LAPORAN PROJEK ILMIAH TAHAP AKHIR II
WXES 3182

KIDNEY SIMULATION IN 3 DIMENSIONAL ENVIRONMENTS
-DigiKid-

DENNIS FOONG YEW HAN
WEK 010066
SESI 2003/ 2004

Supervisor

Pn Maizatul Akmar Ismail

This report is proposed to
Faculty of Computer Science and Information Technology
University of Malaya

as part of the requirements for
Bachelor of Computer Science degree

ABSTRACT

DigiKid is a standalone system that promises quick and efficient ways to gain knowledge on kidney anatomy. The entire learning experience is integrated with interactive 3D elements. DigiKid is available will cater the hunger for any individuals especially the non- biology students.

The objectives of DigiKid are to create an interactive learning process in virtual reality environment. The user interface design is target at non- expert computer users to widen the scope of users.

Rapid Application Development model is used to develop DigiKid. The tools involved in the development of DigiKid are 3ds MAX, Adobe Photoshop 7.0, Adobe Premiere Pro, Macromedia Director MX and much more.

It is hope that DigiKid will offer more knowledge and information as well as promote the importance of kidney health to the public. Getting to know kidney problems and diseases will make us aware of the damage done to our body at every second of our life. Quizzes and questions also enable users to determine the level of knowledge gain from the system. Repetitions of studies can be done if there appears to be any dissatisfaction of quiz results.

After all, conducting a learning process offers more benefits than a one way traffic style of education absorption. This is why DigiKid is created; interactive learning experience for all the eager learners out there.

"Life is enjoyed when life is healthy."

ACKNOWLEDGEMENTS

DigiKid's development was carried out along with advises, assistance, contributions and ideas from various people.

First and foremost, I would like to extend my most sincere gratitude to Pn. Maizatul Akmar Ismail, my project supervisor whom has offered me with unlimited support, time and guidance.

Not the least, Mr. Teh Ying Wah, my project moderator deserves as much gratitude for spending precious time to moderate my project and offering opinions that directly contributed towards the success of DigiKid.

Thanks to the staff from the Faculty of Computer Science and Information Technology, University of Malaya for their wonderful co-operation and assistance in the development of DigiKid.

Last but not least, I would like to thank all my wonderful friends and seniors especially Goh Lee Ching, Chan Haw Min, Liew Hoi Ming, Cham Chong Kooi, Goh Ki Wei and Teo Soo Fang for sharing their precious time and knowledge with me. Your motivations and supports are greatly appreciated. Thanks to everyone.

TABLE OF CONTENTS

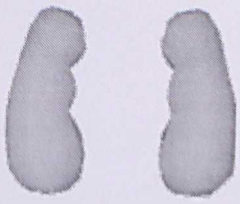
APPENDIX

LIST OF FIGURES

CHAPTER 6

LIST OF TABLES

CHAPTER 3



CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 PROJECT OVERVIEW

The system that will be developed is named as DigiKid which means for digital kidney. DigiKid is a system planned to provide educational information about the importance of human kidney using 3D environment.

The urinary system rids the body's waste materials and controls the volume and composition of the body fluids. Highly specialized cells in the kidneys are essential to these processes. Kidney is among the important parts of the urinary system. The urinary system is composed of paired kidneys and ureters, the urinary bladder and the urethra [1].

Many are aware of the importance of the human kidney but the true fact is that only few know how to protect it from having problems and diseases. The common psychological frameset of mind that most of us have is that kidney problems only occur when someone is in the mid of their life. But this is not at all true because kidney problems strike not accordingly to age but mainly are because of our daily diet.

In parallel to this ignorance and naivety, DigiKid is developed to further equip the community especially the students with the understanding of the human kidney's anatomy, functions, diseases and problems.

The concept of the system is to create an interactive educational sessions for users with the assistance of 3D animations and audio visual effects. Users will experience a multimedia learning style where they are given choices to learn what they are interested within a 3D environment. The visual elements which are developed in a 3D environment will give the users a more realistic idea of what an actual human kidney looks like.

1.2 PROJECT MOTIVATIONS

The rapid advancement of digital multimedia presentations technology for educational purposes has generated a phenomenal increase in the number of multimedia learning tools. This has made digital interactive learning popular and essential. It is well known that learning through mediums that are less interactive such as books are not as efficient compared to interactive mediums. The level of understanding one can get through a book compared to listening to teachers or any other audio visual elements are vast [2].

Learning through digital multimedia elements actually takes the learning process into another whole new world. This is so because learners are exposed to fun and interactive multimedia elements such as 3D animations, audio visual presentations et cetera. Users are also given the flexibility to view the topics which attracted them most as often as possible. Whenever users meet with difficulty in understanding certain subjects of the study, they can easily replay the whole explanation movie within just a click of the mouse button.

Previous or even currently, some higher/ middle educational centers, plastics models are used to teach pupils the functions and anatomy of human kidney. It is hard for all the students to get hands- on experience on these models. This is a disadvantage for them when they are to face with real- life encounter with a human kidney (this refers to the early level students of medicine school). With the assistance of DigiKid, all they need is a personal computer to start exploring the human kidney. For non- medicine school users, DigiKid can help them understand the structure of one of the anatomy in their own body.

1.3 PROJECT OBJECTIVES

DigiKid is an application developed with high visions and true motivations. This educational multimedia learning system fits in for most computer literate users who are interested in knowing and understanding more the structure of the kidney anatomy.

Below are the objectives of the development of DigiKid: -

- **To Develop a System that Brings Knowledge on Human Kidney to Users**

  DigiKid's prime objective is to let users understand more about human kidney and its functions. Explanations will be presented in an interactive lessons style. As many are aware of the importance of kidney, but nonetheless only few know the proper way to lead a healthy kidney. There are even lesser who knows about how kidney problems actually come along.

- **To Create a Multimedia Interactive Learning System in 3D Environment**

  Learning in an interesting environment such as 3D Environment can actually attracts the users to absorb more of the output produced. This also can encourage them to keep on coming back to the system for reference at any time. Interactive Learning that requires users to explore a lot will further imprint the knowledge learnt in the users mind for a much longer period. Audio visual learning with practical presentations is more effective compared to textual learning. Therefore there is always a great advantage for users to learn with an interactive process.

- **To Produce User Interface to Help Users to Navigate through the Learning Sessions**

  The user interface is designed in such a way that users can easily navigate around the lessons without getting lost. Quizzes and questionnaires on lessons learnt will always be there for them to test themselves. Besides that, a friendly user interface will also enlighten the user to explore the system without getting frustrated.

- **To Create Quizzes for Users Self Knowledge Measurement**

  Every lessons included in the system will be accompanied with a set of quiz questions to give the users a chance to test out their understanding on the human kidney. Hints and tips will also be provided along whenever users are lost within the quizzes.

1.4 EXPECTED OUTCOME

DigiKid is expected to achieve the following outcomes: -

- System can perform some basic functions and meet some importance criteria such as stability, consistency, reliability and user friendly.
- System will be able to adapt in the educational purposes environment.
- An interactive, standalone application that provides audio visual specifications such as 3D environment.
- A system that is informative to users who are eager to learn more about the human kidney.
- Quizzes and tutorials that will put the users at test of knowledge obtained through the lessons.
- The final implementation should allow for future enhancement as well as additional modules to extend the system's functionality.
- System able to provide true and interesting facts to users rather than misleading them.

1.5 PROJECT SCOPE

1.5.1 SYSTEM SCOPE

The implementation of this application would be limited to computers with graphical cards and other multimedia elements. This is because the whole system is created in a high specified environment using the latest state- of- the- art tools.

DigiKid will include topics related to the anatomy of human kidney. Scopes that is covered under the human kidney lessons are parts of kidney, functions of kidney, problems arises in kidney and the cause of these problems.

Every lesson will be packed with exciting and fun quizzes to squeeze some juices from users' brain. These quizzes will be very interactive and interesting rather than just normal 'fill in the blanks' style. All these are made possible with the presence of multimedia elements in the system.

1.5.2 USER SCOPE

DigiKid is suitable for users from age 12 and above. As DigiKid is an interactive multimedia system, it is very suitable even for rookie computer user. It doesn't require the user to be well computer literate. The basic requirement is one must be able to use the mouse and keyboard.

1.6 PROJECT LIMITATIONS

Every developer will always try to strive for the best results in the system that they are working on. No doubt that nothing is perfect, yet ambitious individuals will always look far beyond compared to the rest.

DigiKid is developed with great and enthusiastic visions. Yet, somehow there are still some limitations that handicapped it. As there are no databases attached to the system, the quizzes developed in DigiKid are always multiple choices or matching keywords rather than alphanumerical input by users. This is because alphanumerical input would require a key matcher to a list of probable answers from the database and very often this isn't very accurate.

Another limitation that crippled DigiKid's further advancement is the time constraint. Time planning had been scheduled properly to work its way out in order produce the maximum output within the restricted duration of time.

The limitation of knowledge on 3D tools also restricted me to further enhance my animations and environment into a neat piece. As most of the multimedia tools are picked up along the way and the learning time is rather short, therefore the output produce on this issue is quite limited.

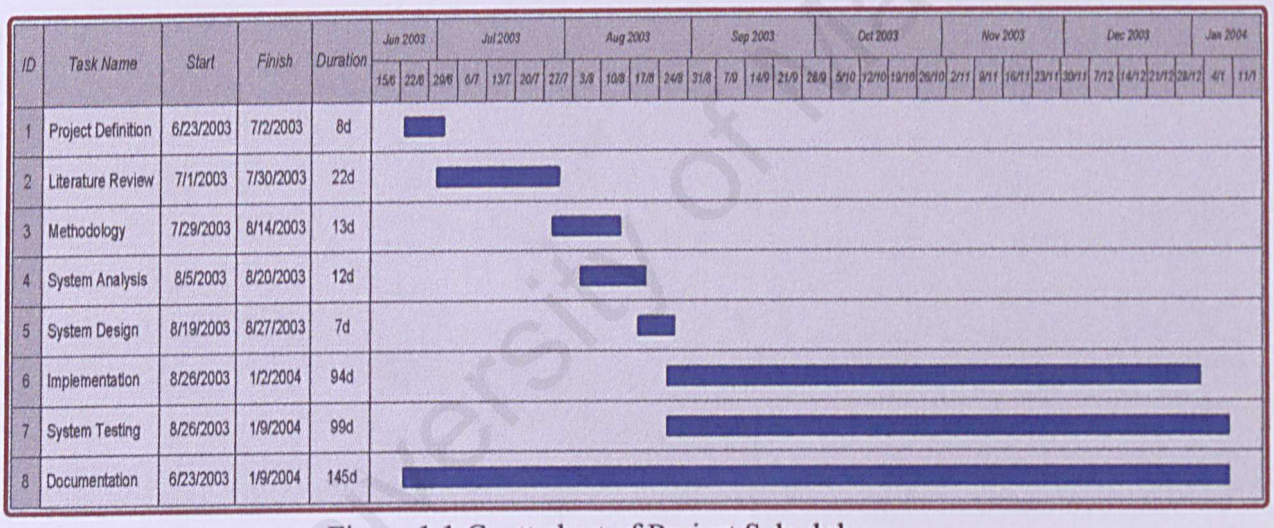
As DigiKid will be built with an English interface, non- English users might face problem understanding the flow of the system. Addition of other languages version will be planned after the first face is released to provide better user coverage.

It is well understood that 3D modeling and rendering requires large sum of storage space. Therefore, limited storage space also constrains the progressive of DigiKid.

1.7 PROJECT SCHEDULE

In developing a system, the following series of activities will be carried out: -

- Project Definition
- Literature Review
- Methodology
- System Analysis
- System Design
- Implementation
- System Testing
- Documentation

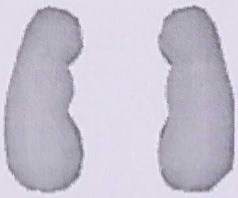


ID	Task Name	Start	Finish	Duration
1	Project Definition	6/23/2003	7/2/2003	8d
2	Literature Review	7/1/2003	7/30/2003	22d
3	Methodology	7/29/2003	8/14/2003	13d
4	System Analysis	8/5/2003	8/20/2003	12d
5	System Design	8/19/2003	8/27/2003	7d
6	Implementation	8/26/2003	1/2/2004	94d
7	System Testing	8/26/2003	1/9/2004	99d
8	Documentation	6/23/2003	1/9/2004	145d

Figure 1.1 Gantt chart of Project Schedule

1.8 SUMMARY

In this chapter, the motivations, objectives, expected outcome, scopes, limitations of DigiKid have been highlighted. Besides that, the time planning of the whole system development process is also reported using a Gantt chart. The whole project started in the mid of June 2003 and will follow a series of development activities in the development process. Series of activities are being matched with their corresponding development stage of software development cycle.



CHAPTER 2 LITERATURE REVIEW

CHAPTER 2 LITERATURE REVIEW

2.1 WHAT IS LITERATURE REVIEW

Literature review is where most of a dissertation's sources are cited. Previous research studies (usually found in professional journal articles) that have contributed to the field in a theme similar to what DigiKid is will be reviewed. In essence, the literature review section serves to plant the seeds that will grow into DigiKid [3].

Literature review is a document containing reports and results of consultations to gather information about the planned project. This report will be categories into few segments, which each will contribute towards the success of the project as well as minimizing problems expected to be encountered. The activities involved in the process of producing a good literature review are facts finding, data analyzing, summarizing of information and services comparisons. These activities help to give a strong effect on the overall project development.

Literature review's main strength is to create a trust and confident to the readers regarding the developer's knowledge and understanding of the system. Readers will be able to get a clearer picture of reasons behind each action and decision taken in every phases.

2.2 WHY LITERATURE REVIEWS

The goals of a literature review have been defined as:-

1. **To demonstrate a familiarity with a body of knowledge and establish credibility.** A review tells a reader that the researcher knows the research in an area and knows the major issues. A good review increases the reader's confidence in the researcher's professional competence, ability, and background.
2. **To show the path of prior research and how a current project is linked to it.** A review outlines the direction of research on a question and shows the development of knowledge. A good review places a research project in a context and demonstrates its relevance by making connections to a body of knowledge.
3. **To integrate and summarize what is known in an area.** A review pulls together and synthesizes different results. A good review points out areas where prior studies agree, where they disagree, and where major questions remain. It collects what is known up to a point in time and indicates the direction for future research.
4. **To learn from others and stimulate new ideas.** A review tells what others have found so that a researcher can benefit from the efforts of others. A good review identifies blind alleys and suggests hypotheses for replication. It divulges procedures, techniques, and research designs worth copying so that a researcher can better focus hypotheses and gain new insights.

2.3 DOMAIN STUDIES

This chapter covers the information of human kidney with its functionality and problems related to it. Existing systems and web portals providing information of kidney are also put into study for further understanding of creating an interactive kidney learning package. Strengths and weaknesses of each information portals will be reviewed in detailed. Besides that, possible tools are studied in-depth to ensure the best results produced at the end of the day.

2.4 KIDNEY

2.4.1 WHAT IS A KIDNEY? FUNCTIONS AND HEALTH IMPACT

Everyone has two kidneys. They are in the middle of the abdomen in the back and they are the size of a fist. They drain into two tubes called the ureters, which lead into the bladder [4].

Below is the summary of the functions of human kidney and its impact towards human health extracted from conversation with Dr. Chan See Fong [5], a practicing urologist from Elizabeth Hospital, Hong Kong.

The kidney is the main organ responsible for regulating the body's internal equilibrium or the balance of all of our chemicals and whatever we eat and the waste products are excreted in the kidney. Without the function of the kidney, we could not regulate the levels of electrolytes, hormones and fluid balance. We would be like fish out of water.

The main function of the kidney is to excrete wastes that we produce from our diet and metabolism. The kidney also controls the composition of body fluids and produces a number of hormones that deal with body functions. These are accomplished by blood filtering within the kidney. The amount of blood filtered through the kidney is at an unimaginable amount; an average human filters about two hundred quarts of blood through the kidneys each day, and from this amount two quarts are reabsorbed, which is the urine.

The kidneys are involved in minute- to- minute regulation of body fluids, so if a large quantity of fluid is not processed, one cannot keep up with the changes that normally occur in the body. It is very important that a large quantity of fluid be processed, and that is the only way the kidney can control the minute-to-minute regulation. Another way of thinking about it is, every time the heart beats, twenty percent of the blood flow goes directly to the kidney, which means it receives more blood flow than any other organ in the body.

Figure 2.1 Blood vessels in a kidney

Figure 2.1 shows the human body's intricate blood supply that is demonstrated in dramatic detail by this special treatment. The blood vessels in a kidney are injected with coloured epoxy resin (red for the artery and blue for the vein). The surrounding tissue then eroded away. The ureter, a tube linking kidney and bladder is shown here in yellow [4].

In addition to filtering waste from body, the kidneys also regulate electrolytes in the body system. Suppose one drink a bottle of orange juice, the body sees a sudden excess of an electrolyte, so the kidney has sensors that look at the body fluid going through the kidney as plasma, and it detects that the plasma's potassium has gone up, and it immediately increases the excretion of potassium so everything returns to normal. Moreover, that is just one electrolyte that the kidney controls. There are at least a hundred elements and electrolytes that are controlled by the kidney.

Kidney controls the number of red cells in the body. It has sensors that look at the oxygen content of the blood flowing through it, and if it detects that the oxygen concentration is low, it makes a hormone that increases the bone marrow's production capacity to make more red cells. The hormone level is critically important in people with normal kidney function, and people who have failing kidneys do not make this hormone, so one of the features of chronic kidney disease is the anemia that develops. Patients feel horribly fatigued and are unable to make red blood cells. The pharmaceutical industry has cloned the genes to make this hormone, and this medication replaces the natural hormone.

2.4.2 IDENTIFYING KIDNEY FAILURE

Approximately 20 million people are affected today by kidney and urinary tract diseases, and more than 50,000 people die each year as a result of these diseases [6].

Kidney failure can exist for long periods before making itself known. It is possible, for instance, to lose as much as 75% of your normal kidney function before becoming aware that kidney failure is present.

The kidney is directly responsible for controlling the acidity of blood, and as the kidney fails, blood becomes more acid. The kidney makes a hormone that regulates our red blood cells, and during the process of chronic kidney failure, the hormone fails and we do not make enough red blood cells. The symptoms of this red blood cell deficiency are anemia, fatigue, sleepiness and poor concentration, none of which is unique to kidney disease. Therefore, troubles with these symptoms are faced because they overlap. Anemia symptoms and kidney disease symptoms look alike. We can treat the anemia symptoms by replacing the hormone. Once we do that, many of the symptoms of kidney disease largely disappear until the illness is very far advanced.

We have a tremendous amount of reserve in the kidneys before any symptoms manifest, and typically, we do not see patients come in with any problems until they are down to about 25 or 30% of normal kidney function. The second issue is that the symptoms that accrue from kidney damage are so vague that one might easily ascribe it to something like depression or fatigue from working too hard, and in reality there is a lot of

damage being done in the kidney that could lead to many problems like high blood pressure and anemia. Again, it is difficult to detect.

A general practitioner will typically do screening blood work. A marker called the serum creatinine is used, which is a general gauge of kidney function. When that number is elevated, then the general practitioner might suspect that there is something awry with the kidneys.

Another screening test the general practitioner could use would be urinalysis, where they look for the presence of protein or inflammatory cells. Sometimes the blood work, in addition to the creatinine, might give the practitioner a clue that there is a problem. The serum protein level, the albumin, might be reduced, or the lipid levels or cholesterol might be elevated. All could be features of subtle kidney disease.

These are routine screening tests. The standard blood work done in a regular check-up should look for an index of kidney function, as well as liver function and the blood count and things of that sort.

If a person feels perfectly and suddenly feels run down, tired, or weak, they should definitely seek help from a practitioner. Kidney failure could be the cause for all this. If there is pain in the flanks where the kidneys are, if there is pain down there and it is recurrent and disabling, one should definitely go to a doctor, because there could be a stone sitting there, causing progressive kidney damage.

If one have a burning of the urine, if one feel scratching in the skin, these are some of the signs, or one have lost appetite out of the blue, for no reason, or not able to concentrate.

Besides those mentioned above, all these symptoms could relate to kidney problem: -

A person might urinate more frequently at night, or their ankles might be swollen, or the screening test will have shown that their blood pressure is mildly elevated. Those could be the first presentations of some subtle form of kidney disease.

Unfortunately, the kidneys are essential organs for life, and if left untreated, a patient would die. However, in the last 30 years there is a technique called dialysis or transplant that acts in place of our own kidneys. With dialysis, patients can maintain life with reasonable quality, but not normal quality, because they are dependent on an artificial means of kidney replacement. Still, they can live reasonable lives.

Transplantation is the treatment of choice for kidney failure, but unfortunately, because of organ shortages, transplants cannot be provided for everyone. At this point, the number of transplants done in the United States has been stable for a decade. About 9,000 per year and that are dependent on a shortage of kidney donors. In addition, despite public awareness programs, it is hard to raise that number.

2.4.3 KIDNEY PROBLEMS AND CAUSE

For the past centuries, urologist and nephrologists are working hard to identify the problems one can faced with their kidney. Throughout this literature review process, few common problems are identified and will be shared in the system for public's knowledge. The few common problems are as of listed below: -

- Acute Pyelonephritis
- Chronic Renal Failure (CRF)
- Focal Segmental Glomerulosclerosis (FSGS)
- Acute Glomerulonephritis
- Kidney Stone

2.4.3.1 ACUTE PYELONEPHRITIS

Each year, an estimated 250,000 persons in the United States consult physicians for acute pyelonephritis, which often necessitates hospitalizations [7]. In United States, there were 831 deaths due to infections of the kidney in 1997 for an annual death rate of 0.3/100000. Acute Pyelonephritis occurs more frequently among women than men and pregnant and diabetes are important risk factors [8].According to a study did in 1997, females are five times as likely as males to be hospitalized for acute pyelonephritis (11.7/10000 vs2.4/10000), but males had higher mortality rates (16.5/1000 vs7.3/1000). Acute pyelonephritis occurs most often as a result of ascending infection from the bladder to the kidney parenchyma [8]. Bacteria can travel from the vagina or anus into the urethra and bladder. Because the location and size of their urethra, women are more prone to have bladder infections than men are. In both men and women, lower urinary tract infections may spread to the kidneys, causing pyelonephritis. Clinical manifestation include fever, flank pain and costovertebral angle tenderness that may be accompanied by symptoms of cystitis (frequent and painful urination). It can be serious because of the important function of the kidneys and because the infection may enter bloodstream. In women who are pregnant, it may cause premature labor. [9]

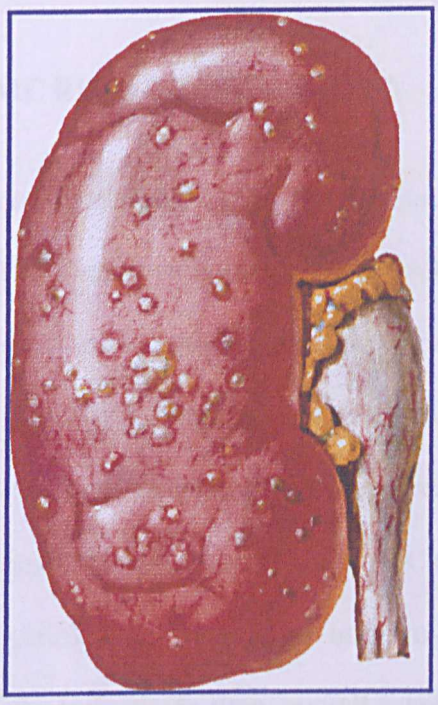


Figure 2.2 Surface aspect of kidney: Multiple minute abscesses [9].

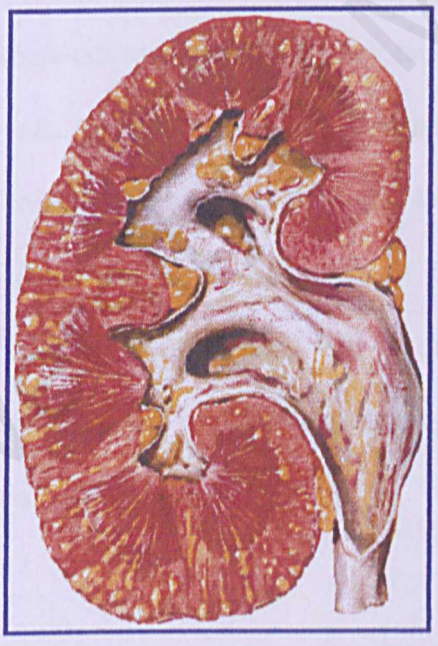


Figure 2.3 Cut Section: Radiating yellowish gray streaks in pyramids and abscesses in cortex; moderate hydronephrosis with infection; blunting of calyces (ascending infection) [9].

2.4.3.2 CHRONIC RENAL FAILURE (CRF)

Chronic renal failure (CRF) is the progressive loss of kidney function. The kidney attempts to compensate for renal damage by hyperactive filtration (excessive straining of the blood) within the remaining functional nephrons (filtering units that consist of a glomerulus and corresponding tubule). Over the time, hyperactive filtration causes further loss of function. Chronic loss of functions will cause shrinking in kidney size and progressive scarring within all parts of the kidneys. In time, overall scarring obscures the site of the initial damage. However, it is often not until over 70% of the normal combined function of both kidneys is lost that most people begin to experience symptoms of kidney failure. The causes of CRF sometimes can be determined by a detailed medical history, a comprehensive physical examination and laboratory studies. More often than not, determining the cause of CRF is difficult if not impossible. Even a kidney biopsy may be inconclusive, because all forms of kidney failure eventually progress to diffuse scarring and look the same on kidney biopsy [10].

2.4.3.3 FOCAL SEGMENTAL GLOMERULOSCLEROSIS

Many cases of kidney disease in the United States are linked to other serious medical conditions like high blood pressure or diabetes. However, there are also forms of kidney disease that strike without clear cause and have serious repercussions. One of such disease is focal segmental glomerulosclerosis (FSGS) [11]. This illness attacks the glomerulus or the main filtering part of the kidney. There are two forms of FSGS and they both cause protein to leak into the urine. Over time, the protein acts as a toxin that injures the remaining parts of the nephrons. The rate of the resulting damage fluctuates from patient to patient. For some it is progressive and slow, in others it is rapid. In any case, the damage leads to kidney failure, which requires dialysis or transplant.

Comparing with all the diseases that cause kidney failure, FSGS is not common. Nevertheless, it is one of the most common causes of nephrotic syndrome or leakage of protein from the kidneys to the urine. FSGS largely affects males and in United States, it affects African American more than white Americans. It has some association with illicit drugs use and HIV and AIDS and it is associated with obesity, urinary tract infections and mechanical reflux of urine from the bladder into the uterus. FSGS is first identified by detecting protein in the urine. Equally common is the patient who presents with body swelling because of salt and water retention. Patients are also diagnosed with high blood pressure and

not commonly, FSGS can progress without any symptoms causing kidney failures. Currently, the illness could not be cured by present medications but the patient can be placed in a clinical remission. A responder would be someone whose blood pressure is well controlled and the protein in the urine is eliminated. When this happens, it is hoped that the patient can sustain the remission for a long period. One of the unknown variable is, how long should the patient be treated. It is the subject of much research but there are not a lot of answers yet.

2.4.3.4 ACUTE GLOMERULONEPHRITIS (AGN)

Acute Glomerulonephritis is an inflammatory disease of both kidneys predominantly affecting children from ages 2 to 12 [12]. Chronic glomerulonephritis can develop over a period of 10- 20 years and is most often associated with other systemic disease, including diabetes, malaria, hepatitis or systemic lupus erythematosus. It is an inflammatory of the glomeruli, bundles of tiny vessels inside the kidneys. The damaged glomeruli cannot effectively filter waste products and excess water from the bloodstream to make urine. The kidney appears enlarged, fatty and congested.

AGN most often follows a streptococcal infection of the throat or skin. In children, it is most often associated with an upper respiratory infection, tonsillitis or scarlet fever. Kidney symptoms usually begin two or three weeks after initial infection. Exposure to certain paints, glue or other organic solvents may also be the causative agent. It is thought that the kidney is damaged with exposure to the toxins that are excreted into the urine [13]. Severe AGN may exhibits symptoms like fatigue, nausea and vomiting, shortness of breath, disturbed vision, high blood pressure, swelling especially noted in face, hands feet and ankles, blood and protein in the urine, resulting in a smoky or slightly red appearance [14].

2.4.3.5 KIDNEY STONE

Kidney stone disease or nephrolithiasis or renal stone disease or urinary lithiasis is a common disorder involving around 10 percent of the United States population [15]. When waste materials in the urine do not dissolve completely, crystals or kidney stones are likely to form.

Small stones can cause some discomfort as they pass out of the body. Regardless of its size, stones may pass out of the kidney, become lodged on the ureter and cause severe pain that begins in the lower back and radiates to the side or groin. A lodged stone can block the flow of urine, causing pressure to build in the affected ureter and kidney. Increased pressure will cause stretching and spasm, which creates severe pain [15]. There are four most common types of stones, which comprised of calcium, uric acid, struvite and cystine. Most commonly, kidney stones have some form or type of calcium. In fact, more than 70% of kidney stones have some type of calcium component. These may be so-called calcium oxalate or calcium phosphate stones or some mixture of these two types [12].

There are three common causes for kidney stones [6]. They include hyperactive calciuria. This is kidney producing urine that has too much calcium. It may be due to absorption of too much calcium from the intestines and the bloodstream or it may be due to the kidney allowing too much calcium to be leaked into urine.

Regardless of the mechanism, what happens is that there is too much calcium in the urine and as a result, a crystal forms. This crystal represents a kidney stone. Another reason why kidney stones form is that the kidneys may actually allow too much of the substance called oxalate in the urine. Oxalate is an important substance in the urine that contributes to the formation of a stone when there is an overabundance. Another common cause for kidney stones to form is kidneys allow too much uric acid in the urine and as a result, uric acid stone formation is much more likely.

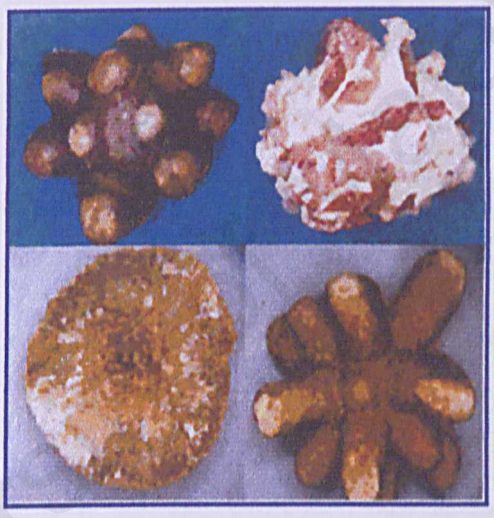


Figure 2.4 Samples of kidney stones [16]

2.5 MULTIMEDIA

Multimedia is more than one concurrent presentation medium (for example, on CD- ROM or a website). Although still images are a different medium than text, multimedia is typically used to mean the combination of text, sound and/ or motion video.

Multimedia can be arguably be distinguished from traditional motion pictures or movies both by the scale of the production as multimedia is usually smaller and less expensive. The possibility of audience interactivity or involvement makes the interactive multimedia. Interactive elements can include; voice command, mouse manipulation, text entry, touch screen, video capture of a user or live participations.

Multimedia tends to imply sophistication in both production and presentation than simple text and images. Multimedia presentations are possible in many contexts including the web, CD- ROMs and live theatre. A rule of thumb for development cost of a packaged multimedia production with video for commercial presentation is USD1000 a minute of presentation time. Since any web site can be viewed as a multimedia presentation, however, any tool that helps develop a site in multimedia form can be classed as multimedia software and the cost can be less than for standard video production. For multimedia websites, popular multimedia players include MPEG, QuickTime and Shockwave.

2.6 VIRTUAL REALITY

Virtual reality is the simulation of a real or imagined environment that can be experience visually in the 3 dimensional of height, width and depth. Virtual reality simulation of a real environment like the interior of a building or a spaceship often is with the purpose of training or education. It is usually a development of an imagined environment, typically for a game or educational adventure.

2.6.1 3D GRAPHICS

3D graphics are developed to give the audience a perception of depth. The experience of interactive 3D animations is known as virtual reality.

2.7 SYSTEM ARCHITECTURES

Overall, there are a few types of system architectures available and each promises different advantages as well as disadvantages. These architectures work well accordingly to the type of system that will be developed.

2.7.1 WEB- BASED APPLICATIONS

Web- based applications are developed and being executed on the internet. It involves the participations of servers and clients. Clients can access to permitted information from the server even though he is in a distance using the World Wide Web [17].

The advantages of web- based applications are: -

- Accessible from almost anywhere with internet access
- Information updating is easy as it is done on the server side
- Requires common software on the client side; web- browsers
- Various types of information can be stored with various methods

The disadvantages of web- based applications are: -

- Hard to be maintained with complicated programming
- Have to maintain a server
- Vulnerable to hackers even though password protected
- Dependent on World Wide Web; almost useless in places with no internet access
- Information loaded to the web is very limited in term of size

2.7.2 STANDALONE APPLICATIONS

Standalone applications are systems that run locally on the users' computer. The whole application resides in the user's computer and it usually does not support connectivity of data. Either developer will have to distribute the application or users will have to download it from a specific website. Therefore, the distribution of the system is rather flexible and is not single media dependant like the web- based applications. Systems can be written into compact discs, flash drives, zip drives et cetera.

Another way that developer can use to support software updates is by creating an intelligent update agent that will automatically patch into the existing application. The drawback with this method is the size constraint for web downloading [17].

The advantages of standalone applications are: -

- Resides totally on the users' computer
- Independent and works without any technical limitations
- Various ways of distribution are supported
- No server side programming required
- Information can be in multiple format

The disadvantages of standalone applications are: -

- Software update requires redistribution
- Dependent on practical limitations (hard disk size)
- Requires installation on the users' computer

2.8 DEVELOPMENT TOOLS

There are a few categories of tools that need to be used to produce an interactive 3D kidney simulation. The categories are: -

- 3D modeling tools
- Raster graphic tools
- Video production/ Codec for animation files
- Playback developer applications

Each category of tools will be studied in detailed to provide a better understanding its strength and weaknesses.

2.8.1 MAYA COMPLETE 4.5

Figure 2.5 Maya Complete 4.5 by Alias Wavefront [18]

Maya Complete™ is used to make the foremost 3D content creation tools accessible to a broad range of computer graphics professionals in the film, broadcast, industrial design, visualization, game development and Web design industries. It is the leading full 3D production solution.

It includes features for: -

- Intuitive User Interface
- Modeling
- Animation
- Visual Effects
- Brush- Based Technology
- Rendering

2.8.1.1 SYSTEM REQUIREMENTS FOR MAYA COMPLETE 4.5

The software requirements for Maya to run on a personal computer are: -

- Microsoft® Windows® XP Professional or
  Microsoft® Windows® 2000 Professional or
  SGI® IRIX® 6.2.15 or
  RedHat™ Linux® 7.3 or 8.0 or
  Apple® Mac® OS X 10.2.4 or higher
- Microsoft® Internet Explorer® 4.0 or higher or
  Netscape® 7.0 or higher

The hardware requirements for Maya are: -

- Intel® Pentium® II or higher or AMD Athlon™ processor
- 512 MB RAM
- CD- ROM
- Hardware-Accelerated OpenGL® graphics card
- 3-button mouse with mouse driver software
- 450 MB of hard disk space

2.8.1.2 OPINIONS ABOUT MAYA COMPLETE 4.5

Maya is the 3d application of choice for large studios. It handles large and complex scenes well without losing stability, has perhaps the most built-in features and refined toolsets, is highly customizable, but is also fairly difficult to learn for the average 3d user. It has excellent NURBS modeling, advanced sub-division surfaces and stable Booleans for polygons or NURBS. Maya is node-based, making linking and connection of node attributes (such as shader/ texture elements, animation controls, and the like) very graphic and artistic. Maya has excellent character rigging and animation tools. Its dynamics and particle options are incredible [18]. On the downside, Maya's internal built-in renderer is not particularly good. Though it is fully capable of producing very high quality images, the renderer has bugs, is rather slow even though the main application is quite stable. Maya is also quite difficult to learn for many. However, with its unbelievable power, Maya is a great choice for 3D simulation development [19].

2.8.2 3DS MAX 6

Figure 2.6 3DS Max 6 by discreet [20]

3ds max 6, the world's most widely used professional 3D modeling, animation and rendering solution, offers the ultimate professional 3D tools required for creating eye-catching visual effects, cutting edge games, and distinct design visualizations.

It comes with various features to enhance its popularity among 3D designers internationally [20]: -

- Animation
- Modeling
- Texture Mapping
- Rendering
- Lighting
- Games Support
- Cameras
- Materials and Mapping
- Viewport Interaction
- MAXScript®

2.8.2.1 SYSTEM REQUIREMENTS FOR 3DS MAX 6

The software system requirements for 3DS Max 6 to run smoothly are: -

- Microsoft® Windows® XP Professional or
  Microsoft® Windows® XP Home
  Microsoft® Windows® 2000 Professional (service pack 3)
- Microsoft® Internet Explorer® 6 or above
- DirectX® 8.1 (DirectX 9.0 recommended)

The hardware requirements for 3DS Max are: -

- Intel® or AMD® based processor at 300 MHz minimum (Dual Intel® XeonTM or dual AMD AthlonTM system recommended)
- 512 MB RAM (1GB recommended)
- Graphics card supporting 1024 x 768 x 16-bit colours with 64MB RAM with OpenGL and Direct3D hardware acceleration supported (3D graphics accelerator 1280 x 1024 x 24-bit colours with 256MB RAM preferred)
- 3-button mouse with mouse driver software
- CD- ROM
- 500 MB of hard disk space (2 GB recommended)

2.8.2.2 OPINIONS ABOUT 3DS MAX 6

3DS Max is expected to be easier to learn than most applications, packed with features and excellent polygon modeling tools and very useful tools for video game model-design. When combined with Brazil R/S (a rendering application), 3DS Max can produce incredible still image and animation results that are hard if not impossible to beat. By itself (with its built-in scanline renderer), render output is fair at best and animation output is plagued with quality issues such as pixel jitter, pixel crawl, and pixel roping. If 3DS Max is going to be used for anything other than simple colour logo animations or design, it is strongly recommended to use the Brazil plug-in renderer. When combined with Character Studio (an expensive plug-in character design/animation package), 3DS Max has superb character features. The downside to 3DS Max is that it is perhaps the least stable of the pro applications and nearly impossible to use for ultra-complex or high-detail scenes (for example, it will become corrupt or unstable when dealing with photorealistic animations involving many elements or complex highly detailed models). Obviously, even if a quality renderer such as Brazil is used, if the primary 3DS Max application often crashes or becomes unstable when working with complex scenes it is impossible to get the work to the renderer. 3DS Max has a huge number of plug-ins available to it, including many other renderers such as VRay (which shows some promise) and FinalRender. FinalRender is an inexpensive renderer that builds upon 3DS Max's scanline renderer

adding many great new features, but thus carries over some of 3DS Max's inherent flaws such as animation artifacts and jitter. When interfaced to RenderMan, such as through MaxMan or even Entroy's own Max-to-RIB translators, 3DS Max does export NURBS as true surfaces providing perfectly smooth curves and edges at any resolution. 3DS Max 6 now includes built-in global illumination (GI) and enhanced ray tracing sufficient to produce beautiful still renderings. To avoid motion artifacts when producing broadcast quality high-contrast photorealistic video it is most likely that Brazil's advanced adaptive sampling abilities will be needed [19].

2.8.3 LIGHTWAVE 3D SEVEN

Figure 2.7 LightWave 3D SEVEN by NewTek [21]

LightWave 3D® is versatile enough to make the transition to and from all kinds of projects. Proven for years in television, film, and games, LightWave 3D® is also being used to create graphics for print, web, industrial design, architecture, medical imaging, and anywhere else a 3D package is needed. A full, robust program, LightWave 3D® includes many of the tools that other packages require to be purchased separately. LightWave 3D® ships with all the tools an artist needs to create [21].

Its features include the following: -

- Animation
- Rendering
- Layout Workflow and User Interface Enhancements
- Modeling Tools
- Modeler Workflow and User Interface Enhancements
- SDK- LScript

2.8.3.1 SYSTEM REQUIREMENTS FOR LIGHTWAVE 3D®

The software requirements for LightWave 3D® are: -

- Microsoft® Windows® 98 or

  Microsoft® Windows® Me or

  Microsoft® Windows® 2000 or

  Microsoft® Windows® NT 4 (Service Pack 6a) or

  Microsoft® Windows® XP Professional

  Microsoft® Windows® XP Home

  Power Macintosh Processor (G3 or higher recommended)

  Mac OS 9

  Mac OS X (recommended)

The hardware requirements for LightWave 3D® are: -

- 128 MB RAM for Windows® based operating systems

  384 MB RAM for Mac OS 9

  128 MB RAM for Mac OS X

- 32 MB of hard disk space
- CD- ROM
- Minimum screen resolution of 800 x 600
- TCP/IP Network Protocol Installed

2.8.3.2 OPINIONS ABOUT LIGHTWAVE 3D®

In some ways, LightWave 3D® is the best all-around solution available. It is stable, can deal with large complex scenes, has a full suite of toolsets, and is very affordable. Its built-in renderer is the best of any 3d application's built-in renderers except for SoftImage's MentalRay, usable for production right out of the box. Rendering options now include advanced features such as global illumination. LightWave 3D® is relatively easy to learn, is divided into modeling and animation packages (both a pro and a con, but mostly a pro), and well supported. The downside is that its motion blur is not the best by a long shot and advanced renderer features such as global illumination are unusually slow. Still, if the needs are not as extravagant as high-end film effects then it is advised to buy LightWave 3D®. Another downside to LightWave 3D® is a lack of support for RenderMan. There is an independent LightMan RIB exporter, but due to LightWave 3D®'s internal structure that many advanced RenderMan features are non-attainable. For example, there is no way to export sub-division surfaces as true curves, meaning RenderMan will receive polygonal curve/edge approximations only [19].

2.8.4 BRYCE® 5

Figure 2.8 Bryce 5 by Corel [22]

Corel Bryce® 5 can be used to create realistic 3D landscapes and animations. Striking an optimum balance between power and ease of use, this innovative software is an ideal way to integrate 3D technology into creative process. Smooth Network Rendering, and new Light and Tree Labs let users open new worlds of creativity.

The features included in the Corel Bryce® 5 package are: -

- Network Rendering
- Tree Lab
- Enhanced Terrain Editor

2.8.4.1 SYSTEM REQUIREMENTS FOR BRYCE® 5

The software requirements for Bryce® 5 are: -

- Microsoft® Windows® 2000

  Microsoft® Windows® XP Professional

  Microsoft® Windows® XP Home

The hardware requirements for Bryce® 5 are: -

- Pentium® processor (200 MHz or higher)
- 64 MB RAM for Microsoft Windows® 2000

  128 MB RAM for Microsoft Windows XP
- 800 x 600 x 256 colour SVGA monitor
- CD-ROM
- Mouse or Tablet

2.8.4.2 OPINIONS ABOUT BRYCE® 5

In true fact, Bryce® 5 is the best tool for creating landscape views and 3D scenery. Therefore, it is always the best choice for developing amazing results for backgrounds. Bryce® 5 is a component- based application where it supports a lot of drag and drop features which enables even beginner to master it within the shortest period.

One important feature that Bryce® 5 lacks of is the NURBS modeling option. This makes it a less advisable application for character modeling. The job functions that run around within Bryce®5 is rather simple and it require no further knowledge of 3D programming.

Even though there is a setback for Bryce® 5 without NURBS modeling, it however comes with a wonderful feature. The feature is Metaballs modeling. Metaballs works by joining multiple organic shape objects using anti- aliasing and smooth algorithm. This makes Bryce® 5 simple and easier to use when it comes to modeling low-poly character. The renderer within Bryce® 5 is among the best of the built-in renderer. It can render at a fast speed besides producing excellent quality still and animated images.

2.8.5 WINGS 3D RELEASE 0.98.15a

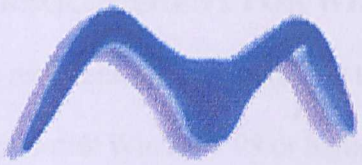


Figure 2.9 Wings 3D by SourceForge [23]

Wings real strength is in modeling. There is currently rudimentary support for assigning materials on a per-face basis. There is also support for vertex colours. Models can be textured with an experimental plug-in (AutoUV).

Currently, Wings 3D exports to the following formats: -

- Nendo (NDO)
- 3DS Max (3DS)
- Maya (OBJ)
- VRML (WRL)
- RenderMan (RIB)
- Hash, Animation Master (MDL)
- PovRay 3.5

The files imported by Wings 3D: -

- Nendo (NDO)
- 3DS Max (3DS)
- Maya (OBJ)
- Adobe Illustrator 10.1 (AI)

2.8.5.1 SYSTEM REQUIREMENT FOR WINGS 3D

The software requirements for Wings 3D to run are: -

- Microsoft® Windows 98 or higher

  Macintosh OS X

  UNIX

- OpenGL drivers

The hardware requirements for Wings 3D are: -

- Pentium 166
- 2MB display card
- CD- ROM

2.8.5.2 OPINIONS ABOUT WINGS 3D

Wings 3D is an OpenSource polygon mesh written using Erlang programming language by Bjorn Gustavsson. It is a freeware that is distributed on the web at SourceForge Project page. The best advantage of Wings 3D is that it can import and export between various file format such as .3ds (3ds Max), .ndo (Nendo®), .obj (Maya) etc. This can be done easily by just renaming the file extension to .wings.

There are two basic methods of modeling; polygonal modeling and spline based modeling. Subdivision modeling is a form of polygon modeling. Other forms of polygon modeling include MetaNurbs (LightWave and TrueSpace), Metaballs (Bryce), and Metashapes (Amorphium). All of these rely on the direct manipulation of objects geometry as if sculpting something in clay. There are no true curves in polygon modeling because the models are made up of only polygons. That is to say, curves are simply approximated by a series of short straight lines connecting vertices. Because of this polygon modeling is an ideal for organic modeling but not a good choice for the highly accurate modeling needed for machining manufactured parts. It is also good for modeling man made items that do not require precise curves.

At present state, Wings 3D as a polygon mesh modeler only support polygon modeling but it is expected to be able to support splines and NURBS in the near future.

Splines (sPatch) and NURBS (Maya and Amapi) on the other hand are a method of modeling that uses true curves to define a shape. The curve is then swept along a path to form a patch. Patches are then welded together to form an object. Since true mathematically defined curves are used, very precise and accurate models can be made that could actually be used to drive a machining tool. No matter how far you zoom in on a curve it will always remain curves because it is mathematically defined. Spline based modeling is not generally considered the best choice for organic modeling.

2.8.6 ADOBE® PHOTOSHOP® 7.0

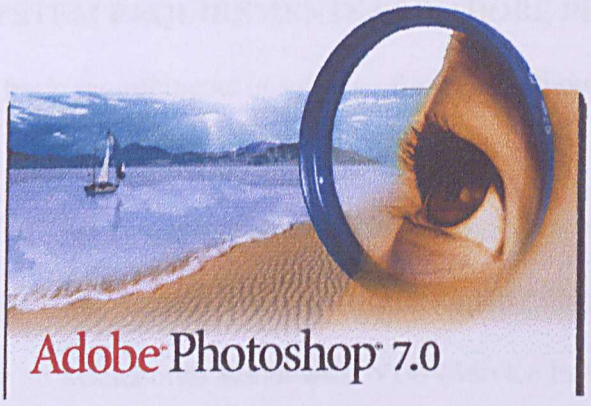


Figure 2.10 Adobe® Photoshop® 7.0 by Adobe® [24]

Adobe® Photoshop® 7.0 is a professional image- editing software which can enable users to work more efficiently, explore new creative options and produce the highest quality image for print, Web and anywhere else.

The features of Adobe® Photoshop® are like: -

- Web output enhancement
- Auto colour command
- Painting engine
- Healing brush
- Customizable workspace
- Multiple Layer editing

2.8.6.1 SYSTEM REQUIREMENTS FOR ADOBE PHOTOSHOP 7.0

The basic requirements in software for Adobe Photoshop 7.0

- Microsoft® Windows® 98 or

  Microsoft® Windows® 98 Second Edition or

  Microsoft® Windows® Millennium Edition or

  Microsoft® Windows® NT® (Service Pack 6a) or

  Microsoft® Windows® 2000 (Service Pack 2) or

  Microsoft® Windows® XP

  Mac® OS software version 9.1, 9.2 or

  Mac® OS X version 10.1.3

In term of hardware, the essential components needed to be available are: -

- 128 MB RAM (192 MB recommended)
- 280 MB hard disk space (Microsoft® Windows®)
- 320 MB hard disk space (Macintosh)
- 800 x 600 colour monitor
- 16- bit colour video card or higher

2.8.6.2 OPINIONS ABOUT ADOBE® PHOTOSHOP® 7.0

Adobe® Photoshop is among the few most sophisticated drawing tools available. It is a raster drawing tool that supports layer editing.

Layers editing gives users more control over the artwork. Student can always work on one layer with reference to other layers without fear of accidentally spoilt other layers.

Besides the common paintbrush tool, it also supports industry-standard pen tool for precision drawing. Others than tools for creating wonderful artwork, Adobe® Photoshop® is also an ideal application for photo editing. It has a very powerful colour correction tools. The tonality and texture of the original photo can be preserved while removing flaws using the healing brush.

Adobe® Photoshop® is able to support a wide format of graphics elements such as; .psd, .pdd, .bmp, .rle, .dib, .gif, .eps, .jpg, .jpeg, .jpe, .pcx, .pdf, .pdp, .pct, .pict, .pxr, .png, .raw, .sct, .tga, .vda, .icb, .vst, .tif, .tiff [24]. This gives it extra advantages for cross format graphic editing among the available software.

2.8.7 ADOBE® PREMIERE® PRO

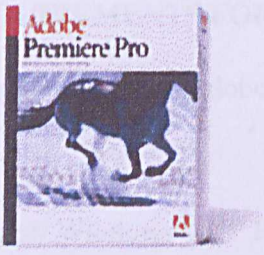


Figure 2.11 Adobe® Premiere® Pro by Adobe® [25]

Adobe® Premiere® provides real- time editing for professional video editing. It supports playback on NTSC, PAL and VGA monitors. Adobe® Premiere®'s range of features is so wide and assisting to no matter professional or even beginner in this line [25]:

- Real- time effects
- Real- time motion paths
- Real- time colour correction
- Real- time titles
- Multiple, nestable timelines
- Dockable palettes
- Enhanced interactive project windows
- Enhanced DV detection
- Enhanced audio mixer
- Floating tool palette
- Keyframable effect parameters
- Native YUV processing
- Advanced colour correction
- Waveforms and vector scopes

2.8.7.1 SYSTEM REQUIREMENTS FOR ADOBE PREMIERE PRO

The software requirements for Adobe® Premiere® to run smoothly are [25]: -

- Microsoft® Windows® XP Professional

  Microsoft® Windows® XP Home (Service Pack 1)

The hardware requirements however are much more demanding: -

- Intel® Pentium® III 800 MHz processor (Pentium 4 3.06GHz recommended)
- 256 MB RAM (1 GB recommended)
- 800 MB hard disk space
- CD- ROM
- Compatible DVD recorder (DVD- R/RW+ R/RW) required for Export to DVD
- 1024 x 768 32- bit colour video display adapter (1280 x 1024 or dual monitors recommended)
- For DV: OHCI- compatible IEEE 1394 interface and dedicated large-capacity 7200RPM UDMA 66 IDE or SCSI hard disk or disk array
- ASIO audio hardware device; surround speaker system for 5.1 audio playback (optional)

2.8.7.2 OPINIONS ABOUT ADOBE® PREMIERE® PRO

Adobe® Premiere® Pro software is a revolutionary nonlinear video editing application that delivers a break- through render- free experience. Its high- performance toolset takes video and audio production to a new level, giving a professional edge. It can promise precise results with frame accurate control for short and long format projects.

Besides that, extensive support for importing and exporting video formats allows users to actually work without much constraint. Adobe® Premiere® is built for the superior performance of Microsoft® Windows® XP systems. Therefore, it is well recommended by experts in this line and it had received various awards to support its fame [25].

2.8.8 DIRECTOR MX

Figure 2.12 Director MX by Macromedia®

Director MX is known as the solution for creating rich content and applications for CD/ DVD- ROM, kiosks and the web. It supports interactive audio, video, bitmaps, vectors, text, fonts and more integration.

Director MX works effectively with the shared Macromedia MX user interface and takes advantage of unprecedented Macromedia Flash MX integration.

The features packed in Director MX are: -

- High usability
- High Accessibility
- Great Power and Control
- Wide Media Support
- Interactive 3D
- Macromedia Flash MX integration
- Multiple deployments
- Lingo scripting

2.8.8.1 SYSTEM REQUIREMENTS FOR DIRECTOR MX

The requirements for Director MX are divided into authoring and playback requirements.

AUTHORING

- Intel Pentium II processor or higher

  Power Macintosh with Power PC processor, G3 processor or higher
- Microsoft® Windows 98 Second Edition

  Microsoft® Windows 2000

  Microsoft® Windows XP

  Mac OS X 10.1.2 or higher (10.2 recommended)
- Microsoft DirectX 5.2

  OpenGL 1.1.2 (recommended)
- 128 MB RAM or higher
- 1024 x 768, 16- bit colours display or better
- 3D accelerator (recommended)
- 100 MB hard disk space
- CD- ROM

PLAYBACK

- Intel Pentium processor (Pentium II recommended)

  Power Macintosh Power PC processor (G3 recommended)
- Netscape 4.0 or later

  Microsoft® Internet Explorer 4.0 or later

  AOL 4.0 or later

2.8.8.2 OPINIONS ABOUT DIRECTOR MX

Macromedia Director® is a tool used to create contents for CD/ DVD, kiosks presentations, internet promising to deliver the most media- rich, high performance quality.

Director offers capabilities for multimedia authoring and is differentiated by the breadth of multimedia file types that can be integrated and controlled. The resulting contents and applications can be deployed for optimal playback across platforms.

Director can incorporate photo- quality, full- screen or long- form digital video, sounds, animation, 3D models, text, hypertext, bitmaps and Macromedia content.

Director can provide a rich suite of tools to control how and when these elements appear, move, sound and change while the movie plays. The power of Director is multiplied by the addition of custom features and functionality through Xtra extensions, all parts of the extensible plug- in Director MX architecture.

Director® allows user to create interactive 2D and real- time 3D animation, video, sound, graphics, macromedia Flash, text and fonts. Director® also offers advance architecture of memory management system. With this, a consistent, smooth playback for end- users even though the file is a few hundred megabytes of size.

2.9 CURRENT AVAILABLE SYSTEMS AND SERVICES

There are not many applications that broadcast information about kidney available in the market. There majority of information regarding kidney can be obtain through medical websites online. For CD- based system wise, there is only one interactive human kidney learning kit found. Yet, this system is not developed within a 3D environment. Therefore, the development of DigiKid can be considered as among the few if not the first interactive human kidney learning package in 3D environment.

However, the methods of details presentation from various websites are studied to learn more about the way information are broadcasted out to public. The websites and application that will be studied are: -

- INTERACTIVE PHYSIOLOGY- URINARY SYSTEM
- American Association of Kidney Patients Homepage
- Nephrology Channel Website

The above-mentioned services mainly explain the functionalities of human kidney as well as providing information regarding common problems of human kidney. The information of these services will be explained in latter part of this chapter.

2.10 TYPES OF INFORMATION AVAILABLE ON APPLICATIONS AND WEBSITES RELATED

2.10.1 DESCRIPTION OF THE ANATOMY OF KIDNEY

The information about the anatomy and parts of human kidney is the minimum detail covered by the services studied. These anatomy descriptions include parts and names of kidney members.

2.10.2 FUNCTIONS OF KIDNEY

Functions of every part of the kidney are explained and taken care of. Some services even include illustrations to assist the description.

2.10.3 PROBLEMS

The problems and diseases one can face that will lead to kidney failures are described and certain services do include illustrations for better understanding.

2.10.4 QUIZZES AND TUTORIALS

Quizzes and tutorials are parts and parcel of some services where else some do not offer such self-examination facilities.

2.10.5 ILLUSTRATIONS AND ANIMATION GUIDE

Even though not all services offer illustrations or photos to guide users to a better understanding, but there are some that includes really tight and neat photos.

2.10.6 HELP AND SUPPORT

Help and support for users whom face problems is a very essential element in learning kits. Therefore, the extensiveness of the help section within the services will also be evaluated.

2.11 SERVICES EVALUATION

2.11.1 interActive PHYSIOLOGY-URINARY SYSTEM

SOURCE: Marvin J Branstorm. Interactive PHYSIOLOGY, Urinary System [CD]. A.D.A.M Software Inc. 1997

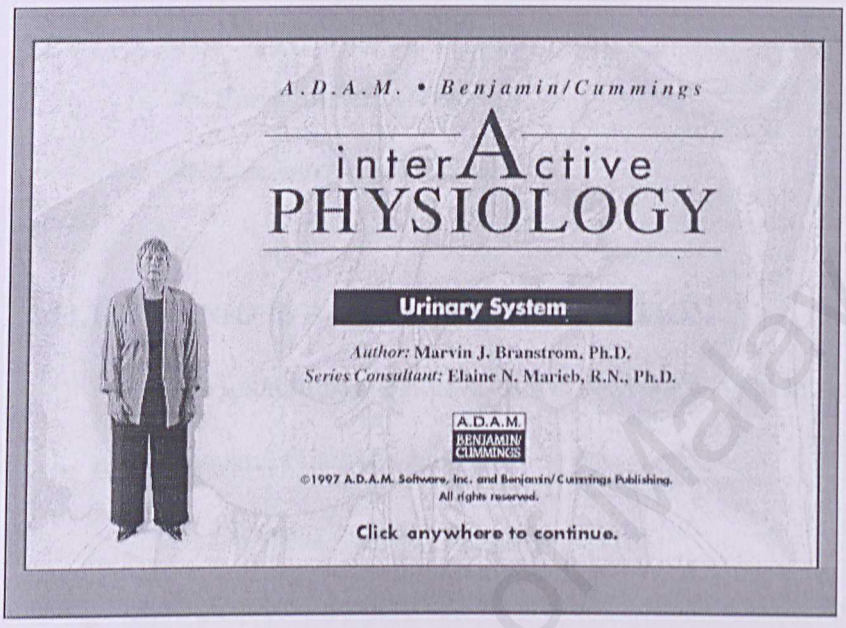


Figure 2.13 Splash screen of interActive PHYSIOLOGY- Urinary System

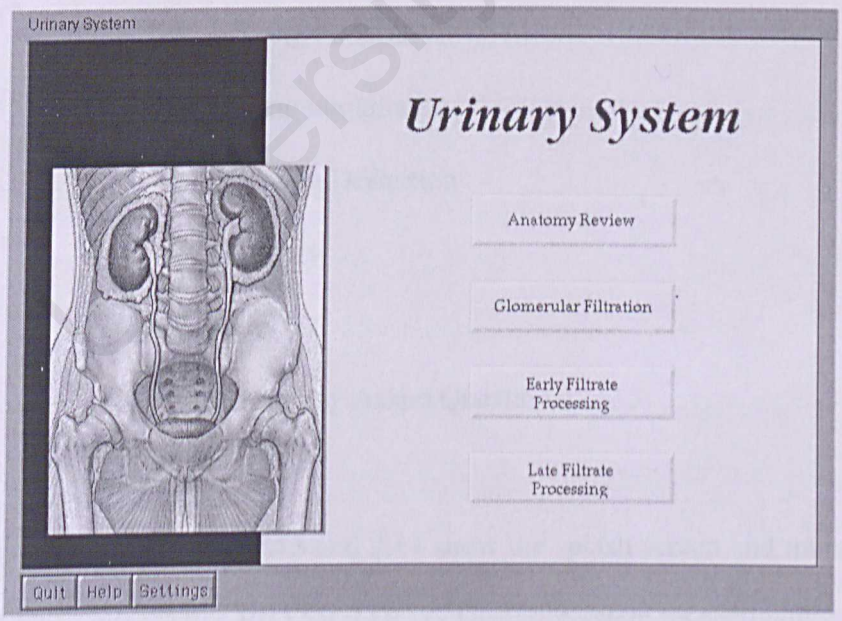


Figure 2.14 Main menu of interActive PHYSIOLOGY- Urinary System

2.11.1.1 CONTENTS

The interActive PHYSIOLOGY- Urinary System contains information about: -

- Anatomy review of the urinary system and kidney
- Glomerular filtration
- Early filtrate processing
- Late filtrate processing

2.11.1.2 OPINIONS ABOUT THE APPLICATION

The interActive PHYSIOLOGY- Urinary System application provides some functions such as: -

- Choosing topics
- Quizzes shortcuts
- Bookmarks
- Placing bookmarks
- Saving bookmarks
- Showing Definition
- Glossary
- Help
- Frequently Asked Questions

Figure 2.13 and 2.14 show the splash screen and main menu of interActive PHYSIOLOGY- Urinary System respectively.

The topics titles' arrangement is simple and accessible only from the main menu. This approach is not ideal because it is very hard for users to check out the overall list of topics available halfway through the course.

The division of topics is laid out and well neat. This helps users to obtain knowledge from the system in multiple levels. The colours used shows contrast and this will make the users more alert to clickable sections.

The application offers a systematic way to look for the type of information needed. Explanations and descriptions are presented clearly in large text coupled with audio output.

Functions and the importance of kidney towards a healthy lifestyle are included into the description. All the presentations are equipped with 2D graphics to enable users to obtain a clearer view of the kidney.

At the end of each chapter, there will be quizzes awaiting fellow users to let them cross- examine their new knowledge. Such quizzes are presented in a multimedia format with animations, text and audio to attract the interest of users.

The help section of this application is organized neatly. Users can refer to the help section for any uncertainties on terms and usage of the system.

2.11.2 AMERICAN ASSOCIATION OF KIDNEY PATIENTS

SOURCE: http://www.aakp.org

Date accessed: 5 AUGUST 2003

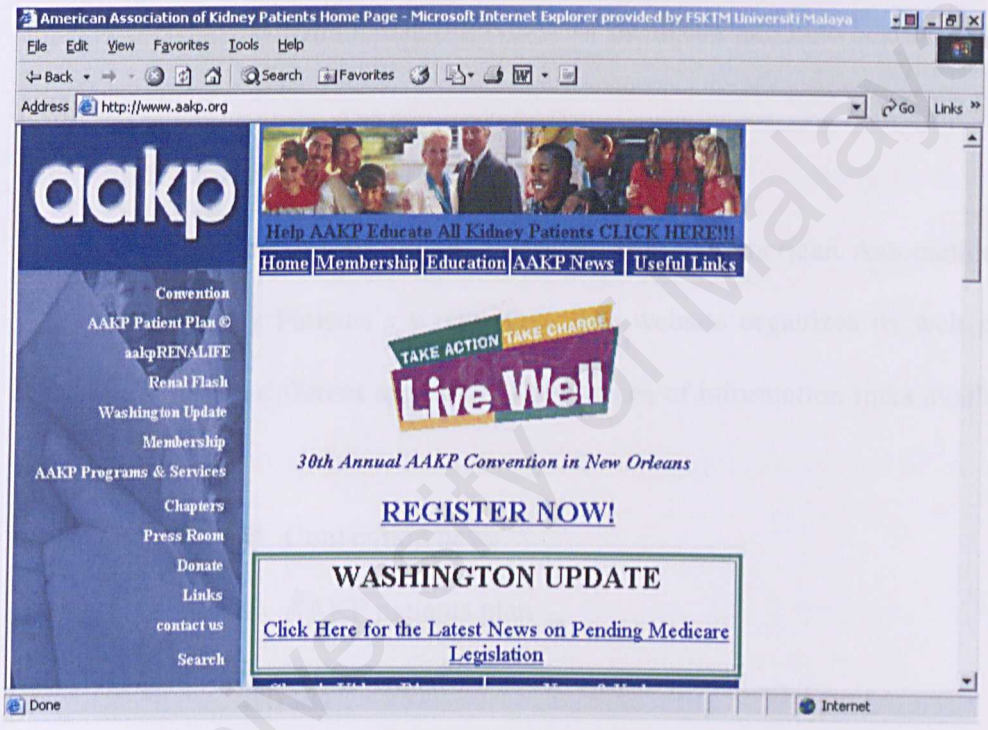


Figure 2.15 American Association of Kidney Patients

2.11.2.1 CONTENTS

The American Association of Kidney Patients web page contains information about:

- Problems faced by kidney patients
- Causes of kidney problems
- Preventive measure towards a healthy kidney
- Lifestyle of kidney patients
- Membership services for the needy and kind hearted

2.11.2.2 OPINIONS ABOUT THE SERVICE

Figure 2.15 shows the web page of American Association of Kidney Patients's screen shot. The website organizes its web page with a different approach. The choices of information links available are:

- Convention news
- AAKP patients plan
- AAKP RenaLife
- Renal Flash
- Washington Update
- Membership
- AAKP Programs and services
- Chapters
- Press rooms
- Donate
- Search

The links are organized in a list located at the left part of the web page. It also has the same links located at the top part of the page to highlight it to users' attention. The colour used on the links are attractive and attention catching. The combinations of colours used are contrasting and the fonts used and size used is more to an informal presentation. This is to give a warmer feeling to the visitors of the page.

The description of human kidney anatomy is not as attractive as other web pages due to lack of graphical illustrations. The functions and essential of kidney to us is well explained and the language used is very much understandable.

Another drawback of the page is that it consists of no quizzes and tutorials. On top of that, there are very few diagrams or illustrations used to guide the presentation of information in the web page.

Even though the page does not offer a help directory, yet users can always send e- mails to the support team of the association for further understanding on certain problems.

As a conclusion, this page did a very good job as an association web pages but still lack of graphical elements being an information portal.

2.11.3 NEPHROLOGY CHANNEL

SOURCE: http://www.nephrologychannel.com

Date accessed: 5 AUGUST 2003

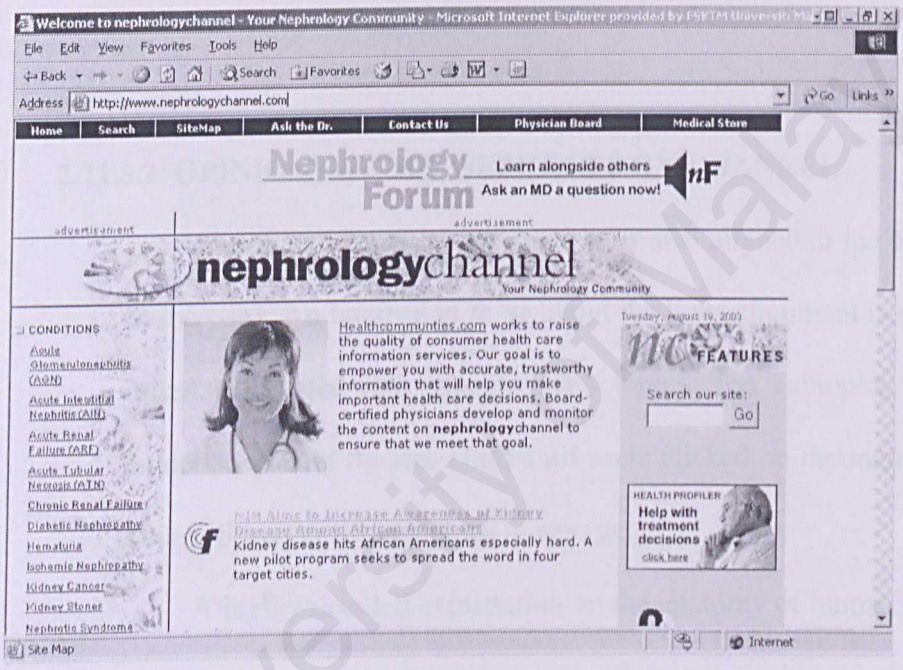


Figure 2.16 The Nephrology Channel

2.11.3.1 CONTENTS

The information that can be found in Nephrology Channel is: -

- Anatomy distribution of kidney
- Functions of kidney
- Problems and diseases of kidney
- Kidney transplant statistic
- Leading a healthy lifestyle with a healthy kidney
- Help and support

2.11.3.2 OPINIONS ABOUT NEPHROLOGY CHANNEL

The links of various information is also aligned at the left part of the page. An interesting thing about the links alignment is that the links are divided into specific main topics. The subtopics are all hidden as part of the tree child until users clicked on the main topic. This will trigger the subtopics to emerge.

A highly detailed explanation on the anatomy of human kidney is presented, even though there are no diagrams used in this website. The fonts used are small and hard to be read. Therefore, even though the contents may be compacted, yet the knowledge that can be successfully obtained is limited.

Kidney problems regardless of its commonalities are available for users' reading and references. There is no help section embedded into the website to support its functionalities.

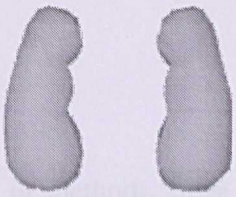
2.12 SUMMARY

From what have been reviewed and analyzed, the suggested DigiKid will have most features which most existing services offer. The features, which DigiKid will have are: -

- Illustrations and animations for the presentation of the system
- Interactivity between users and system
- Description of kidney anatomy
- Functions of human kidney
- Kidney problems that threaten the health of an individual
- Quizzes to test users of their new knowledge
- Help and support section

The purpose of embedding 3D animations into the system is to enable users better understand the features of human kidney. Even though only common problems that will be included but, the description will be accompanied by 3D simulations and audio output.

All the above mentioned features and suggestions are being made after analyzing existing services and relevant systems to suit the need for healthy conscious individual. DigiKid is a standalone system, same as the interActive PHYSIOLOGY.



CHAPTER 3
METHODOLOGY

CHAPTER 3 METHODOLOGY

Managing software engineering projects is tough. The body of methods, rules, postulates, procedures and processes that are used to manage a software engineering project are collectively referred to as methodology [26]. This will ensure a proper documentation on the work and tasks need to be carried out.

3.1 RAPID APPLICATION DEVELOPMENT

Rapid Application Development is an ideal methodology for systems planned to be built in as little as 60- 90 days, often with some compromises. It is a methodology for compressing the analysis, design, build and test phase into a series of short, iterative development cycles. This has a number of distinct advantages over the traditional sequential development model.

Rapid Application Development is suitable if there is a plan to converge early towards a design acceptable to the customer and feasible for the developers. By using Rapid Application Development as well, a project's exposures to the forces of change will be very much limited besides saving development time, possibly at the expense of economy or product quality.

3.2 SCHEDULE versus ECONOMY versus QUALITY

The tradeoffs of cost and quality in using Rapid Applications Development determine the pace of development.

	SCHEDULE	ECONOMY	QUALITY
Efficient Development	Faster than average	Costs less than average	Better than average quality
Sensible RAD	Much faster than average	Costs a little less than average	A little better than average quality
All- Out RAD	Fastest possible	Costs more than average	Worse than average quality

Table 3.1 Schedule vs. Economy vs. Quality [27]

The efficient development is a very balance distribution with economy, schedule and quality at its midpoint. However, for Sensible RAD, the distribution tilts away from economy and quality towards a faster schedule. The heaviest variation of RAD is the All- Out RAD which involves ample of heavy coding and trades off economy and product to a higher extreme.

The conclusions that can be made from Table 3.1 are: -

- RAD has a fair chance of success if the development will negotiate either economy or quality
- RAD has better chance for success if the development will negotiate both economy and quality

Negotiating quality does not mean accepting a higher defect rate. It means accepting a product that is less usable, less fully- featured or less efficient. Therefore, with RAD, one or more of the following goals may be unachievable: -

- The fewest possible defects
- The highest possible level of customer satisfaction
- The lowest development costs

Therefore, the development of DigiKid is very much based on the distribution of Efficient Development. This is to ensure the quality and cost of development is at stake as well as controlling the life cycle period of the whole development process.

3.3 ADVANTAGES OF RAPID APPLICATION DEVELOPMENT [28]

3.3.1 EARLY VISIBILITY

By producing iterative operational prototype through out the development life cycle, a clear cut of the final system's idea can be generated. This allows me to further identify the level of fulfillment of all the functional and non- functional requirements prior to completion of a task. From this processes, DigiKid will be put through various refinement to ensure its performance and quality.

3.3.2 GREATER FLEXIBILITY

Through iterative operational prototyping in each phase of the development life cycle, I can always identify the necessity for changes and amendments to be made. This also allows me to recognize the best approach to be utilized in order to achieve the requirements set. Such flexibility to look for the best approach at any time of the development life cycle is an added advantage for the overall performance of the final product of DigiKid.

3.3.3 GREATLY REDUCED OF MANUAL CODING

Rapid Application Development encourages the usage of available wizards, code generators and code reuse. This is ideal for development which is constraint by short development time such as DigiKid. As familiarity in 3D tools is very limited as well, such method in assisting to achieve an ideal system is very much helpful and essential.

3.3.4 POSSIBLY FEWER DEFECTS

As there will be operational prototypes created all the time through out the development of DigiKid, defects and handicaps can be identified at a much early stage and this can almost be easily overcome. Iterative process which is very much allowed in Rapid Application Development reduces the possibilities of meeting defects unsolved at the end of development process.

3.3.5 POSSIBLY REDUCED COST

As the saying "Time is Gold" goes, time is as valuable as money by itself. Therefore the reduction in development time also means the reduction of cost. Besides that, the encouragement for code reuse also cut down the development cost in a great deal. This is especially suitable for the development of DigiKid which should involve only the minimal cost used for production.

3.3.6 SHORTER DEVELOPMENT CYCLES

In Rapid Application Development model, the development distribution generally tilts more towards schedule; this means the reduction of time in each and every development cycle. This may not seems like an added advantage by itself, but it influences other factors such as cost et cetera and is very essential in achieving the objective of completing the system within the shortest possible time.

3.4 DISADVANTAGES OF RAPID APPLICATION DEVELOPMENT [26]

3.4.1 HARDER TO GAUGE PROGRESS

As there are no classic milestones in the Rapid Application Development model, naturally it is somehow rather harder to gauge the progress of each phase. Therefore the clarity and discipline to achieve requirements must be there to ensure the progress is well monitored.

3.4.2 LOSS OF SCIENTIFIC PRECISION

No formal methods are being used in the Rapid Application Development model; therefore the scientific precision in the final product will always be challenged by people all around. In order to overcome this problem, the feedback and comments from users during the development process must all be look upon heavily to minimize the dissatisfaction from them at the end of the development cycle.

3.4.3 REQUIREMENTS MAY NOT CONVERGE

From one iteration to the next, users and developer's interest may diverge and this will causes the requirements to change all the time. In order to overcome this obstacle, the need to review back on previous iteration results to specify new iteration's rule is another matter of discipline. Therefore it is also very essential to keep track of passed iterations' results and outcome before continuing on to the next iterations.

3.5 RAPID APPLICATION DEVELOPMENT ROUTE

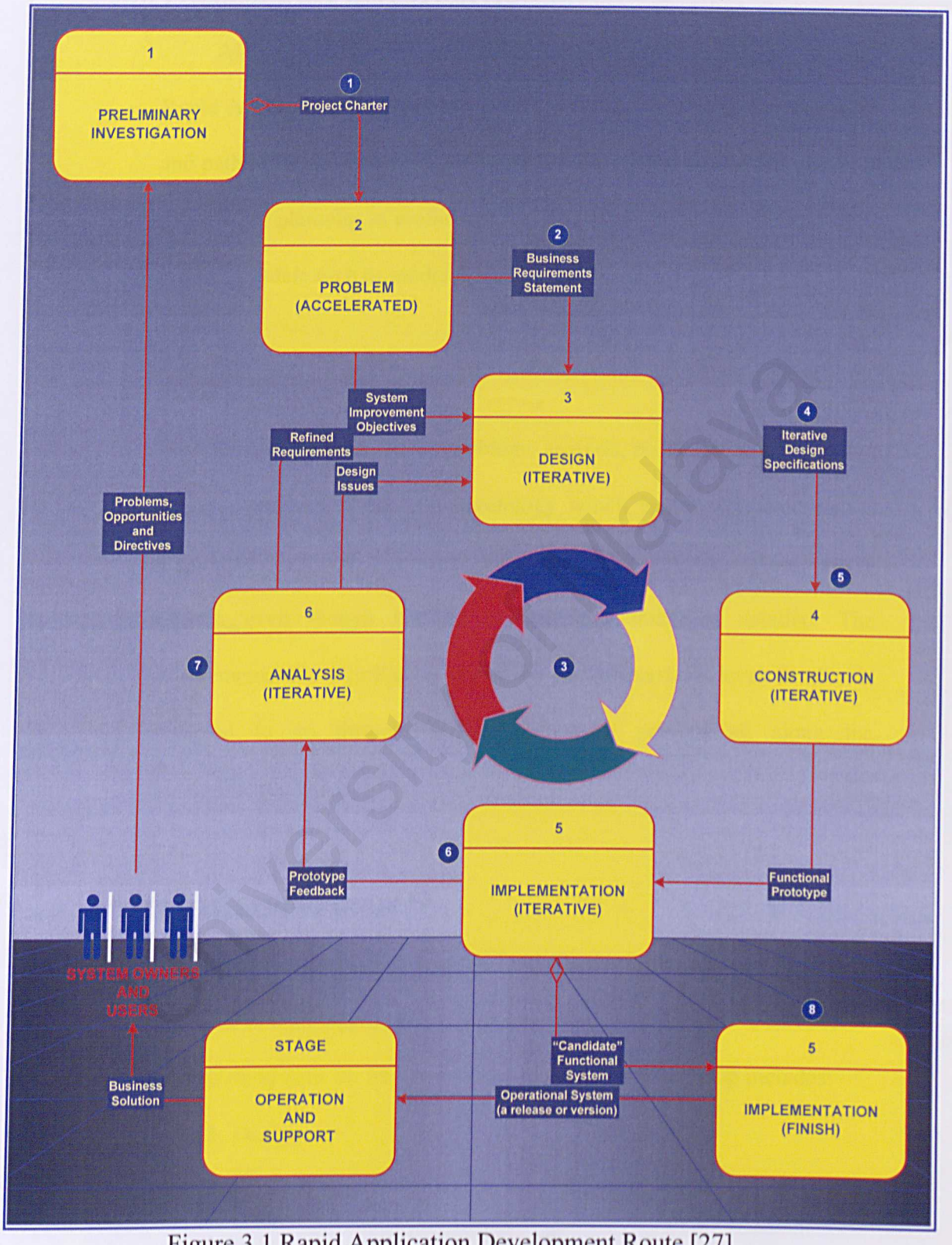


Figure 3.1 Rapid Application Development Route [27]

3.5.1 PRELIMINARY INVESTIGATION

All projects need to be planned and scoped. The decision on using Rapid Application Development model is decided in this phase. The route and path of the development of DigiKid is also determined in this phase. In this model, planning in preliminary investigation phase is less detailed as in other models such as model driven development model.

3.5.2 PROBLEM ANALYSIS

This phase includes the problems analysis, requirement analysis and decision analysis of basic methodology which are consolidated into a single analysis phase. The requirements statements include various system models, even though it may not be very much in detailed. The requirements for DigiKid is identified on the surface level as this is expected to go through further refinement process all along the development process.

3.5.3 PROTOTYPING LOOP

After analysis had been carried out, Rapid Application Development model iterates through a prototyping loop until the prototype is considered a candidate system for implementation. This prototyping loop includes: -

- Design
- Construction
- Implementation
- Analysis

3.5.4 ITERATIVE DESIGN

The design phase of DigiKid involves models and various prototypes. The final design is suppose to evolve from subsequent working prototypes. Therefore, the prototypes developed along the development process are operational prototypes instead of interface prototypes alone. As the fundamental principle of iterative development is that each iteration delivers a functional version of the final system. It is a properly engineered, fully working portion of the final system and is not the same as a mere prototype. For example, the first iteration might deliver 10% of 100%, the second iteration 25% of 100 % and so forth.

3.5.5 ITERATIVE CONSTRUCTION

The construction phase involves greater time spent constructing the working prototypes. This is to ensure the quality of deliverables at the end of each iteration. The construction of functional prototypes in DigiKid involves longer period as 3D modeling takes up slightly more time than common coding construction. The rendering process of a model will require repetitive construction even though only on a single scene.

3.5.6 ITERATIVE IMPLEMENTATION

Prototypes are implemented to the extent that users are given the opportunity to experience working with that prototype. The expectation is that users will clarify requirements, identify new requirements and provide feedback on design for next iteration through the design- by prototyping loop. Such implementation in DigiKid will be integrated into Macromedia® Director MX to enable users to have a hand- on experience of the working prototype.

3.5.7 ITERATIVE ANALYSIS

Analysis is revisited based on user feedback to the prototype. This analysis tends to focus on revising requirements and identifying user concerns with the design. Analysis cycles back to iterative design ( ) and the prototyping loop repeats itself.

3.5.8 IMPLEMENTATION

Eventually, a prototype will be deemed worthy for implementation. This release of the system is placed into operation. The next version of the system may continue through the design- by- prototyping loop.

3.6 TIMEBOX [28]

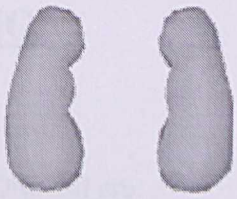
The technique used to limit the duration of the prototyping loop is timeboxing. A timebox is a non- extendable period of time, usually 60- 120 days, by which a candidate system must be placed into operation. In timeboxing technique, secondary features are dropped as necessary to stay on schedule.

3.7 THE ADVANTAGES OF PROTOTYPING LOOPS

The prototyping loops bring several advantages to the system's final product by:

-

- Allows users' need to be verified
- Allows verification of design versus specifications
- Enable the best design to be selected
- Allows testing of designs under varying environments
- Demonstrates a new product to the upper management and system owner



CHAPTER 4
SYSTEM ANALYSIS AND DESIGN

CHAPTER 4 SYSTEM ANALYSIS AND DESIGN

4.1 DATA GATHERING TECHNIQUES

The methods used in collecting data required for developing DigiKid are: -

- Discussion with supervisor
- Printed materials
- Information from the World Wide Web
- Application Survey
- Conversation

4.1.1 DISCUSSION WITH SUPERVISOR

Discussion is the first tool used by me to gather data and information. The purpose of discussion is to learn the supervisor's objective in having DigiKid built. This discussion is also used to determine what the supervisor considers the success of DigiKid based upon.

4.1.2 PRINTED MATERIALS

The secondary method of collecting data and information about the system is by printed materials such as books, journals, past theses et cetera. As printed materials can offer magnificent ideas as well as information, it plays an important role towards the success of DigiKid. Besides text, graphics and tables from these printed materials contributed nevertheless the most information. As the old saying goes "A picture is worth a thousand words", this proves the contribution of all these printed materials.

4.1.3 INFORMATION FROM THE WORLD WIDE WEB

As the exchange portal of information, the World Wide Web of course offers more valuable information than anywhere else. Data collected from the World Wide Web includes data about 3D aspects, kidney information, development tools and many more. Major search engines such as Googles, Copernic, Excite, Yahoo, Search and Metacrawler enable relevant information sites to be viewed with only a click away. From the search, there are many relevant and available systems implemented by foreign developers but few by local developers. The keywords used in searching relevant web pages are: -

- Kidney
- Nephrology
- Urinary
- Interactive kidney

The keywords Nephrology and Urinary were used because kidney is part and parcel of these systems and it is often categorized under these systems.

4.1.4 APPLICATION SURVEY

Current available systems were searched to gain a clearer picture of the architecture and functionality design involved. As there are very few CD- ROM based systems on human kidney is available in the market, this method provide very limited yet essential data for the development of DigiKid.

4.1.5 CONVERSATION

Informal conversation was held with friends as they would be able to provide their opinions from the point of view of a system user. The purpose of this informal conversation is to get "the other side story". Each person will probably have a different view of DigiKid. Each person will interact with the system differently when it is built. Thus the data collected and reported by the system addresses the needs of varying audiences.

4.2 REQUIREMENT ANALYSIS

The requirements for DigiKid are categorized into two categories which are:-

- Functional requirements
- Non- functional requirements

4.2.1 FUNCTIONAL REQUIREMENTS

The functional requirements of DigiKid are as of below: -

- Kidney Anatomy Module
- Kidney Functions Module
- Kidney Problems Module
- Kidney Quiz Module

4.2.1.1 KIDNEY ANATOMY MODULE

This module will explain the parts and elements of the human kidney. The name and shape of each anatomy part will be explained to the users.

4.2.1.2 KIDNEY FUNCTIONS MODULE

The functions of kidney will be described so that users will have a clear picture of what task the human kidney actually accomplish everyday. The process will be animated in a 3D environment.

4.2.1.3 KIDNEY PROBLEMS MODULE

Problems and diseases that could lead to kidney failure, necessity for kidney transplant and dialysis will be lectured in detail under this module. DigiKid will show the gradual process which causes the occurrences of these problems and diseases.

4.2.1.4 KIDNEY QUIZ MODULE

Quizzes will be available for users to test new knowledge gain from the system. These quizzes will be based on the information modules above; which includes anatomy, functions and problems quiz.

4.2.2 NON- FUNCTIONAL REQUIREMENTS

The non- functional requirements for DigiKid includes the following: -

- User Friendliness
- User Interface Design
- Expandability
- Reliability
- On Time

4.2.2.1 USER FRIENDLINESS

The system by itself should be made to look simple. Users will not need to know much about how the system goes but they should only be made to understand what they need to input when they want to make a request.

4.2.2.2 USER INTERFACE DESIGN

The interface design should be kept as simple as possible. A good combination of colours, fonts, pictures, and layout is essential. Multimedia elements should be incorporated when needed.

4.2.2.3 EXPANDABILITY

The system should be able to be extended to accommodate more functionality in the future. This will allow the progression and advancement of technology to take part in the future of the system.

4.2.2.4 RELIABILITY

The ability for the system to perform its intended functions with required precision and accuracy is very important. Thus, the system should be able to perform its daily functions and operations correctly.

4.2.2.5 ON TIME

The punctuality of the system schedule is expected to be met.

4.3 TECHNOLOGY SPECIFICATIONS

Analyses were carried out on development tools technologies such as platform needed, 3D modeling tools, multimedia authoring tools and others. Apart from considering the suitability of the technology and tools according to the requirement, these tools must be able to support each other.

Most of the common features of these tools were reviewed in the literature review, so it is come to the comparison part and making the final decision of what kind of tools are going to be used to develop the system proposed. The tools that will be used to develop DigiKid are: -

- Microsoft Windows 2000
- 3DS Max 6
- Adobe Photoshop 7.0
- Adobe Premiere Pro
- Macromedia Director MX

Technology has created the path for high- end multimedia elements to come into our world. Based on the applications and tools involved in the development of DigiKid, an indication line of minimum hardware requirements was drawn to provide efficiency in developing DigiKid. These requirements were determined by taking into account all the minimum hardware requirements specified by each tool. Judging from this information, the requirements are identified and set.

There are 2 sets of hardware requirements set; the developer side and user side. The hardware requirement for developer is much higher than the user side.

4.3.1 HARDWARE REQUIREMENTS

4.3.1.1 DEVELOPER SIDE

The hardware requirements for developer side had been identified as:

-

- Intel® Pentium® III 800 MHz processor
  (Pentium 4 3.06GHz recommended)
- 512 MB RAM
  (1 GB recommended)
- 20 GB hard disk space
  (40GB recommended)
- Graphics card supporting 1024 x 768 x 16-bit colours with 64MB RAM with OpenGL and Direct3D hardware acceleration supported
  (3D graphics accelerator 1280 x 1024 x 24-bit colours with 256MB RAM preferred)
- 32X CD- ROM
- 3-button scroll mouse with mouse driver software
- Multimedia Keyboard
- Microphone
- Surround Speaker System

4.3.1.2 USER SIDE

- Intel Pentium processor (Pentium II recommended)

  Power Macintosh Power PC processor (G3 recommended)

- Netscape 4.0 or later

  Microsoft® Internet Explorer 4.0

4.3.2 SOFTWARE REQUIREMENTS

4.3.2.1 PLATFORM- MICROSOFT WINDOWS 2000

Windows 2000 is to be used as the platform for the development of DigiKid. Third party studies that assess reliability from three different perspectives; lab- based testing, customer- site measurement and user perceptions concludes that Microsoft Windows 200 Professional is the most reliable desktop operating system. It can go up to 30% faster and according to tests by Microsoft and Independent Hardware and Software Testing (NTSL), it is 13 times more reliable than Windows 98. In short, Microsoft Windows 2000 Professional is the most reliable Windows ever.

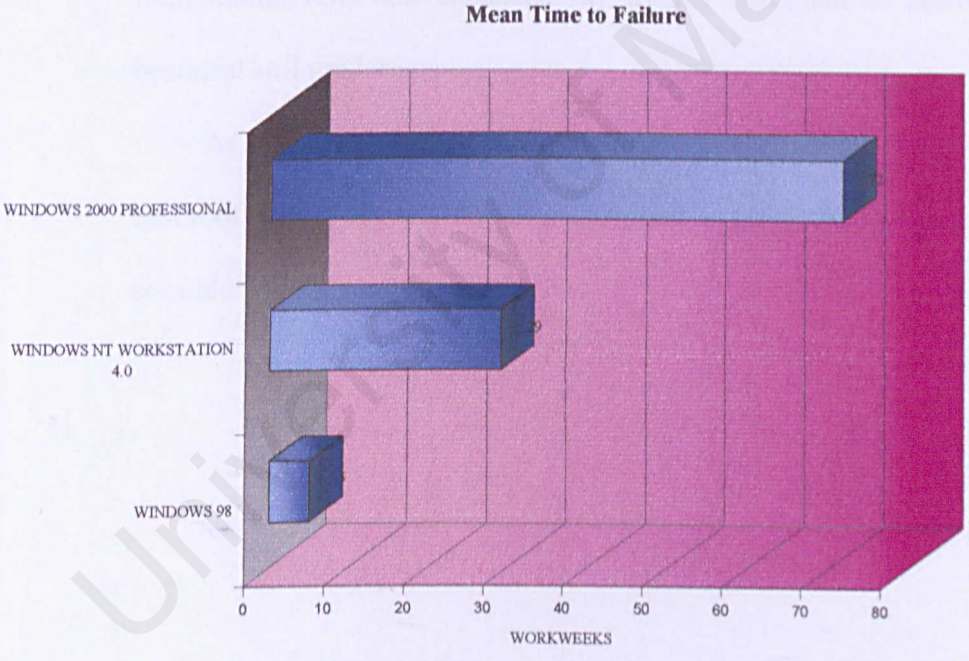


Figure 4.1 Windows 2000 mean time to failure greatly exceeds that of Windows NT Workstation 4.0 and Windows 98 [29]

4.3.2.2 3D TOOLS- 3DS MAX 6

As 3DS Max is easier to be learnt than most applications, packed with features and useful tools. By itself with its built-in scanline renderer, render output is fair at best and animation output is plagued with quality issues such as pixel jitter, pixel crawl, and pixel roping.

3DS Max has superb character features when combined with Character Studio (a plug-in character design/animation package). 3DS Max has a huge number of plug-ins available to it, including many other renderers. 3DS Max 6 now includes built-in global illumination (GI) and enhanced ray tracing sufficient to produce beautiful still renderings.

As my knowledge on 3D tools is very limited, 3DS Max is the best tool to start of with. This allows a good result within the shortest possible period.

4.3.2.3 GRAPHIC TOOL- ADOBE PHOTOSHOP 7.0

Adobe® Photoshop is among the few most sophisticated drawing tools available.

It is a drawing tool that supports layer editing. Layers editing gives users more control over the artwork. Student can always work on one layer with reference to other layers without fear of accidentally spoilt other layers.

It also supports industry- standard pen tool for precision drawing besides the common paintbrush tool. Others than tools for creating wonderful artwork, it has a very powerful colour correction tools. The tonality and texture of the original graphic can be preserved while removing flaws using the healing brush.

A wide range of format is supported by Adobe® Photoshop® such as; .psd, .pdd, .bmp, .rle, .dib, .gif, .eps, .jpg, .jpeg, .jpe, .pcx, .pdf, .pdp, .pct, .pict, .pxr, .png, .raw, .sct, .tga, .vda, .icb, .vst, .tif, .tiff. This gives it extra advantages for cross format graphic editing among the available software.

4.3.2.4 ADOBE PREMIERE PRO

Adobe® Premiere® Pro software is a revolutionary nonlinear video editing application that delivers a break- through render- free experience. It can promise precise results with frame accurate control for short and long format projects.

Its extensive support for importing and exporting video formats allows users to actually work without much constraint. It is well recommended by experts in this line and it had received various awards to support its fame.

4.3.2.5 MACROMEDIA DIRECTOR MX

Macromedia Director offers capabilities for multimedia authoring and is differentiated by the breadth of multimedia file types that can be integrated and controlled. The resulting contents and applications can be deployed for optimal playback across platforms.

Incorporation of photo- quality, full- screen or long- form digital video, sounds, animation, 3D models, text, hypertext, bitmaps and Macromedia content is made possible in Macromedia Director MX.

A rich suite of tools is provided to control how and when these elements appear, move, sound and change while the movie plays. The power of Director is multiplied by the addition of custom features and functionality through Xtra extensions, all parts of the extensible plug- in Director MX architecture.

Director® also offers advance architecture of memory management system. With this, a consistent, smooth playback for end- users even though the file is a few hundred megabytes of size.

4.4 SYSTEM DESIGN

The overall design of DigiKid will be shown in this part of the chapter. Suitable functions for every page needed will be identified by creating detailed functionality design. These functions are mainly based on the functional and non- functional requirements listed in the system analysis.

These ideas will be transformed to reality by building the flow chart. Flow chart will indicate the flow of processes a user experience while using DigiKid.

4.4.1 FUNCTIONALITY DESIGN

System functionality design translates system requirements into system functionality. In functionality design, large systems are decomposed into simpler modules. DigiKid is decomposed to the following modules: -

- Kidney Anatomy
- Kidney Functions
- Kidney Problems
- Kidney Quiz

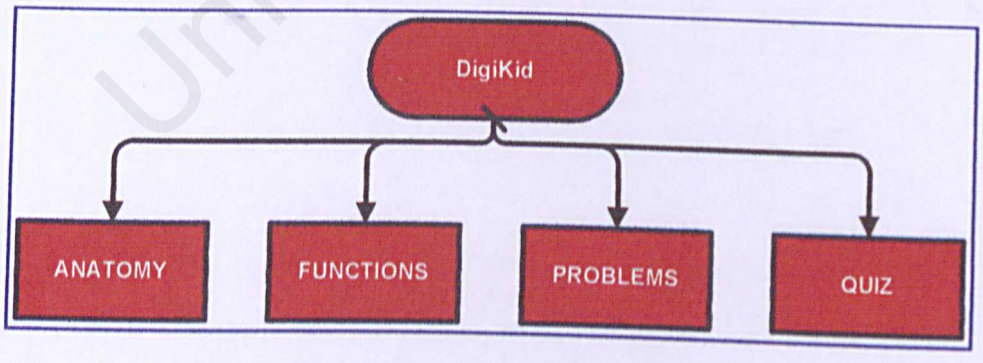


Figure 4.2 Functionality Design- Main modules

Each of these modules is further divided into sub- modules. Graphical representation is chose to present the system structure rather than process or narrative.

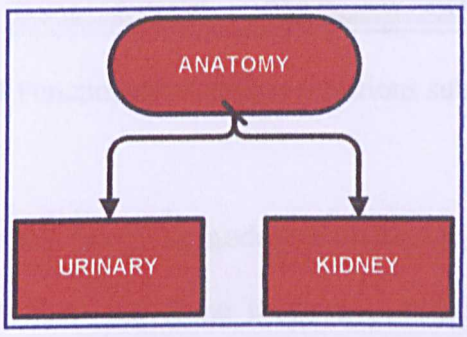


Figure 4.3 Functionality Design- Anatomy sub- modules

The Kidney Anatomy module is divided into 2 sub- modules which consist of urinary anatomy and kidney anatomy. This module will allow users to recognize the anatomy of human kidney and its related system. Parts within the anatomy of human kidney will be introduced to users.

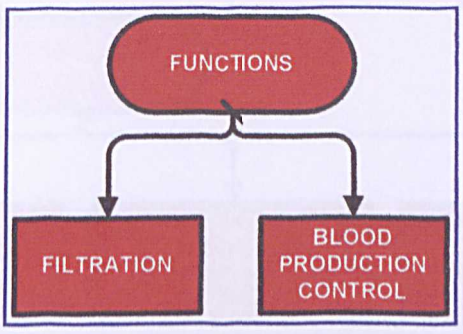


Figure 4.4 Functionality Design- Functions sub- modules

The Kidney Functions module is divided into 2 sub- modules which consist of filtration and blood production control. The process flow of kidney functions will be animated in 3D environment to allow users to get a better idea on the duty of kidney.

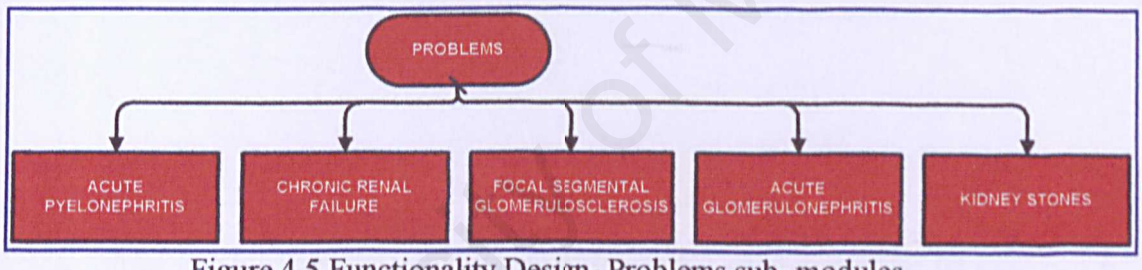


Figure 4.5 Functionality Design- Problems sub- modules

The Kidney Problems module will cover several common kidney problems which are Acute Pyelonephritis, Chronic Renal Failure, focal Segmental Glomerulosclerosis, Acute Glomerulonephritis and Kidney Stones. The causes of these problems are taught and the gradual process that leads to these problems will also be shown to users.

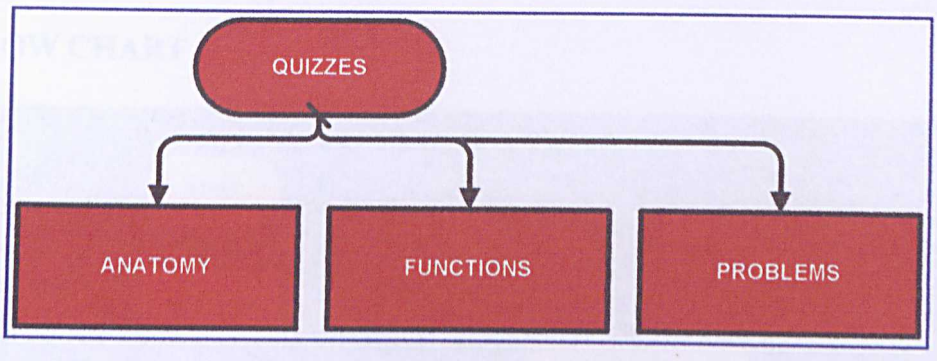


Figure 4.6 Functionality Design- Quiz sub- modules

Kidney Quizzes module contains sub- modules which allow users to determine their level of knowledge input from the system. Quizzes will be grouped into sub- modules based on the 3 main information modules. This allows users to review the knowledge and understanding that they manage to gather from the system.

4.5 FLOW CHART

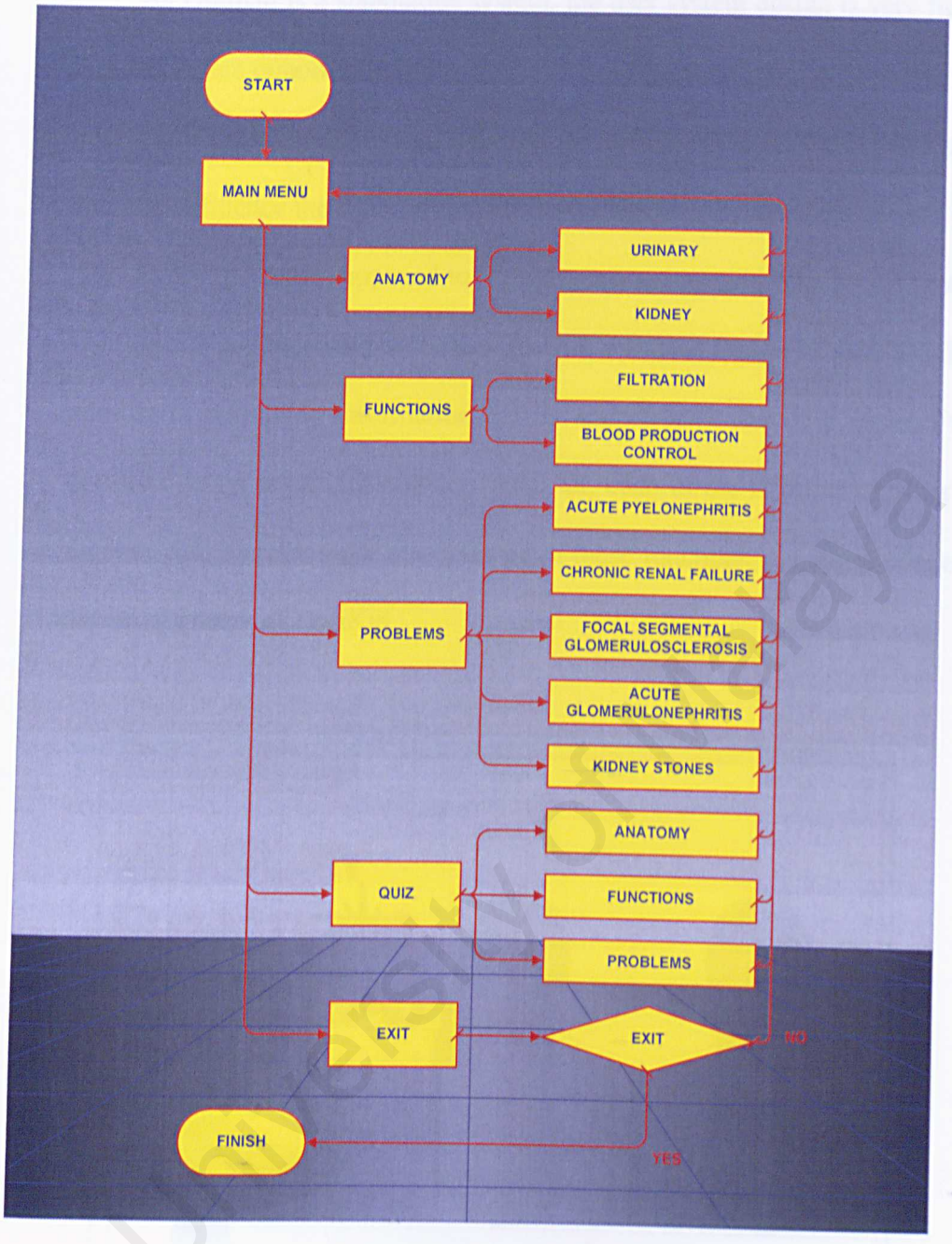


Figure 4.7 Flow chart of DigiKid

The flow of functionality is illustrated to show its options and availability to users.

4.6 USER INTERFACE DESIGN

As DigiKid is a standalone system, the user system design is very flexible and this offers opportunity for attractive and interesting designs. Typically, user interface is to help users navigate through the whole system and provide input. It will also influence the order of output that is requested by users.

Every system is supposed to have its own unique and standardize features. User interface design should be design with a formal design to suite DigiKid's purpose of delivering information clearly and directly. Data are planned to be displayed in an organized manner. After all, each of the interfaces has its own function and therefore, the arrangement of these functions is a major concern in the development of DigiKid.

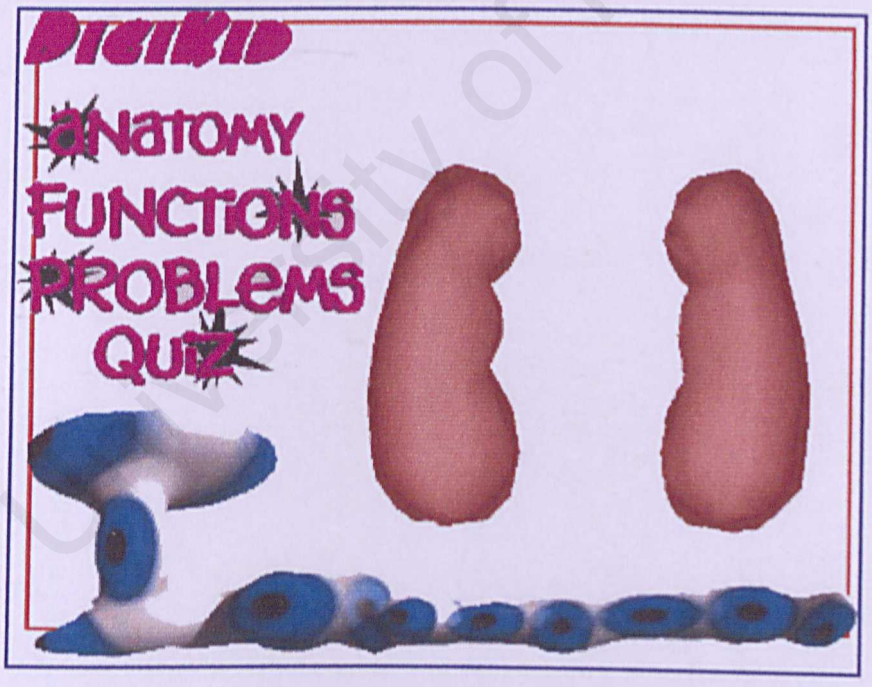


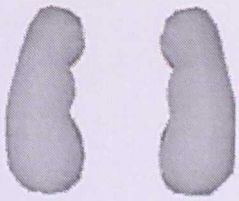
Figure 4.8 Prototype of DigiKid

4.7 SUMMARY

This chapter lined out the requirement analyses and ways on how these requirements will be met in DigiKid.

The system analysis part analysis the requirements such as functional and non- functional requirements. This is followed by functionality design which will work out the requirements specified before it is being further designed using flow chart. This is then followed by the suggested user interface.

In short, the system analysis and design chapter will act as the seed that will be fully grown by the end of implementation stage.



CHAPTER 5
SYSTEM IMPLEMENTATION

CHAPTER 5 SYSTEM IMPLEMENTATION

5.1 CHAPTER INTRODUCTION

System implementation consists of the process to convert system requirements and designs into workable program. Therefore, the implementation of DigiKid is fully based on the requirements specified.

The process starts from installation of development tools such as 3D Studio MAX, Macromedia Director MX, Macromedia Flash MX, Adobe Photoshop, and modeling with 3D Studio MAX before it is integrated onto the application stage in Macromedia Director, debugging, testing and users' evaluation. All these involve modeling, storyboard designing, system flow design, user interface design and debugging. As Rapid Application Development methodology is used as the development methodology, operational prototypes are developed throughout the duration once every new models and module is completed. Once these models are integrated into the Director MX storyboard, the flow and Lingo programming are tested thoroughly to ensure its performance.

Modeling techniques, programming methods and animation designs will be fully laid out in this chapter.

5.2 MODELING TECHNIQUES

Modeling with 3D Studio MAX allows numerous types of approach that each of it comes with its own pros and cons. The different approaches of modeling are: -

- Polygonal modeling
- NURBS modeling
- Mesh modeling

Mainly, the development of DigiKid only involves 2 of the approaches which are the polygonal modeling and NURBS modeling.

5.2.1 POLYGONAL MODELING

Polygonal modeling is an approach where models are shaped out from polygon shapes such as cubes, spheres, cones et cetera. These shapes are modified using 3D modifiers in order to obtain the desired shape. The most commonly used 3D modifiers are Bend, Noise, Lathe, Extrude and much more. After each and every part is modeled, it is combined together to create its compilation shape. These shapes are grouped and again combined together to create even more complex models. Modeling with polygonal approach creates models that are smaller in term of file size but it lose out on its smoothness. Figure 5.1 shows the model of a kidney intersection that is created using the polygonal modeling approach.

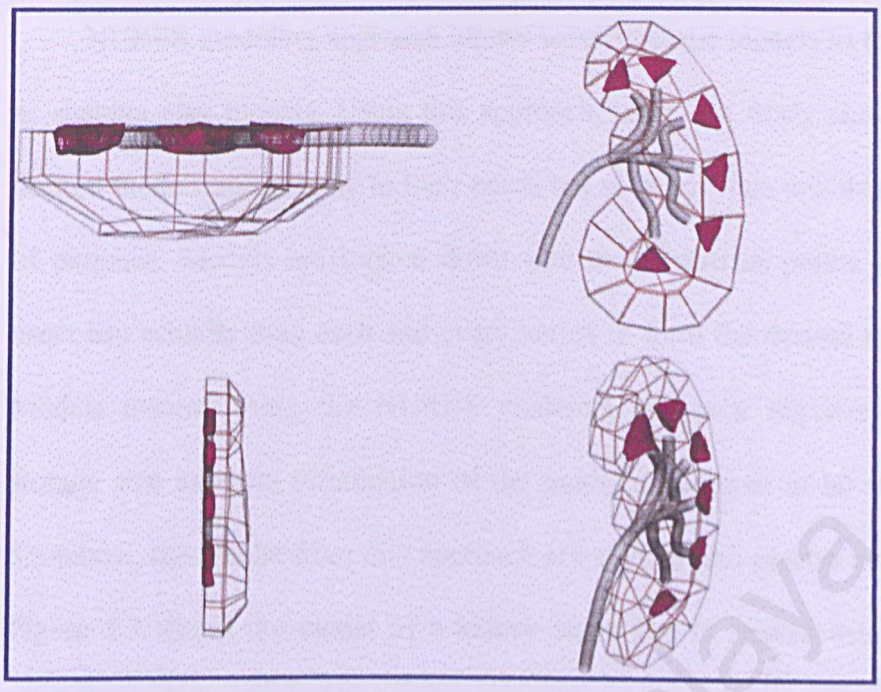


Figure 5.1 Polygonal modeling approach models from different perspectives

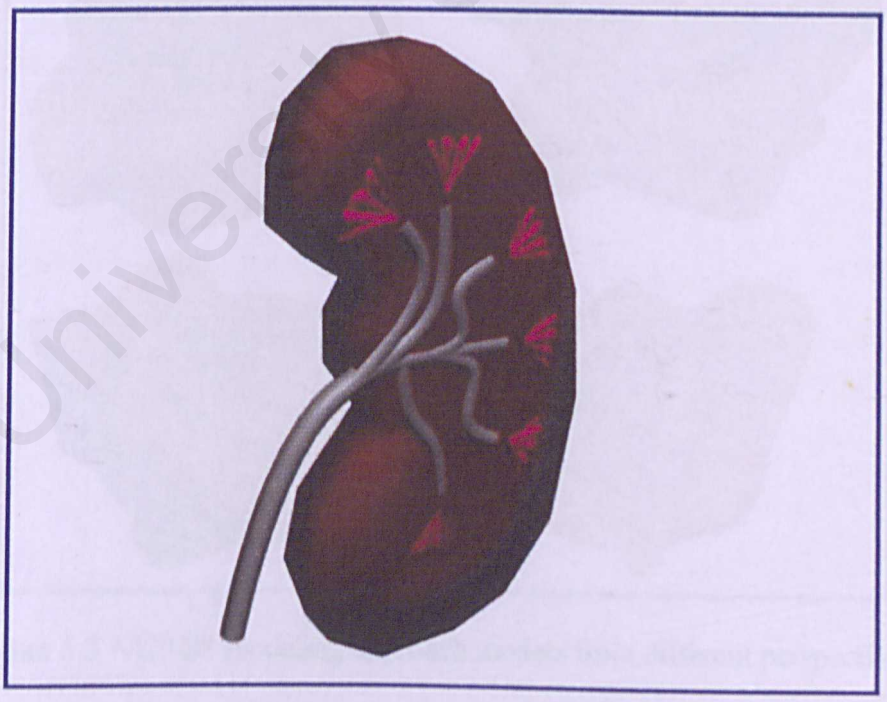


Figure 5.2 Rendered model created using polygonal modeling approach.

5.2.2 NURBS MODELING

NURBS modeling approach allows users to shape models as though as shaping clay models. Using this approach, users can freely shape the desired models accordingly to their needs but somehow this requires a lot of patience. Models are broken down into many vertices points where users can actually drag each and every vertex to form the desired model. Models created using the NURBS modeling approach requires more storage size as more information of the model is required to be stored. Somehow, the results from this approach are smooth and precise models. Figure 5.3 shows the model of a kidney stone that is created using the NURBS modeling approach.

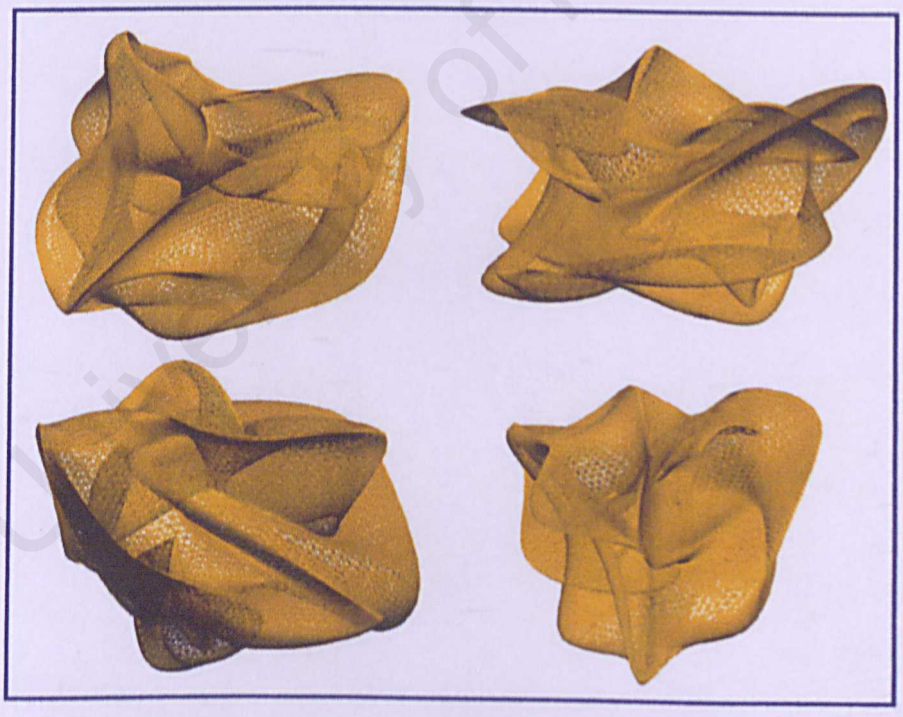


Figure 5.3 NURBS modeling approach models from different perspectives

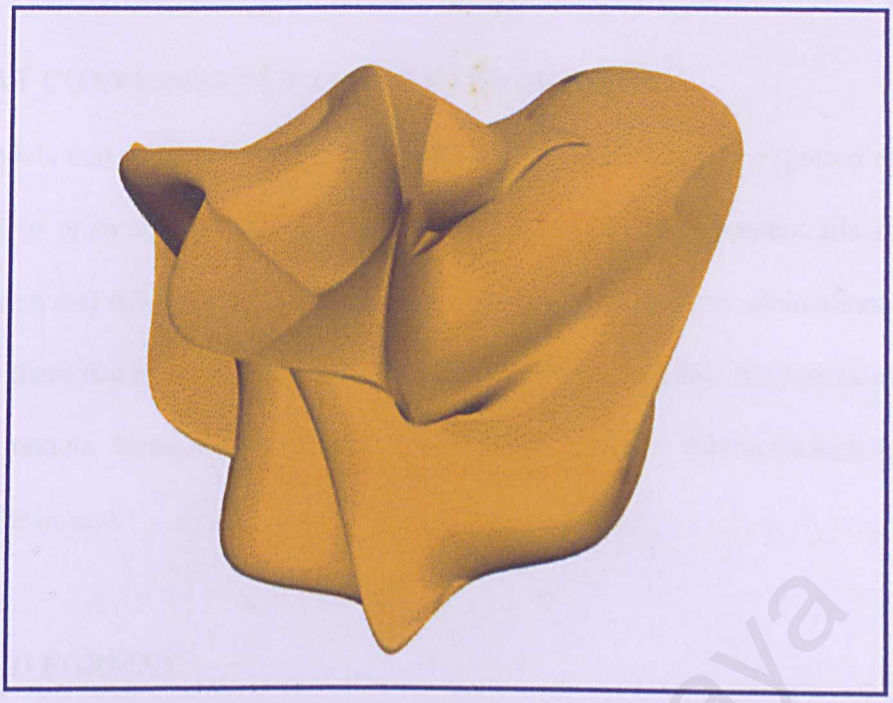


Figure 5.4 Rendered model created using NURBS modeling approach

5.3 FORMAT CONVERSION OF COMPLETED MODELS

Models that are created within 3D Studio MAX will be either exported or animated to other format. As 3D Studio MAX stores its development file in .max format and this format is not supported for playback in other applications, therefore there is a necessity for conversion of file format to enrich the functions of these models. Basically the models are exported into two formats which is either .w3d or .avi.

5.3.1 .W3D FORMAT

Models exported to this format can be integrated into Macromedia Director MX and controlled in it. Therefore, for models that provide users interaction with it, it will be exported to this format. In order to export .max models to .w3d, the is a necessity to install an extra plug- in provided by Macromedia Director MX into 3D Studio MAX; which is the Shockwave Exporter. Models in .w3d format are small in size as it is only exported in single timeframe together with the model's information. Somehow, the surfaces of the models will be ignored when the models are exported to this format. Thus, users have to juggle between quality and performance.

5.3.2 .AVI FORMAT

.avi is a movie playback format where models are first animated within 3D Studio MAX before it is exported to this format. The animation will play its role as the storyline of that particular model. Therefore, models that are presented to users with explanation and at the same time provide less interaction with the users will be exported to .avi format. Models that are exported to this format consume large amount of storage space because each and every timeframe will be rendered and stored sequentially. The quality of the movie playback can be customized by users depending on its movie size, playback rate (frame per second- fps) and other factors. .avi files exported from 3D Studio MAX to be used in DigiKid carries the following specifications: -

- 800 * 600 pixel movie size
- 30 frame per second (standard NTSC playback rate)
- encoded with Cinepak codec

These models are integrated into Macromedia Flash MX for further animation enhancements before it is exported again into Macromedia Director MX.

5.4 ANIMATION TECHNIQUES

Animation movies that are exported from 3D Studio MAX will be preprocessed by Macromedia Flash MX before it is embedded into Macromedia Director MX. Macromedia Flash MX animations require the usage of Action Script to control the key frame flow of the animation. Action Script is a script that reflects similarity to object- oriented style of programming. It is considered as one of the most popular used multimedia programming script [30]. Figure 5.5 shows the screen shot of introduction animation created using Macromedia Flash MX with movie exported from 3D Studio MAX. The movie at the centre of the stage is created using 3D Studio MAX while phrase animations that appears on both the top and bottom of the stage are animated using Macromedia Flash MX.

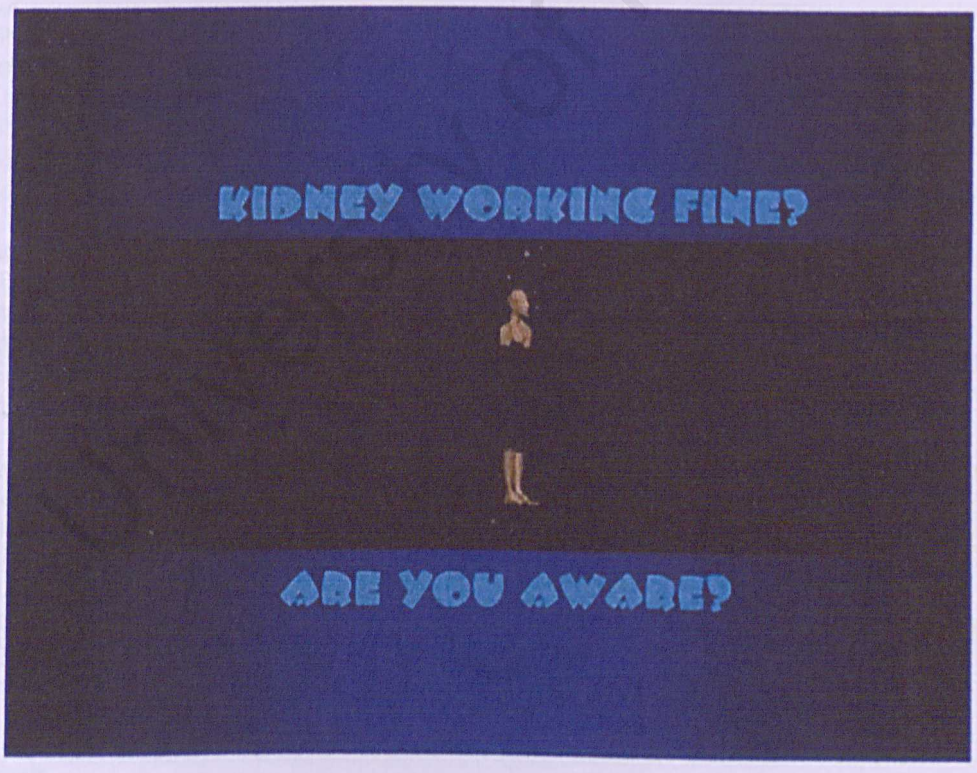


Figure 5.5 Screen shot of animated created using Macromedia Flash MX

5.5 STORYBOARD FLOW IN MACROMEDIA DIRECTOR MX

Storyboard design in Macromedia Director MX is develop using the key frame concept which is widely used in Macromedia products. Buttons and links are created to enable the active key frame to go to the desired frames. Macromedia Director MX requires the scripting knowledge of Lingo script to create behavior controls within Macromedia Director MX. Lingo script is also another widely used script in the competitive multimedia programming field [30].

Below is the sample of Lingo script that is used in DigiKid: -

```
global gMenuJumpList
global gTrackingList
global gPageCounter
global gStartMilliseconds
global gLessonTitle, gNavSetting, gShowMenu, gMenuExpansionChars, gShowHelp,
gShowExit
global gShowFeedback, gMaxTries, gKnowledgeTrack, gWeighting,
      gTotalNumberOfTrackedQuestions
global gTotalPointsPossibleForTrackedQuestions, gLoginFile, gActivityID, gActivityName
global gShowTypePages
global XMLObj, gQuestions, gQuestionNum, gScore, gCounter, gManyTime, grandfile, n,
      gstate, xmlCheck

on initGlobals
  gLessonTitle = "DIGIKID"
  gNavSetting = 1
  gShowMenu = 1
  gMenuExpansionChars = 0
  gShowHelp = 1
  gShowExit = 1
  gShowFeedback = -1
  gMaxTries = -2
  gKnowledgeTrack = -1
  gWeighting = -1
  gTotalNumberOfTrackedQuestions = -1
  gTotalPointsPossibleForTrackedQuestions = -1
  gShowTypePages = 1
end initGlobals

on prepareMovie
  clearGlobals
  clearCache
  initGlobals

  if gNavSetting = 0 then
    gShowMenu = 0
  end if
```

```
  gPageCounter = 0
  buildJumpAndTrackingLists
end prepareMovie


on startMovie
  err = voiceInitialize()
  if err = 1 then
    beep 1
    alert "This machine is not equipped with Text- To- Speech Engine."&return&"TTS Engine is
      required to run DigiKid."&return&"Installation of TTS Engine will be executed."
    open "tts\SAPI4SDKSUITE.exe"
    quit()
  end if

  gStartMilliseconds = the milliseconds
  currentFolder()
  XMLObj=newObject("XML")
  setCallback(XMLObj, "onLoad", #loadMyXML, 0)
  XMLObj.ignoreWhite=TRUE

  if grandfile <10 then
    XMLObj.load("xml\quiz000"&grandfile&".xml")
  else
    XMLObj.load("xml\quiz00"&grandfile&".xml")
  end if

 reSetText()

  gScore=0
  gManyTime=0
  gQuestionNum=0
end startMovie

on currentFolder
  gstate = 0
 repeat while gstate <> 1
     grandfile = random(501)-1
     put grandfile
     if grandfile <10 then
       repeat with i = 0 to 500
         n = getNthFileNameInFolder("@\xml", i)
         if n = EMPTY then exit repeat
         if n = "quiz000"&grandfile&".xml" then
           gstate = 1
       exit repeat
      end if

 end repeat
 else

 repeat with i = 0 to 500
        n = getNthFileNameInFolder("@\xml", i)
        if n = EMPTY then exit repeat
```

```
        if n = "quiz00"&grandfile&".xml" then
          gstate = 1
   exit repeat
        end if
   end repeat
   end if
   end repeat
 end currentFolder


 on currentQuestion (gQuestionNum)
 member("questions").text=(gQuestionNum+1)&"."&&XMLObj.firstChild.childNodes[gQuestion
    Num].firstChild.firstChild.toString()
  repeat with a=1 to 4
  member("answer"&a).text=numToChar(96+a)&")"&&\
  XMLObj.firstChild.childNodes[gQuestionNum].childNodes[a].childNodes.toString()
  end repeat
  gCounter=integer(XMLObj.firstChild.childNodes.length)
 end currentQuestion


 on buildJumpAndTrackingLists
  gMenuJumpList = []
  thisPageNum = 0
  menuList = the markerList
  inSection = FALSE
  currentSectionNum = 0
  currentSectionName = ""
  whichLineNum = 1
  repeat with i = 1 to menuList.count
    menuItemFrameNum = menuList.getPropAt(i)
    thisMenuItem = menuList.getProp(menuItemFrameNum)
    case TRUE of

     ((thisMenuItem.char[1..2] = "P:") or \
     (thisMenuItem.char[1..2] = "C:") or \
     (thisMenuItem.char[1..2] = "Q:")):
     thisPageNum = thisPageNum + 1

     addPageToMenuJumpList(inSection, thisMenuItem, menuItemFrameNum, \
     currentSectionNum, currentSectionName)

     addPageToTrackingList(thisPageNum, thisMenuItem, menuItemFrameNum, inSection, \
     currentSectionNum, currentSectionName)

     ((thisMenuItem.char[1..5] = "Type:") and gShowTypePages):

     thisPageNum = thisPageNum + 1

     addPageToMenuJumpList(inSection, thisMenuItem, menuItemFrameNum, \
     currentSectionNum, currentSectionName)

     addPageToTrackingList(thisPageNum, thisMenuItem, menuItemFrameNum, inSection, \
     currentSectionNum, currentSectionName)

     (thisMenuItem.char[1..2] = "S:"):
```

```
        currentSectionNum = currentSectionNum + 1
        inSection = TRUE

        listItem = [#menuItem: thisMenuItem, #frameNum: menuItemFrameNum, \
        #sectionNum: currentSectionNum]
        gMenuJumpList.add(listItem)
        delete thisMenuItem.char[1..2]
        currentSectionName = thisMenuItem
        (thisMenuItem.char[1..5] = "S_End"):
        inSection = FALSE

      end case
      end repeat

    listItem = [#menuItem: "", #sectionNum: -1]
    gMenuJumpList.add(listItem)
  end buildJumpAndTrackingLists

  on addPageToMenuJumpList inSection, thisMenuItem, menuItemFrameNum,
  currentSectionNum, \
  currentSectionName

    if inSection then
      listItem = [#menuItem: thisMenuItem, #frameNum: menuItemFrameNum, \
      #sectionNum: currentSectionNum, #sectionName: currentSectionName]
    else
      listItem = [#menuItem: thisMenuItem, #frameNum: menuItemFrameNum, \
      #sectionNum: 0, #sectionName: ""]
    end if
  gMenuJumpList.add(listItem)
  end addPageToMenuJumpList

  on addPageToTrackingList thisPageNum, thisMenuItem, menuItemFrameNum, inSection, \
  currentSectionNum, currentSectionName
    if voidP(gTrackingList) then
      gTrackingList = []
    end if
    if gTrackingList.count < thisPageNum then
      thisPageList = [:]
      thisPageList[#name] = thisMenuItem
      thisPageList[#frameNum] = menuItemFrameNum
      if inSection then
        thisPageList[#sectionNum] = currentSectionNum
        thisPageList[#sectionName] = currentSectionName
      else
        thisPageList[#sectionNum] = 0
        thisPageList[#sectionName] = ""
      end if
      thisPageList[#completionStatus] = 0
      gTrackingList.addAt(thisPageNum, thisPageList)
    end if

  end addPageToTrackingList

  on goNextMarker
```

```
  if gPageCounter < gTrackingList.count then
    whichFrameNum = gTrackingList[gPageCounter + 1][#frameNum]
    go frame whichFrameNum
  end if
end goNextMarker

on getNavSetting questionSpriteNum
  if not(voidP(gNavSetting)) then
    if gNavSetting < -1 or gNavSetting > 2 or not(integerP(gNavSetting)) then
      gNavSetting = -1
    end if
  else
    gNavSetting = -1
  end if
  if gNavSetting = -1 then
    navSetting = sendSprite(questionSpriteNum, #getNavSetting)
  else
    if gNavSetting = 0 then
      navSetting = "None"
    else if gNavSetting = 2 then
      navSetting = "Auto Go Next Marker"
    else
      navSetting = "Next Button"
    end if
  end if
  return(navSetting)
end getNavSetting

on getPageInTrackingList whichMarker
  thisPage = VOID

  repeat with i = 1 to (the markerList).count
    if whichMarker = (the markerList).getPropAt(i) then
      exit repeat
    end if
  end repeat

  thisPageName = (the markerList)[i]

  repeat with thisPage in gTrackingList
    if thisPageName = thisPage.name then
      exit repeat
    end if
  end repeat

  return(thisPage)
end getPageInTrackingList

on getPageNumInTrackingList whichMarker
  repeat with i = 1 to (the markerList).count
    if whichMarker = (the markerList).getPropAt(i) then
      exit repeat
    end if
  end repeat

  thisPageName = (the markerList)[i]
```

```
  pageNum = 0
  repeat with thisPage in gTrackingList
    pageNum = pageNum + 1
    if thisPageName = thisPage.name then
      exit repeat
    end if
  end repeat

  return(pageNum)
end getPageNumInTrackingList

on getLessonStatus me
  lessonStatus = "c"
  repeat with thisPage in gTrackingList
    if thisPage.completionStatus < 2 then
      lessonStatus = "i"
      exit repeat
    end if
  end repeat
  return(lessonStatus)
end getLessonStatus

the floatPrecision = oldFloatPrecision
percentPointsEarned = integer(percentPointsEarned)
return(percentPointsEarned)
end getPercentCorrect
```

Figure 5.6 Sample of Lingo scripting

Lingo scripting is required in each an every behavior declared within Macromedia Director MX. Therefore, to complete the whole behavior scripting, very heavy programming application is needed.

5.6 RETRIEVAL OF QUIZ QUESTIONS FROM XML

For the quiz section in DigiKid, questions are loaded randomly from XML files using Lingo linkage. XML or eXtensible Markup Language is a uniform language that is used to describe data and its structure is very much well formatted compared to any other languages. Below is the sample content of a XML quiz file used in DigiKid: -

```
<?xml version="1.0"?>
<quiz>
    <question>
        <questionText>What does the urinary system does not do?
        </questionText>
        <incorrect>Produce Urine
        </incorrect>
        <incorrect>Control the volume and composition of body fluid
        </incorrect>
        <correct>Assist in respiratory process
        </correct>
        <incorrect>Rids the body of waste materials
        </incorrect>
    </question>
    <question>
        <questionText>The kidney is embedded in the...
        </questionText>
        <incorrect>Adrenal Gland
        </incorrect>
        <incorrect>Renal Vein
        </incorrect>
        <incorrect>Inferior Vena Cava
        </incorrect>
        <correct>Adipose Capsule
        </correct>
    </question>
    <question>
        <questionText>Blood enters the kidney through the...?
        </questionText>
        <incorrect>Ureter
        </incorrect>
        <incorrect>Inferior Vena Cava
        </incorrect>
        <incorrect>Adrenal Gland
        </incorrect>
        <correct>Renal Hilus
        </correct>
    </question>
```

```
<question>
        <questionText>Which is not one of regions of the kidney?
        </questionText>
        <correct>Renal Pyramid
        </correct>
        <incorrect>Renal Pelvis
        </incorrect>
        <incorrect>Renal Cortex
        </incorrect>
        <incorrect>Renal Medulla
        </incorrect>
</question>
<question>
        <questionText>Which is the structural and functional unit of the kidney ?
        </questionText>
        <incorrect>Glomerulus
        </incorrect>
        <correct>Nephrons
        </correct>
        <incorrect>Renal Artery
        </incorrect>
        <incorrect>Afferent Arteriole
        </incorrect>
</question>
<question>
        <questionText>Which is the most accurate order of blood circulation in the
                        kidney
        </questionText>
        <incorrect>Interlobar Artery, Arcuate Artery, Glomerulus
        </incorrect>
        <correct>Interlobar Artery, Arcuate Artery, Interlobular Artery
        </correct>
        <incorrect>Afferent Arteriole, Arcuate Artery, Efferent Arteriole
        </incorrect>
        <incorrect>None of the above
        </incorrect>
</question>
<question>
        <questionText>What is the nickname for the Cells Proximal Convulated?
        </questionText>
        <correct>Brush border Cells
        </correct>
        <incorrect>Brush brush cells
        </incorrect>
        <incorrect>Basolateral Cells
        </incorrect>
        <incorrect>Tight junctions
        </incorrect>
</question>
```

```
        <question>
                <questionText>The thick ascending loop of Henle is similar ?
                </questionText>
                <incorrect>Late DCT
                </incorrect>
                <correct>Early DCT
                </correct>
                <incorrect>PCT
                </incorrect>
                <incorrect>Cortical Collecting Duct
                </incorrect>
        </question>
</quiz>
```

Figure 5.7 Sample of XML language coding

Within XML, new quiz questions can easily be added without much hassle. Task is even simplified because XML coding requires no special compilation and it can be edited even on Microsoft Notepad or through the basic Microsoft Command Prompt.

5.7 TEXT- TO- SPEECH TECHNOLOGY

Text- to- speech engine technology is one of the Speech Application Protocol Interface (SAPI) features introduced by Microsoft. In DigiKid, TTS is used to read out the contents and information about human kidney to users. This is to enable users to catch the correct pronunciations of the keywords. Besides that, the main reasons DigiKid chose to imply the TTS technology is because it can read text typed in DigiKid and it requires no audio recording. Therefore, this will drastically reduce the size of the application file. A smaller application file size allows faster loading of the application. Within Macromedia Director MX, Lingo is again used to call to execute the TTS Engine. Below is the tag used in Lingo to execute the TTS Engine: -

```
speak("This application is equipped with Text- To- Speech feature")
```

Figure 5.8 Sample tag of TTS execution using Lingo script

5.8 DEVELOPMENT TOOLS

Table 5.1 describes the outline of software tools that need to be installed on the development and client side.

SOFTWARE	INSTALLATION	DESCRIPTION
Microsoft Windows XP	Developer and User	Operating system
3D Studio MAX	Developer	3D modeling tools
Macromedia Flash MX	Developer	Animation tools
Macromedia Director MX	Developer	Development of storyboard
Text- to Speech Engine	Developer and User	To enable TTS technology
Microsoft Notepad	Developer	XML editing
Adobe Photoshop	Developer	Image processing

Table 5.1 Development Tools

5.9 DEBUGGING

Debugging is an activity to detect flaws and bugs within the system. Throughout the development of DigiKid, the main debugging cycle iterates around the Lingo scripting. Macromedia Director MX allows debugging to be done easily as it provides a Lingo debugger within the application itself.

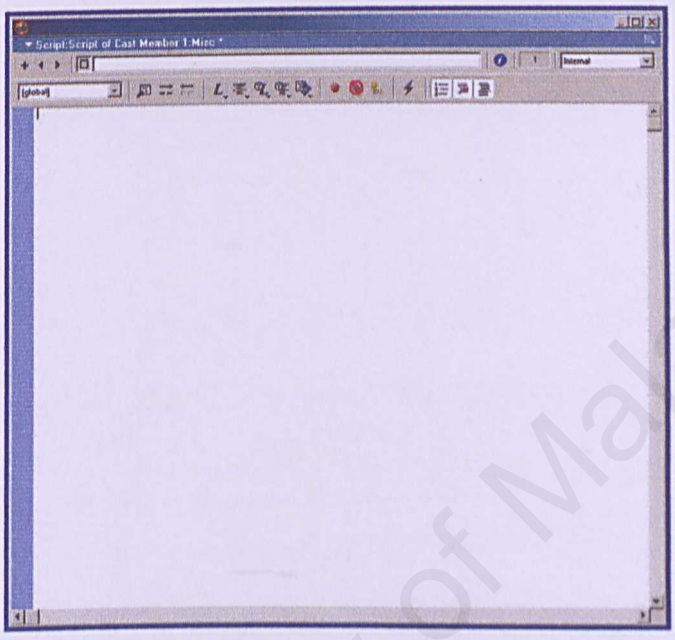
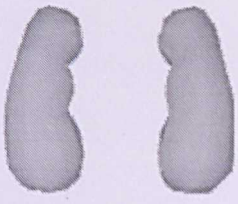


Figure 5.9 Script debugger in Macromedia Director MX

5.10 SUMMARY

Chapter 5 presents the system implementation in terms of the modeling approaches, animation methods, scripting principle and development tools used. As Rapid Application Development methodology is chose to used, therefore implementations of the system together with integration is carried out all the while during the development duration.



CHAPTER 6 SYSTEM TESTING

CHAPTER 6 SYSTEM TESTING

6.1 CHAPTER INTRODUCTION

System testing is an important phase in the development of DigiKid. All of the models, scripting, software, processes, and hardware involved in the development of DigiKid must be tested thoroughly. System testing process is carried out throughout the development duration of the system whenever new integrations are made and another full testing is done once the system is completed.

As the implementation of system is based around the requirement specification, system testing is therefore essential to detect as well as ensure that it is able to fulfill all the requirements. Due to errors that have been done during the system development and design stage, faults and failures may happen even when the entire system has been developed. The main idea of system testing is to demonstrate the correctness of the program, identify the errors in the Lingo scripting and system design. The errors found during the system testing will have to be fixed before the final product is presented.

6.2 TYPES OF TESTING

Basically the testing process can be divided into three different stages which are the: -

- Unit testing
- Integration testing
- System testing

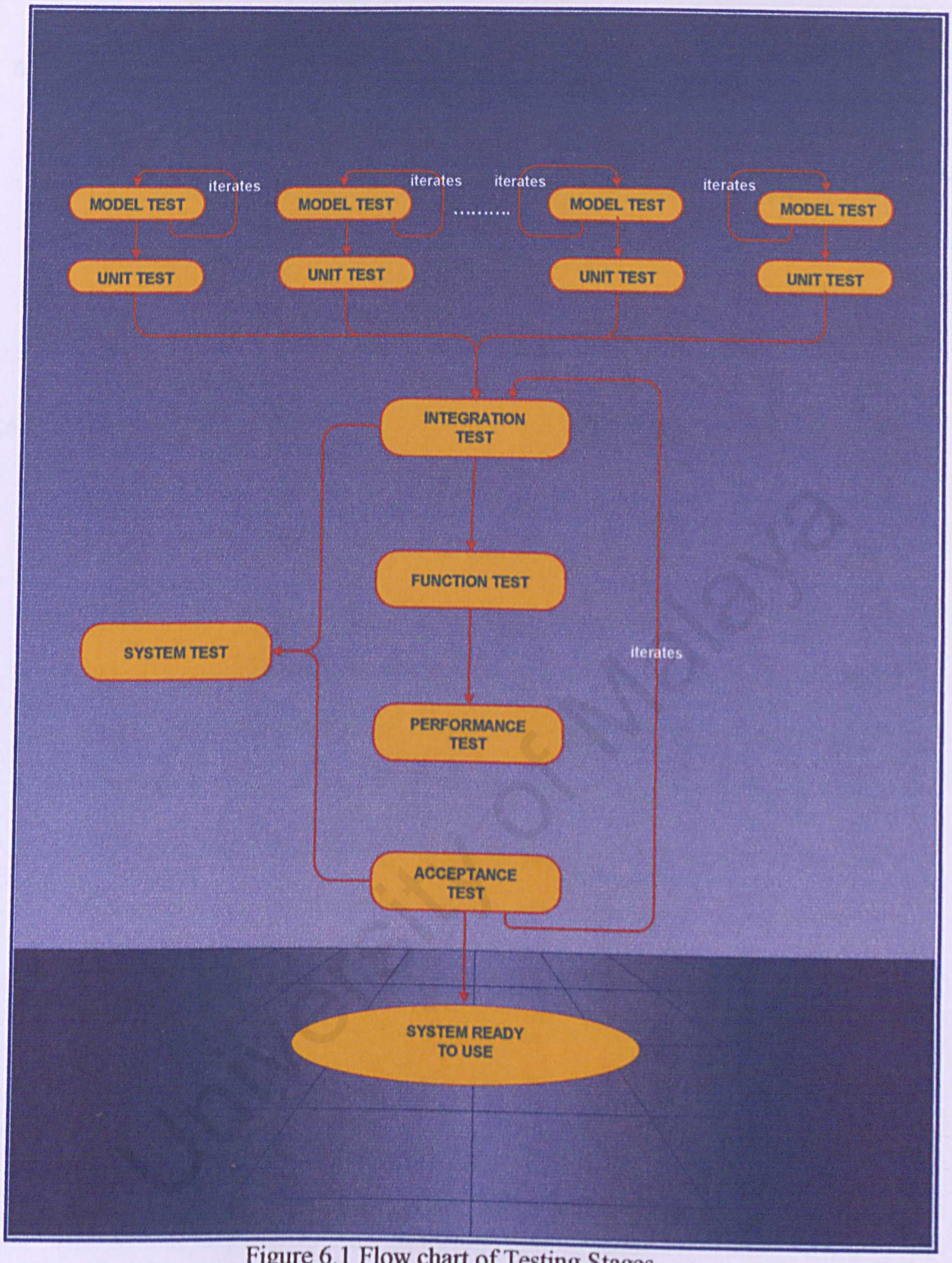


Figure 6.1 Flow chart of Testing Stages

6.3 MODEL TEST

Models are tested within 3D Studio MAX to ensure its quality and precision before it is exported for integration purposes. These models will be examined from various angles and perspectives to ensure its likeliness to the actual object.

6.4 UNIT TEST

Unit testing focuses on evaluating individual modules that had been animated in Macromedia Flash MX as well as Macromedia Director MX. These individual modules are testing includes the testing of Action Script and Lingo Script. The main objective of unit testing is to ensure program accuracy, data integrity, usability and efficiency at the module level.

Within this unit testing, dynamic analysis test is undertaken. Dynamic test require the module to be executed on a machine. White box testing is a test case design method that uses the control structure of the procedural design to derive test cases. It can be conducted in parallel for multiple modules.

The steps involved in unit testing are: -

- Manually examine the code simply just from reading through it, trying to spot algorithm and syntax errors.
- Comparing the codes with the specification defined and also with the design is necessary to ensure all relevant cases are considered
- Compile the code and eliminate remaining syntax faults
- Develop test cases to show that the behaviors controls are properly converted to the desire actions.

The following section discusses some of the modules testing in details.

6.4.1. MODELS AUTO ROTATION MODULE

Cursor is put over the models to enable the rotation of the models in clockwise direction. Cursor is moved out of the models region. After that, the cursor is moved into the model region to enable the model to rotate at anti- clockwise direction.

6.4.2. PAGE NAVIGATION MODULE

Testing starts from the menu page. Browse to the first page of the anatomy review. Browsing continues in forward direction. Return to menu page by clicking on the menu link. Again browse to one of the content pages through the menu page. Click on the help button. Click on back button. Check if page appears if the page last browsed.

6.4.3. QUIZ CONNECTION TO XML FILES

Testing starts from the menu page. Browse to the quiz page to enroll into quiz. The connection is confirmed by the loading of the quiz questions on the quiz page. The sequence and questions are recorded onto a scratch pad. Restart system. Again browse to the quiz page through the menu page. Check if the questions loaded are in different order or even different questions are loaded after all.

6.5 INTEGRATION TESTING

The integration testing process is carried out after the unit testing process has been done. When satisfied, that individual component or module is combined into the main storyboard. Several independent modules' integration can cause some unpredicted and unexpected errors. Integration testing is a systematic approach for constructing the application while conducting tests to uncover errors associated with interfacing of different components or modules.

One of the objectives of conducting integration testing is to determine the defectiveness of the modules. For example, image buttons in the menu page was tested whether it calls other modules or not and also whether the image button changes on situations like mouse over, mouse down and button unavailable.

Another objective is to ensure that the different unit- tested modules in DigiKid system can function smoothly together to the exaction of the system requirements. The major concerns here are the shared variable, models and linkage.

There are many approaches that can be used to do the integration testing, such as; bottom- up integration, top- down integration, big- bang integration, sandwich integration and much more. For DigiKid, the bottom- up approach has been used. When this method is used, each component or module at the lowest level of the system hierarchy is tested individual first. Then, the next components to be tested are those that call the previously tested ones. This approach is followed repeatedly until all components or modules are included in the testing. After finishing the integration test, those errors and faults discovered is corrected as soon as possible in order to proceed to the system- testing phase.

6.6 SYSTEM TESTING

The entire system will be validated once it is completed. Validation is done by carrying out the system testing process. Testing the whole system is very different from unit and integration testing. When doing the system testing process, the entire system's attributes are taken into account, these includes; supporting software, supporting hardware, XML files, operating system and the whole computer system.

The objective of system testing is to verify and validate the functional and non- functional requirements of the system. The functional and non- functional requirements of DigiKid system are as defined in earlier chapters.

There are several types of system testing that can be used to test a software system. But only three types of system testing are used for this system:

- **Function Testing**

  Function testing focus on the functionality of the system. It is based on the system functional requirement. The process is to check whether the system provides the function to do the task, which it is suppose to do.

- **Performance Testing**

  This testing is carried out after the function testing process. When the system performs the function required by the requirements, the testing process then turn to test the way in which those functions are performed. Thus, the performance testing addresses the non- functional requirements. The purpose of this testing is to test the run time performance of this system within the context of an integrated system. It involves both hardware and software instruments.

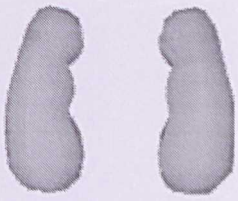
6.7 ACCEPTANCE TESTING

The final stage of testing process before DigiKid is being accepted by the user is the acceptance testing. Testing by the user will reveal the errors and omissions in the system requirements definition because the acceptance testing involves testing from the users. This will also reveal the requirement problems where the system facilities do not really meet the users' demand or the system's performance is unaccepted.

Acceptance testing for DigiKid is conducted by asking the users to experience themselves with the system. After completed using the system, informal question and answer session was conducted to ask them to evaluate the system.

6.8 SUMMARY

Chapter 6 presents the system testing in terms of the types of testing conducted for the system. Firstly, model test is conducted followed by unit testing. After that, integration testing is carried out to uncover errors associated with the interfacing of different components or modules. System testing is carried out after integration testing to make sure the whole system is working fine with the entire environment of the system. Lastly, acceptance testing is performed by the end users of the system.



CHAPTER 7
SYSTEM EVALUATION

CHAPTER 7 SYSTEM EVALUATION

7.1 CHAPTER INTRODUCTION

This is the final phase in the life cycle of this project. During the period of modeling and programming as well as implementation, various problems were encountered. So this chapter will highlight some of the problems faced throughout the project duration and also with the solution that has been taken to solve it. Besides that, this chapter also will include the evaluation of the system to identify its strengths and limitations. As suggestions to further improvements of this system, the possibilities to enhance the system are also explored.

7.2 PROBLEMS ENCOUNTERED

7.2.1 DIFFICULTY IN DETERMINING DEVELOPMENT TOOLS

Choosing the right development tools is the most essential and critical process in the software development cycle. There are many software tools available in the market to choose from, such as 3D Studio MAX, LightWave, Maya, Bryce, Macromedia Flash MX, Macromedia Director MX, Swish and so on, not to mention the choices for other software such as data storage et cetera. Unfortunately, this range of tools available had raised the problem on making the decision to choose the best suitable tools for the system needs.

In order to ensure that the suitable tools are chosen to develop DigiKid, the first step is to define the needs of the system. Then doing some research based on the type of software needed that listed before. The research was done by surfing the internet and seeking advice from experience people. The results and outcome of these approaches are well recorded in the literature review which is at the earlier part of the report. Finally to choose the best combination among them, all the suitable software tools were listed out.

7.2.2 LACK OF KNOWLEDGE AND EXPERIENCE IN 3D MODELING

Lack of experience and knowledge has proved to be an obstacle in the beginning. This is because the concepts of 3D modeling require lots of patience and a high performance machine which in this case, the hardware specification just barely manage to meet its requirements. The new exposure of the new technologies of products such as 3D tools, animation

tools, and upcoming operating systems has increased the learning curve before starting the development of DigiKid.

Surfing the internet for information and reading up on the concept of 3D modeling and animations which include the features of 3D Studio MAX, were some of the approached taken to overcome this problem. Most of the confusions are resolves by reading up on relevant materials and most importantly advice and guidance from course mates and supervisor.

7.2.3 DIFFICULTY IN OBTAINING MORE KIDNEY INFORMATION

As the name DigiKid (Digital Kidney) implied, it was not easy to find related links. Links to kidney information with image explanation were very limited. In order to solve this problem, medical search engine are used to browse for information and keywords chosen need to be more precise. The selection of search engine is essential, as it will provide different search results. Careful selection search engines had helped to overcome this problem.

Besides that, analysis need to be done on the information provided from the websites to make sure it is relevant. This is also to make sure the information is correct and does not mislead the users to have gained the wrong information. Besides that, medical reference books were look up to search for related links provided by the author itself.

7.3 SYSTEM STRENGTHS

The following points illustrate the overall strength of DigiKid.

7.3.1 SIMPLE AND USER- FRIENDLY INTERFACE

The interface of the system is rather simple and easy to use. The system makes full use of Menu and Navigation techniques, allowing users to visual objects to navigate through the system. Clear, precise instructions guidance is also given to guide the users. Hence, users will find DigiKid easy to use and browse.

7.3.2 INTERACTIVE MULTIMEDIA ENVIRONMENT

As the contents of the system are presented using multimedia elements which includes 3D animations, speech, images, text and more, this provide an interactive learning experience.

Users will be able to absorb knowledge faster when they are exposed to multimedia elements rather than just plain text. Text- To- Speech technology also enable users with hearing impair to enjoy DigiKid to a certain extend.

7.3.3 SYSTEM TRANSPARENCY

System transparency refers to the condition where the users do not need to know where the image files resides, how the system is structured, its information management system and anything related to the system built. This protects users against complicated Lingo scripting and confusion with various development versions.

7.4 SYSTEM CONSTRAINTS

The following list expresses the limitations of DigiKid.

7.4.1. UNABLE TO ADD MORE KIDNEY INFORMATION

As the information on kidney is all embedded into Macromedia Director MX, there is no way to add new information into the system unless editing with Macromedia Director MX is done. This requires a lot of Lingo scripting knowledge and experience as well as familiarity to the scripting structure of the system.

7.4.2. 3D MOVIES SLOW DOWN LOADING TIME

The 3D movies embedded into DigiKid somehow slow down the loading of certain pages within it. This limitation is rather hard to be solve as developer will have to juggle be quality and performance. It is hard to settle for a solution that benefits both the factors. Therefore, slight sacrifice on either factor is almost unavoidable.

7.5 FUTURE ENHANCEMENTS

7.5.1. CONVERSION OF SYSTEM TO WEB- BASED SYSTEM

Currently the structure system of DigiKid involves a lot of 3D animations which consume a large amount of storage space; therefore it is hard to export the system to web- based system. However, with the advancement of technology day by day, in the near future it is predicted that animations that consume smaller storage space as well as larger internet bandwidth will be realistic. This will lead to the first step of Online DigiKid.

7.5.2. MORE VARIETY OF QUIZZES

To further enhance the system, various quizzes should be included to make the system somehow more interesting and challenging. Besides that, users will have more selection on the types of quiz to practice. Hence, users will not feel bored and will keep using DigiKid for new quizzes. This will also help them improve their understanding on the human kidney.

7.6 KNOWLEDGE AND EXPERIENCE GAINED

From the DigiKid thesis project, I have gained additional knowledge on 3D modeling and animations as well as user interface flow designing. Before I was involved in this project, I have no programming knowledge on 3D modeling; this includes 3D Studio MAX or any other 3D tools. Besides increasing the knowledge on 3D modeling, I have also learned to use XML files for storage of data as act as a mini database. Moreover, theories and knowledge gained throughout the course of Bachelor of Computer Science studies like system analysis, design and software engineering were literally put in practice.

Besides that, I also learnt to solve problems by searching for the suitable reference especially from the internet and library resources. The valuable experience of working independently is especially helpful for future involvement in software development.

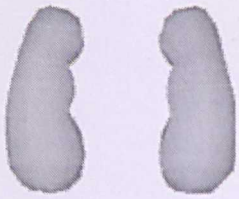
7.7 SUMMARY

Chapter 7 presents the system evaluation in terms of problems encountered and its solutions, evaluation by end users, system strengths and system constraint. Future enhancements are also included in this chapter so that DigiKid can be further enhanced to provide a better quality system. This chapter concludes with the knowledge and experience garnered throughout the development of DigiKid.

7.8 CONCLUSION

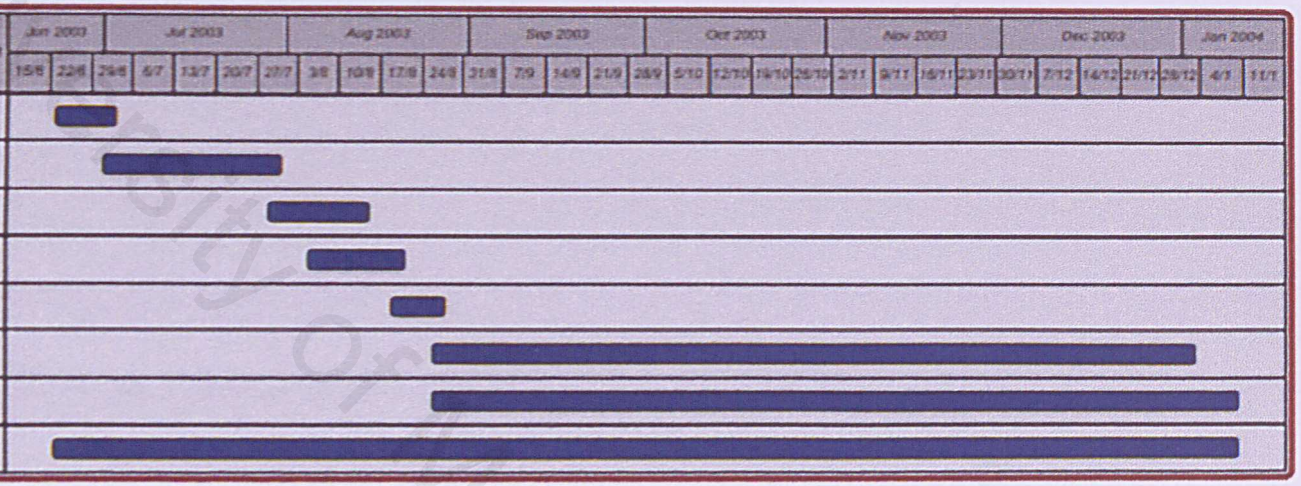
Overall, DigiKid has achieved the system objectives defined during the analysis stage and fulfilled all the functional and non- functional requirements. Throughout this project, useful knowledge and experience are gained. From the development of DigiKid, time is used to master 3D modeling tools, animations control and more skills which will be important for future multimedia programming. Besides that, I also gained a lot of experience in working independently to develop DigiKid. Here, theories and knowledge gained throughout the course of Bachelor of Computer Science studies like system analysis and design, software engineering were literally put into practice.

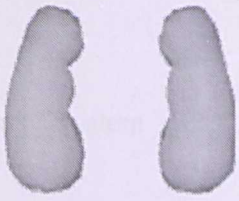
DigiKid has fully tested and is reliable system. The software engineering concepts, principles and techniques applied in DigiKid are carefully selected and analyzed to determine its suitability. The development of this project using these techniques will ease the tasks of future enhancements and expansions of DigiKid. These experiences are especially helpful to me no matter where I land in the near future.



APPENDIX

ID	Task Name	Start	Finish	Duration
1	Project Definition	6/23/2003	7/2/2003	8d
2	Literature Review	7/1/2003	7/30/2003	22d
3	Methodology	7/29/2003	8/14/2003	13d
4	System Analysis	8/5/2003	8/20/2003	12d
5	System Design	8/19/2003	8/27/2003	7d
6	Implementation	8/26/2003	1/2/2004	94d
7	System Testing	8/26/2003	1/9/2004	99d
8	Documentation	6/23/2003	1/9/2004	145d





REFERENCES

REFERENCES

1 Marvin J Branstorm. Interactive PHYSIOLOGY, urinary system [CD]. A.D.A.M Software Inc., 1997.

2 Emrika Padus. THE COMPLETE GUIDE TO YOUR EMOTIONS AND YOUR HEALTH, revised edition. Rodale Health Publishing, Pennsylvania, 1992

3 Dissertation and Theses [ONLINE]
Available from:
http://www.dissertationsandtheses.com/literature_review.html
[ACCESSED 12 JULY 2003]

4 Antony Hopkins CBE, FRCM, Hon RAM, 1995. The New Joy of Knowledge Encyclopedia- Medicine and Psychology. Oriole, London, 1995

5 Dr. Chan See Fong, MD, MRCP (UK)

6 About.Com [ONLINE]
Available from:
http://kidney.about.com
[ACCESSED 15 JULY 2003]

7 National Vital Statistics Reports, 1999. Deaths: Final Data for 1997. Nat Center for Health Stat., 1999.

8 Nicolle LE, Friesen D, Harding GKM, Roos LL, 1996. Hospitalization for acute pyelonephritis in Manitoba, Canada, during the period from 1989 to 1992. Clin Infect Dis. 1996.

9 RX Med [ONLINE]
Available from:
http://www.rxmed.com/b.main/b1.illness/b1.1.illness/KIDNEY%20INFECTION,%20ACUTE%20(PYELONEPHRITIS,%20ACUTE).htm
[ACCESSED 15 JULY 2003]

10 Nephrology Channel [ONLINE]
Available from:
http://www.nephrologychannel.com/crf/
[ACCESSED 5 AUGUST 2003]

11 World Drug Mart [ONLINE]
Available from:
http://worlddrugmart.healthology.com/webcast_transcript.asp?f=kidney_health&b=worlddrugmart&c=urology_fsgsintro&transcript=yes&spg=VID
[ACCESSED 25 JULY 2003]

12 Branch, William. Office Practice of Medicine. W. B. Saunders Co., Philadelphia, 1982.

13 Brunner, Lillian and Doris Suddarth. Textbook of the Medical- Surgical Nursing.
J. B. Lippincott, Philadelphia, 1975

14 Health at OZ [ONLINE]
Available from:
http://www.healthatoz.com/healthatoz/Atoz/ency/glomerulonephrtitis.html
[ACCESSED 6 AUGUST 2003]

15 World Drug Mart [ONLINE]
Available from:
http://www.worlddrugmart.com
[ACCESSED 25 JULY 2003]

16 Herring Lab Photos [ONLINE]
Available from:
http://www.herringlab.com/photos/
[ACCESSED 1 AUGUST 2003]

17 Experts Exchange [ONLINE]
Available from:
http://www.experts-exchange.com
[ACCESSED 4 AUGUST 2003]

18 Alias Wavefront [ONLINE]
Available from:
http://www.alias.com/eng/products-services/maya/indew.shtml
[ACCESSED 8 AUGUST 2003]

19 ZAON Forum [ONLINE]
Available from:
http://www.zaon.com/index.php
[ACCESSED 8 AUGUST 2003]

20 Discreet [ONLINE]
Available from:
http://www.discreet.com
[ACCESSED 9 AUGUST 2003]

21 NEWTEK [ONLINE]
Available from:
http://newtek.com/products/lightwave/product/index.html
[ACCESSED 9 AUGUST 2003]

22 Corel [ONLINE]
Available from:
http://www.corel.com/servlet/Satellite?pagename=Corel/Products/productInfo&id=1042551234521
[ACCESSED 8 AUGUST 2003]

23 ERLANG [ONLINE]
Available from:
http://www.wings3d.com
[ACCESSED 7 JULY 2003]

24 Adobe [ONLINE]
Available from:
http://www.adobe.com/products/photoshop/
[ACCESSED 8 AUGUST 2003]

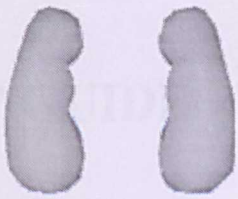
25 Adobe [ONLINE]
Available from:
http://www.adobe.com/products/premiere/
[ACCESSED 8 AUGUST 2003]

26 Ronald LeRoi Burback, 1997. Methodology [ONLINE]
Available from:
http://www-db.stanford.edu/~burback/water-sluice/sluice6.2.25.97/ws/node3000.html
[ACCESSED 12 AUGUST 2003]

27 Walter Maner, 1997. Rapid Application Development [ONLINE]
Available from:
http://csweb.cs.bgsu.edu/maner/domains/RAD.htm
[ACCESSED 12 AUGUST 2003]

28 Steve C McConnell, 2001. Rapid Development- Taming Wild Software Schedules [ONLINE]
Available from:
http://www.credata.com/research/rad.html
[ACCESSED 15 AUGUST 2003]

29 Microsoft Corp. [ONLINE]
Available from:
http://www.microsoft.com
[ACCESSED 16 AUGUST 2003]



USER GUIDE

CONTENTS OF DIGIKID USERS' GUIDE

CHAPTER 1 INTRODUCTION

1.1 HARDWARE REQUIREMENT

The minimum requirements to run DigiKid are:

- Intel Pentium processor (Pentium II recommended)

  Power Macintosh Power PC processor (G3 recommended)
- 32MB RAM (64 MB recommended)
- SVGA Graphic Adapter (able to support 800 X 600 resolution)
- Sound Card
- Speakers
- Keyboard
- Mouse

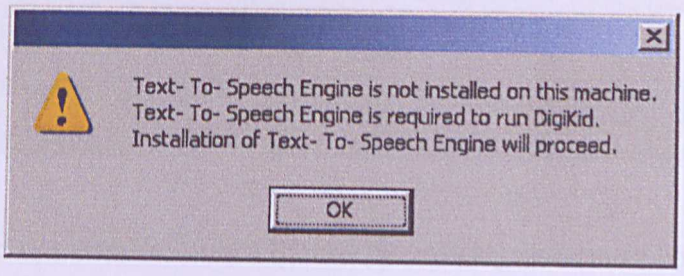
1.2 SOFTWARE REQUIREMENT

The minimum software requirements to run DigiKid are:

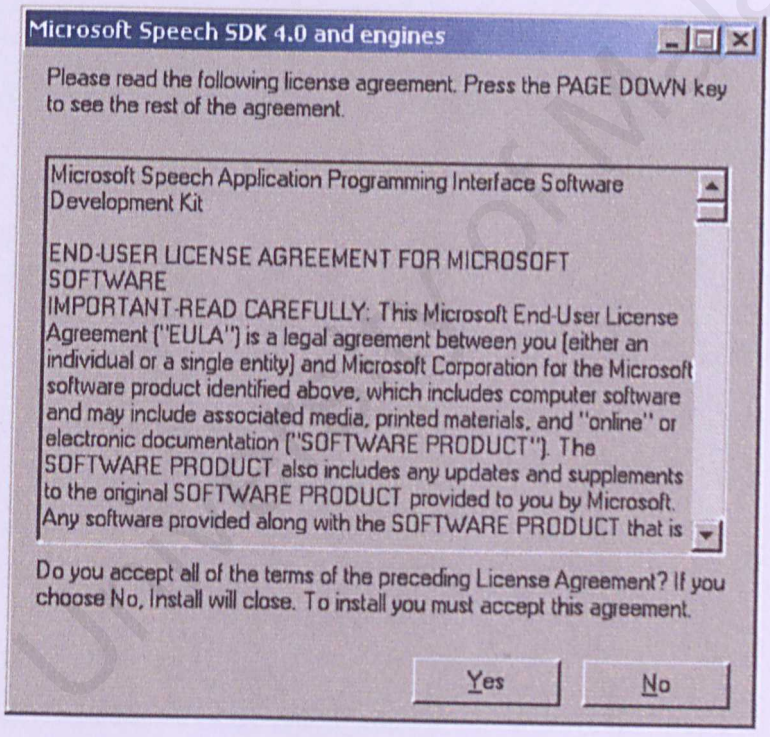
- Microsoft Windows 2000
- Microsoft Windows XP Home or Professional Edition
- Text- To- Speech Engine

CHAPTER 2 DIGIKID INSTALLATION

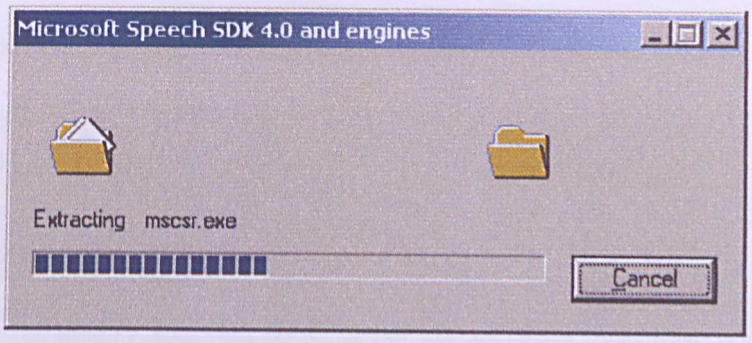
To start DigiKid, insert the CD into the CD- ROM. If there is no Text- to- Speech Engine installed, DigiKid will prompt you to install the Text- to Speech Engine.



Press OK to proceed with the installation. A Microsoft Speech SDK 4.0 and Engines End User License Agreement will appear. After reading and understanding the agreement, proceed with the installation if you agree by pressing Yes.



After you have pressed Yes, the installation will immediately take place.

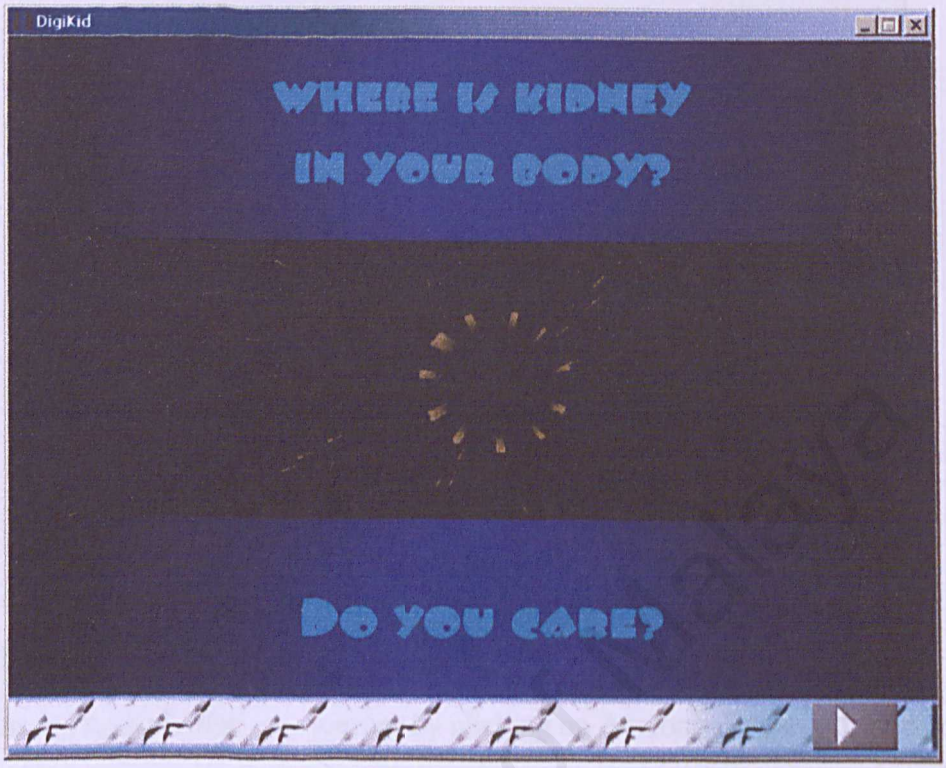


You may cancel the installation at any time by pressing the cancel button and double confirm your decision.

Restart DigiKid after installation to start using DigiKid.

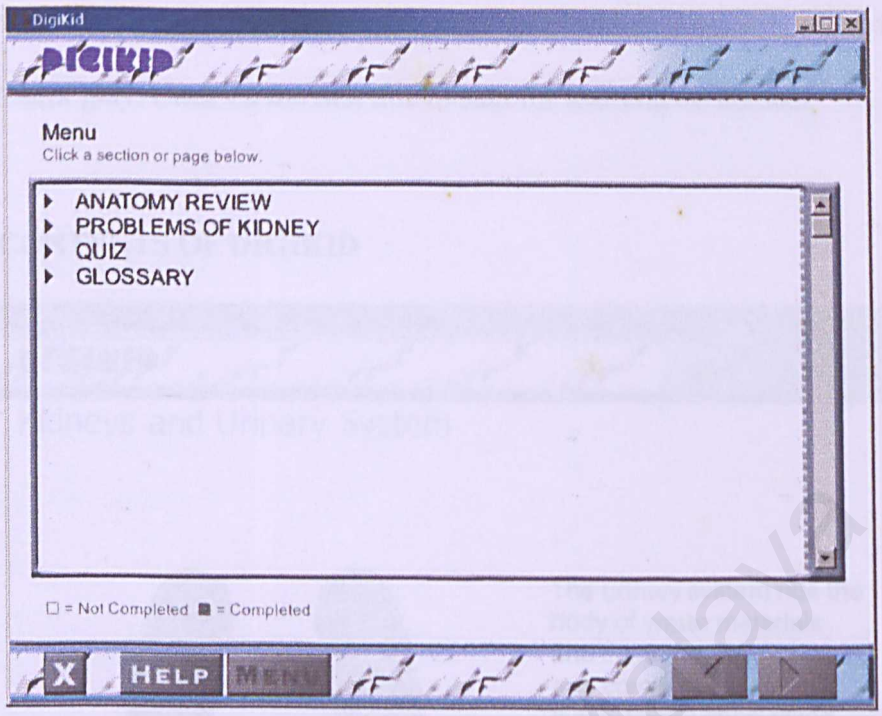
CHAPTER 3 USING DIGIKID

Once you entered DigiKid, you will be greeted by the Welcome animation.

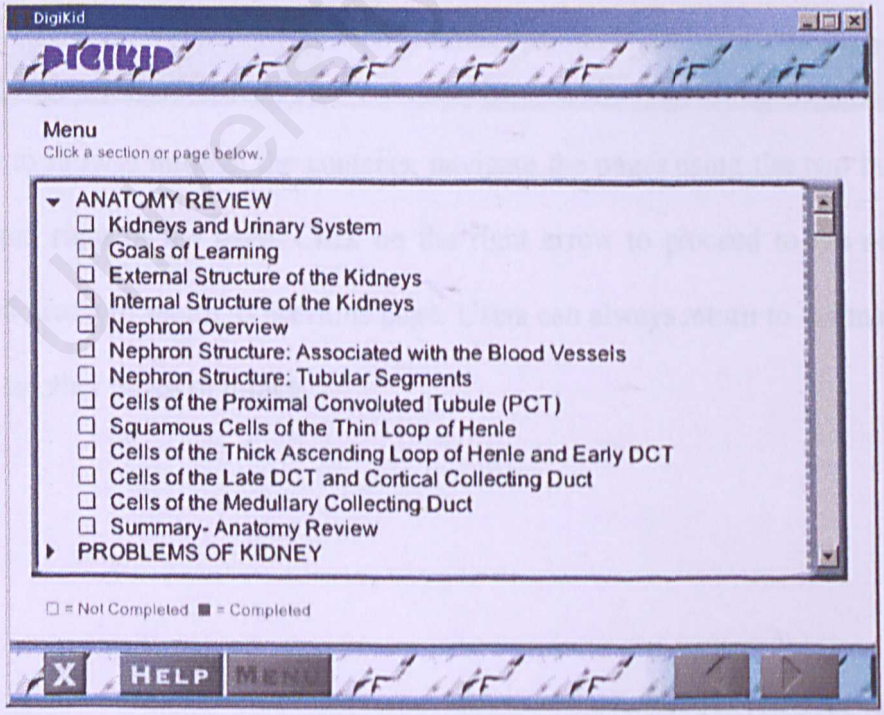


You may skip the Welcome screen by clicking on the right arrow button.

Below is the main menu of DigiKid.

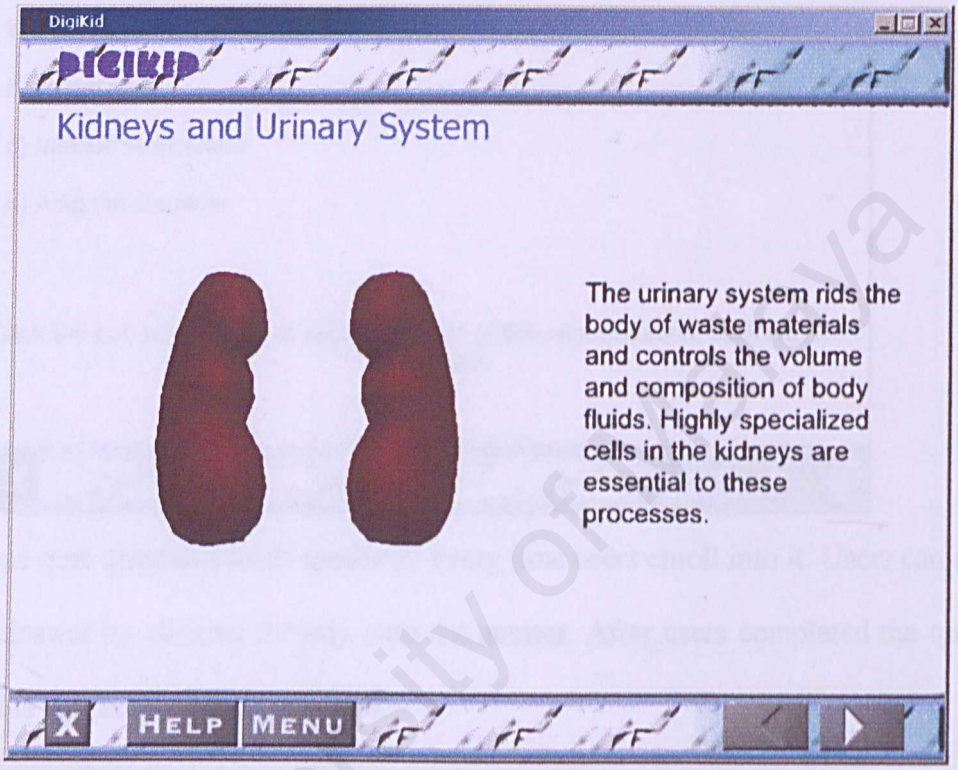


You may click on the Help button to get a better description on functions of every buttons in DigiKid. Start you journey by clicking on Anatomy Review in the menu. The menu will roll out with contents of Anatomy Review being displayed.



The white boxes on the left of the title indicate the status of the page. For pages that are not viewed, the box will remain white until it is viewed. After it is viewed, it will turn into dark gray. Click on the first title to start the learning excitement.

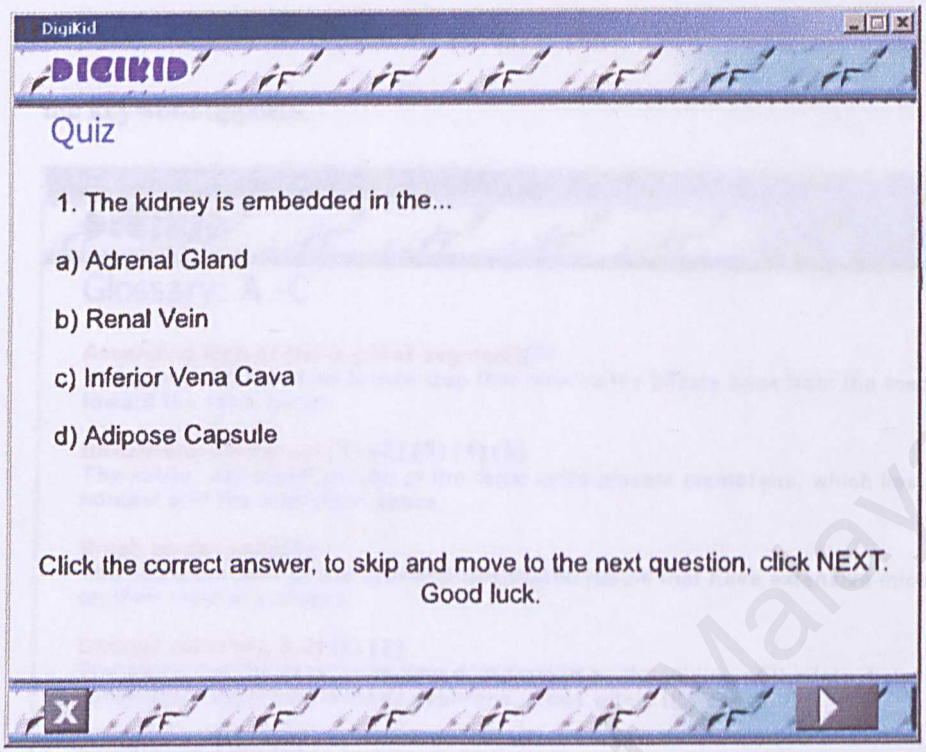
3.1 CONTENTS OF DIGIKID



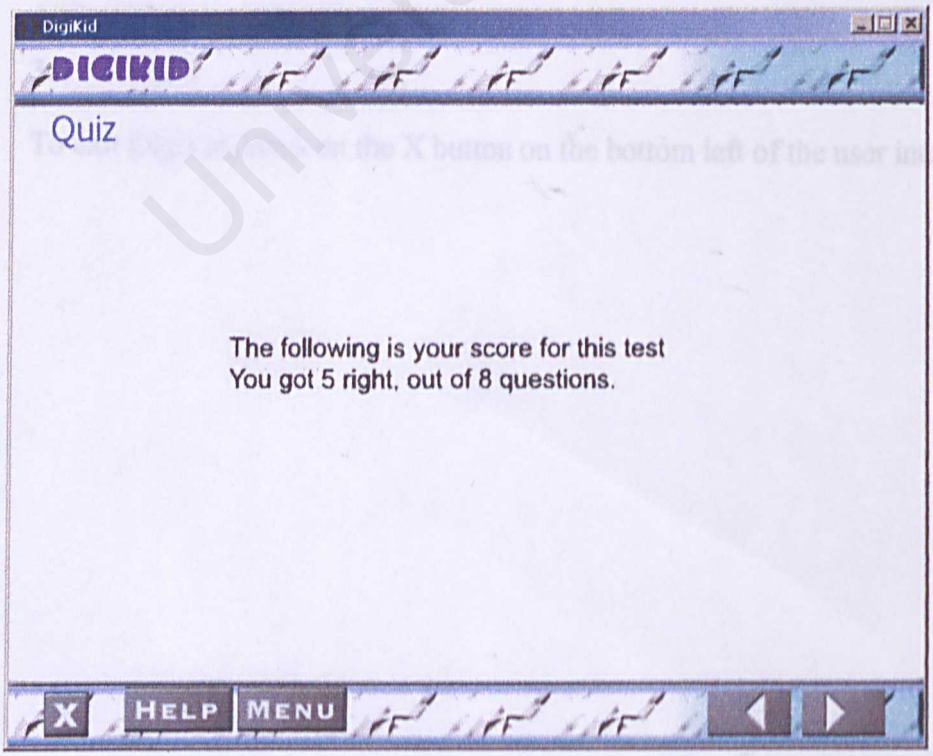
In order to browse through the contents, navigate the pages using the two buttons at the bottom right of the page. Click on the right arrow to proceed to the next page while left arrow to return to previous page. Users can always return to the main menu to jump to other pages or topics.

3.2 QUIZ

Now, go back to the main menu and click on Quiz.

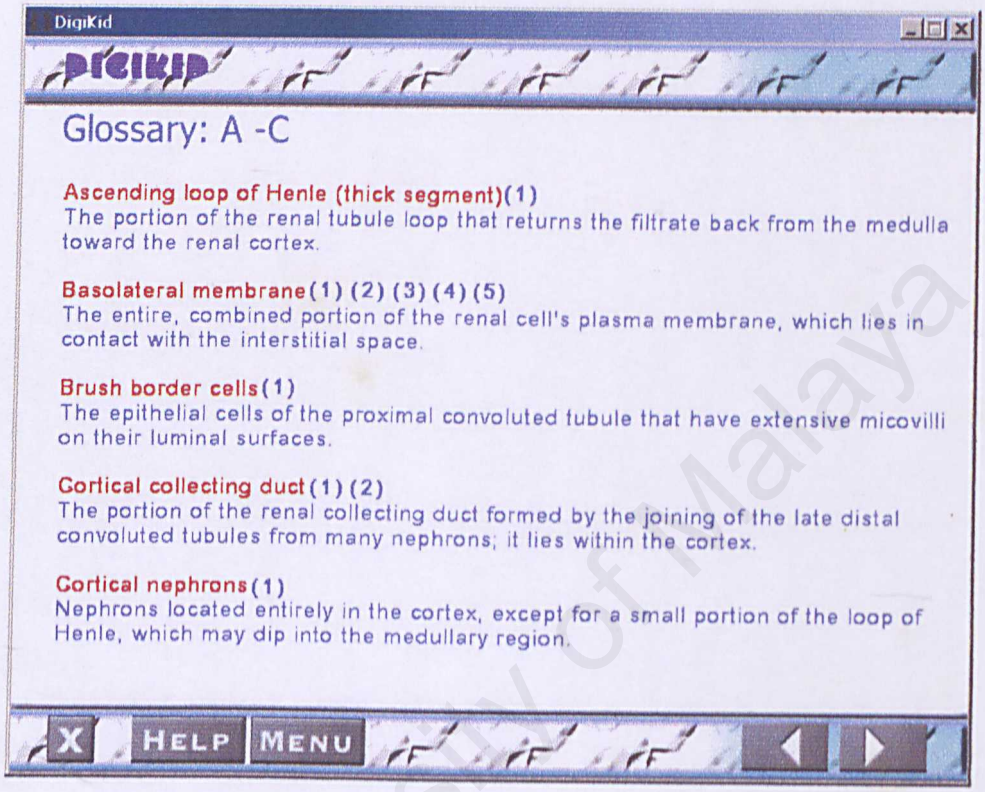


These quiz questions loads randomly every time users enroll into it. Users can choose the answer by clicking directly onto the answer. After users completed the quiz, the results will be published as follow: -



3.3 GLOSSARY

Return to the main menu and click on glossary. From here, users can browse for keywords and its definition. At the same time, users can always go to the page where the keyword appears.



3.4 EXIT

To exit DigiKid, click on the X button on the bottom left of the user interface.