3D in Medical Fields

By

Mohammad Shahidh Bin Mohammad Khaidir

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

JULY 2004

UNIVERSITY TECHNOLOGY PETRONAS
TRONOH, PERAK
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CERTIFICATION OF ORIGINALITY

'his is to clarify that I am responsible for my work submitted in this project, that the original /ork is my own except as specified in the references and acknowledgements, and that the riginal work contained herein have not been undertaken or done by unspecified sources or ·ersons.

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MOHAMMAD SHAHIDH BIN MOHAMMAD KHAIDIR

CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

....

(Mr. Helmi Md. Rais)

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ABSTRACT

This document contains mainly about the 3D development and its characteristics. The topics discussed are mainly about the implementation of 3D in medical fields. Under introduction, there are four topics which are the background statement, the problem statement, the objectives of the project and the feasibility studies. In the background statement, there is certain comparison between 2D images and 3D images. One of them is 3D image results in a higher quality of image. In the problem statement, the main problem of using old methods within the medical fields is that they need more space and costs great amount of money. One of the objectives discussed in the objectives' topic is to create a learning environment using 3D. In the feasibility studies, there are some constraints mentioned to build the project. In the Literature and Review section, the facts and findings of the research regarding 3D and a human arm is stated. The methodology section stated that the project uses the incremental methodology. It consists of 6 main phases. In the results and discussion section, there are some comparisons between methods used in medic. The methods are compared and the advantages of using 3D are stated. As for the conclusions and recommendations section, 3D should be implemented in medical fields and also should be used as an alternative solution towards other problems in other events.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND STATEMENT

3 Dimension (3D) images is an additional approach to see images in a more detail manner despite 2 Dimension (2D) images. For the past recent years, people had been using 3D as an alternative to make research and presentations more effective. It is because it provides some characteristics that the 2D images can provide. As an example, 2D images cannot provide images that are as realistic as the 3D images. 3D makes the object created more brought up to front. It does not look flat like the objects created using 2 Dimensional approaches.

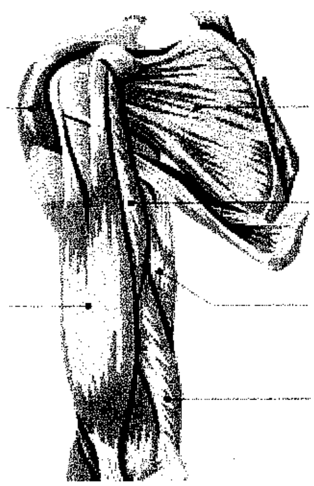

Figure 1.1 Images created in 2D

Figure 1.1 shows an image of an arm and the combination of muscles around it. The image looks flat and it does not look brought up to front. The appearance is also more towards a sketch of image; image done by a simple technique of drawing. If there are animations being done using 2 Dimensional images, the images are still flat and it is hard to keep an accurate size of muscles as picture frames are drawn to represent the movements. When using 3 Dimensional approach, object is created one once with an accurate design and once the arm is finished,, the arm is recorded and animated. As the arms are animated, the size stays the same and a more accurate presentation is formed.

Figure 1.2 The image of an arm using 3D

Figure 1.2 shows an image of an arm being created using 3D. The image is more brought up to front; thus, showing the muscles in a detailed form. In *figure 1.2* the shape of the muscles are clearly seen; whether it is round or "cylinder like". The 360 degrees view also made the 3 Dimensional images created an advantage rather than the 2 Dimensional images. The view of the arm can be done in a very detail manner as it can be viewed at any angle of the arm. The arm can be easily rotated and every angle can be examined to ensure its designs are accurate. For the past years, people and researchers had also been trying to implement these 3D images to their daily work. For example, for animations, people had been using 3 Dimensional approaches to *enhance the creativity of the images*. Enhancing the creativity of images means providing more attempts on making the image as real as it gets. For example, to make it more realistic, using the creativeness that the 3D software can provide, textures are implemented to the muscles. This makes it look more like a muscle, rather than just a plain object. The images will also look livelier than the 2 Dimensional approaches. The aspect of *"livelier"* in this term is defined as the nearest approach of the arm (animation of the arm) towards the realistic environments. In other examples, people had been using 3D in architectures such as the design of buildings and other instruments. Through this, people can actually view the images in a more proper way, as they manipulate 3D images into an act of entering a real live building. The process is done by creating the 3D images of a house and simply assigning tasks of a first person (individual) entering the building. However, people also tend to create images to show presentations more effectively. For example, models have been made using

3D to show audiences the better understanding of the subject if there is more interactivity. This includes medical terms. In medical researches, 3D can be used to imitate a figure of a human being. This is to show how human moves in real live.

1.2 PROBLEM STATEMENT

The use of 2D images in medical terms is not as effective as 3D images. 3D images have more advantages than the 2D images. Substituting 2D images with 3D images provides more functions to the user. As stated earlier in the background statement, the functions of 3D include the rotation of object, which the object can be rotated 360 degrees. The object can be rotated without changing any parameters. Other than that, the view within the 3D can also be rotated in 360 degrees to enable viewing the specific angle in a detail manner. 3D also provides the function of creating the surfaces of an object in a detailed perspective. This involves a carefully act of analyzing every part of surfaces to make it look more specific. The images of 3D are more effective than the normal 2D images. As an object such as the human arm, people tend to see just a flat arm. People cannot see the whole part of the arm; the curves along the biceps and triceps, but only one view of the arm. People cannot see how the arm actually works. *Figure 1.1* shows the 2D view of the arm and *figure 1.2* shows the 3D form of the parts of arm. The differences make the 3D version of arm livelier than the 2D images. The differences include the texture of the arm, the polygon of the arm the realistic views as the arm animates and other aspects. 2D images give less information and unable to view certain parts of the human arm. If another part of the arm wanted to be viewed specifically, another 2D image has to be created. The other image created using 2D is not accurate and exactly the same as the first one. This is because it is hard to maintain the accurate data of design; this includes the length, width, diameter and other parameters. As multiple images are created, they are not exactly the same unless some drastic approach on measuring each object is done.

2D images are images that do not represent a high quality form of image. They are created using sketch and is not actually accurate.

In applying these problems to the medical world, the images created by 2D are less effective because users will need to gain information by viewing the images. The more realistic the images can be the more effective and informative the images can be. There are some difficulties in understanding the images in 2D as it does not provide some functionality that users want.

1.3 OBJECTIVES AND SCOPE OF STUDY

In terms of study, this research aims to create an easier environment for the users to understand what is being presented. The more informative it would be, the more effective it is. As attractive and effective as it looks, 3D provides many functions that 2D images cannot provide. The objective of the study is to recognize the advantages of using 3D rather than using just 2D images. This includes rotating images 360 degrees in terms of view point. Viewing can be very informative as it can be viewed in a very detail manner. In showing an image of the arm, it can show how the arms move very interactively. In terms of presentation, 3D provides more information to the user. As an example, labels on three dimension images are easier to see as the images can be easily rotated to a certain view. A part of an arm is easily rotated and viewed. Therefore user can focus on any part he or she wants. 3D is more interactive than 2D. For example, users interact with the picture shown as users can move it around and seeing the labels attached to it. Users can also view on the movements of the arm by simply clicking on the provided functions. For medical purposes, interactivity is important to give out information as much as it can to users.

1.4 FEASIBILITY STUDIES

Feasibility of the study is the practicality of study. It is considered one of the important parts in the project planning. In this study, there are some constraints that must be considered in completing the project. Three most important constraint for the project are time, scope and cost.

Time is the highest priority where must determine all the tasks must accomplished in order to complete the project. This is because the project requires many processes to be done and also some research to taken. From the tasks, it must determine time needed for each of the tasks.

Scope of the project has been determined earlier at the preliminary phase. Scope is important where it can guide in completing each tasks and objective of the project. The topics that determine must relate to the project and the 3D topic. The topics have been discussed with the supervisor to get more details on the requirement.

CHAPTER 2: LITERATURE REVIEW

2.1 HISTORY IN MEDICATION

In medical fields, the uses of visual aids are very important to present or understand how certain parts of a body work. It is also important to understand how certain diseases grows and what are their resources. The most important part is how to detect the signs of diseases that could be harmful, perhaps fatal to an individual. In managing this, people tend to sketch figures (refer *figure 2.1*) of signs that cause diseases. They also tend to take photographs of an incident of a disease and how it looks like. However, certain people which have poor eye sight and poor understanding of these diseases would probably have some trouble in preventing these diseases.

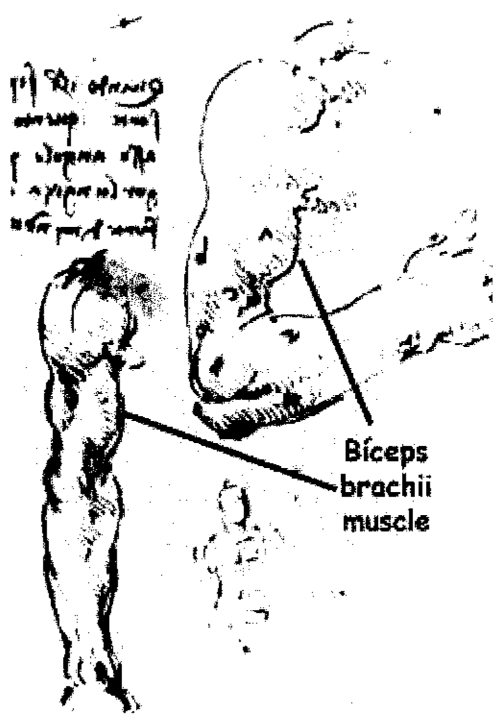

Figure 2.1 Traditional method of sketching

Therefore, the 3D method of explaining theories about diseases is built to enhance the understanding to certain people; thus, giving them in a more informative manner.

These 3D system aims to describe information more clearly of how the diseases spread. The 3D images can illustrate a clearer view of how the diseases look in the early stages, so the probability to prevent the disease is high. Through the 3D images and models, the individual can understand more and perhaps prevent them from happening. 3D is produced in high quality of images. Software that can build 3D is usually full of functions and capabilities. There is a lot of function that other software does not have and this makes the 3D software more productive than other software. For example, 3D has characteristics that provide function in a more detail manner rather than 2D; such as the quality of image and the smoothness of animation.

2.2 PROJECT ARCHITECTURE

This design phase will include architecture design and interface design. The project phase is the most important phase in project development where if the project design failed, the other phases in the project development cannot be continued. Student must keep alert in this phase and the outcome from this phase, design and requirement review will be used in the development phase later.

2.2.1 Architecture Design

In architecture design, (*refer figure 2.2.1*), the architecture consists of three parts of arm; the upper part of the arm, the lower part of the arm and the wrist-to-finger part of arm. The upper arm consists of the humerus bone, and the lower arm; which is the radius and ulna bone.

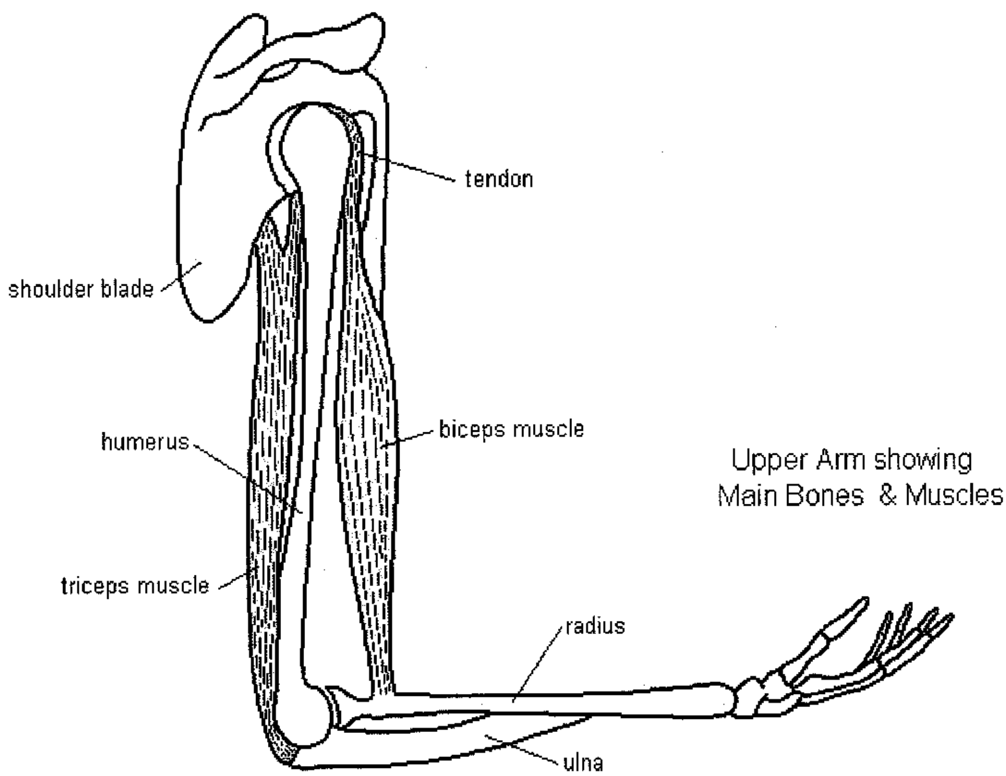

Figure 2.2.1 The parts of arm.

The wrist-to-finger consists of the metacarpals bones and phalanges bones. These bones form the palm and the finger of the hand (*see figure 2.2.2*).

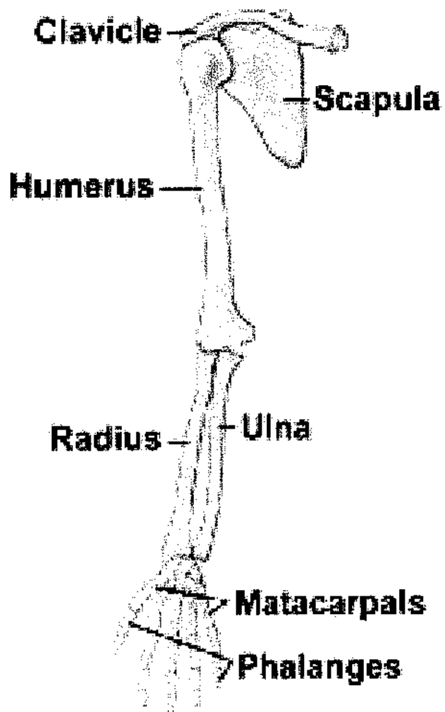

Figure 2.2.2 The detailed parts of arm

The following is the detailed description about part of muscles within the arm that had been picked from a website.

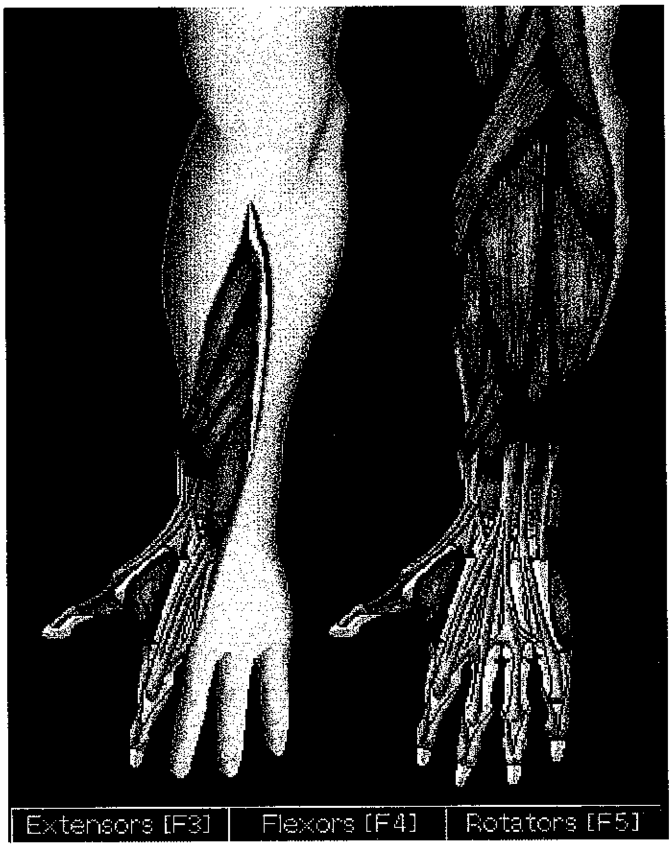

Figure 2.2.3 The parts of muscles

Figure 2.2.3 shows the part of muscles within an arm. The muscles work together in groups contracting and relaxing to produce the fine control needed for movements such as picking up an object or writing. When the flexor muscle contract the arm bends at the elbow. When the extensor muscles contract and the flexor muscles relax the arm straightens. Similar pairs of opposing muscles flex and extend the wrists and fingers. The rotator muscles work with the other muscles to turn the arm and wrist. The extensor carpi radialis brevis is a short, wide, flattened muscle. It arises from the humerus (upper arm bone) and narrows into a long, flat tendon about two-thirds of the way down the arm. It lies between the extensor carpi radialis longus and the extensor digitorum along the outer surface of the radius. This muscle extends and radially deviates the hand at the wrist joint. The extensor carpi radialis longus is a short, flat muscle that arises from the humerus and extends down the arm. The muscle belly narrows into a long flat tendon at the upper third of the forearm and continues down to the outer edge of the radius. This muscle helps to extend and radially deviate hand at the wrist. It also helps flex (bend) the elbow joint. The extensor carpi ulnaris is a superficial muscle on the forearm. It is a narrow, elongated, flattened muscle that extends from the humerus (upper arm bone) to the base of the fifth metacarpal bone of the little finger where it inserts via a flat, narrow tendon. The tendon begins three-fourths of the way down the forearm. This muscle helps extend the wrist. The extensor digiti minimi is a small, slender muscle that originates from the humerus (upper arm bone), and lies between the extensor digitorum and the extensor carpi ulnaris. At the wrist, the muscle develops a double tendon which inserts into the little finger. It is the predominant tendon of the little finger. The extensor digitorum is a wide, lateral muscle group. It has a flat, fusiform belly that extends from the humerus (upper arm bone) and towards the lower half of the forearm and develops into four tendons that insert into the middle and distal phalanges of the fingers. It does not insert into the thumb. This muscle works to extend all the joints of the fingers. It also extends the wrist. The extensor indicis is located deep in the forearm, where it originates from the back of the ulna. At the wrist it develops into a tendon that extends along the back of the hand with the extensor digitorum and inserts in the index finger. It extends and adducts the index finger. Combined with the abductor pollicis longus, the extensor pollicis brevis (thumb muscle) creates a narrow, triangular muscle form which wraps around the lower end of the radius (the bone of the forearm on the thumb side). The extensor pollicis brevis originates from the back side of the radius and inserts in the base of the first phalanx of the thumb. This muscle extends the thumb and continued action rotates the hand. The combination of the abductor pollicis longus and the extensor pollicis brevis forms the oblique carpal muscle group. The abductor pollicis longus lies next to the extensor pollicis brevis forming a narrow, triangular muscle which wraps around the lower end of the radius. The muscle inserts in the base of the metacarpal bone of the thumb on the back surface near the palm. This muscle abducts and extends the thumb. It also assists in bending the hand at the wrist. The extensor pollicis longus originates deep in the forearm from the shaft of the ulna (the forearm bone on the index finger side), crosses over the tendons of the extensor carpi radiales brevis and longus and descends along the back of the thumb and inserts in the last phalanx of the thumb. This muscle extends the thumb and helps to extend the hand at the wrist. The triceps brachii (three-headed muscle) lies at the upper portion of the inside of the arm. It is the main extensor of the arm and is made up of three teardrop shaped heads: the long head, the lateral head, and the medial head. When working with other nearby muscles it can also move the shoulder, since its upper ends are attached to the scapula. The long head, the largest of the three heads, is attached to the scapula (shoulder blade) just below the rounded socket of the shoulder joint, and extends almost three-fourths of the way toward the front of the arm. The lateral head lies on the back and side of the upper arm. The medial head curves around the back of the humerus (upper arm bone) and is mostly covered by the long head. The lower end is attached to the flattened end of the ulna. The triceps brachii extend the forearm at the elbow joint. It works with the biceps brachii to control the up and down movement of the forearm. The anconeus is a small triangular muscle that lies just below the elbow joint and extends a fourth of the way down the forearm. It is located on the outer back corner of the elbow. It extends and stabilizes the elbow joint.

2.2.2 Interface Design

There is also the interface design phase. This is the most time is spent in the project life cycle. This is because there are many tasks are required in developing the prototype. In interface design phase, the designs of the arm is developed using 3D Max software. The software requires many steps and procedures in order to develop the product. It is also time consuming as the process of rendering the product takes time. The story board shows how the interface for the system will be. From the story board, it will transfer the interface design into the real environment using the hardware and software that use in this project.

2.3 GENERAL FACT ABOUT 3D

3D Images have been around for a century and a half. It is simply a method of photographically recreating what has already perceive depth in everything that can be seen. Standard images are only 2-dimensional representations of the normal images. 3-Dimensional images are taken from two perspectives (a person has two eyes, hence two perspectives on a scene). By forcing each eye to see only one image, i.e. the left eye sees the left image and the right eye sees the right image, the brain will reconstruct the depth information from the two pictures and the person will see a 3D image. There are various ways of doing this, and 3D images are designed to give a demonstration of viewing them. Today is the era when everything is possible. It is possible to open image gallery and not even to go out of home, or to visit such gallery without moving one's feet. The point of view with this fact – if people would like to visit many galleries, probably they would have to give up at some point, because they would not have enough time to walk. By this way, computer image gallery enables people to see all image galleries that they meant to see. These results are necessities for modern artists to use computers as their instrument of expression. So, it is the fact that computer art leads to more limits, but at the same time it gives new possibilities, as it introduces new techniques. This additional limits may scare someone, but if there were no limits, then there would be no art, at least not in the form that is now known.

2.4 GENERAL HISTORY 3D SINCE 1970

The 1970s saw the introduction of computer graphics in the world of television. Computer Image Corporation (CIC) developed complex hardware and software systems such as ANIMAC, SCANIMATE and CAESAR. All of these systems worked by scanning in existing artwork, then manipulating it, making it squash, stretch, spin, fly around the screen, and other animations. Bell Telephone and CBS Sports were among the many that made use of the new computer graphics. While flat shading can make an object look as if it's solid, the sharp edges of the polygons can detract from the realism of the image. While one can create smaller polygons (which also means more polygons), this increases the complexity of the scene, which in turn slows down the performance of the computer rendering the scene. To solve this, a Henri Gouraud in 1971 presented a method for creating the appearance of a curved surface by interpolating the color across the polygons. This method of shading a 3D object has since come to be known as Gouraud shading. Founded in 1962, Triple I was in the business of creating digital scanners and other image processing equipment. Between E&S and Triple I there was a Picture Design Group. After working on a few joint projects between E&S and Triple I, Demos and Whitney left E&S to join Triple I and form the Motion Picture Products group in late 1974. Since the 1960's the University of Utah had been the focal point for research on 3D computer graphics and algorithms. For the research, the classes set up various 3D models such as a VW Beetle, a human face, and the most popular, a teapot. It was in 1975 that a M. Newell developed the Utah teapot, and throughout the history of 3D computer graphics it has served as a benchmark, and today it's almost an icon for 3D computer graphics. The original teapot that Newell based his computer model on can be seen at the Boston Computer Museum displayed next to a computer rendering of it. Ed Catmull received his Ph. D. in computer science in 1974 and his thesis covered Texture Mapping, Z-Buffer and rendering curved surfaces. Texture mapping brought computer graphics to a new level of realism. Catmull had come up with the idea of texture mapping while sitting in his car in a parking lot at UU and talking to another student, Lance Williams, about creating a 3D castle. Most objects in real life have very rich and detailed surfaces, such as the stones of a castle wall, the material on a sofa, the wallpaper on a wall, the wood veneer on a kitchen table. Catmull realized that if he could apply patterns and textures to real-life objects, he could do the same for their computer counterparts. Texture mapping is the method of taking a flat 2D image of what an object's surface looks like, and then applying that flat image to a 3D computer generated object. Much in the same way that he would hang wallpaper on a blank wall. Systems Simulation Ltd. (SSL) of London created an interesting computer graphics sequence for the movie "Alien" in 1976. The scene called for a computer-assisted landing sequence where the terrain was viewed as a 3D wireframe. Initially a polystyrene landscape was going to be digitized to create the terrain. However, the terrain needed to be very rugged & complex and would have made a huge database if digitized. Alan Sutcliffe of SSL decided to write a program to generate the mountains at random. The result was a very convincing mountain terrain displayed in wireframe with the hidden lines removed. This was typical of early efforts at using computer generated imagery (CGI) in motion pictures, using it to simulate advanced computers in Sci-Fi movies. Meanwhile the Triple I team was busy in 1976 working on "Westworld's" sequel, "Futureworld." In this film, robot Samurai warriors ıeeded to materialize into a vacuum chamber. To accomplish this, Triple I digitized still ›hotographs of the warriors and then used some image processing techniques to manipulate :he digitized images and make the warriors materialize over the background. Triple I leveloped some custom film scanners and recorders for working on films in high resolutions, ıp to 2,500 lines. Also in that same year at the Jet Propulsion Laboratory in Pasadena, California (before going to NYIT), James Blinn developed a new technique similar to Texture Mapping. However, instead of simply mapping the colors from a 2D image onto a 3D object, :he colors were used to make the surface appear as if it had a dent or a bulge. To do this, a nonochrome image is used where the white areas of the image will appear as bulges and the black areas of the image will appear as dents. Any shades of gray are treated as smaller bumps or bulges depending on how dark or how light the shade of gray is. This form of mapping is called Bump Mapping. Bump maps can add a new level of realism to 3D graphics by simulating a rough surface. When both a texture map and a bump map are applied at the same time, the result can be very convincing.

2.5 3D IMPLEMENTATION AROUND 1990

In May of 1990, Microsoft shipped Windows 3.0. It followed a GUI structure similar to the Apple Macintosh, and laid the foundation for a future growth in multimedia. While in 1990 only two of the nation's top ten programs ran under Windows, this rose to nine out of ten just a year later in 1991. Later that year, in October, Alias Research signed a 2.3 million dollar contract with ILM. The deal called for Alias to supply 3D, state of the art computer graphics systems to ILM for future video production. Disney and Pixar announced in 1991 an agreement to create the first computer animated full length feature film, called "Toy Story," within two to three years. This project came as a fulfillment to those early NYIT'ers who had the dream of producing a feature length film. Pixar's animation group, with the success of their popular Listerine, Lifesavers and Tropicana commercials, had the confidence that they could pull off the project on time and on budget. "Terminator 2" (T2) was released in 1991 and set a new standard for CGI special effects. The evil T-1000 robot in T2 was alternated between the actor Robert Patrick and a 3D computer animated version of Patrick. Not only were the graphics photorealistic, but the most impressive thing was that the effects were produced on time and under budget. The same year another major film was released in which CGI played a large role, "Beauty and the Beast." After previously having one success after ınother with computer graphics, Disney pulled out all the stops and used computer graphics ·hroughout the movie. In terms of the beauty, color and design Disney did things that they ɔould not possibly have done without computers. Many scenes contained 3D animated ɔbjects, yet they were flat shaded with bright colors so as to blend in with the hand-drawn ɔharacters. The crowning sequence was a ballroom dance in a photorealistic ballroom ɔomplete with a 3D crystal chandelier and 158 individual light sources to simulate candles. Nintendo announced an agreement with Silicon Graphics, Inc. (the leader in computer graphics technology) to produce a 64-bit 3D Nintendo platform for home use. Their first product, Ultra64 will be an arcade game to be released in 1994, while a home version will follow in late 1995. The home system's target price will be $250. In the early 1990's Steven Spielberg was working on a film version of the latest Michael Crichton best seller, "Jurassic Park." Since the movie was basically about dinosaurs chasing (and eating) people, the special effects presented quite a challenge. Originally, Spielberg was going to take the traditional route, hiring Stan Winston to create full scale models/robots of the dinosaurs, and hiring Phil Tippett to create stop-motion animation of the dinosaurs running and movements where their legs would leave the ground. Tippett is perhaps the foremost expert on stop-motion and inventor of go-motion photography. Go-motion is a method of adding motion blur to stop-motion characters by using computer to move the character slightly while it is being filmed. This new go-motion technique eliminates most of the jerkiness normally associated with stop-motion. As an example, the original King Kong movie simply used stop-motion and was very jerky. ET on the other hand used Tippett's go-motion technique for the flying bicycle scene and the result was very smooth motion. Tippett went to work on Jurassic Park and created a test walk-cycle for a running dinosaur. It came out OK, although not spectacular. At the same time, however, animators at ILM began experimenting. There was a stampeding herd of Gallimimus dinosaurs in a scene that Spielberg had decided to cut from the movie because it would have been impossible to create an entire herd of go-motion dinosaurs running at the same time. Eric Armstrong, an animator at ILM, however, experimented by creating the skeleton of the dinosaur and then animating a walk cycle. Then after copying that walk cycle and making 10 other dinosaurs running in the same scene, it looked so good that everyone at ILM was stunned. They showed it to Spielberg and he couldn't believe it. So Spielberg put the scene back into the movie. Next they tackled the Tyrannosaurs Rex. Steve Williams created a walk-cycle and output the animation directly to film. The results were fantastic and the full motion dinosaur shots were switched from Tippett's studio to the computer graphics department at ILM. This was obviously a tremendous blow to the stop-motion animators. In ɔrder to create realistic movement for the dinosaurs, Tippett along with the ILM crew leveloped the Dinosaur Input Device (DID). The DID is an articulate dinosaur model with notion sensors attached to its limbs. As the traditional stop-motion animators moved the nodel, the movement was sent to the computer and recorded. This animation was then ouched up and refined by the ILM animators until it was perfect. The dinosaur skins were created using hand-painted texture maps along with custom Renderman surface shaders. The final scene which is a show-down between the T-Rex and the Velociraptors was added at the ast minute by Spielberg since he could see that ILM's graphics would produce a realistic sequence. 1995 saw the release of the first full-length computer 3d animated and rendered notion picture. It came from Pixar and was called Toy Story. It did not feature any revolutionary enhancements, however just by being a full-length motion picture it had a major impact on the way people perceived computer graphics. By 1995 the audiences worldwide were used to amazing graphics in motion pictures, but there was another graphics revolution, which started that year. Sony released their Playstation (X) game-console worldwide. (It was actually released in December 1994 in Japan) Until then the so-called Video Game consoles only managed to display 2 D graphics, but the Playstation (which was sold all the time for the rest of the decade) actually contained a chip (besides the CPU) for hardware-accelerated 3D capable of drawing 360.000 polygons/sec.

2.6 3D HISTORY IN 2000-2004

The computer graphics during the past decades had been improving especially in 3D graphics. People tend to make use of 3D as an alternative towards their daily life. By the year 2000, people tends to be more inerested in developing 3D graphics in games and even movies. The animations via 3D tends to make people more aware about 3D and how affective it could be in attracting their attention. In medical fields, 3D developers still trying to make approaches to improve the understanding of the medical terms used. Figures are built to represent body parts and these figures make understanding more easier because presenting using animations is more effective than just reading.

CHAPTER 3: METHODOLOGY/PROJECT WORK

3.1 METHODOLOGY

The project of creating and designing 3D images and system is a project that requires proper planning. Therefore, in this project, the Incremental type of Model is used as its' methodology. The try an error type of model is suitable for this project as it must be built by connecting the body parts in various ways. The methodology used for this contains 6 phases, which are *Requirement Definition, Plan Increments, Design Increment, Build Increment, Implement Increment and Evaluate Increment.*

3.1.1 The Requirement Definition Phase

The first phase, which is the *Requirement Definition*, requires the act of defining the requirements of the entire development of the project. This is where all the software and hardware needed in building this project is listed and prepared. In this project, the software required is 3D Studio Max and a high processor computer is used as hardware. Other than that, Adobe Photoshop software is also required to alter some graphics that are used to developing the system. Macromedia Flash is also used in designing the interfaces of the system. There is also some minor software such as the recording software in windows to be used. Despite software to be used in the project, in this phase, the methodology that is going to be used also must be stated. Other than that, medical facts are also gathered to understand the functions of an arm and how the muscles within an arm interact. All the criteria and elements needed to be included in this project should be listed and awareness of time management through out this project life cycle is taken seriously. During the *Requirement Definition*, understanding the objectives and problem statements within the upcoming project is done. This is to make sure the process of making the arm flows smoothly.

3.1.2 The Plan Increments Phase

The second phase of the hybrid model is the *Plan Increments* phase. Planning involves analyzing each of the processes required in developing the project; thus, assigning them to a specific time in order they are to be followed accordingly. Planning also involves drastic approaches in understanding the flow of process models. By referring to the elements stated in the *Requirement Definition*, they are to be arranged according to the requirements to each process. For example, 3D Max software is required in the designing phase.

3.1.3 The Design Increment

The third phase would be the *Design Increment*. This is where the designs of an arm are sketched. They are planned on how to be developed. The architectures on how the arm moves are analyzed. This is to make sure the animations that are going to be generated matches the descriptions.

3.1.4 The Build Increment

The next phase would be the *Build Increment* phase. This is the phase where time is spent the most. This is because this system emphasizes on the designs and structures of the arm and careful measures are done. The designs are done according by part. The first part would be designing the skeletons of an arm. The objects created in the 3D Studio Max are the forms of polygons such as squares and spheres. Then major alterations are done to the objects to form a human skeleton (the bone of the arm). Through the development phase, developing the models of arm is involved part by part. *Figure 3.1.1* shows the skeleton of an arm which are developed using the objects within the 3D Max software.

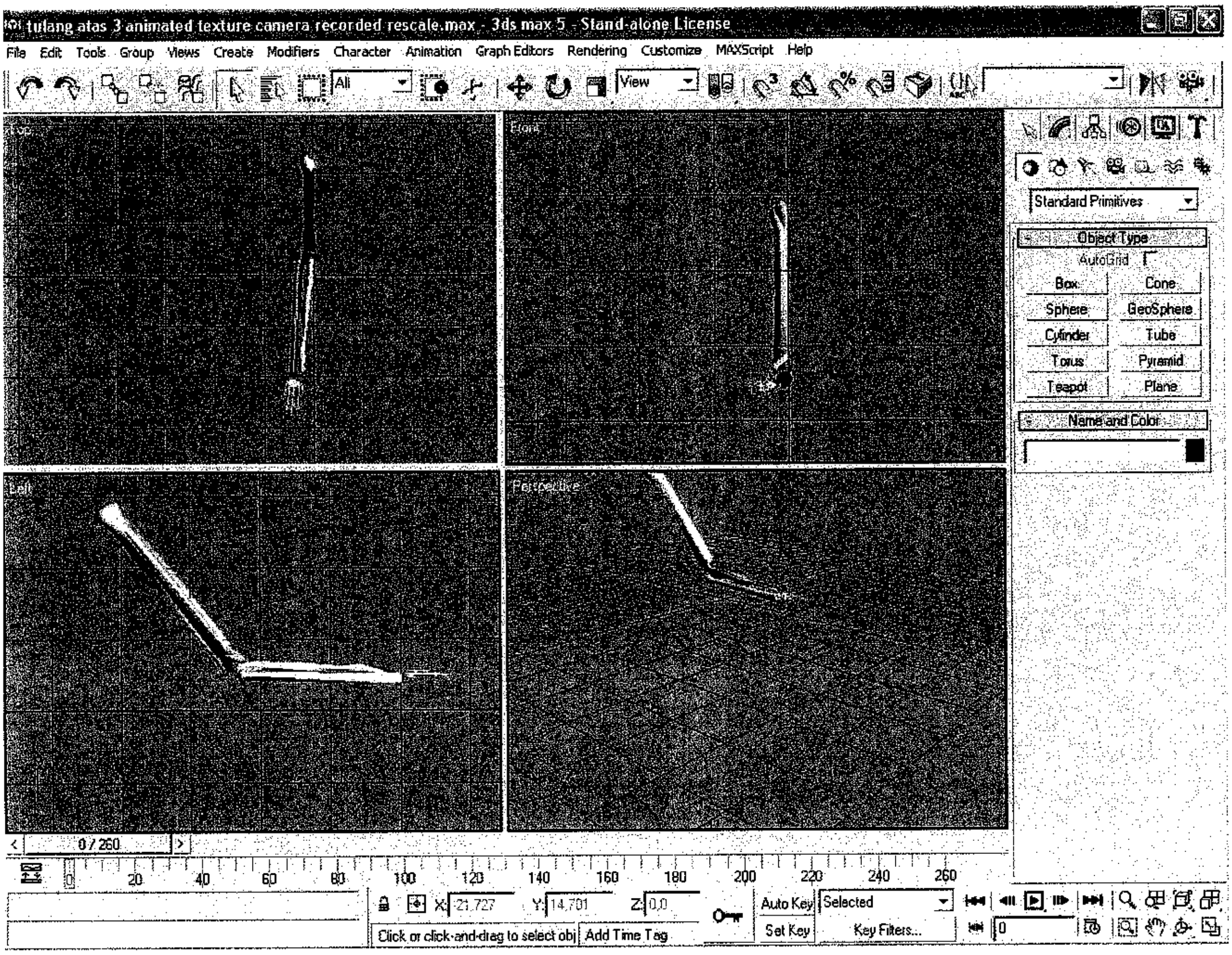

Figure 3.1.1 Designing of a Skeleton

After the skeleton of an arm is developed, the muscles are then developed using the same steps of developing the skeleton. The surfaces are converted into editable meshes to enable it to be altered. When referred to *figure 3.1.2*, the blue points are editable meshes and these meshes are positioned to design the contours of the surface until it forms a muscle.

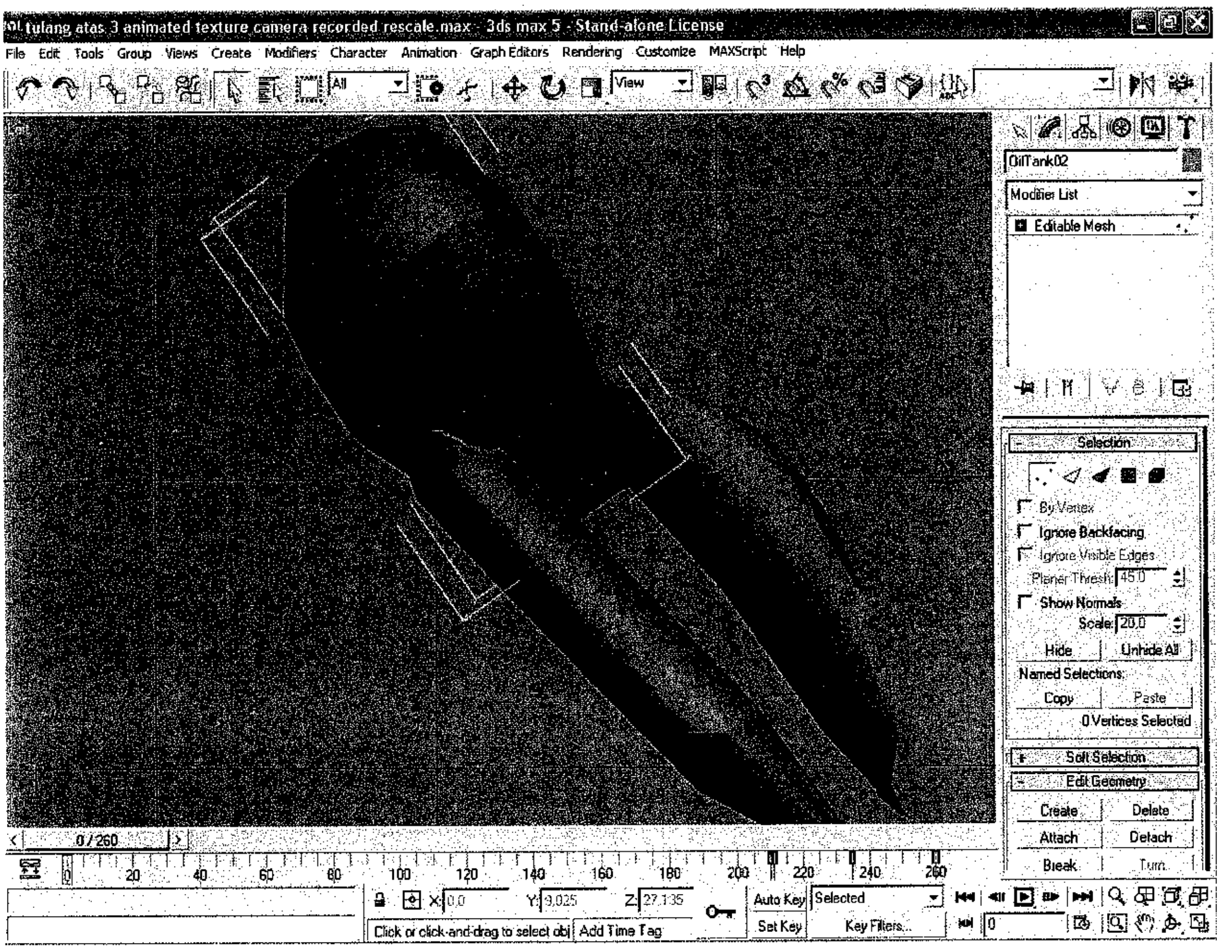

Figure 3.1.2 Editable Meshes are Redesigned

The muscles are designed and positioned according to medical facts. For example, the biceps muscles are located on top of the skeleton of the arm and the triceps are located below the skeleton of the arm. The next part would be the implementation of the texture of an arm. A sample within the internet is gained from a Turbo Squid Product (a texture website that sells texture samples). The samples are used as guides to build a sample of muscle texture using the Adobe Photoshop software.

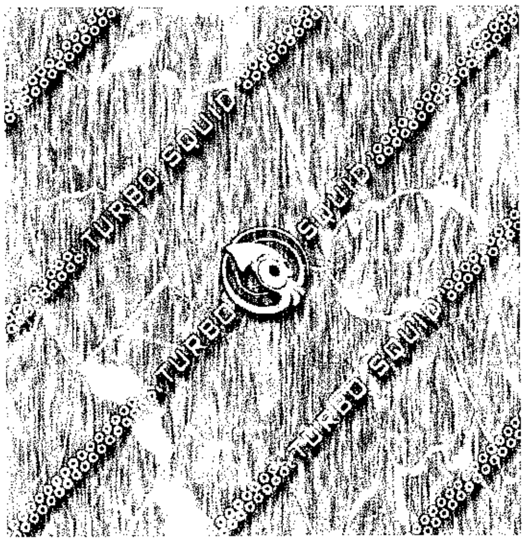

Figure 3.1.3 The Turbo Squid Product

Figure 3.1.3 shows the original sample of the Turbo Squid Product and *Figure 3.1.4* shows the texture (own texture) being made by using Adobe Photoshop software.

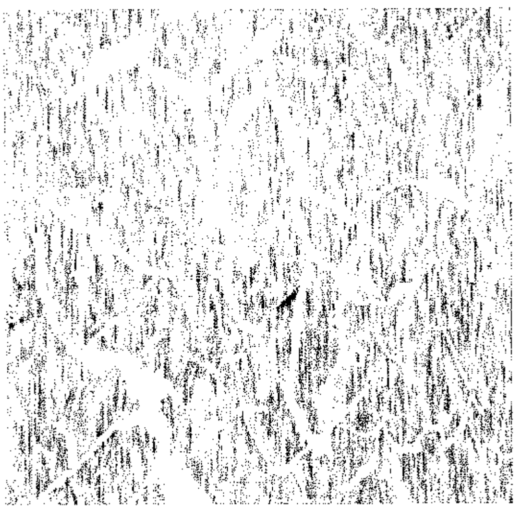

Figure 3.1.4 Textures Designed using Adobe Photoshop

After designing the major parts of arm (the skeleton and the muscles), a guide of movement is implemented in the system. In this case, when using 3D Max as a software development tool, a function call "bones" are used. They are used to guide object so that the objects can move as realistic as it can be.

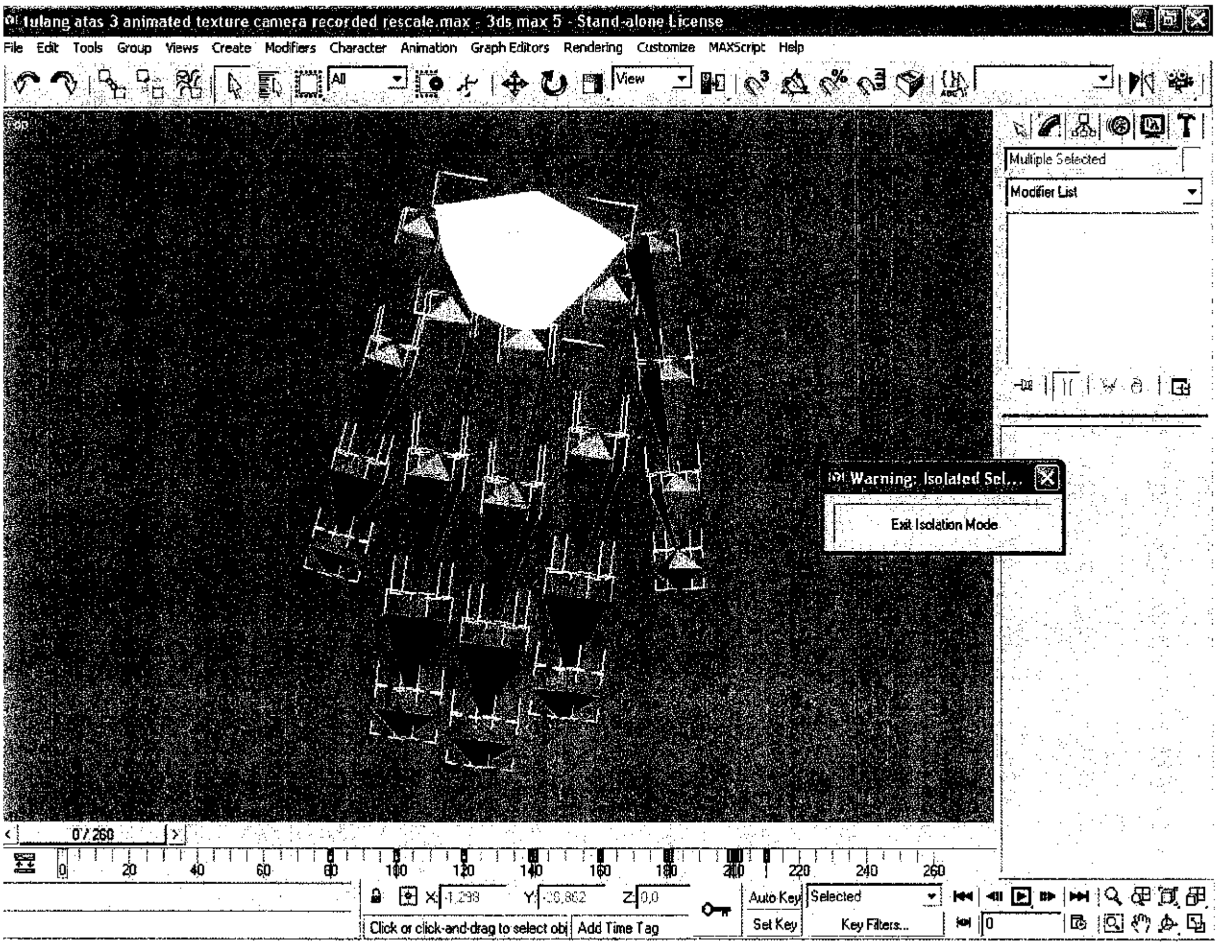

Figure 3.1.5 The Bones are used as a Guiding Mechanism

By referring to *figure 3.1.5*, the figure shows the bones within a palm that is used to guide the finger movement. Each skeleton of the arm are attached to a bone, so that it will follow the bones as it moves. The animations are actually based on the movements of the bones and the objects (muscles and skeleton) that follow it. When the animations are done, the bones are set to be invisible, so it will not appear during the actual recordings. For more pictures as reference, refer to appendix 7.1. The next session is the recording session where the animations are done. On this part of project, all the bones are assigned to a position in a frame. A frame is used in the recording tray, to animate the bones. As an example, the hand will form a grip on the 145th frame of the recording tray. In this case, all the bones are aligned to form a grip of a hand and be recorded on the 145th frame.

The following figure (*refer figure 3.1.6*) shows the recording tray used for animating. The numbers on the figure shows the frames within the animation and the points on the numbers shows the recording points that have been made for an object.

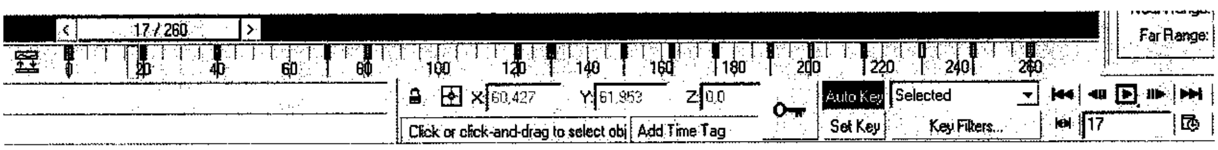

Figure 3.1.6 The tray used for Recoding Sessions

After recording, the objects are rendered to form to an **.avi* format, to make the animations into a video type. The animations are done separately according to the type of view assigned (free view, left view, top view, upper arm view, lower arm view, palm view, left palm view and shoulder view.). However, the free view is recorded using a camera to give it a full 360 degree view. The camera is positioned where desired and animated. As the animation progresses through the frames, the camera position also changes as the desired view is positioned. The camera will move around the objects. The figure (*refer to figure 3.1.7*) below shows the camera is position to the desired position and being recorded to a certain frame.

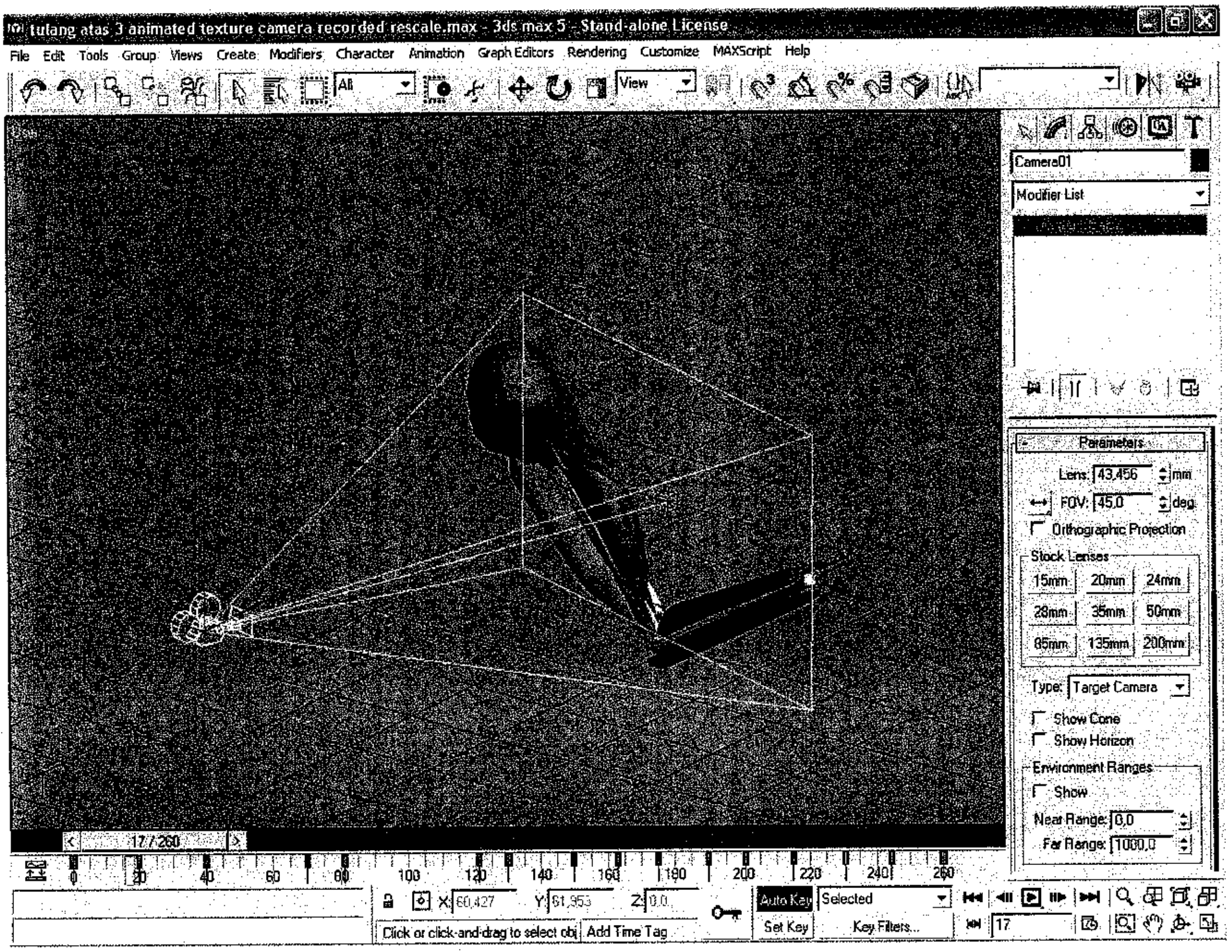

Figure 3.1.7 The Camera is positioned to get the Desired View

After the videos are obtained, the process of making the interfaces is done. This is done using the Macromedia flash software. The suitable interfaces are chosen to create a software environment; thus, making the presentation more effective. An appropriate background is chosen to match the occasion of the software. The figure below (refer *figure 3.1.8*) shows the layout of the software created by using flash animation.

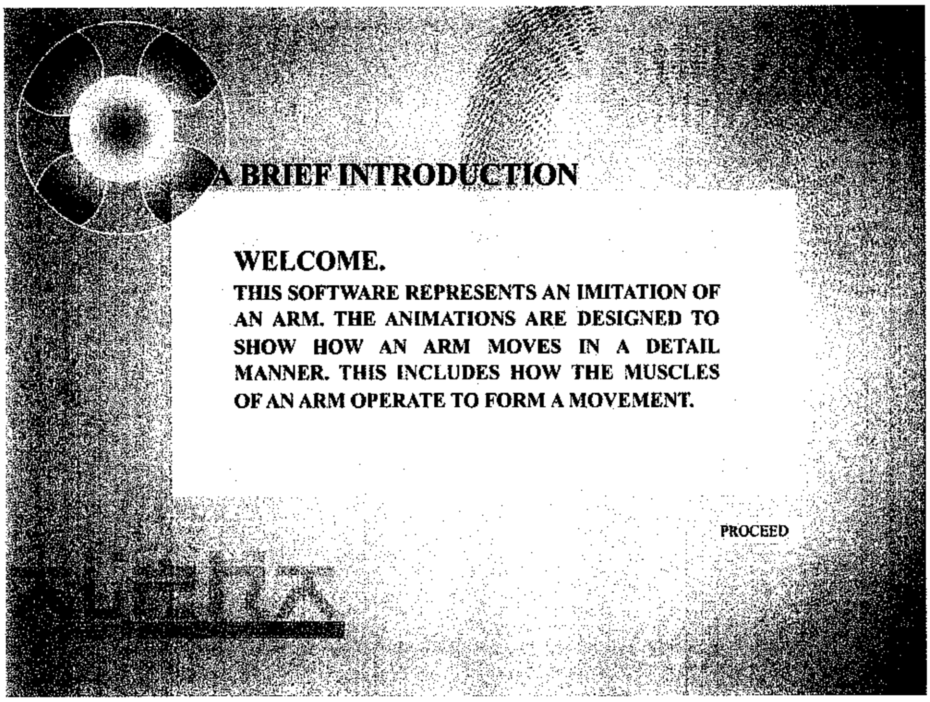

Figure 3.1.8 The First Page of the System

In *Figure 3.1.8*, it shows the general description of the software and the button "Proceed" to continue with the program. The next figure (refer to *figure 3.1.9*) shows the animation page of the system.

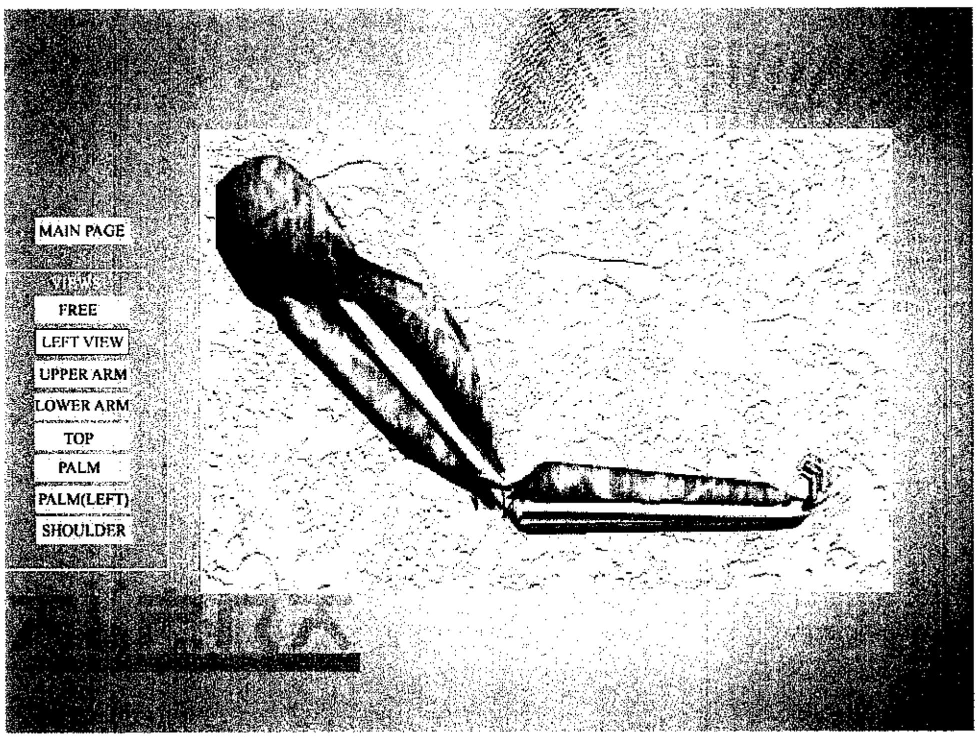

Figure 3.1.9 The Animation Page

When referred to *figure 3.1.9*, there are several parts divided in the page. The button "Main Page" is the directory to the first page (refer to *figure 3.1.8*). Under the "Main Page" button is the View Section. The view section provides 8 different views of the arm. They are the free view, left view, upper view, lower view, top view, palm view, left palm view and the shoulder view. Each button will direct to the animations that is desired according to view.

3.1.5 The Implement Increment Phase

In the next phase, which is the Implement Increment Phase the arm presented to the end users. This is to see the feedback of the user in the future. Implementation plays an important role of evaluating the project developed. If there are some aspects there troubles the end users, the product will be corrected in the development phase. The satisfaction of the end users is important to determine the effectiveness of delivering the product. Each reaction the end users do will be noted down and brought to attention.

3.1.6 The Evaluation Increment Phase

The next phase would be the *Evaluation of Increment Phase*. In this phase, the product is monitored and an evaluation is made depending on the feedback that the users give. If there is the need to improve, the product should go to *the Plan Increment Phase* or *the Design Increment Phase* to change according to the end users' needs and opinions.

3.1. 7 The Incremental Methodology

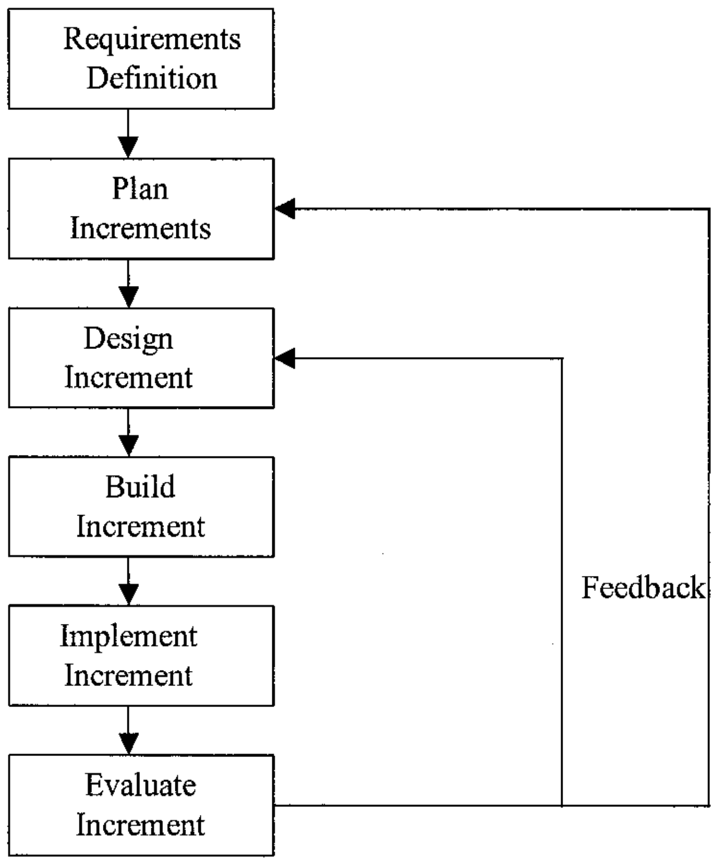

Figure 3.1.7 The Incremental Model Methodology

3.2 BASIC INFORMATION ABOUT THE INCREMENTAL METHODOLOGY

In planning, the project has to be divided into several parts and an estimated time has been given to each part to be developed. Analyzing the project is where the requirements of the project are analyzed and brought to priority. Then the development and designing stages is processed to see the architecture of the arm. Lastly, implementation or presentation is held to see on the working arm. The stages must be followed properly to ensure the smoothness of project development. However, there are certain procedures had to be undergone other than the four major phases. Besides these four stages, there are also other stages in the project development life cycle such as testing and costing which student has to consider in completing the project. The testing and costing phase is tested properly to make sure the prototype is functioning properly as desired.

3.2.5 Project Analysis

Project analysis phase involve analyze problem statement from the preliminary report and solve it as the project's product. It will specify certain problem and aimed to solve the problem as the project objectives. The final outcome of this project analysis phase would be the completion of system requirement documentation which detailed about the problem analysis, requirement analysis and specification.

3.2.5.1 Problem analysis

Problem analysis is done in order to get well-known with the problem statement which stated earlier in the preliminary and feasibility study. The analysis shows the relevancy of the topic with the current problem. From the analysis, it divided into two parts, the research and the system development parts.

To start, a research is done in studying the functions of 3 dimensional projects. The functions are stated properly and any possibility of problem is stated. In other words, this analysis phase is a phase to identify problems and possibility of errors. The errors are analyzed and solved. To make the case or the problem more detail, the implementation of 3D is implemented in medical fields and the possibility of inappropriateness is stated. Other than that, the limited knowledge of developing these kinds of product is also a problem. This is because 3D is software that is unfamiliar to majority of people working under medical fields including in certain IT departments. However, proper training can ensure people to solve these problems.

In development, the 3D Max software is not user friendly software as the interfaces are scattered all over the software and it is not easy to develop a simple project. However, the 3D Max software is very powerful software as it is capable of animating various animations.

3.3 TOOLS

The tools used for this project would be the 3D Max software which is a 3D building and rendering software and Adobe Photoshop which is software to enhance graphics' looks. Software would be the Macromedia Flash MX to enhance the system's looks and appearance. The interfaces are designed using Flash to make it look like more like a software.

CHAPTER 4: RESULT AND DISCUSSION

4.1 MEDICAL RESEARCH IN 3D

Medical research is more available in two dimensional images rather than three dimensional through the internet. Usually, in these web pages, researchers tend to show a figure and then spend a few pages explaining on the functions of the parts of the body. Sometimes the explanations are too complicated for the users to understand. This also can cause the users get lost in the explanation and perhaps might even bore them. However, using the 3D approach, researchers do not have to explain on how the body parts work. Researchers will just have to design the body part and simply record on how the body parts work. In this project, an arm is designed in 3D form to imitate the movement of a real arm. Therefore users can see how the muscles of the arm interact with each other to move the arm without explaining it in a very detail manner. This makes the subject to be understood easily. There are only few implementations of 3D images in medical fields as some researchers has less knowledge about the term 3D and how it operates. In a general view, using three dimension images in medical fields, people can get a better understanding about a subject and maybe prevent certain diseases from spreading. Other than that, the very interactive approach of a 3D image can also attract people to use it, thus gaining knowledge about the subject. This helps to save lives. There are also some approaches in representing the human figures or other figures such as using the "Macromedia Flash" software, Adobe Photoshop and other software. The other approaches made by recent researchers are by using a real figure. For example, the arm of a real human corps is used to show medical trainees the parts of arm, which also includes surgery. This complicates doctors to show trainees the parts of arms by having to undergo a surgery to show trainees the parts of arm. Another method, people also tend to build a replica of a human arm which costs very expensive. The 3D image that simulates an arm is an effort to cut cost and prevent difficult procedures such as surgeries to just show the parts of arm. This saves plenty of cost and also saves time. Other than that, this method also has a commercial value as it can be sold as a medical instrument that can aids people with information. This effective method can be sold to any medical center that needs it. The people in the medical center should be able to pay the small amount of money in exchange of the beneficial 3D images. When compared to other method of visual aids, the 3D system should be the cheapest.

4.2 COMPARISON BETWEEN METHODS

To build a project, 3D Max is used in developing this project. The powerful software has ubiquitous plugin architecture. It is low in cost if compared to other commercial software. Although it is low in cost, it has powerful editing capabilities. There are many functions within the software that can create all sorts of designs and animations. Compared to Macromedia Flash, 3D Max is better software. This is because 3D can build a figure that can be built in 3 dimensional views. This is compared when the images are produced according to the x, y and z axis; where else the Macromedia flash can produce images in 2 dimensional which is the x and y axis. The z axis makes the object designed by 3D Max can be rotated 360 degrees in any direction.

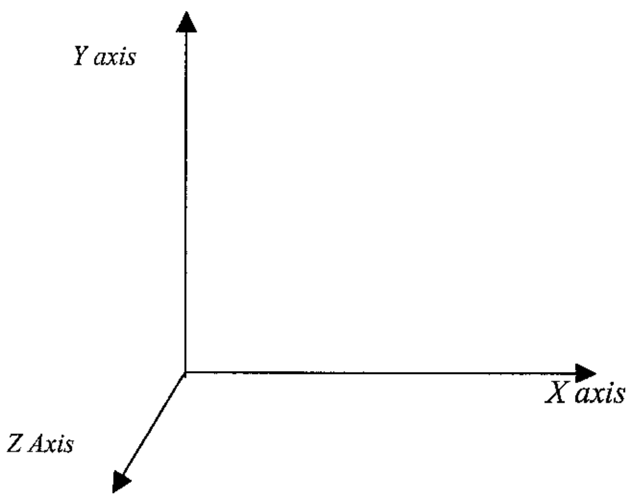

Figure 4.2 The axis in 3D Max

The above figure (refer *figure 4.2*) shows that the X, Y and Z axis. Each object created in the 3D Max Studio has an axis such as the figure. This enable the user to create an object according the posture the user wants. As an example, an arm can be designed;

thus, the surface of the arm is facing in front. As compared to other methods, such as creating a replica of a skeleton or building postures of a human body part, this is very costly and takes longer time. If a doctor manages many kinds of diseases, many postures of human body parts had to be built and cost a great deal of money. 3D system can replace all these by just having a computer and certain software. The ease of obtaining certain figure is nothing compared to time-consuming of ordering postures of human body parts. This also saves time and room. *Figure 4.3* shows a medic working with a dummy as an exercise and learning experience.

Figure 4.3 A Medic Working with a Dummy

The following is a figure (*refer figure 4.4*) of a skeleton that is sketched to get a glimpse of how a skeleton actually looks like.

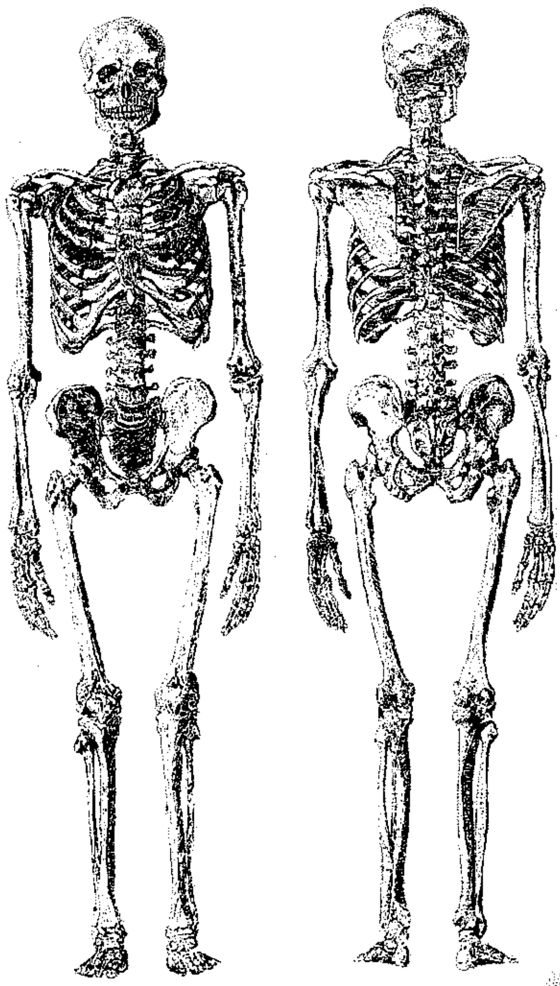

Figure 4.4 A sketch of a human skeleton

The figure shown is about the figure of a skeleton. The sketch does not show the whole form of a skeleton as it only shows a flat picture. There are also models of dummies that form a skeleton as a presentation. However, the model is expensive and requires space. Therefore, the most suitable method to be used is via 3D. Using 3D Max as a medium to implement 3D environment does not cost much and yet effective.

If there is a comparison between the existing 3D software, the most frequently used software is 3D Studio Max and Maya 3D. However, on top of that, 3D Max manages to win the number of users. It has been said that the 3D Max software is more powerful and gives more advantage rather than Maya 3D. The following figure (*refer figure 4.5*) shows the studies.

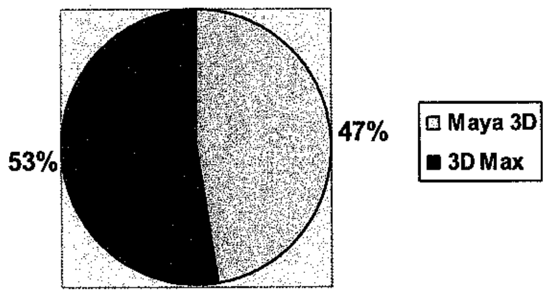

Figure 4.5. Poll voted (3D Max vs Maya 3D)

4.3 BENEFITS AND ADVANTAGES

There are many benefits that can be gained by using the 3D image system. One of them is the ease of gaining knowledge about a subject. Very effective visual aids can make understanding easier. Therefore, less time on understanding and explaining throughout the subject is managed. As an example, when the upper arm view is selected in the 3D software, the view tends to focus on the movements of the biceps and triceps. When the arm lifts something, the biceps tends to contracts and the triceps tend to expand (*refer figure 4.5*). These information can be obtain by just looking at the 3D animations and the quality of the images makes the image clear to be viewed.

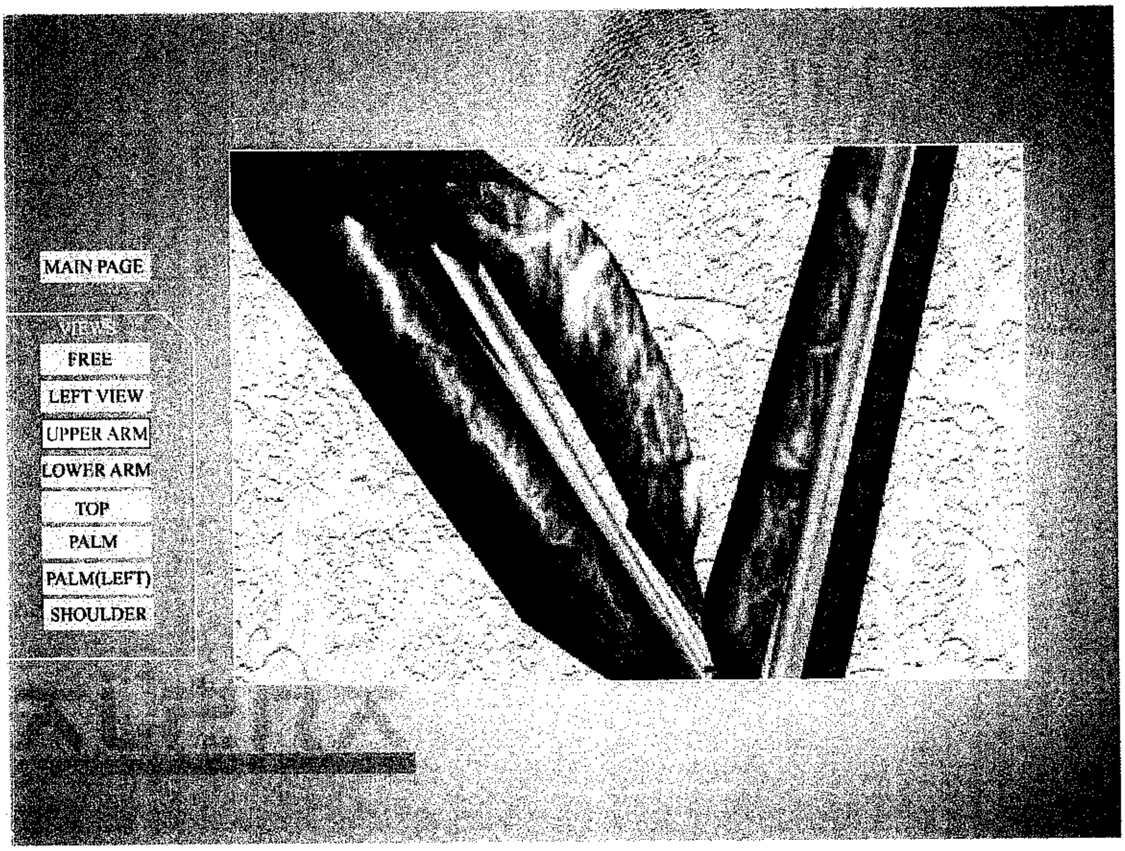

Figure 4.5 The Biceps Tend to Contract while the Triceps Expands

Other than that, the 3D image system can produce a high quality picture which can be viewed even in a very detailed view. Therefore, it is very informative even in a slight angle. The design of the picture can be created in a high quality value. This will make the image looks more clearly and more lively. The animation will also be clearer and smoother. A high quality of images can result in the higher understanding of the product. 3D images are also cheaper than other methods of visual aids. Therefore, it also saves money. Visual aids such as the 3D image system sometimes more useful than other expensive equipments. As an example, a simple figure of an arm costs about RM500 and above. This is expensive if compared to 3D system which can cost only RM500 for a design of the whole major body part.

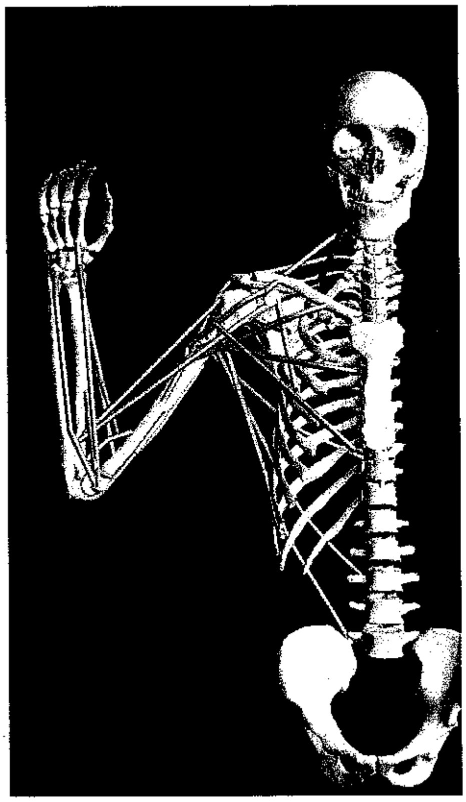

Figure 4.6 Skeleton in 3D form

The 3D (refer *figure 4.6*) image system can also be marketed as it has its own commercial value. Medical centers should be the ones that are very interested in buying these figures. Therefore, generating these kinds of figures can also give incomes.

4.4 THE RISK EVALUATION FACTOR FOR INCREMENTAL METHODOLOGY

The incremental methodology is a suitable methodology for developing software. How ever, despite the advantages, there are also some risks to be considered and evaluated. One of the risks is the structure of the methodology is hard to determine the end of the system. The end phase that is the evaluation phase (evaluate increment) is the part where all the evaluations are done. Therefore, all the feedbacks are revised and changes are made on the plan increment phase or the design increment phase. The process continues until the product achieves its motive to satisfy end users. However, there is no clear line on stating where the process stops and this will cause confusion between the development team and the end users.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

As a conclusion of the results of discussion, there are certain advantages that people can gain from using the 3D images rather than the other methods. The advantages and benefits that people can gain should be brought up. Therefore, software regarding 3D image building system should be implemented through courses in universities and colleges. Students and new youths these days should be exposed to this kind of software so that they can be more productive in the courses.

Specifically, in this research, which includes the medical fields, people should consider this alternative approach to improve the way of understanding and delivering a subject. An effective presentation is a step to greater influence to others. Presenting with very helpful visual aids can make work easier. Easy-to-understand visual aids can make explanations to patients an easier task. If understanding about a subject can be explained to a patient, preventive measures would be easier. Generally, people should attempt to think 3D as a virtual solution to other events. The idea of mixing 3D in the normal working life can be more effective than other method, considering it is cheaper and can bring benefits.

Although there many attempts in implementing 3D in various occasions, medical field is one of the most suitable for 3D as it can enhance the development of the medical field.

5.2 RECOMMENDATIONS

The software designed should be recommended to workers that are working in the medical field. The attempt to introduce this kind of software should be made so that the doctors and medics know on how to use the software other than knowing the benefits. These attempts should be used to encourage medics to use computer based education.

3D should replace some learning procedures. As an example, lecturers tend to teach medical students surgeries using a real life human. However, it is hard for the students to experience it first time. Therefore, the 3D approach plays a part in presenting on how the surgery is undergone. The 3D approach of an x-ray arm can be implemented in practical surgeries. The figure below (*refer figure 5.2*) shows the implementation 3D images in a surgery simulation.

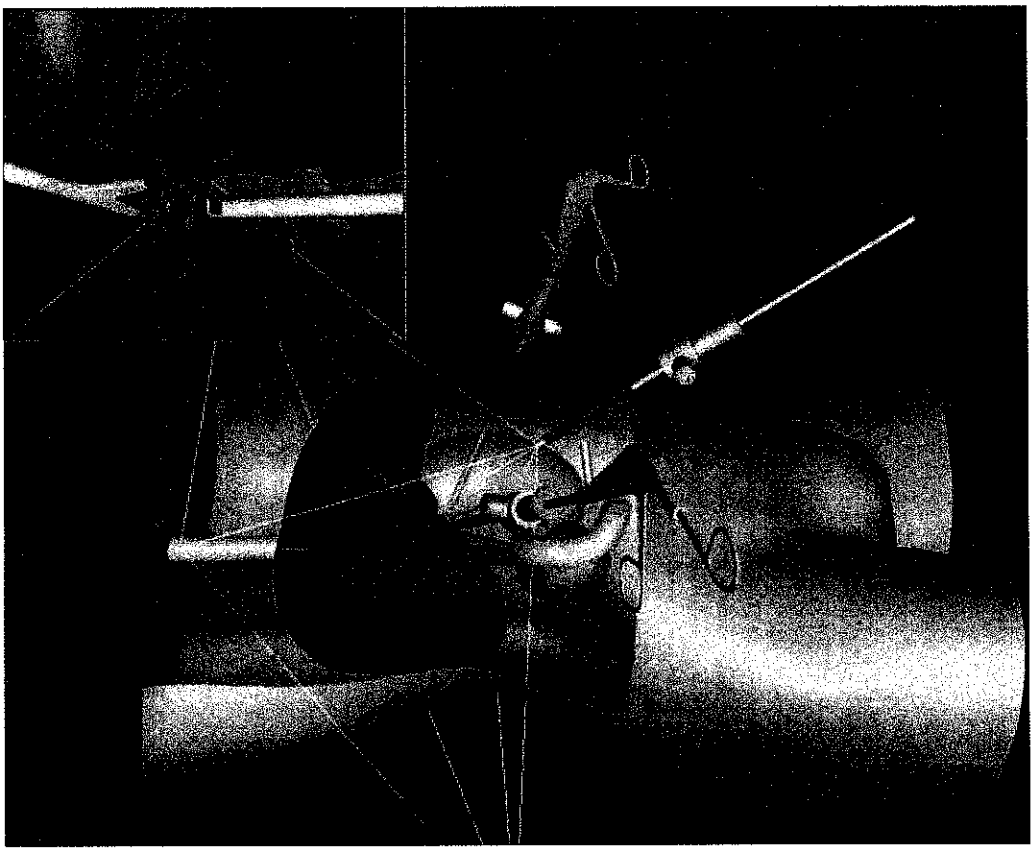

Figure 5.2 Surgery Simulations via 3D

The 3D creates a medical environment and this helps the trainees to feel more comfortable when doing a 3D simulation as training. The 3D images/ system is assigned to a specific device using various coding to make it interact with each other. Specifically, the 3D surgery is the nearest simulation towards a real surgery and generally, 3D simulations are the most suitable training for any kind of simulation including piloting airplanes. This method aims to replace expensive simulation machinery. The following figure (*refer figure 5.3*) show a trainee undergoing a surgery training.

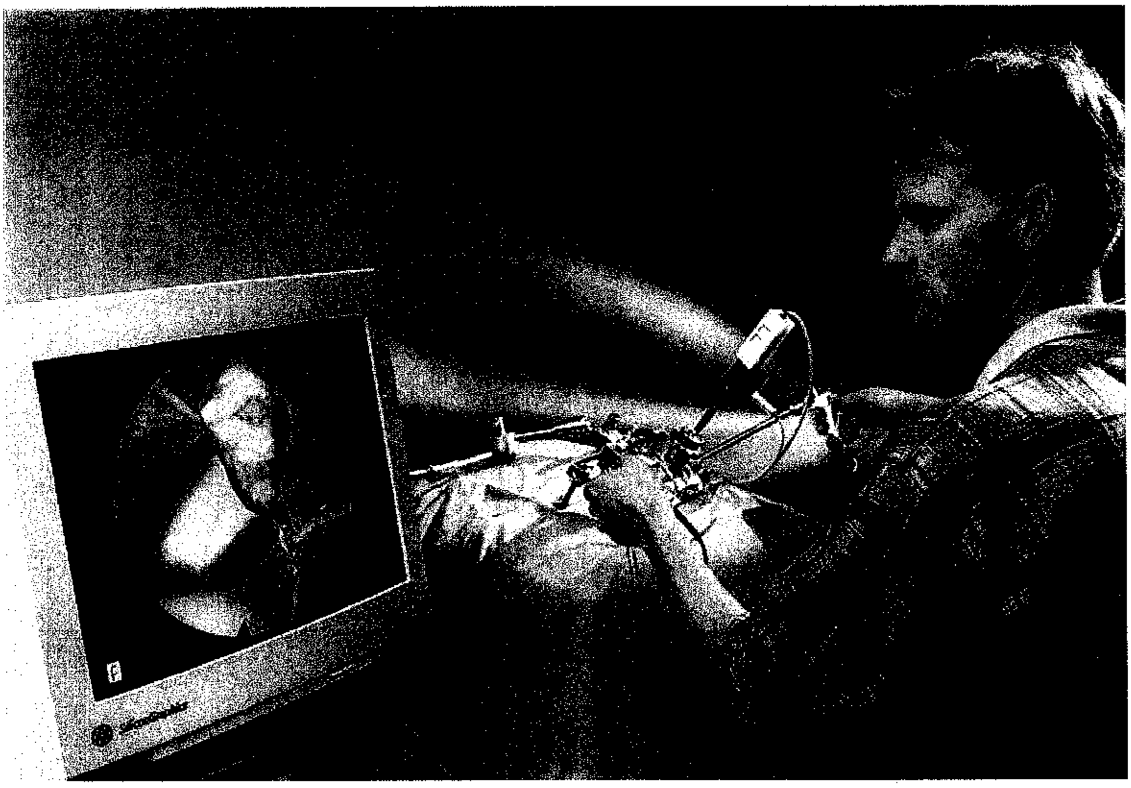

Figure 5.3 A Trainee Undergoing a Surgery Training

For more images of 3D, view *appendix 7.3.*

6.0 REFERENCES

1 URL: <http://www.pharma-lexicon.com/medicalnews.php?newsid=10637&language=spanish>

2 URL: <http://www.3dlinks.com/shop/ProductDescription.cfm?id=304/>

3 URL: <http://www.sirinet.net/ ~jgjohnso/muscle.html>

4 URL: <http://www.bbc.co.uk/science/humanbody/body/factfiles/skeletalsmoothandcardiac/orbicularis_oris_animation.shtml>

5 URL: <http://sv1.3dbuzz.com/vbforum/showthread.php?s=364a1fff9d715f742eb885e2593af995&threadid=39295>

6 URL: <http://www.rapidbase.net/folio/art/anatomy/anatomy.html>

7 URL: <http://www.american.edu/adonahue/m9arm.htm>

8 Nelson Textbook of Pediatrics, 13th edition, Behrman And Vaughan

9 The New Atlas of Human Anatomy, 1999, Thomas A. McCracken

10 Medical Terminology with Human Anatomy, 2004, Jane Rice

11 URL: <http://www.lionden.com/254musclelab.htm>

12 URL: <http://www.3danimation.de/software/3dsmax/3dsmax.html>

13 URL: <http://www.sitepoint.com/forums/printthread.php?t=121504>

14 URL: <http://www.cad-software.org/Designcad-3D-Max.html>

15 URL: <http://www.3dcafe.com/asp/>

16 URL: <http://www.cs.bham.ac.uk/~jxj/2004_2005/Lectures/genesis.pdf>

17 URL: <http://www.3dphoto.net/stereo/world/space/eros1.html>

18 URL: <http://www.adaelectronic.co.yu/~ivanii/o.htm>

19 URL: <http://hem.passagen.se/des/hocg_1970.htm>

7.0 APPENDIX

7.1 The Process of Developing the 3D Product

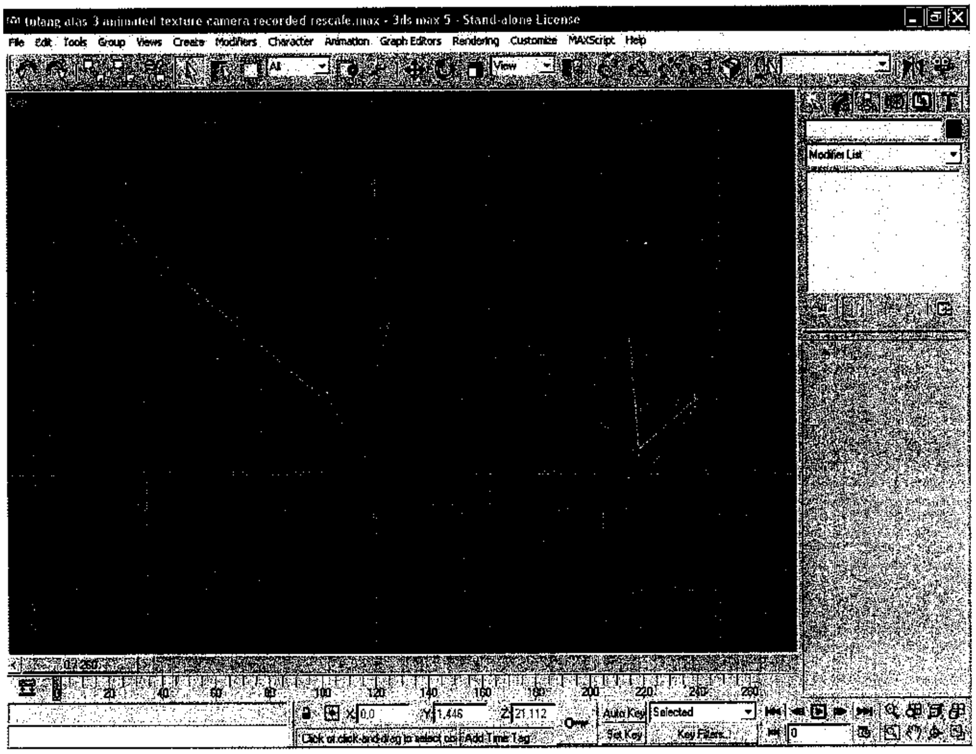

Figure 7.1 The Bones of an Arm

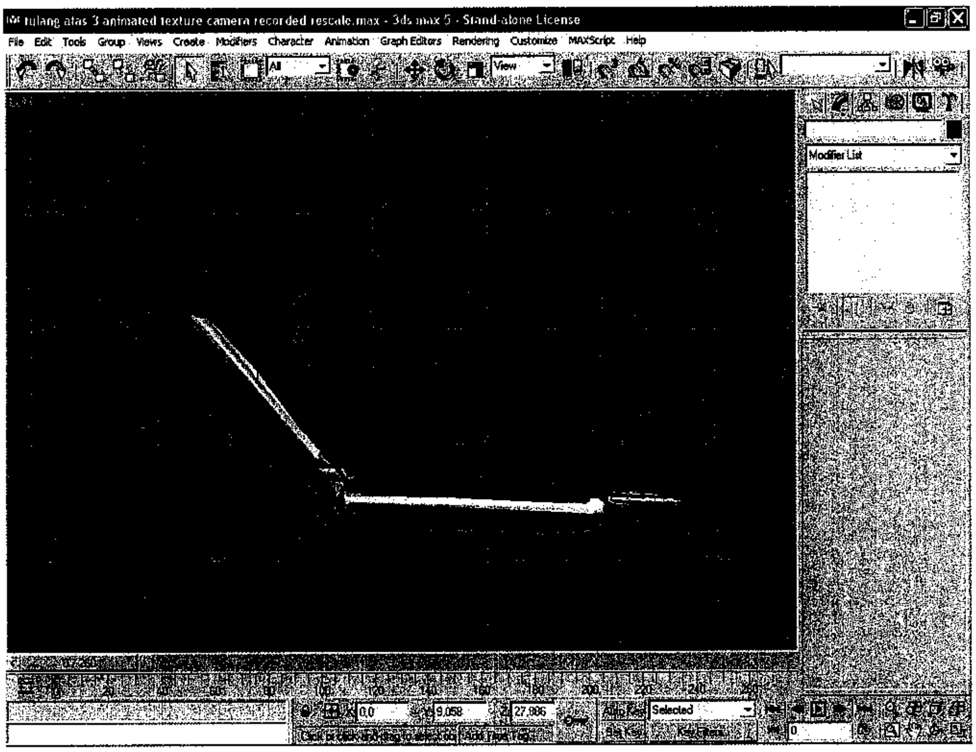

Figure 7.2 The Complete Design of an Arm

7.2 Medical Images on Arms

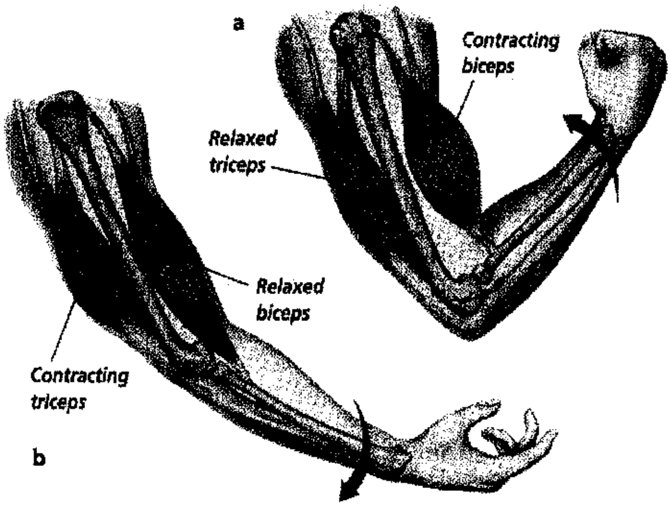

Figure 7.3 The Movements of an Arm

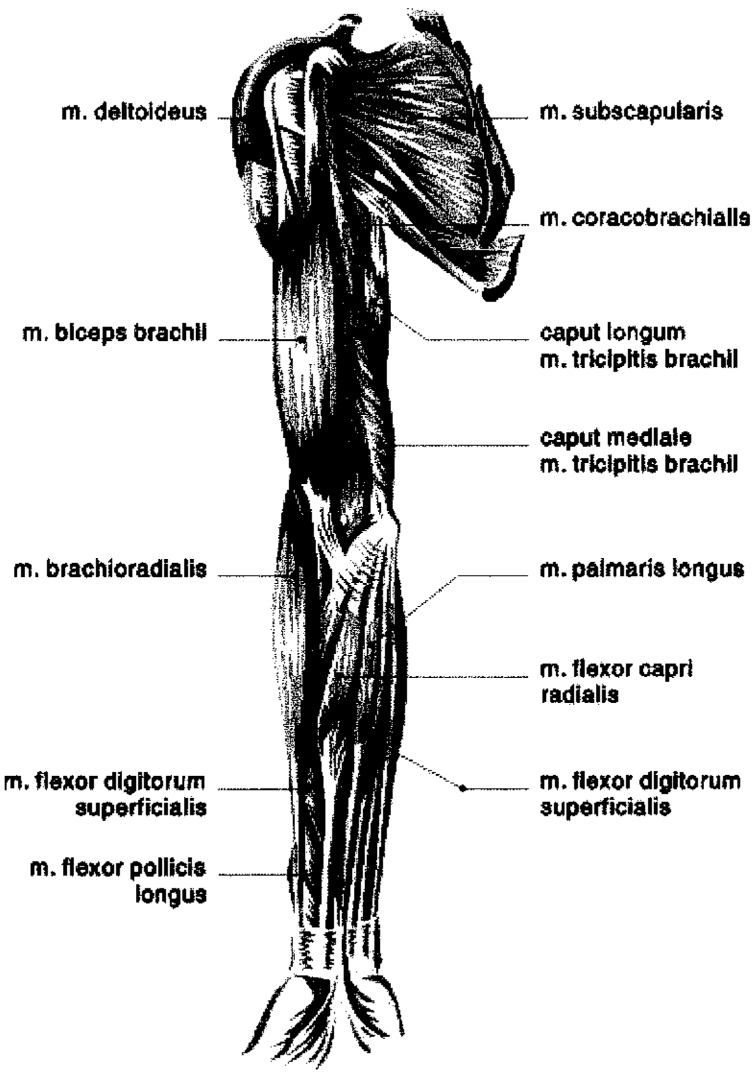

Figure 7.4 The Muscles within the Arm

7.3 Surgery Using 3D (Recommendations)

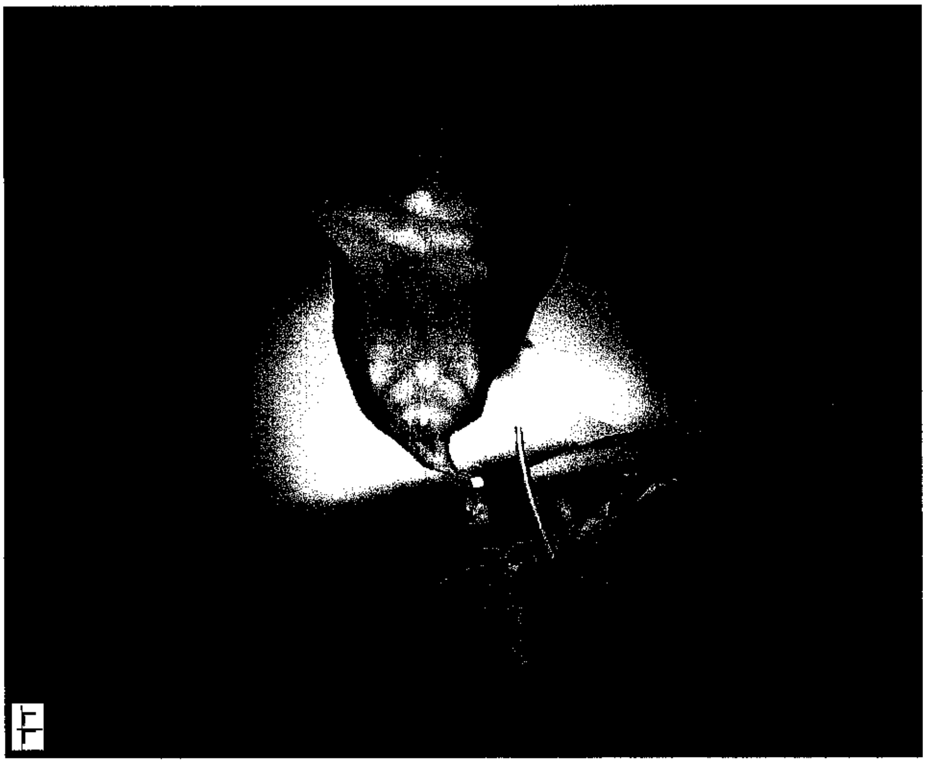

Figure 7.5 3D Surgery

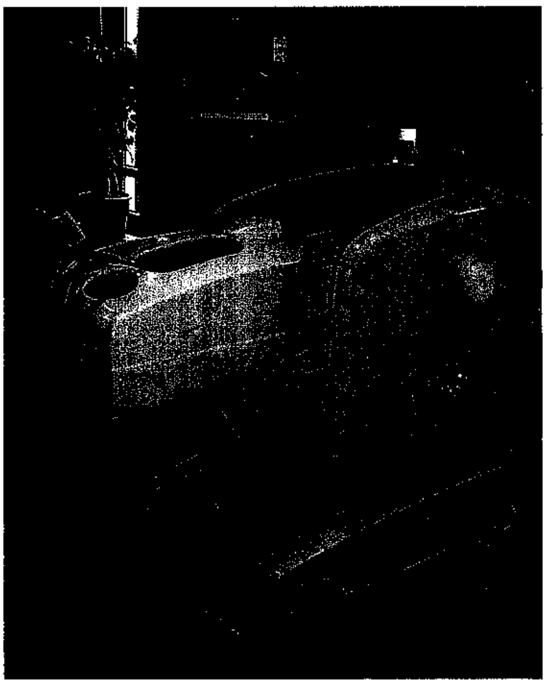

Figure 7.6 Equipment to Perform 3D Surgery

7.4 3D Muscles

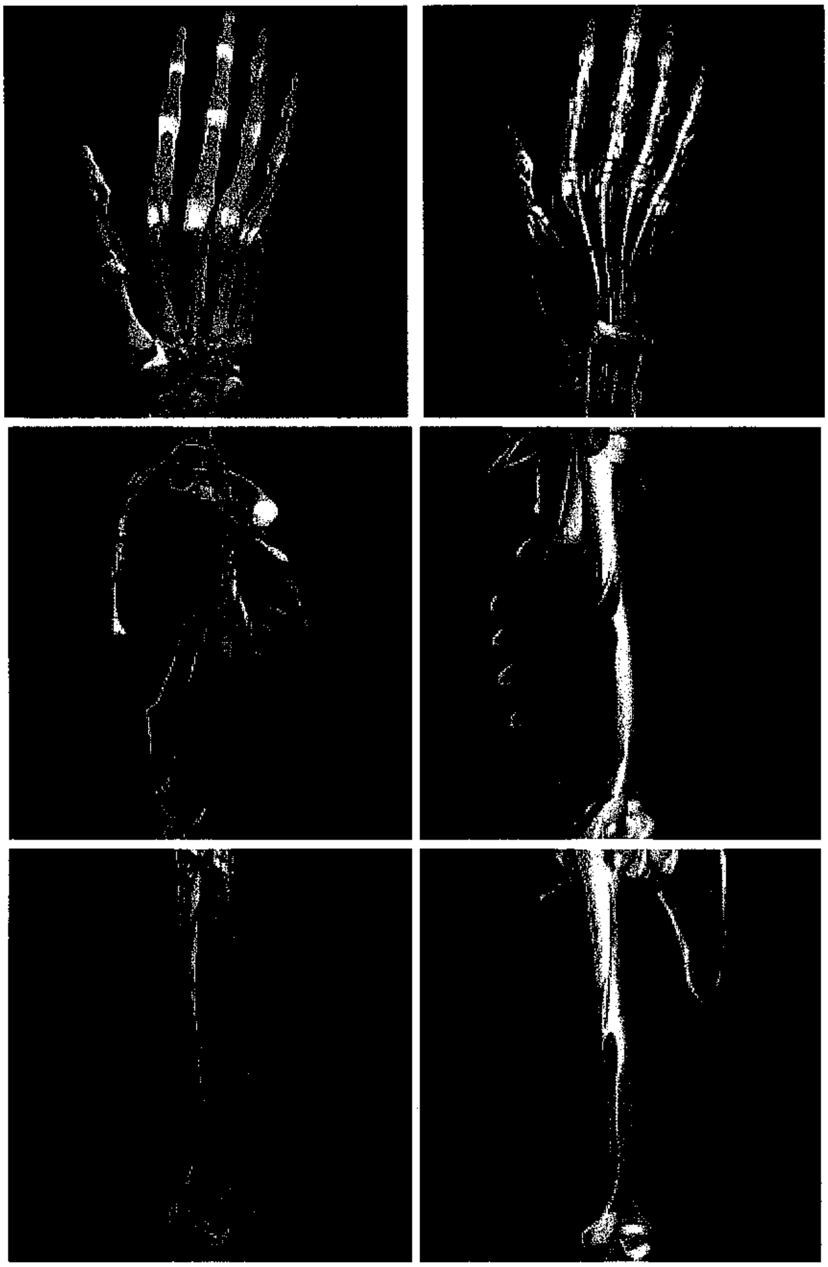

Figure 7.6 3D Images reffered to 3D arm develop System

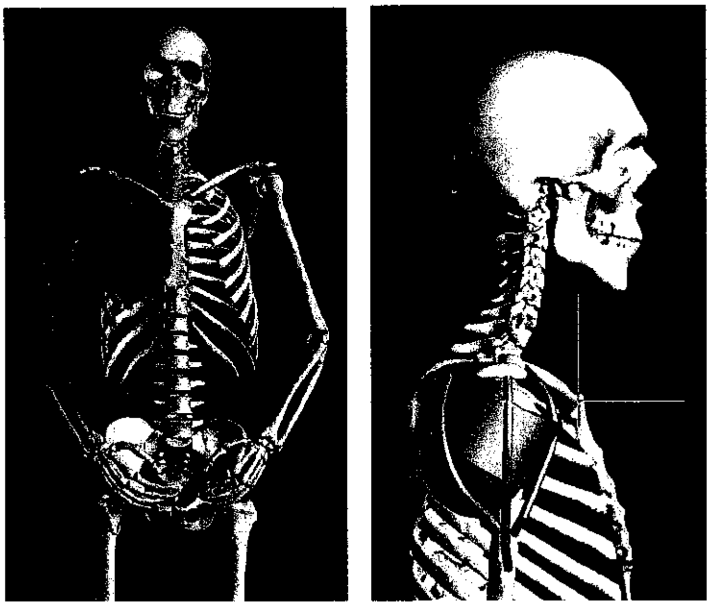

Figure 7.7 3D Images reffered to 3D arm develop System