300 0.51240

-9.22000 5.45300 0.39240

-9.18000 5.63300 0.40240

-9.38000 4.06300 0.65240

-9.31000 4.60300 0.55240

-9.46000 3.71300 0.76240

-9.31000 4.70300 0.53240

-9.30000 4.84300 0.50240

-9.45000 3.63300 1.02200

-9.45000 4.07300 0.97240

-9.46000 4.07300 0.78240

-9.46000 4.07300 0.72240

-9.41000 4.06300 1.00200

-9.28000 4.02300 1.11200

-9.43000 4.06300 0.98240

```
 -9.43000 1.78300 1.46200
 -9.25000 4.02300 1.09200
]
}
coordIndex [
 0 1 2 -1
 1 3 4 -1
 1 4 2 -1
 3 5 6 -1
 3 6 4 -1
 5 7 8 -1
 5 8 6 -1
 7 9 8 -1
 0 2 10 -1
 2 4 11 -1
 2 11 10 -1
 4 6 12 -1
 4 12 11 -1
 6 8 13 -1
 6 13 12 -1
 8 9 13 -1
 0 10 14 -1
 10 11 15 -1
```

57 53 52 -1

58 59 60 -1

58 46 59 -1

55 59 56 -1

55 60 59 -1

61 44 62 -1

61 45 44 -1

61 62 59 -1

61 46 62 -1

60 55 57 -1

60 57 51 -1

60 51 63 -1

60 63 58 -1

43 58 42 -1

43 58 63 -1

43 63 48 -1

54 49 47 -1

54 47 48 -1

54 48 63 -1

54 63 51 -1

64 50 65 -1

64 65 66 -1

64 66 67 -1

111 103 109 -1

111 112 103 -1

112 111 113 -1

114 115 112 -1

116 117 112 -1

112 113 116 -1

118 119 120 -1

112 121 118 -1

112 118 120 -1

122 123 120 -1

124 125 120 -1

120 126 124 -1

127 97 96 -1

120 123 128 -1

120 128 127 -1

120 127 96 -1

100 101 129 -1

100 129 130 -1

100 130 102 -1

99 129 101 -1

98 131 129 -1

98 129 99 -1

95 131 98 -1

97 127 131 -1

97 131 95 -1

105 104 130 -1

105 130 106 -1

102 130 104 -1

107 108 132 -1

108 130 132 -1

108 106 130 -1

109 133 111 -1

133 109 110 -1

110 132 133 -1

110 107 132 -1

116 111 133 -1

116 113 111 -1

133 117 116 -1

133 114 117 -1

133 134 114 -1

134 115 114 -1

121 135 118 -1

134 121 115 -1

134 135 121 -1

135 119 118 -1

135 126 119 -1

153 177 158 -1

177 153 152 -1

161 179 156 -1

179 161 159 -1

179 154 156 -1

179 175 154 -1

157 154 175 -1

177 159 158 -1

177 179 159 -1

169 170 173 -1

168 180 150 -1

168 150 166 -1

167 180 168 -1

167 173 180 -1

167 169 173 -1

160 155 165 -1

160 165 164 -1

139 147 160 -1

145 155 143 -1

139 160 164 -1

145 165 155 -1

150 179 177 -1

150 180 179 -1

180 175 179 -1

180 173 175 -1

142 144 174 -1

148 178 149 -1

147 176 148 -1

147 150 176 -1

156 155 161 -1

158 160 147 -1

163 170 164 -1

168 166 139 -1

171 145 146 -1

141 166 150 -1

176 150 177 -1

170 162 173 -1

181 182 183 -1

181 183 184 -1

181 184 185 -1

186 187 188 -1

186 189 187 -1

190 186 188 -1

181 191 192 -1

181 192 182 -1

193 184 194 -1

208 229 212 -1

230 231 232 -1

230 233 231 -1

234 235 236 -1

234 231 235 -1

237 231 234 -1

238 231 237 -1

232 231 238 -1

235 239 240 -1

235 240 241 -1

235 241 236 -1

242 243 239 -1

239 244 242 -1

239 243 245 -1

239 245 246 -1

239 246 240 -1

244 247 248 -1

244 248 249 -1

244 249 250 -1

251 247 252 -1

248 247 253 -1

253 242 250 -1

253 230 242 -1

253 251 230 -1

243 242 230 -1

232 238 245 -1

232 245 243 -1

232 243 230 -1

234 236 240 -1

234 240 246 -1

234 246 237 -1

237 246 245 -1

237 245 238 -1

207 213 254 -1

209 207 254 -1

209 254 227 -1

254 213 231 -1

254 231 233 -1

213 217 235 -1

213 235 231 -1

217 221 239 -1

217 239 235 -1

221 225 244 -1

221 244 239 -1

225 227 247 -1

225 247 244 -1

227 254 233 -1

227 233 247 -1

242 244 250 -1

252 247 233 -1

253 247 251 -1

251 255 230 -1

240 236 241 -1

249 248 253 -1

250 249 253 -1

206 214 207 -1

228 225 224 -1

222 219 216 -1

210 223 211 -1

93 88 92 -1

93 92 84 -1

94 88 93 -1

85 93 84 -1

91 86 87 -1

90 91 87 -1

89 90 87 -1

86 93 85 -1

86 91 93 -1

91 94 93 -1

```
          91 90 94 -1
          90 88 94 -1
          90 89 88 -1
        ]
       }
      }
     ]
    }
   ]
  }
 ]
}
DEF dad_lineoftext0 Transform {
 translation 2.287 7.106 -13.908
 rotation 1.0 0.0 0.0 1.571
 scale 0.95 0.95 0.95
 children [
  DEF lineoftext0 Group {
   children [
    DEF dad_letter_O Transform {
     translation -2.29861 0.0 0.0
     children [
      DEF letter_O Group {
```

```
children [
 DEF dad_letter0 Transform {
  children [
   DEF letter0 Shape {
    appearance Appearance {
     material DEF Red_mat Material {
      ambientIntensity 0.200
      shininess 0.200
      diffuseColor 1.0 0.0 0.0
      emissiveColor 0.0 0.0 0.0
      specularColor 0.0 0.0 0.0
     }
    }
    geometry IndexedFaceSet {
     creaseAngle 0.524
     coord Coordinate {
      point [
       0.02778 0.0 -0.34744
       0.03882 0.0 -0.24585
       0.07194 0.0 -0.15636
       0.12413 0.0 -0.08293
       0.19238 0.0 -0.02951
       0.27591 0.0 0.00304
```

0.37391 0.0 0.01389

0.52805 0.0 -0.01375

0.65321 0.0 -0.09668

0.73622 0.0 -0.22073

0.76389 0.0 -0.37174

0.74004 0.0 -0.50917

0.66851 0.0 -0.61632

0.55499 0.0 -0.68533

0.40516 0.0 -0.70833

0.38325 0.0 -0.66667

0.45936 0.0 -0.65725

I couldn't give a full script because it takes about 353 pages. This is why I choosed 3D Studio Max to create the model.

Example coding for an interface.

Software used : Dreamweaver

```
<html>
<head>
<!-- #BeginEditable "doctitle" -->
<title>clavicle</title>
<!-- #EndEditable -->
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>
```

```
<body bgcolor="#333333" text="#000000">
<table width="97%" border="0" height="607">
 <tr>
  <td height="79" colspan="2"><!-- #BeginEditable "region2" --><img
src="2ndbanner.gif" width="950" height="100"><!-- #EndEditable --></td>
 </tr>
 <tr>
  <td height="147" width="664" align="left" valign="top">
   <p> <embed src="clavicle_link2.wrl" width="525" height="390">
    </embed></p>
   </td>
  <td height="147" width="283"> <!-- #BeginEditable "region3" -->
   <textarea name="textfield" cols="50" rows="24" wrap="VIRTUAL">Clavicle
```

The clavicle is a long, slender, s-shaped bone that lies horizontally just beneath the skin. It articulates with the sternum and first costal cartilage medially and with the acromion process of the scapula laterally. The clavicle acts as a strut that holds the arms away from the trunk. It also serves to transmit forces from the upper limb to the axial skeleton, and it provides attachment for muscles.

The clavicle is subcutaneous throughout its length; it's medial two-third are convex forward and its lateral third, concave forward

```
</textarea>
    <!-- #EndEditable --></td>
  </tr>
  <tr>
    <td colspan="2">
      <div align="left">
        <OBJECT

ID="mediaPlayer"

CLASSID="CLSID:22d6f312-b0f6-11d0-94ab-0080c74c7e95"

CODEBASE="http://activex.microsoft.com/activex/
controls/mplayer/en/nsmp2inf.cab#Version=5,1,52,701"

STANDBY="Loading Microsoft Windows Media Player components..."

TYPE="application/x-oleobject">
        <PARAM NAME="fileName"
VALUE="clavicle.wav">
```

```
<PARAM NAME="animationatStart" VALUE="true">
<PARAM NAME="transparentatStart" VALUE="true">
<PARAM NAME="autoStart" VALUE="false">
<PARAM NAME="showControls" VALUE="true">
</OBJECT><a href="linking_page.html"><img
src="VERTEBRAE_BACK2.gif" width="60" height="59" alt="BACK"
border="0"></a><a href="clavicle.wav"><img src="AUDIO3.gif" width="65"
height="43" alt="VERBAL INFO" border="0"></a></div>
</td>
</tr>
</table>
</body>
</html>
```

This is a scripting for description page for clavicle.

BIBLIOGRAPHY

[1] http://searchwin2000.techtarget.com/sDefinition/vrml97.htm

[2]Whitten , Jeffrey L.,Bentley, Lonnie D., Dittman, Kevin C. (200), **Systems Analysis and Design Methods,** 5th ed.,Irwin/McGrawHill, NY,US

[3]http://www.angelfire.com/nc2/processIT/vmodel.html

[4]Kendall, Kenneth E., Kendall, Julie E. (1999) **System Analysis And Design,** 4tgh ed. Prentice Hall International Inc, New Jersey, US

[5]http://www.sci.port.ac.uk/rad/anatomy/05/introduction.html

[6] www.vapourtech.com

[7] http;//www.vrml.org/vrml20info.html

[8]http://www.vrml.org/vrmlpad.html

[9] http://www.vrml.org/crossroad.html

[10] http://sonicfoundry.com/productioninfo.htm

[11] www.microsoft.com

[12] www.whatis.com/hardware/memory.htm

[13] www.hoise.com/tech/articeles/ soundblaster.htm

[14]http://cosmoplayer.com

[15]http://www.hoise.com/tech/articles/LV_VM_09-98-27.htm

[16] http://www.vrml.org/tools/ cosmo.htm

[17] http://searchein2000.techtarget.com/sDefinition/virtual.htm

[18] http;//www.sdsc.edu/SDSC/Microsoft/repo-software.htm

[19] Pfleeger,Shari Lawrence (2001), **Software Engineering:Theory and practice,** 2nd ed. Prentice hall International Inc, new jersey US

REFERRENCES

1.0: http://www.bartleby.com/107/

2.0: http://www.comet-cartoons.com/toons/3ddocs/facialmodeling/modeling.html

3.0: http://lighting.prohosting.com/~veras/facetx.htm

4.0: http://www.3dcafe.com/asp/tut3dsz.asp

5.0: http://www.3dlinks.com/tutorial-alias.cfm

6.0: http://www.comet-cartoons.com/toons/3ddocs/odymodeling/index.html

7.0: http://www.vfs.com/~alejandro/bopart.htm

8.0: http://www.3d-files.co.il/tutorials.htm

9.0: Lynn Kyle, **Essential Flash 4 for Professional**, The Prentice Hall, Inc, Upper Saddle River, New Jersey.

10.0: Kim Lee, **3Ds Max 4**, New Riders Publishing, (Inc) USA

11.0: Richard S.Shell,M.D.,Ph.D, **Clinical Anatomy for Medical Students,** 5th Edition, Little Brown Company (Inc.), Boston

12.0: Shari Lawrence Pfleeger, **Software Engineering Theory and Practice**,2nd Edition, Prentice Hall International (Inc.), USA

13.0: Frank H. Netter,M.D., **Atlas of Human Anatomy,** 2nd Edition (1997), Novartis, East Hanover,New Jersey