Faculty of Computer Science and Information Technology

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Natural Water Cycle Simulation

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ABSTRACT

The name of this project is Natural Water Cycle Simulation (NWCS). This system consists of two subsystem, the interface for this system and the simulation. Interface function as an introductory page and provides navigation buttons that will guide user to interact with it. This simulation is showing the process that involved in natural water cycle phenomena in 3D visualization.

The Internet had become an important medium of communication today. Since then, the world had seen the evolution of information representation. The use of 3D on the Web allows virtually infinite amount of interactivity. The most important achievement of 3D technology is the making of 3D simulation, which provides interaction with the user in 3D graphic that look exactly like real. The Natural Water Cycle Simulation applies the concept of simulation by creating 3D objects like object in the real world. It emphasizes on the user interactivity where user can interact with the simulation and learn through 3D environment.

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

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Chapter 1: Introduction

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Chapter 1: Introduction

1.1 Multimedia

Multimedia is a developing technology to produce multimedia product. It's a collection of technologies based on utilizing a computer which gives the user the capacity to access and process information in at least the three following ways, text, graphics, fixed images, images with movement and audio. Multimedia can be categorized to interactive multimedia, where user is allowed to control certain elements and the moment in which they should be shown and hypermedia, which the user can navigate if a structure of related elements, is included.

The media that user can use to developed multimedia project consist text; whatever type of text information, fixed images; color photos, drawings, graphics. Images with movement where user can divide it into video and animation. Audio either voice, music, sound, sound effects. Multimedia product is the presentation of information, by integrating different media using a computer, when the user can interact with that information. A very important element in every multimedia product is the interaction.

Interaction is based on the principle that the user decides where to go when given a series of options. Interaction implies the basic concepts immersion, navigation and manipulation. Immersion is where the presentation must be interesting in order to get user's attention. Navigation doesn't have to be in one dimension, which means the user can choose to go any place in the presentation. Manipulation in addition to navigation, the presentation must give different options to interact with.

1.2 Multimedia Learning Package

In short a multimedia learning package can be defined as a self-contained, independent unit of a planned series of learning activities designed to help the student to accomplish certain well-defined objectives. Multimedia approaches give the framework for the planning of teaching and learning opportunities through which student self-activity is developed. Instructions are given in the study guide and refer the students to different sources, i.e. handbooks, the reality, video programs, slide shows, articles, group sessions etc to be able to achieve the set aims and objectives.

A few characteristics for the multimedia learning package must to be determined and considered:

i) A lot of different learning activities should be involved. The activities should be structured in such a way that the student is guided to achieve the set objectives himself.

ii) The multimedia learning package should be self-sufficient.

iii) There should be self-tests so that the student can monitor his/her progress.

iv) Multimedia learning packages could be remedial.

v) Theory and practice can be combined.

vi) Different learning strategies, styles and approaches can be addressed.

vii) The lecturer becomes manager of teaching and learning and not a dispenser of knowledge.

viii) The student takes responsibility for his/he own learning.

As one of the teaching and learning instruments, the multimedia learning package should have certain corresponding characteristics with the study guide. The multimedia learning package is a separate but also a part of the study guide, therefore the multimedia learning package was developed according to the guidelines.

1.3 3D Animation

3D animation consists of varying properties of a 3 dimensional scene defined in numerical quantities. A 3D model can change properties such as position, rotation, shape and surface style. An animated 3D scene is defined by the change of these numerical properties through time. Apart from 3D objects, a scene contains a camera (point of view) and lights, which can also be animated.

In order to create an animation each 'state' of the 3D scene needs to be rendered to create a frame. The playback of these individual renderings at a certain rate (24, 25 to 30 frames per second) creates the illusion of animation. As all properties are defined numerically, one can take advantage of various processes for automating the process of generating different 'states' for each frame. A central notion to animation is the use of 'keyframes', with its origin in classic (paper-based) animation, keyframes allow for the definition of the main 'states' in a particular movement or action while the continuity between these states is generated. In classic animation, 'junior' animators would draw these in-between frames.

In 3D animation and other forms of computer animation, interpolating between the numerical values that are defined in any two consecutive keyframes generates these frames. Typically, in 3D animation this interpolation takes the form of 3 dimensional Bezier curves (paths) that are constructed as a series of control points, allowing for the interactive manipulation of smooth 3D curves.

The construction of complex 3D scenes is dependent on numerous techniques and is often achieved through the combination of various tools such as motion capture, "keyframe" interpolation, kinematics, generators such as particle systems and smoke creators. In addition to this variety of animation techniques the use of digital photography and video is essential for the capturing of real-world textures and environments that create contexts for animated objects. The integration of all of these elements is certainly the most challenging aspect of professional animation.

1.4 Natural Water Cycle

The natural water cycle is also known as the hydrological cycle. Hydrology is the science concerned with the distribution of water on the earth, its physical and chemical reactions with other naturally occurring substances, and its relation to life on earth.[11]

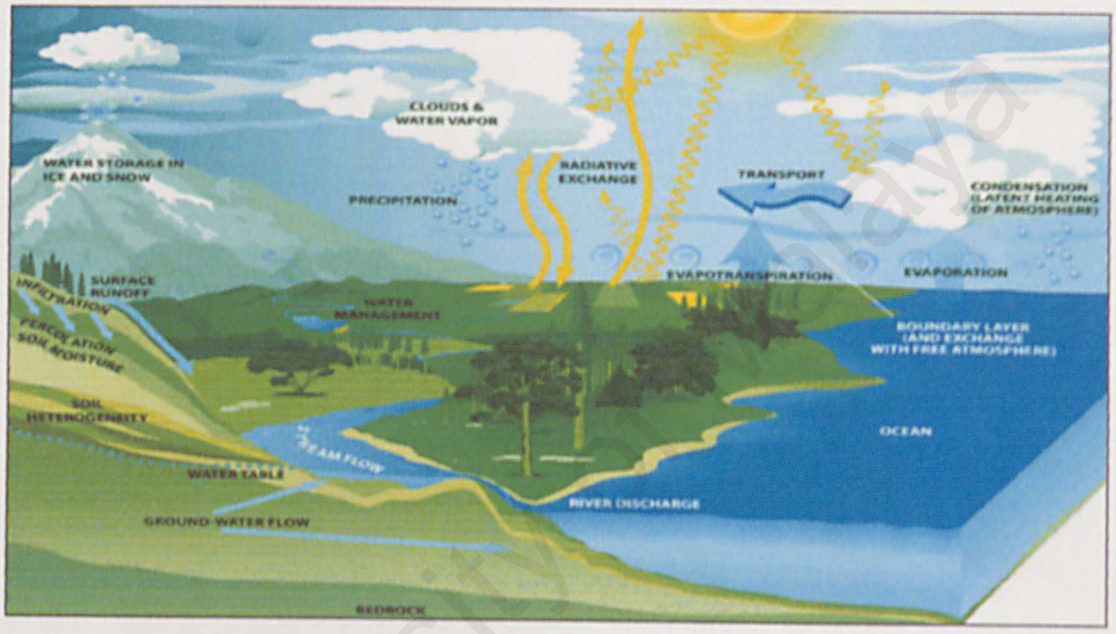

Figure 1: Natural Water Cycle

Water cycle consist 5 basics processes:

i) Rain and snow fall.

ii) Water flows as surface water and groundwater.

iii) Enters into rivers, lakes and reservoirs and sea.

iv) Water evaporation.

v) Condensation to be cloud.

Generally, the snow and rain fall onto forests, farmlands, and residential areas, the water flows as surface water and groundwater (exchange occurs between these waters) while some is retained by the soil, and enters into rivers,

lakes and reservoirs, and sea. Under several influences, water is evaporated from both water and land surfaces and is transpired from living cells. This vapor circulates through the atmosphere become cloud and fall to earth in the form of rain or snow.[12]

1.5 Objectives

The objectives to develop this learning package are as follow:

i) Explain to the student all the process that involved in natural water cycle in 3D environment using 3D software tools.

ii) The learning package is also prevents student to get bored in the class because it is combination of text, graphics, photographs, 3D animation, sound and video. It is not like students read textbook as we know the page can be hundred.

iii) When the students use this learning package, they will be interested with the multimedia and 3D animation and automatically they want to know what the IT world is all about.

iv) Teachers and students also can get information through this learning package in others word, it can be a digital reference to them.

v) Students do not need to imagine the process that happened in natural water cycle in their mind because there will have a 3D animation that will let them to see how the process from the beginning till the end.

vi) Teachers will get an extra time to concentrate on their students that do not understand on the related matter. Currently teacher will write down on the whiteboard about the subject they teach, with this learning package teacher just need to display it to the class.

1.6 Scopes

In this learning package, the scopes are as follow:

i) It explains about natural water cycle as a learning module using 3D animation.

ii) This learning package focuses on the graphical user interface (GUI) and the 3D animation about natural water cycle.

iii) The explanation about natural water cycle in this learning package is much more clearer and detail compared to the information available in the Internet or textbookss.

iv) The learning package explanation coming with text, audio and video.

v) There are two version of language (Bahasa and English) that will be used in this learning package.

vi) The information about natural water cycle is referred to the standard of KBSM syllabus.

vii) This learning package is a friendly user.

viii) The natural water cycle in this package comes with audio and text explanation while the 3D animation will be appeared at the same time. .

ix) The 3D animation must look realistic.

x) An instrument for distance education.

1.7 Target Users

The target users for this learning package are:

i) Teachers

Currently, teachers are having a lot of problem while teaching science to their student because in this subject there are many thing need to be memorized by students. By this new teaching approach all the learning material will be easily understood by students.

ii) Students

Obviously, student having a problem with science subject especially when it is related to the certain processes. By this new approach the learning session can be much more interesting and can be easily accepted by students.

1.8 Project Outcomes

This learning package will explained to the user about the natural water cycle in 3D environments assisted by other media such as text, audio and 3 dimensional graphics. This package will allow user to interact by using the input devices such as mouse and keyboard in order to participate with the learning process. Students can easily understand about the natural water cycle rather than reading and teachers conduct their classes more effectively.

1.9 Project Schedule

WXES 3181

No	Task	Month	Jun				Jul				Aug				Sep				Oct				Nov				Dec				Jan				Feb			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Analysis and Requirement																																					
2	Literature Review																																					
3	Project Methodology																																					
4	Systesm Analysis																																					
5	System Design																																					
6	System Implementation																																					
7	System Testing																																					
8	System Evaluation																																					
9	Documentation																																					

Figure 2 : Project Schedule

Chapter 2: Literature Review

2.1 Computer Graphics

2.1.1How Computer Graphics Work

2.1.1 Creating 3-Dimensional Computer Graphics

2.2 Computer Animation

2.2.1 How Computer Animation Work

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2.4.1.5 Macromedia Director MX

2.4.1.6 Macromedia Dream Weaver MX

2.4.2 Platform

2.4.2.1 Microsoft Windows 2000 Professional

Chapter 2: Literature Review

1.10 Computer Graphics

Computer Graphic, two- and three-dimensional images created images created by computers that are used for scientific research, artistic pursuits, and in industries to design, test and market products. Computer graphics have made computers easier to use. Graphical user interfaces (GUIs) and multimedia systems such as the World Wide Web, the system of interconnected worldwide computer resources enable computer users to select pictures to execute orders, eliminating the need to memorize complex command.[4]

2.1.1 How Computer Graphics Work

Before an image can be displayed in the screen it must be created by a computer program in a special part of the computer's memory, called a frame buffer. One method of producing an image in the frame buffer is t use a block of memory called a bitmap to store small, detailed figures such as text character or an icon. A graphical image is created by dividing the computer's display screen into a grid of tiny dots called pixels. Frame buffer memory ca also stored other information, such as the color of each pixel.[4]

2.1.1.1 Color Representation

Computers store and manipulate colors by representing them as a combination of three numbers. For example, in the Red-Green-Blue (RGB) color system, the computer uses one number each to represent the red, green, and blue primary component of the color. Alternate schemes may represent other color properties such as the hue (frequency of the light), saturation (amount, and value (brightness).

If one byte of memory is used to store each color component in a three-color system, then over 16 million color combinations can be represented. Bu in the creation of a large image, allowing so many combinations can be very costly in the term of memory and processing time. An alternate method, color mapping, uses only one number per color combination, storing each number in a table of available colors like a painter's palette. The problem with color mapping is that the number of colors in the palette is usually too small to create realistically colored images. Choosing the colors that make the best image for the palette, called color quantization, becomes a very important part of the image-making process. Another method, called dithering, alternates the limited palette colors throughout the images – to give the appearance of more colors than are actually in the image.[1]

2.1.1.2 Aliasing and anti-aliasing

Since a computer monitor is essentially a grid of colored squares arranged like a sheet of graph paper, diagonal lines tend to be displayed with a jagged "stair step" appearance. This effect, called aliasing, can be lessened by calculating how close each pixel is to the ideal line of the drawn image and then basing the pixel's color on the line, it may be given the darkest color, and if it is only on the line, it may be given a lighter color. This process effectively smoothes the line.[1]

2.1.1.3 Image Processing

Image processing is among the powerful and important tools in computer graphics. Its underlying techniques are used for many applications, such as detecting the edge of objects; enhancing images and removing noise in medical imaging; and blurring, sharpening, and brightening images in feature films and commercials.[1]

Image warping lets the user manipulate and deform an image over time. The most popular use of image warping is morphing, in which one image deforms and dissolves into another. Morphing is different from similar processes, in which one image simply fades into another, because the actual structure of the original image changes.[1]

2.1.2 Creating Three-Dimensional Computer Graphics

Many uses of computer graphics, such as computer animation, computer-aided design and manufacturing (CAD/CAM), video games, and scientific visualization of data such as magnetic resonance images of internal organs, require drawing three-dimensional (3D) objects on the computer screen. The drawing of 3D scenes, called rendering, is usually accomplished using pipeline or assembly line approach, in which several program instructions can, at any given time, be executed in various stages on different data.

This graphics pipeline is implemented either with special-purpose 3D graphics microprocessors (hardware) or with computer programs (software). Hardware rendering can be expensive, but it enables the user to draw up to 60 images per second and to make immediate changes to the image. Software renderers are very slow, requiring from a few hours to render a single image. However, computer animation almost always uses software renderers because they provide greater control of images and potentially photo-realistic quality.[2]

2.1.2.1 Modeling

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

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

2.1.2.2 Transformation

Once these models have been created, there are placed in a computer-generated background. For example, a render sphere might be set against a backdrop of clouds. User instructions specify the object's size and orientation. Then the colors, their location, and the direction of light within the computer-generated scene, as well as the location and direction of the viewing angle of the scene, are selected.

At this point, the computer program-generally breaks up complex geometric object into simple "primitives," such as triangles. Next, the renderer determines where each primitive will appear on the screen by theusing the information about the viewing position and the location of each object in the scene. [2]

2.1.2.3 Lighting and Shading

Once a primitive has been located, it must be shaded. Shading information is calculated for each vertex based on the location and color of the light in the computer-generated scene, the orientation of each surface, the color and other surface properties of the object at that vertex, and possible atmospheric effects that surround the object, such as fog.

Graphics hardware most commonly uses Gouraud shading, which calculates the lighting at the vertices of the primitive, and interpolates, or blends, colors across the surface to make the objects appear more realistic. Phong shading represents highlights by blending the lighting and colors in a direction perpendicular to the surface at each vertex, the normal, and calculating the lighting at each pixel. This provides a better approximation of the surface but requires more calculation.[2]

2.1.2.4 Mapping

Several techniques permit the artist to add realistic details to the models with simple shapes. The most common method is texture mapping, which maps or applies an image to an object's surface like wallpaper. For example, a brick pattern could be applied to a rendered sphere. In this process only the object's shape, not features of the texture, such as the rectangular edges an grout lines of the brick, affect the way the object looks in the lighting; the sphere still appears smooth.

Another technique, called bump mapping, provides a more realistic view by creating highlights to make the surface appear more complex. In the example of the brick texture, bump mapping might provide shadowing in the grout lines and highlight upon some brick surfaces. Bump mapping does not look of the image's silhouette, which remains the same as the basic shape of the model. Displacement mapping addresses this problem by physically offsetting the actual surface according to a displacement map. For example, the brick texture applied to the sphere would extend to the sphere's silhouette, giving it an uneven texture.[2]

2.1.2.5 Blending

Once the shading process has produced a color for each pixel in a primitive, the final step in rendering is to write the color into the frame buffer. Frequently, a technique called Z buffering is used to determine which primitive is closest to the viewing location and angle of the scene, ensuring that objects hidden behind others will not be drawn. Finally, if the surface being drawn is semitransparent, the front object's color is blended with that of the object behind it.[2]

2.1.2.6 Physically Based Rendering

Because the rendering pipeline has little to do with the way light actually behaves in a scene, it does not work well with shadows and reflections. Another common rendering technique, ray tracing, calculates the path that light rays take through the scene, starting with the viewing angle and location and calculating back to the light source. Ray tracing provides more accurate shadows than other method and also handles multiple reflections correctly. Although it take a long time to render a scene-using ray tracing, it can stunning images.

In spite of its generally accurate portrayal of shadows and reflections, ray tracing calculates only the main direction of reflection, while real surfaces scatter light in many directions. This scattered-light phenomenon can be modeled with global illumination, which uses the lighting of the image as a whole rather calculating illumination on each individual primitive. Many scientific applications of the computer graphics require viewing 3D volumes of data on a 2D computer

screen. This is accomplished through techniques that make volume appear semitransparent and use ray tracing through the volume to illuminate it.[2]

2.2 Computer Animation

Computer Animation, creation of the illusion of motion by viewing a succession of computer-generated still images. Prior to the advent of computers, animation was accomplished by filming hand-drawn or painted sequences on plastic or paper, called cells, one frame at a time. Computers were the first used to control the movements of the artwork and the camera. Now computers create the artwork and simulate the camera.

Computer animation can be used to create special effects and to simulate images that would be impossible to show with non-animation techniques such as a spacecraft flying by the planet Saturn. Computer animation also produce images from scientific data, and it has been used to visualize large quantities of data in the study of interactions in complex systems, such as fluid dynamics, particle collisions, and the development of severe storms. These mathematically based models use animation to help researchers see relationships that might otherwise be overlooked. Computer animation has also been used in legal cases to reconstruct accidents.[3]

2.2.1 How Computer Animation Work

In traditional frame-by-frame animation, the illusion of motion is create by filming a sequence of hand-painted cells and then the images back at high speeds, typically 14 to 30 frame per second. In computer animation, the art is created using computer programs, frame by frame, and then recorded, edited, and played back.

Another computer animation technique is real-time animation, in which the frames are created using a computer and then immediately displayed on a computer monitor. This technique eliminates the interim step of digitally recording the images; however, real-time animation currently does not produce high quality or richly detailed results. It is best suited for creating simple animations for video games.[3]

2.2.2 Computer-Assisted Animation

In the traditional process of animation, a *storyboard* (a scene-by-scene illustration of the plot) is drawn first, the soundtrack is completed, and a senior animator creates key animation frames. Other animators then draw the frames in between the key scenes, color is added, and each frame is then filmed. Computers can be used o assist or replace every phase of this animation process.[3]

2.2.2.1 In-Betweening

The process of creating the intermediate frames to fill in the action from key scene to key scene is called in-betweening. Techniques have been developed that allow the computer to create the in-between frames by estimating common points from key to frame key. In the simplest case, the computer draws the in-between movement of two corresponding points by calculating the mid-point distance. Repeated calculation of midpoints can provide the illusion of smooth and continuous motion.[3]

2.2.2.2 Painting systems

The hand painting of animated cells is a painstaking process, with an average output of 25 cells per day per painter. Sometimes cells are stacked together to create different images-for example, the cells may interact, overlap, or provide backgrounds for one another. When a large number of cells are stacked, the transparent layers become slightly opaque. The cell painter must then compensate for this effect by varying the image colors; this process often introduces errors.

Computer can eliminate these errors and increase production by consistently coloring the most complex areas of frames. Computer painting uses a coloring, or filling, process in which the artist specifies a color and then selects a pixel, the smallest individual picture element on the computer screen. The computer then changes all adjacent pixels that have the same color (or nearly the same color) to the newly specified color.[3]

2.2.2.3 Camera Stands and Editing

Once the frames are painted they must be filmed. Traditionally, an animation stand positions both the cells and the camera to allow the layers of cells and the camera to move independently. Computers simulate the animation stand and the camera. The computer controls this virtual camera in three-dimensional space, while focusing on the cells and the camera reside within the computer.

Special characteristics of real cameras, such as fish-eye lenses and lens flare, can be simulated by the virtual camera. This ability to control a virtual camera, combined with powerful digital video editing, enables the animator to complete the film entirely in a computer-generated environment.[3]

2.2.2 Computer-Modeled Animation

Computer-modeled animation is the process of three-dimensional models of animated objects. Typically, this is achieved by representing the objects using the following methods: wire-frame, surface and solid.

Wire-frame representations are specified by a set of line segments, typically the object's edges and a set of points on the surface called vertices. While a wire-frame representation often does not produce very realistic images, it is good for quick studies, such as how the object will move and fit in a particular scene. Surface representations are specified by a set of primitive features, such as a collection of polygons to produce smooth curves and surfaces.

While it is possible to perfectly model an object's surface as a collection of primitive features, it may not be practical to measure and store these features

because complex objects may require an infinite number of features to create a perfectly smooth surface. Solid representations are specified by a set of primitive shapes or portions of primitive shape. For example, a human might be represented by a sphere for the head and cubes that compose the torso and limbs. Solid representations can specify both inner and outer surfaces of an object.[3]

2.2.3.1 Image Rendering

The process of creating a realistic three-dimensional scene is called rendering. The computer is given a detailed description of the objects that comprise the scene, along with the specification of the camera. To create photographic like images, the computer must calculate the viewer's perspective of the images, the visible objects and surfaces; add shading, by determining the available light on each surface; add reflections and shadows; provide surfaces with textures, patterns, and roughness to make objects appear more realistic; add transparency of the objects; and remove surfaces hidden by other objects (see Computer Graphics).

Once the objects and light in a three-dimensional scene are rendered, the animator specifies their movement within the scene as well as the motions of the camera. Key frames synchronize the movement of the objects just as in the computer-assisted model, and the in-between frames must be created. One technique, called parametric key-frame animation, interpolates, or blends, the in-between images. Another technique, algorithmic animation, controls motion by applying rules that govern how the objects move. When the objects and their

behaviors have been specified, each scene is rendered frame-by-frame by the virtual camera and stored; then the final animated feature is played back.

Despite the power of today's computer, and the innovations used to accelerate traditional animation processes, modern computer animations require still faster and more powerful computers to exploit new techniques and potentially photo-realistic effects. In the fully animated Disney feature, Toy Story (1995), it took PIXAR Animation Studio an average of 3 hours too render a single frame, and some frames took as long as 24 hours. For this 77-minutes movie, 110,880 frames were rendered, requiring approximately 38 years of computing time distributed among many computers.[3]

2.3 Previous Projects

There are many similar projects have been done previously and published to the public through the Internet that can be reference for this project, three projects using different 3D software have been studied as follow:

i) Interactive Multimedia Academic CD-ROM by Pelangi Book Store.

ii) Metamorphosis Animation

iii) Online Virtual Tour - Explore Taj Mahal.

iv) The White Whale Project

v) Planet 9 Studios

2.3.1 Pelangi Book Store Interactive Multimedia Academic CD-ROM.

Figure 2 : Pelangi Academic CD-ROM

Penerbitan Pelangi Sdn. Bhd. is an established publisher in Malaysia. Having been in operation for two decades, they have proven themselves versatile by successfully publishing a wide range of educational books. Penerbitan Pelangi Sdn. Bhd. also established their name as a publisher of quality children's books. Pelangibooks.com is an on-line retailer of books and other information products.

Today Penerbitan Pelangi Sdn. Bhd publishes a wide range of books and materials for different markets and readerships and they are delighted to introduce themselves to public on their site. Their diverse range of children's titles include activity books, first concept books, storybooks, preschool learning programmes and children's dictionaries, all of which have been well-received. With a strong, dedicated and creative workforce, we are committed to making learning fun, meaningful and effective for readers through quality and innovative products.

Pelangi's Academic CD-ROM is complete with text, 2D-graphics, 2D animation and video, interactive experiments as well as voice-recorded illustrations. The CD-ROM is a great way to revise students Science subjects. All

the contents have been carefully planned and organized. The Academic CD-ROM is follow standard KBSM syllabus and also covered all topics in the syllabus.

Whether, primary or secondary school student can learn with smart way through the various tutorials, interactive experiments and zones, activities as well as extensive exercises that help them prepare for the examinations. The objective of the CD-ROM is to enable student to learn Mathematics more effectively in a fun and enjoyable way.

2.3.2 Metamorphosis Animation.

Figure 3 : Dragonfly Animation

Metamorphosis is design by Brandon Luhring, a student from one of top overseas university. Metamorphosis' 3D animation is design using SoftImage 3D, Premier, and Photoshop, the designer wanted to include a variety of different movements (worm, dragonfly, etc.). It was a wonderful learning experience for the 3d animation designers. This animation tries to replace traditional way on behalf to study about metamorphosis where before this to study about it we just have to read it and refer to 2D visualization like picture.

The animation had implement several techniques in 3D designing, such as modeling the dragonfly, mapping to get more realistic object, use a bone technique for the movement of the dragonfly, camera setting, lighting and also have a sound effect along with the animation.

Metamorphosis animation tries to show the process or stages that involved in dragonfly life cycle from larva stage to complete a dragonfly. Metamorphosis is dividing into five stages (egg-larva-caterpillar-cocoon-dragonfly). Through the animation student that interested in knowing about the dragonfly metamorphosis

can see the process rather than doing experiment with real dragonfly that, as we know is time consuming problem.

Phil Repp a professor is currently using 3D animation video along with others to promote 3D animation program in his classes. This 3D animation had proved that 3D animation is being used in classes for certain topics that must have visualization to be more understand by the students.

2.3.3 Online Virtual Tour - Explore Taj Mahal.

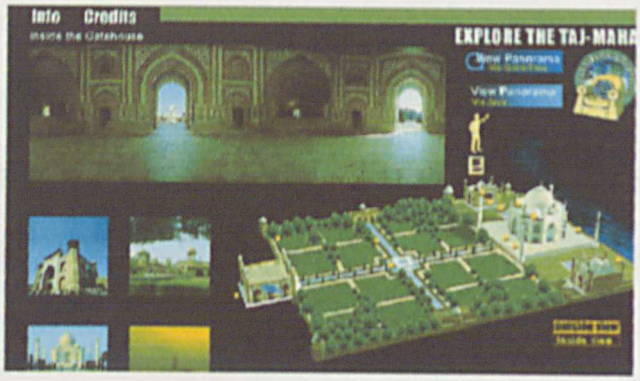

Figure 4 : Explore Taj Mahal

Armchair Travel for Virtual Travel is the first name in photographic virtual environments. It has highest quality, wide experience, on-time delivery, and guaranteed satisfaction and also respected and trusted around the world. Armchair Travel announce an exciting new feature for its online virtual tours (Chat & Tour). This new facility will allow visitors to Explore the Taj Mahal to chat online while traveling about the sites. Visitors may exchange messages with other visitors at the same viewpoint, or may broadcast messages to all visitors at the site.

Armchair Travel for Virtual Travel is set with full-sized sample of high resolution, 360° panoramic photo from the British Submarine HMS/m Ocelot (1Mb) view. Armchair Travel for Virtual Travel can produce even higher resolution panoramas (up to 20 Mb compressed) for education, industrial, cultural, military or commercial requirements.

Virtual Travel is the registered trademark for the proprietary Virtual Reality technology of the Armchair Travel Company Ltd of London, England, used for the filming and organization of thousands of single photographs into a

network of panoramas linked by 'traveling' movies. The technique has been developed and refined over an eighteen year period and has been used to produce over thirty industrial and commercial titles, many of which have won international awards. Originally tailored for videodisc delivery, the techniques have been adapted since 1992 for Internet, CD-ROM and DVD-ROM distribution.

2.3.4 The White Whale Project.

The Virtual Whale Project is 3D animation and sound environment for the visualization of the feeding behaviors of the Pacific Humpback whale. The humpback is the renegade among the mystic whales. Whether wooing mate with song, or engaging in combative sexual displays, this whale break all the rules. Perhaps nowhere is the enigmatic behavior more evident than on the feeding grounds in Southeast Alaska. After traveling thousands of miles to these northern summering areas, Hawaiian Humpback engages in bizarre feeding behaviors, many of which are only beginning to understand.

Schools of Pacific herring are one of their favorite targets but capturing these fast agile fish requires an arsenal of feeding tactics. One of their most effective ploys is to band together in large groups, which may number nearly two dozens whales. The whales will then deploy bubbles, broadcast of loud trumpet sounds and the flash of their flippers at the schools. These tactics apparently herd the prey up towards the surface, where they become trapped within the confines off a huge bubble net. Rocketing up through up this tunnel of bubbles, the whales engulf the entire fish school in their cavernous mouths.

Despite this grand finale, most of the complex behaviors that lead up to the surface lunge take place underwater. Simon Fraser University is using a variety of research tools including sonar, dive tags and hydrophones to understand what happens when these whales slip below the waves. The Virtual Whale Project was developed to help interpret data with the use of 3D graphics and sound.

Perhaps one of the most important goals is to use the Virtual Whale Project as an education and conversation tool to celebrate the lies of humpback whales.

The purpose of the visualization is two things, as a tool for the researcher to experiment with timing and three-dimensional motion to give a fell of the motions of the whales, prey, bubbles and sound in the underwater world. Other one, is to be as teaching tool to explain complex 3D relationships and motions to those who want to know more.

2.3.5 Planet 9 Studios.

Planet 9 Studios is a company that providing real business solutions for the Internet. This company had been produced over 2000 virtual worlds for a variety of application such as product visualization, training, architectural simulation, advertising, marketing, entertainment and education using 3D environment.

Over past ten years, the company has grown from a computer animation firm to the leading of 3D content on the Internet. Planet 9 Studios built the first commercial VRML worlds on the Internet and continues to lead the way with 'first' each year. Their client includes Intel, Microsoft, IBM, Toshiba, ZiffDavis, Nippon Telephone and Telegraph and many other clients are looking forward to expand their Internet and Intranet capabilities.

Know as a 'cyber architect' by VRML evangelist, Mark Pesce, David Collen (founder of Planet 9 Studios) continues to set new precedents in building virtual worlds and virtual cities. Planet 9 Studios works closely with technology developers such as IBM, SRI, Viewpoint, Multigen and Parallel Graphics to assure online users of great 3D experience.

2.4 Development Software and Tools

In this session, several software are studied, the study was focused on the functionality and compatibility of software. Analysis had been made to determine the strength and weakness of software that will be use to develop this project. The software that needed is separate into two types as follow:

i) The tools for water cycle simulation development, which are related to computer graphic and animation design.

ii) The platform (operating system) that convenient with this project.

2.3.2 The Tools for Water Cycle Simulation Development

Nowadays, there are many tools and softwares that supporting graphic and computer animation development. The most popular being used among student are listed as follow:

Tools for 3D Animation:

i) 3D Studio MAX

ii) Light Wave 3D

iii) Maya

Tools for Graphical User Interface:

i) Macromedia Flash MX

ii) Macromedia Director MX

iv) Dream Weaver MX

2.4.2 Tools for 3D Animation

2.3.2.1 3D Studio MAX

3ds Studio Max is the world's best selling professional 3D modeling, animation and rendering software, delivering a unified, object-oriented platform for artists creating visual effects, character animation and next generation games. Since its introduction in 1996, 3ds Studio Max has been the recipient of more than 65 industry awards and is the 3D tool of choice among more than 140,000 3D artists using Windows.

3ds Studio Max delivers CG professionals with advanced tools for character animation, next generation game development and visual effects production. Numerous key new feature additions and architectural enhancements compliment these three major initiatives, making 3ds Studio Max an ideal tool for the 3D animation industry. A highly tuned animation system allows artists to bring their ideas to life with the most advanced tools for modeling and animating characters.

Version 4's state of the art interactive graphics, approachable extensibility, next generation modeling tools and truly open architecture make 3ds Studio Max the premiere 3D content creation tool for next generation game development platforms such as Microsoft X-Box and Sony Playstation 2.

An interactive and photo-realistic Active Shade render engine, customizable and production proven network rendering system, and tight post-production integration with combustion - Discreet desktop 3D composting

software – makes 3ds max 4 the most efficient and productive tools for film and television visual effects.

3ds Studio Max also can utilize other advanced renderers like metal ray and Render Man for distinct rendering capabilities like global illumination, caustics and distributed rendering.

2.3.2.2 Light Wave

Light Wave3D has consistently dominated the television and film markets. The game development market is soon to follow. Designed for production use, Light Wave boasts the industry's fastest most beautiful rendering engine, complete subdivision modeling, and an animation system built upon the world's fastest, most accurate 3D Inverse Kinematics (IK) engine.

The application delivers all the power we need today, the flexibility to expand tomorrow, and at a price the competition cannot beat. With radiosity, caustics, subdivision surface animation, skeletons, thousands of enhancements and an unsurpassed workflow, Light Wave is everything user need in animation system.

NewTek's Light Wave 3D introduced the first real time subdivision surface modeler and now the industry has embraced subdivision as the way of the future. With Light Wave users own a robust tool set for manipulating these revolutionary surfaces, including interactive modifiers that allow users to model in multiple soft models. Light Wave allows users sculpt "digital clay" by direct

manipulation at the vertex level by controlling groups or polygons with an extreme list of operators.

NewTek's IntelligEntities allow designers to create smarter objects that understand animation, including time independent models that ease the producion process. IntelligEntities include Skeletons, endomorph, MultiMeshes and Vmaps, making the objects practically self-aware. Skeletons add the skeletal structure directly in the model so designers can us all the modeler tools to build and manipulate their character's skeletons. Facial animation has been simplified with endomorphs: Teach model about different expressions and lip positions and hen animate and blend them together with complete non-linear access. Combined with layered geometry and expansive extra vertex data their models are more than simple objects, they are digital actors. Light Wave delivers refinements to the animation pipeline that pay major dividends.

Light Wave 3D has long been regarded as the best rendering engine in the business for image quality, features, flexibility and speed. Now, Light Wave sets an all new standard for rendering systems. Built on a pure 160 bit floating-point pipeline, this render engine has image depth beyond compare. Massive amounts of internal data computes at floating-point accuracy ensure the color depth that results in ultra high-quality imagery. With true radiosity, caustics and HyperVoxels integrated into the industry's most mature distributive ray tracing engine, Light Wave is untouchable. These break through enhancements guarantee complete interoperability with motion blur, depth of field and ray traced shadows,

reflection and refraction. This is truly the most feature rich rendering engine available in any 3D animation system.

Light Wave could create surfaces with projections, UV mapping, 3D procedurals and new parametric gradients. All texture types can be infinitely layered with multiple modes for blending from one to the next. With the new real time texture engine we can exploit the expanded set of texturing tools with simplicity and speed. With features like floating point color entry, translucency, procedural plug-ins, and a photo realism in a matter of seconds. The Light Wave surface editor is flexible enough to handle anything from simple animations to massively complex digital movies. With an interface that allows drag and drop texturing and parametric surface controls, case of use and extreme power go hand in hand.

2.3.2.3 Maya

Maya is the sixth major release of the world's most acclaimed professional 3D software from Alias|Wavefront. Maya's combination of animation, modeling, rendering, and visual effects tools, delivers the competitive edge that enables users to produce world-beating CGI on Maya is available on Windows XP Professional, Windows 2000 Professional, Mac OS X, IRIX, and Linux.

Maya is the first choice of digital content creators producing games, 3D animation and visual effects. Maya offers a unique, affordable combination of groundbreaking tools and features, important workflow improvements, and platform choice. The names Alias|Wavefront and Maya have long been synonymous with award-winning 3D graphics used in film, video and games.The advent of low cost, high power graphics solutions for the desktop has now opened the door for Alias|Wavefront to bring this same high-end cinematic, design, and real-time content creation capability to the visualization and Web3D markets.

Maya can increased productivity by enhanced animation tools including improved constraints, forward kinematics/inverse kinematics blending and channel muting give more flexibility and control when creating characters. Expanded range of polygonal modeling tools to create and edit meshes and vastly improve user workflow. Up to 90 percent performance improvement in dynamics computation speed on the Windows operating systems (Intel based PCs). Cloth simulation has been optimized and is now faster than ever. Improved online tutorials and user documentation help user get up and running quickly.

When using Maya, user can create unique creation because Maya has unique image creation possibilities like, new hardware renderer allows user to quickly produce final output images for video, broadcast and the web. New vector renderer allows user to convert 3D images and animation into web or print-ready 2D graphics/animation. Tighter integration with the mental ray renderer includes global illumination and caustics for unprecedented photorealism. Maya rendering options are unified through a consistent rendering user interface and workflow to facilitate learning and experimentation.

With Maya user get more creative resources as brush-based Maya Paint Effects can be drawn as, or converted to, polygon models for an even wider range of organic and mechanical looks. Newly supported data formats such as Flash, Adobe, Illustrator, Encapsulated PostScript and Scalable Vector Graphics. Maya Shockwave 3D Exporter ships with Maya software for Windows operating system only. Maya Fluid Effects has been extended to include "ponds" and "boat wakes". More realistic-looking fur options in Maya Fur, including wet and matted fur, are available via the new Fur Clumping feature.

New and enhanced import/export options transfer data between Maya and other applications with enhanced and new file formats. Newly supported file formats like Flash, DWG, Adobe Illustrator, Encapsulated PostScript and Scalable Vector Graphics. Enhanced support has been added for DXF,IGES, OpenFlight, StudioTools and OBJ.

Even greater extensibility Maya tool developers access to more features and tool sets than ever before. A number of major new classes have been provided

in the Maya API including, exposing high level polygon operations and Complete access to Maya's rendering framework including the ability to integrate a new renderer.

2.3.3 Tools for Graphical User Interface

2.4.2.1 Macromedia Flash MX

Flash MX enhances creativity by providing designers with a higher level of control and expanded integration capabilities with a rich set of design tools. New features help designers quickly create a broad range of content. Instead of focusing on how Flash works, they can give more attention to their designs. Timeline enhancements such as folders for organizing layers, improved pointer feedback, and the ability to resize, cut, and paste multiple frames make it easier to use the Timeline, helping users work faster and with less effort.

Enhanced editing of symbols in place makes document creation easier by letting designers work on symbols in the context of their movies. New controls above the Stage make it easier than ever to edit symbols in place. Library improvements eliminate production bottlenecks by simplifying the creation and manipulation of library symbols. Moving symbols or folders between Flash documents or creating new library symbols is now as easy as dragging and dropping. The new Resolve Library Conflict dialog box simplifies adding library symbols to a document that has an existing library symbol with the same name.

Shared library assets improve Flash movie authoring by letting users share library assets with other Flash documents, either while authoring, or when a movie is played with the Flash Player. Shared runtime libraries help users create smaller files and easily make updates to multiple documents simultaneously by letting user's document show library symbols and shared objects that are stored on an intranet or the Internet. Shared author-time libraries improve user's work

pace by letting users track, update, and swap symbols in any Flash document available on their computer or network.

Workspace enhancements make the Flash MX workspace more manageable and easier to understand for new and veteran designers. The most commonly used features now appear in one context-sensitive Property inspector, eliminating the need to access many other windows, panels, and dialog boxes. Other frequently used features now appear in easily collapsible panels that dock and undock as necessary to conserve screen space. Designers can even save custom panel layouts to personalize their Flash workspace.

New starter templates included with Flash MX simplify the creation of new documents by eliminating many of the common tasks required to start a new document. Users can also create their own templates from documents. Color Mixer improvements make creating, editing, and using colors and gradients easier than ever.

Complete lessons that address the new features in Flash MX make it easy to become familiar with its powerful tools and features. Video support expands the creative possibilities for Flash movies by letting users import video clips in a variety of formats. The Free Transform tool opens new possibilities for user's creative expression by letting them combine the effects of multiple object transformations at once. The Envelope modifier lets users easily create otherwise-difficult graphic objects by letting them warp and distort the shape of the bounding box that surrounds them.

Pixel-level editing adds precision and polish to user's work by letting them align objects with pixel-level precision in their Flash documents. Precisely place objects or points of objects where users want them to appear in user's final movie. The Break Apart feature makes it easy to make creative edits to individual text characters without having to convert the text to symbols, simplifying the creation of complex designs and animation. The Distribute to Layers command quickly and automatically distributes any number of selected objects to their own layers.

Movie clip mask layers let users create animated masks by placing a movie clip on a mask layer. Users can also use ActionScript to create an animated mask with a movie clip. Enhanced sound controls enhance the production quality of user's movies by letting them synchronize movie events with the start or end of sound clips.

2.4.2.2 Macromedia Director MX

New features in Director MX build on a proven development environment to make Director more powerful, more tightly integrated with the Macromedia MX product family, and better suited to create content that is accessible to everyone, even those with disabilities. Developers can deliver rich multimedia content that integrates interactive audio, video, bitmaps, vectors, text, fonts, and more. Director MX lets users work more effectively with the shared Macromedia MX user interface, take advantage of unprecedented Macromedia Flash MX integration, and deliver content to a broader audience.

Integration with other Macromedia MX products Director MX is truly a part of the Macromedia MX family; this is evident in the workspace, which matches those of other Macromedia MX products, as well as in other aspects of the application's strong integration with Macromedia Flash MX, ColdFusion MX, Flash Communications Server MX, and other Macromedia MX products. The Macromedia MX workspace lets users organize and customize an environment that's shared among Dreamweaver MX, Fireworks MX, and Macromedia Flash MX. The familiar and flexible working environment helps users maximize productivity. Dockable panels can be grouped and collapsed or expanded as needed for a smooth workflow.

Enhanced control of Macromedia Flash media through Lingo gives users complete access to all properties and methods of Flash MX ActionScript objects. Greatly reduce their development time by directly controlling all elements within their content that were authored in Flash MX. Access to the Flash MX launch-

and-edit feature lets users simply double-click a SWF file to automatically launch Flash MX. Once users edit the file, it's automatically saved and reimported into Director MX. This roundtrip editing significantly streamlines their workflow.

Macromedia Flash Communication Server MX support allows users to use all the functional capabilities provided by Flash Communication Server MX, including the ability to access installed USB or FireWire cameras as well as installed microphones. Users can combine the power of the Flash Communication Server MX with Director MX to create multiuser games, distancelearning applications, and real-time collaboration forums. Previous users of the Shockwave Multiuser Server are encouraged to use Flash Communication Server MX. However, the Shockwave Multiuser Server is available on the Director installation CD.

Macromedia Flash MX importing lets users take advantage of the power of Flash MX and its lightweight vector graphics by importing Flash files into Director MX content. Director developers can use this powerful combination to create the most effective multimedia content. Macromedia Flash Remoting MX provides a secure, high-performance connection between Macromedia ColdFusion MX and Shockwave Player.

When used with Director MX, Flash Remoting MX lets users easily pass data to ColdFusion MX and back. Macromedia Fireworks MX integration gives Director MX developers access to the robust design and production environment of Fireworks MX, allowing developers to create graphics for presentations or Shockwave content. In addition, the tight integration between Fireworks MX and

Director MX offers a roundtrip workflow between these graphic and multimedia environments. Integration features include launching and editing, Fireworks MX importing, launching and optimizing, and the Fireworks MX Import Xtra.

2.4.2.3 Dream Weaver MX

Macromedia Dreamweaver MX is a professional HTML editor for designing, coding, and developing websites, web pages, and web applications. Whether users enjoy the control of hand-coding HTML or prefer to work in a visual editing environment, Dreamweaver provides users with helpful tools to enhance user's web creation experience. The visual editing features in Dreamweaver let users quickly create pages without writing a line of code. Users can view all their site elements or assets and drag them from an easy-to-use panel directly into a document.

Users can streamline their development workflow by creating and editing images in Macromedia Fireworks, then importing them directly into Dreamweaver, or by adding Macromedia Flash objects users create directly in Dreamweaver. Dreamweaver also includes many coding-related tools and features, including code editing tools in the Code view (such as code coloring and tag completion); reference material on HTML, CSS, JavaScript, CFML, ASP, and JSP; and a JavaScript Debugger. Macromedia Roundtrip HTML technology imports user's hand-coded HTML documents without reformatting the code; users can then choose to reformat code with their preferred formatting style.

Dreamweaver now incorporates and expands on all of the capabilities from Macromedia UltraDev, helping users to build dynamic database-backed web applications using server languages such as ASP, ASP.NET, ColdFusion Markup Language (CFML), JSP and PHP. Dreamweaver is fully customizable, users can create their own objects and commands, modify keyboard shortcuts, and even

write JavaScript code to extend Dreamweaver capabilities with new behaviors, Property inspectors, and site reports.

Dreamweaver includes a variety of resources to help users learn the program quickly and become proficient in creating their own websites and pages. These resources include a printed Getting Started guide, an online help system, and tutorials. In addition, users can find regularly updated tips, TechNotes, examples, and information at the Dreamweaver Support Center on the Macromedia website.

2.3.4 Platform

Microsoft Windows 2000 Professional

Windows 2000 Professional is operating system created by Windows for business desktop and laptop systems. It is mostly being used currently all over the world to run software applications, connect to intranet and Internet sites obviously and access files, hardware and network resources.

Built on Windows NT technology, easy to use and user-friendly, familiar Windows 98 user interface, Windows 2000 Professional gives business users increased flexibility. The integrated Web capabilities let them connect to the Internet from anywhere, at any time access to host of flexible, effective cost for communication options. In addition, broad peripheral and mobile computer support make Windows 2000 Professional an ideal operating system for a workforce that increasingly relies on notebook computers.

Furthermore, the administrator and support staff will appreciate the reliability and manageability enhancements that make desktop management simpler and efficient. The advantages work with Windows 2000 Professional are listed as follow:

i) Work how and where the user wants with new peripheral support and features that extend notebook capabilities.

ii) Rely on user's PC to be up and running with high level quality.

iii) Work the way user did with Windows 98, only much faster. Combine the ease of Windows 98 with he manageability, reliability and security of

Windows NT, at speed 30 percent faster than Windows 98 on PCs with 64 MB RAM or more.

iii) Communication, share information and use the Internet quickly and easily. With integrated support for Internet-enabled applications, business software developers incorporate the new ways to create and share information made possible by the Internet.

Chapter 3: Methodology

3.1 Methodology

3.2 Brainstorming.

3.3 Library Reading

3.4 Internet Surfing

3.5 Interview

3.6 Questionnaire

- 3.6.1 Question 3
- 3.6.2 Question 4
- 3.6.3 Question 5
- 3.6.4 Question 6
- 3.6.5 Question 7
- 3.6.6 Question 8
- 3.6.7 Question 9
- 3.6.8 Question 10

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Chapter 3: Methodology

3.1 Methodology

Several techniques have been used to analyze this system and collect the information needed. These techniques include brainstorming, library reading, Internet surfing, interview and questionnaire.

3.2 Brainstorming

At the initial stage, brainstorming session has been held to gather information about Natural Water Cycle and 3D animation based on knowledge. The purpose of this session is to understand the concept behind this project. The idea firstly came from this project's title, which carried out the 3D natural water cycle learning package.

Many related ideas are gathered. These ideas defined the basic functions that this project should perform, which hen helped to generate the project scope - the boundaries of this project. A plan has been drawn out to help developing this project steps by steps – form the basic structure to the enhancement design.

Current software that available also had been discussed. From the discussing many of friends said that 3D Studio Max is the best software to use as 3D graphic tool in this project.

3.3 Library Reading

As we know, there are so many source of information that might be related to this project. Much information that gathered from library can be implement in this project report, as example Waterfall Model with Prototyping Instruction information.

Many thesis project done by super senior student are stored in the document room. Some of the document related with this project and provide guidelines very helpful to the presentation or techniques used in 3D animation development are very valuable and relevant to this project.

3.1.2 Internet Surfing

The Internet surfing has become the most indispensable source for searching any required general information. It has become the one of the major source for obtaining the latest information. Information can be gathered in the most cost effective and time efficient manner using Internet.

There are many related 3D animation done by international student, company and individual that published their animation to the Internet providing useful information. Besides, several websites of the software companies are visited to gather information to comparison between each of the softwares.

3.5 Interview

Interview has been held to really understand the current system used by the teachers and their students. In addition, suggestion and opinion from the interviewees who are the professionals and at the same time the target users are important to define and gather requirement and functionality of this project.

The interviewees have involved some primary and secondary school students (please refer to appendix). The interviewees also reaffirmed my understanding as well as to identify the weakness and the flaws of he current system.

3.6 Questionnaire

Questionnaire is a very time consuming process but it provides very useful information and accurate data if it done properly. A simple questionnaire was design and sent to the student of primary and secondary schools.

All the information gathered through interview and questionnaires is combined to give us a better view of the system. It is also give extra time to do other thing. This questionnaire had been passed randomly to 100 students at study on form 4 and form 5 at Sekolah Damansara Utama and Sekolah Menengah Jalan Gasing. Analysis had been made from the questionnaire that answer by all the student as follow:

3.6.1 Question 3

Did you know anything about multimedia?

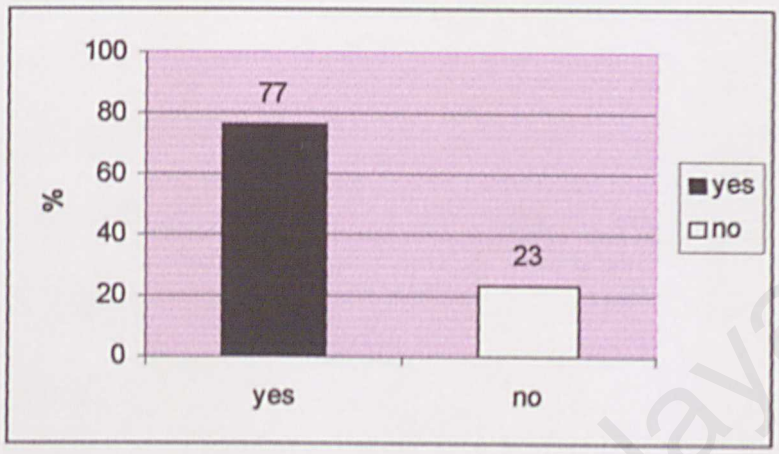


Figure 6 : Questionnaire 3

From the questionnaire that had been pass to the student, 77% know about multimedia and 23% doesn't know anything. The statistic notice that nowadays, many student know about multimedia.

3.6.2 Question 4

Do you have computer at home?

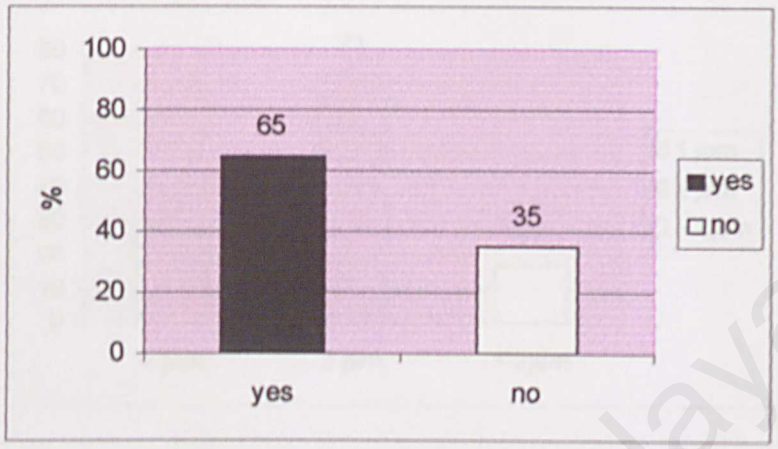


Figure 7 : Questionnaire 4

From both schools, percentage of students have computer at home is 65% while only 35% of students don't have computer at home. It is show that parents around aware of the benefits providing computer to their children.

3.6.3 Question 5

On average, how long you spend your time with computer?

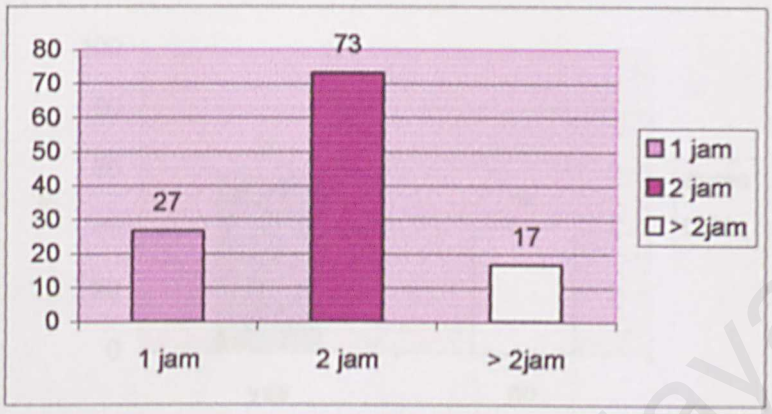


Figure 8 : Questionnaire 5

Around 27% spend 1 hour with their computer at home, 73% spend 2 hours while only 17% spend more than 2 hours with their computer. Obviously, student are using their computer for surfing, watching movie and doing their homework with it.

3.6.4 Question 6

Do you know anything about 2D, 3D or 3D animation?

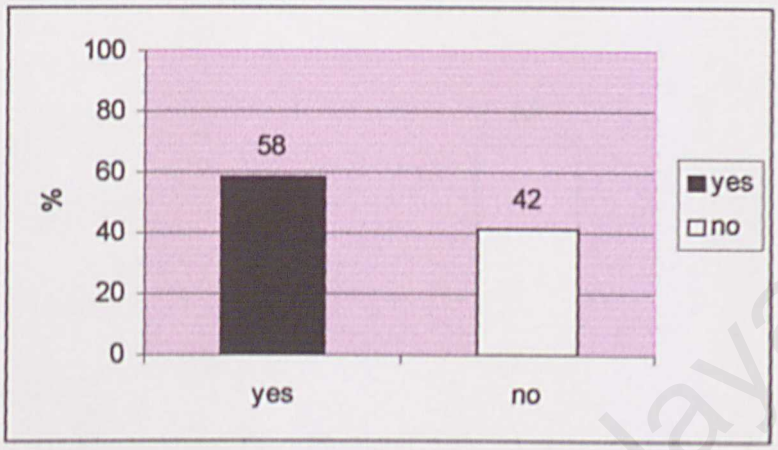


Figure 9 : Questionnaire 6

Many of students know about 2D, 3D and 3D animation, they only notice It after watching 3D cartoon movie or film like Toys Story, Bugs Life, Finding Nemo and many more.

3.6.5 Question 7

Do you know anything about 3D learning package?

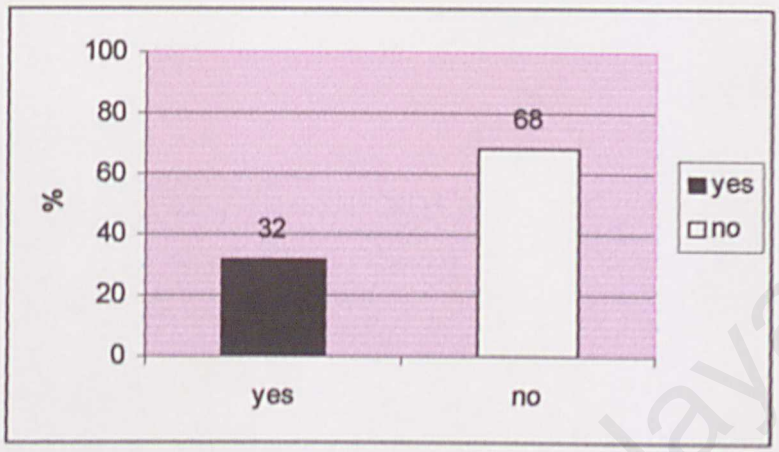


Figure 10 : Questionnaire 7

Only 32% of student that really know about 3D learning package while 68% have no clue at all about what really is the 3D learning package. This kind of statistics show that 3D learning package is not very familiar to student and not being use by the teachers at school in Malaysia.

3.6.6 Question 8

Do you ever use any software or application that consist 3D development?

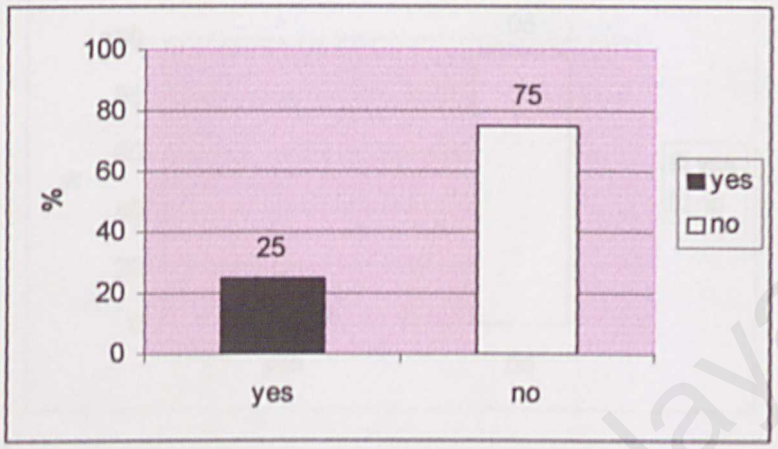


Figure 11: Questionnaire 8

25% of student have used software or application 3D development, these student just explore causing by interested. 75% don't know anything about 3D development or design software.

3.6.7 Question 9

Do you agree with current teaching method by your teachers?

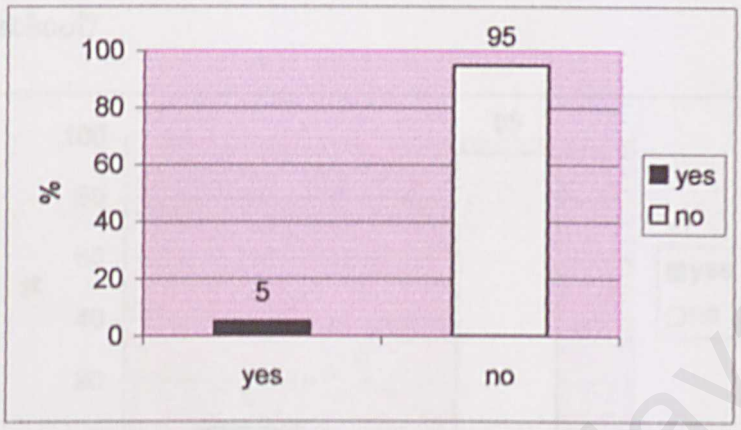


Figure 12 : Questionnaire 9

From the graph above we can noticed that students at school always fell bored class session because they just learning referring to their text book while teachers just read back to the class what is contained in the text book.

3.6.8 Question 10

Do you if 3D learning package being implement as one of teaching methods at your school?

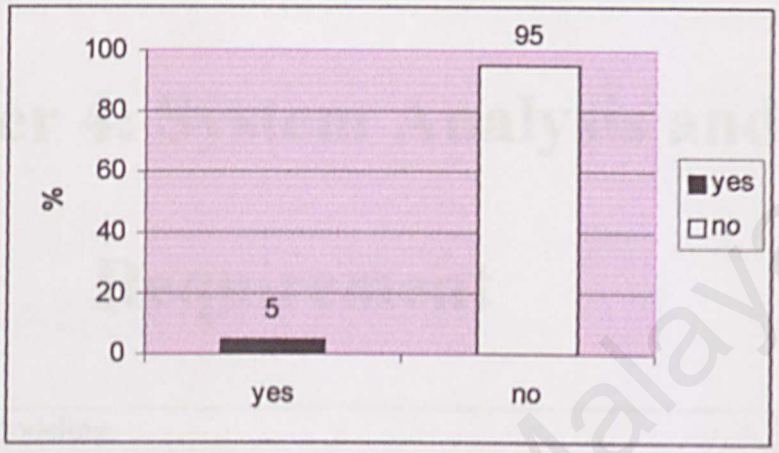


Figure 13 : Questionnaire 10

Many student agree with the idea to implement 3D learning package at the school as a new method of education because they say that it is much more easier to memorized when learning with 3D visualization especially in Science subjects.

Chapter 4: System Analysis and Requirement

4.1 Process Modeling.

4.2 System Requirement

- 4.2.1 Preconditions and Assumptions
- 4.2.2 Interface and Report Requirement
- 4.2.3 Non-Functional Requirement .

4.3 Software Analysis.

4.4 Software Advantages Analysis

- 4.4.1 Advantages Using Microsoft Windows 2000 Professional
- 4.4.2 Advantages Using 3D Studio Max 4
- 4.4.3 Advantage Using Flash MX

Chapter 4: System Analysis and Requirement

4.1 Processing Modeling

Before developing a system, first thing to do is define a System Development Life Cycle (SDLC), the process of creating a new system or changing system is called a life cycle. There is two life cycle patterns have been identified: the waterfall cycle and spiral cycle. This project adopted the Waterfall Model, which describes how the development process being organized. The waterfall life cycle is defined by distinct stages that follow these five steps:

i) Analyze

ii) Design

iii) Build

iv) Test

v) Deploy

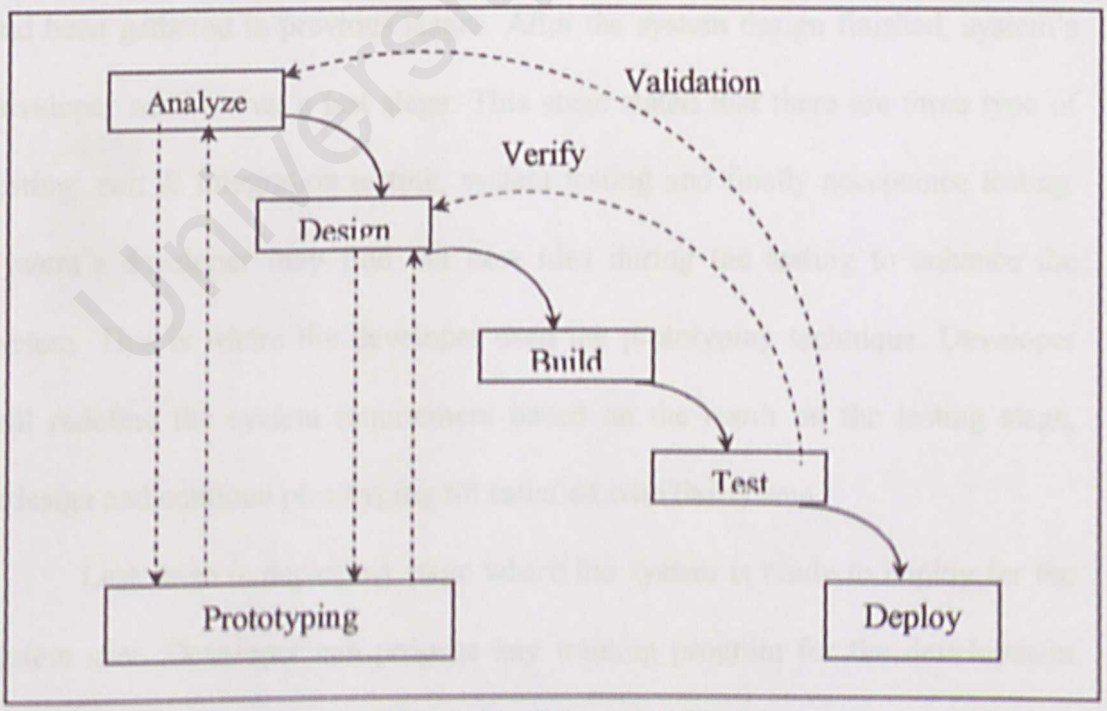


Figure 14 : Water Fall Cycle

In this waterfall cycle, each stage must be completed before the next stage can proceed. Returning to a previous stage is often not permissible. In the first stage it more on the developer identified all requirements of the system. Developer need to list down the requirements to a form called System Requirement Statement. All these requirements have gone through a proper analysis to make sure that there are properly defined.

Flow Chart also is used to show the system's flow when user interacts with the system step by step, from the beginning till he end. For this project, there additional diagram, it is the storyboard for the 3D water cycle animation. The storyboard just gives the roughly scene that must be in the animation to considered by the developer.

Next stage is stage to build or in other word to produced the system. System's developer just needs to follow all the requirement or information that had been gathered in previous stages. After the system design finished, system's developer need to run a test stage. This stage stated that there are three type of testing: unit & integration testing, system testing and finally acceptance testing. System's developer may find out new idea during the testing to enhance the system. This is where the developer used the prototyping technique. Developer will redefine the system requirement based on the result on the testing stage, redesign and continue prototyping till satisfied with the system.

Last stage is deploying stage where the system is ready to deploy for the system user. Developer can propose any training program for the development system in order to teach the user how to use the system.

4.2 System Requirement

4.2.1 Preconditions and Assumption

i) The objects in this project may not be exactly the same as we see in the real world. They are rather modified, represents the objects in the real world.

iii) Both, teachers and students may use this project. This projects just a need to running mostly from CD ROM or can be download from Internet.

4.2.2 Interface and Reporting Requirement

i) This system should work on a Windows System.

ii) When an error is encountered, the system should return the user to the previous screen.

4.2.3 Non-Functional Requirement

i) Reliability

System should be designed in such a way that process errors are avoided or trapped before the result in output becomes error. It shall not cause any unnecessary actions of the overall environment.

ii) Availability

The system shall be available to the user anywhere and anytime to ensure that the operation and the services are running smoothly .

iii) Security

Users that intend to do bad thing should also secure by the system to prevent from misuse and illegal activities. The authenticated users shall have access right to view the system.

iv) Usability

The system must provide documentation or guideline to teach user to use the system. At least, intuitive interface shall present in such a way that makes user fell easy to use.

v) Flexibility

The system shall be capable for future expansion. System should allow the integration with other system and new technologies

vi) Portability

The system should also enable its application to operate on various platform regardless of manufacturer or operating system.

4.3 Software Analysis

Based on the comparison made in Chapter 2 (Literature Review) on the software and tools available in the market and system requirement statement, the following are the software to be used in Natural Water Cycle Learning package.

i) Platform: Microsoft Windows 2000 Professional

The main reason this platform is used is because most of the software tools can be run in this platform for example 3D Studio Max or Maya. Beside, our faculty is now using this platform in most of the laboratories and he lecturer halls. Microsoft 2000 Professional is also proved to be more reliable and sable compare o is NT versions.

ii) Graphical User Interface Tool: Flash MX

Flash MX enhances the accessibility, creativity, and power of Flash. Users who require a higher level of control and integration with industry standard design tools have an unparalleled creative application for creating media-rich content.

Powerful new features build on this creativity, giving application developers access to new capabilities that make Flash MX a robust and exciting application development environment. Users can work with advanced scripting and debugging tools, built-in code reference, and predefined components to rapidly deploy rich web applications.

iii) Modeling Tool: 3D Studio Max 4

The most important feature that 3D Studio Max has is the ability to convert models into VRML 2.0 format that outclasses other modeling tools. In addition, 3D Studio Max has friendly user interface ad gives the designer flexibility and reliability.

4.4 Software Advantages Analysis

4.4.1 Advantages Using Microsoft Windows 2000 Professional

i) Value

The reason to use Windows 2000 Professional is the overall value it offers. As this list proves, Windows 2000 Professional can help user reduce costs through improved management and increase productivity through improved reliability and ease of use.

ii) Reliability

Windows 2000 Professional also included fundamental improvements, such as modifications to the operating system to repair itself, that make it the most reliable desktop operating system Microsoft has ever produced.

iii) Mobility

Mobile computing is simpler and more efficient with Windows 2000 Professional. This means users can work anywhere, anytime while also saving time and increasing productivity.

iv) Manageability

Windows 2000 Professional is easier o deploy, manage and support. Centralized management utilities, troubleshooting tools and support for self-healing applications all make it simpler for administrator and users to deploy and manage desktop and laptop computers and it also reduced costs.

v) Performance

The advancements made throughout Windows 2000 Professional are emphasized by the operating system's speed. Windows 2000 Professional is 32 percent faster than Windows 95 and 27 percent faster than Windows 98. It is also significantly faster than Windows NT 4.0 on configurations with 32 MB of RAM.

vi) Security

Windows 2000 Professional provides comprehensive security features to protect sensitive data, both locally on the desktop computer and it is transmitted over the local area network (LAN), phone lines or the Internet.

vii) Usability

As described before, Windows 2000 Professional combines the power and security of its predecessor, Windows NT Workstation, with the traditional ease of use of Windows 98. It also provides more wizards, a centralized location for common tasks and menus that adapt to the way user work.

viii) Data Access

For any data access, user can take advantage of IntelliMirror in Windows 2000 Professional when conjunction with Windows 2000 Server. This technology let user store important information and desktop settings on a central computer, it lets user work on any computer attached to user network as if the user at his or her own desk.

ix) Hardware

Windows 2000 Professional lets user take advantage of new hardware devices, such as those with universal serial bus (USB) and IEEE 1394 (Firewire) connections. It is mostly ideal for companies.

4.4.2 Advantages Using 3D Studio Max 4

3ds max offers improved capability and usability. In this version, we have concentrated on character animation, support for gaming, enhanced rendering, and greater ease of use. There are many advantages such as follow:

4.4.2.1 Features

i) New open IK system designed around an extensible architecture.

ii) A new Hierarchical Sub-Division surface delivers next generation modeling.

iii) New flexibility IK independent shaded Bones system for more accurate skeletal setups, previews and skinning.

iv) Enhanced Character Deformations including new angle deformer and soft body characteristics.

v) Superior interactive rendering with blazing speed and free customizable network rendering.

vi) Next generation game development environment with support for Direct3D, multi textures per face, opacity mapping, true transparency and pixel/vertex shaders like reflection maps and bump maps.

vii) Intuitive, customizable user interface for creating a workspace to fit the task nee or preference.

viii) Integration with discreet's desktop 3D compositing and paint software combustion.

4.4.2.2 Architecture

i) Multi-threaded throughout for performance and scalability.

ii) Consistent unified environment provides speed and efficient workflow.

iii) Create, model, texture or render in whatever context or point-in-time is most convenient for scenes.

iv) Object oriented architecture provide powerful, easy to learn, consistent methods and operations, selection-sensitive commands and operation, intelligent cursors and menus and shard class references.

v) Full scripting throughout the core level.

vi) Immediate feedback for rapid artistic decision making.

vii) Modeless design conveys immediate results across all views as user adjust parameters.

viii) Interactive view port graphics support OpenGL and Direct3D hardware acceleration, or fast Heidi software for any Windows display.

ix) Animate virtually anything by clicking on ever-present animate button.

x) Create key frame when adjusting nearly any parameter or geometry.

xi) New Point Cache Modifier allows animators to cache or save animation data from the modifier stack, improving performance for previews and final animations.

xii) Controller-based animation provides parametric control over interpolation method of nearly any value.

xiii) Controllers can be layered, blended, scripted, coped, referenced or instanced.

4.4.2.3 System Requirement

i) Windows 2000/ Windows 98 with 128 MB RAM and 300 MB swap space minimum.

ii) Compatible Intel processor at 300 MHz minimum (dual Pentium III system recommended

iii) Graphics card supporting 1024 x 768 x 16 bit color (OpenGL and Direct3D hardware acceleration supported; 24-bit color, 3D graphics accelerator preferred)

iv) CD-ROM Drive and Windows-compliant pointing device (Optimized for Microsoft Intellimouse).

v) Optional: sound card and speakers, video I/O devices, joystick and midi-instrument. Network rendering not supported under Windows 98.

4.4.2.4 File Format Support

i) Image File:

AVI, BMP, CIN, EPS, FLC, GIF, JPG, PNG, RGB, RLA,RPF, TGA,TIF,YUV, PSD, MOV.

ii) Geometry File:

IGES, PRJ, SHP, STL, VRML, 3DS, 3D ASC II SCENE, AI, DWG.

4.4.3 Advantage Using Flash MX

Macromedia Flash MX is the professional standard authoring tool for producing high-impact Web experiences. Whether users are creating animated logos, Web site navigation controls, long-form animations, entire Flash Web sites, or Web applications, users will find the power and flexibility of Flash ideal for their own creativity. Flash MX provides new video capabilities, enhanced color management, Timeline layer folders, and an optimized workspace with a context-sensitive Property inspector for the designer. For the developer Flash MX gives application developers access to advanced scripting and debugging tools, built-in code reference, and Flash components to rapidly deploy rich Web applications.

4.4.3.1 Features

i) Color management

Flash MX provides improved color mixing tools as well as gradient and bitmap fill editing, all integrated into the Color Mixer. Colors can be added to and deleted from the Color Swatches panel with a single click.

ii) Property inspector

Flash MX consolidates many of the panels that were separate in Flash 5 into a context-sensitive Property inspector. Based on user's selection, the Property inspector displays any relevant properties for objects such as text, symbol instances, frames, and components.

iii) International language support

Flash MX adds support for Korean and Chinese, as well the capability to create Flash content that can parse and interpret Unicode strings. In addition, users can author vertical text using the Text tool and new formatting options found in the Property inspector.

iii) Accessibility

Users can create content that can accessed by all persons with disabilities. To author content with accessibility in mind, they just need to choose Window and then click Accessibility.

iv) Author-time shared libraries

Shared library assets let users use assets from a source movie in multiple destination movies. Using shared library assets helps optimize your workflow and movie asset management.

v) Expanded video capabilities

With Flash MX, users can now use the File > Import or File > Import to Library command to import any video file format into their Flash document, including MPG, DV (Digital Video), MOV (QuickTime), and AVI. When users import, a dialog box appears with compression settings, and the video is embedded directly into the Flash MX document.

vi) Pixel-level control

Users can easily align their bitmaps, strokes, and fills with precision to pixel boundaries on the Stage. This provides crisp, clean lines when shapes are viewed in the Flash Player. When users zoom beyond 400%, a pixel grid appears, allowing them to place and draw of shapes and objects more precisely.

vii) Flash components

Flash MX let users quickly develop Web application user interfaces by using components. These reusable objects consist of movie clips with associated parameters. Components can be used for a variety of functions, including interface elements, client/server interactions, and audio/video objects. Flash MX includes all of the most commonly used operating system interface elements, which users will immediately be familiar with. Each component allows users to fully customize the look and feel without compromising usability. To get more information, users need to see the Introduction to Components Tutorial and Using Flash.

viii) Enhanced development environment

Flash MX builds upon its existing ActionScript editing environment by adding support for code hinting, colored syntax highlighting, and extensive customization. The improved ActionScript editor makes it easier for new and existing authors to access the full potential of ActionScript. Enhancements to the debugger combine existing capabilities with an integrated environment that allows users to set breakpoints and single-step through the code as it executes.

ix) Timeline enhancements

Flash MX provides features that make it easier to use the Timeline, including layer folders, improved pointer feedback, and frame resizing. New folder layers make it easy to organize and access content in the Timeline.

x) Dynamic loading of images and sound

Users can now download JPEG and MP3 files directly into the Flash Player using ActionScript. This eliminates the need to import user media during authoring, and greatly reduces the size of user Flash content.

4.4.3.2 System Requirement

The following hardware and software are required to author Flash movies:

i) For Microsoft® Windows: An Intel Pentium 200 MHz or equivalent processor running Windows 98 SE, Windows ME, Windows NT 4.0, Windows 2000, or Windows XP; 64 MB of RAM (128 MB recommended); 85 MB of available disk space; a 16-bit color monitor capable of 1024 x 768 resolution; and a CD-ROM drive.

ii) For the Macintosh: A Power Macintosh running Mac OS 9.1 (or later) or Mac OS X version 10.1 (or later); 64 MB RAM free application memory (128 MB recommended), plus 85 MB of available disk space; a color monitor capable of displaying 16-bit (thousands of colors) at 1024 x 768 resolution; and a CD-ROM drive.

The following hardware and software are required to play Flash movies in a browser:

iii) Microsoft Windows 95, Windows 98, Windows ME, Windows NT 4.0, Windows 2000, or Windows XP or later; or a Macintosh PowerPC with System 8.6 or later (including OS X 10.1 or later).

iv) Netscape plug-in that works with Netscape 4 (or later) in Windows, or works with Netscape 4.5 (or later) or Internet Explorer 5.0 (or later) on the Mac OS.

v) To run ActiveX controls, Microsoft® Internet Explorer 4 or later (Windows 95, Windows 98, Windows Me, Windows NT4, Windows 2000, Windows XP, or later).

iv) AOL 7 on Windows, AOL 5 on the Mac OS

vi) Opera 6 on Windows, Opera 5 on the Mac OS

Chapter 5: System Design

5.1 System Design Objectives.

5.2 Natural Water Cycle Interface System Design

5.3 Simulation System Design.

5.4 System Flow Chart

5.5 Main Interface of Simulation.

5.6 Storyboard of Simulation

Chapter 5: System Design

5.1 System Design Objectives

The system design using Flow Chart and Storyboard. The Flow Chart drawn to let the developer has the highest view of the system. Flow Chart shows developer the flow of the system starting from the first interaction between the users and the system.

Using Flow Chart to develop system will benefit a lot to the developer such as from the Flow Chart, the developer for the particular system whether it is a simple system or complex system might know if there any part of his or her system that is better to drop or add more application.

By using Flow Chart, it also can reduce the total time to finish the system. Developer can also determined that the system might take short time to be done or a lot of time. This matter is general to any developer because to build a system it is a time consuming matter that might to be monitor by the system's developer.

For this simulation system, there are two subsystems that had been determines. The two subsystems are as followed:

i) Natural Water Cycle Interface.

ii) Natural Water Cycle Simulation.

Natural Water Cycle Interface is the system that will guide user on behalf to interact with the system. It will provide user with navigate buttons that specific for particular thing that user want to view. While Natural Water Cycle Simulation is about 3D graphic visualization that explain to the user about process that contain in the natural water cycle phenomena.

5.2 Natural Water Cycle Interface System Design

The interface system design is serves as the main interface of the Natural Water Cycle Simulation system, it is design using Flash MX.

The interface is design as simple as it can be because it can prevent user from being lost when interact with the system. The system starts with main page where user is given a few button. First button is linked to page that explain to the user about the system or in other word as an introduction for the user in edition to let the user know what the system is all about.

The second button linked to the simulation page, which is the major page that has the natural water cycle simulation. In this page, there are simulation in 3D graphics that show to the user about natural water cycle from the beginning of the process till the end and text info that explain about all the process that appear while the simulation is display. There also has an audio that explain about the simulation, it just the same info with the text info that come out, only the different is it just in case user don't want to read the text info then user can just hear the explanation by the audio.

There are buttons with each of it has different feedback such as:

i) Start button - start the simulation

ii) Pause button - pause the simulation

iii) Stop button - stop the simulation

iv) Forward button - skip to particular scene/process

v) Rewind button - back to particular scene/process

vi) Volume control button - user can up/lower the audio volume

5.3 Simulation System Design

Simulation for the natural water simulation is designed using 3D Studio Max. The simulation is creating similar to the general process that involved in the natural water cycle phenomena.

The main thing that had to be considered is the simulation must be as realistic as possible because this will effect user's attraction and interested to the simulation. The simulation is created start from simple graphics to complete graphics. There are many techniques that involved and being implemented in this design phase. The technique that had been used to create the objects in the simulation:

i) Modeling

ii) Transformation

iii) Lighting and Shading

iv) Mapping

v) Physically Based Rendering

The simulation is follow the storyboard that had been study and contained all the process that involved in natural water cycle. The simulation is create from animation that had been implement several technique in computer animation as follow:

i) In-Betweening

ii) Painting Systems

iii) Camera Stands and Editing

iv) Animation Rendering

5.4 System Flow Charts

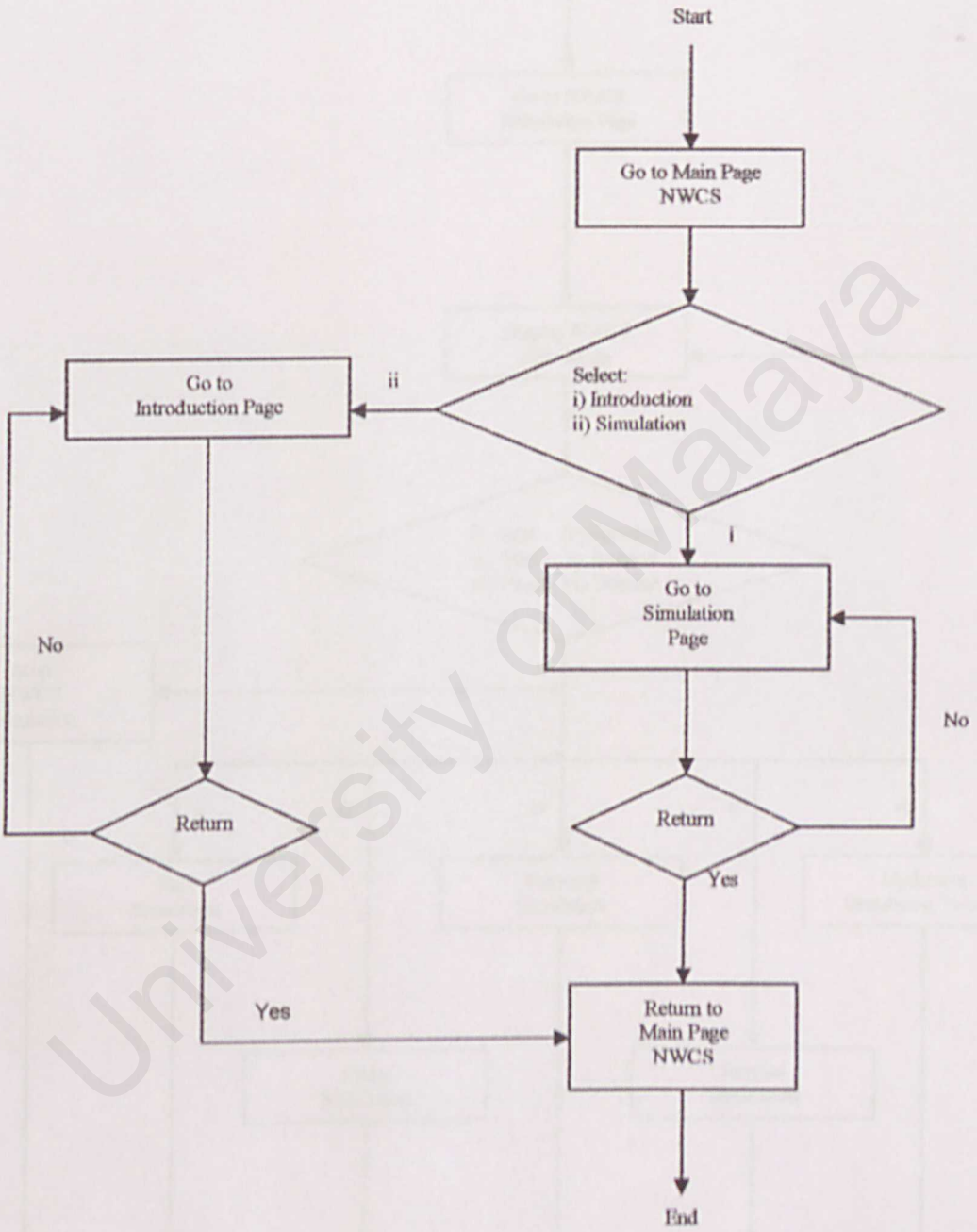


Figure 14 : Flow Chart 1

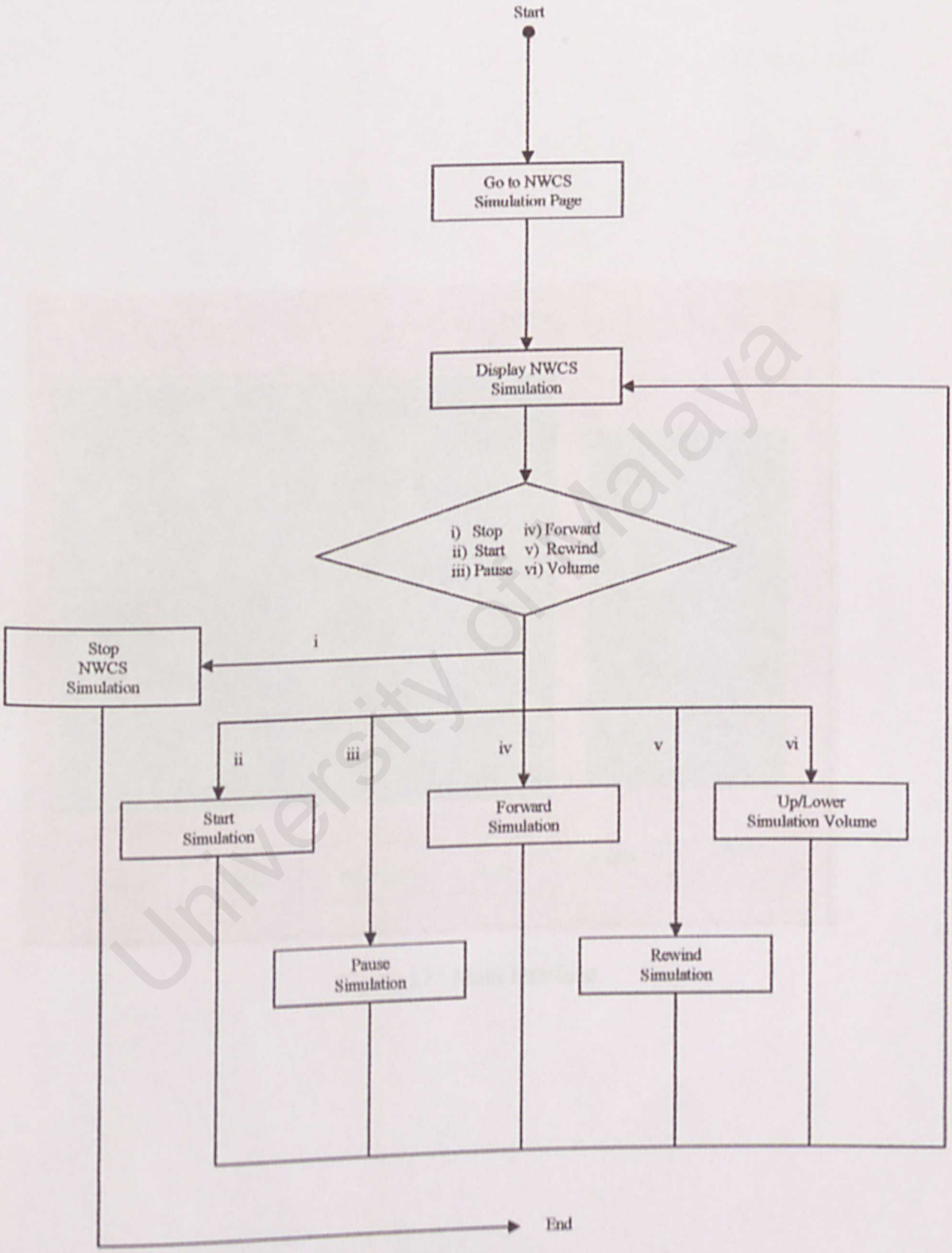


Figure 16 : Flow Chart 2

5.5 Main Interface of Simulation

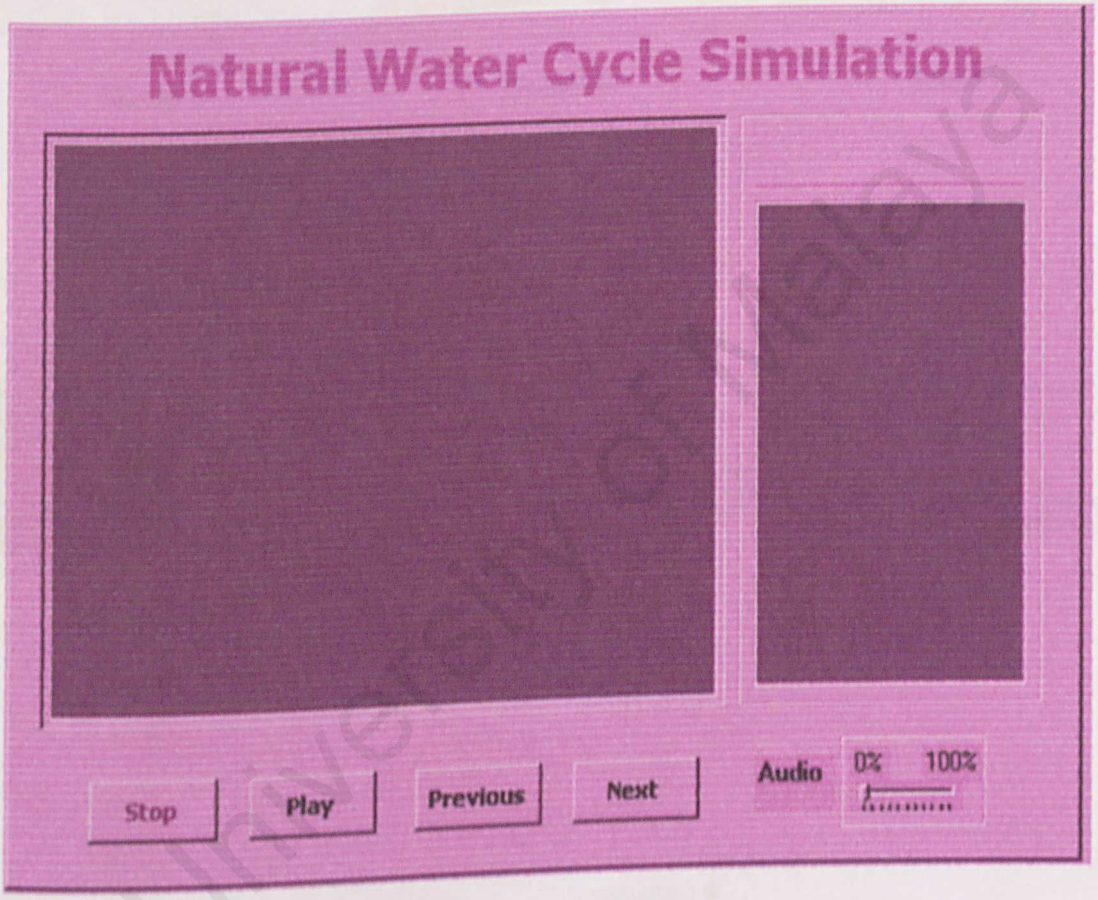
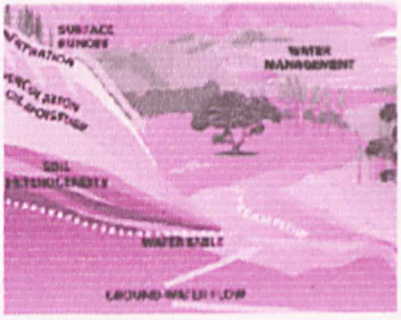


Figure 17 : Main Interface

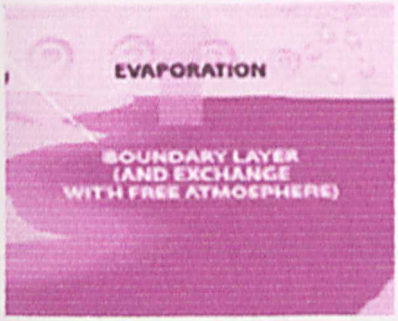
5.6 Storyboard of Simulation

Scene 1



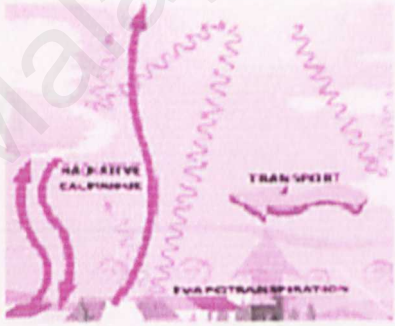
Scene 2

Scene 3

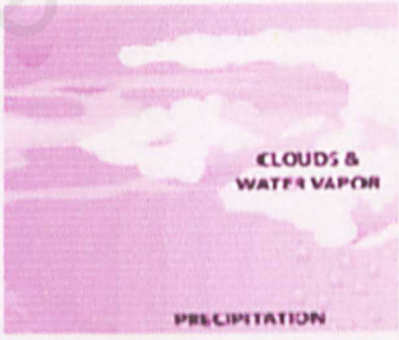


Scene 4

Scene 5



Scene 6



Scene 7

Figure 18: Story board

Chapter 6: System Implementation

6.1 Modeling Implementation

6.2 Interface Implementation

Chapter 6: System Implementation

6.1 Modeling Implementation

3D Studio Max is used to implement the modeling of the natural water cycle environment. There are several techniques that had been implemented to design the animation.

For the surface in the animation is designed by implemented surfaces deformed. This technique let the animation designer to extrude the object that they want to deform, resize, re-shape and extrude (pull the vertex of the animation objects)

The water in the animation designed by using particles technique then added with some 3D Studio Max effects. The water movement was created by using 'frequency effects', those effects let the designer to control the acceleration of the water to flows. While, for the water reflection flat mirror effect was implemented to get more realistic water animation.

For the sun animation, lens flare effect was used to be as the natural sun, at the beginning techniques spotlight had been used as the sun but finally the lens flare effect is more realistic and natural.

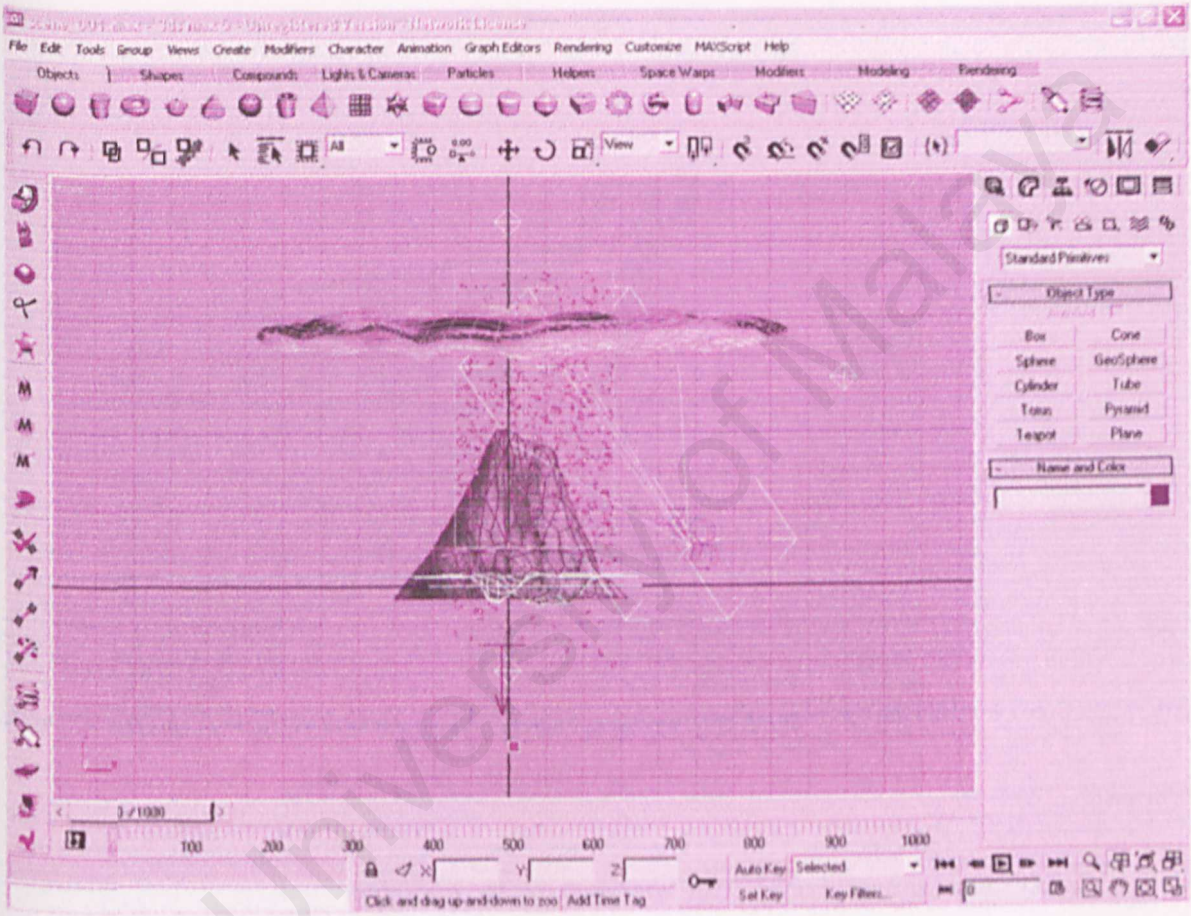


Figure 19: 3D Studio Max scene 1

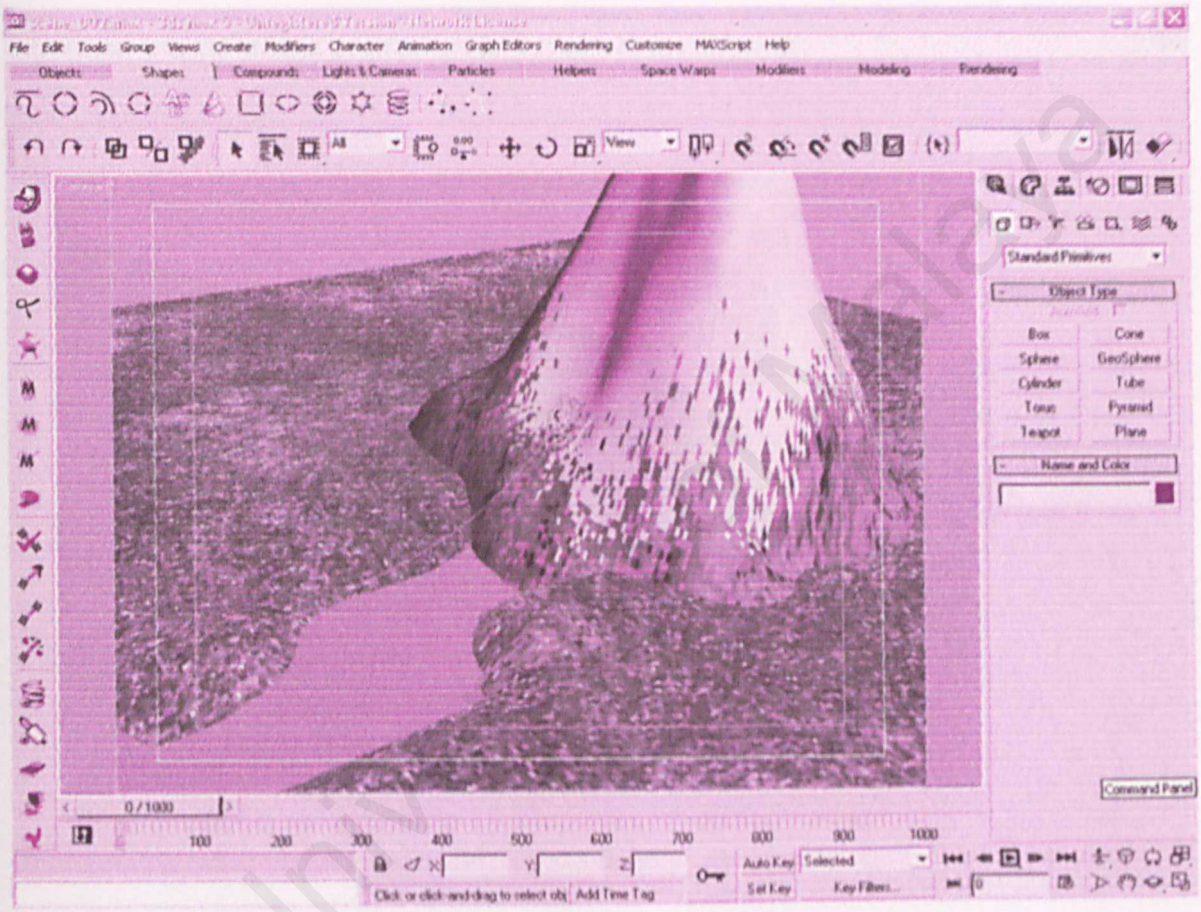


Figure 20: 3D Studio Max scene 2

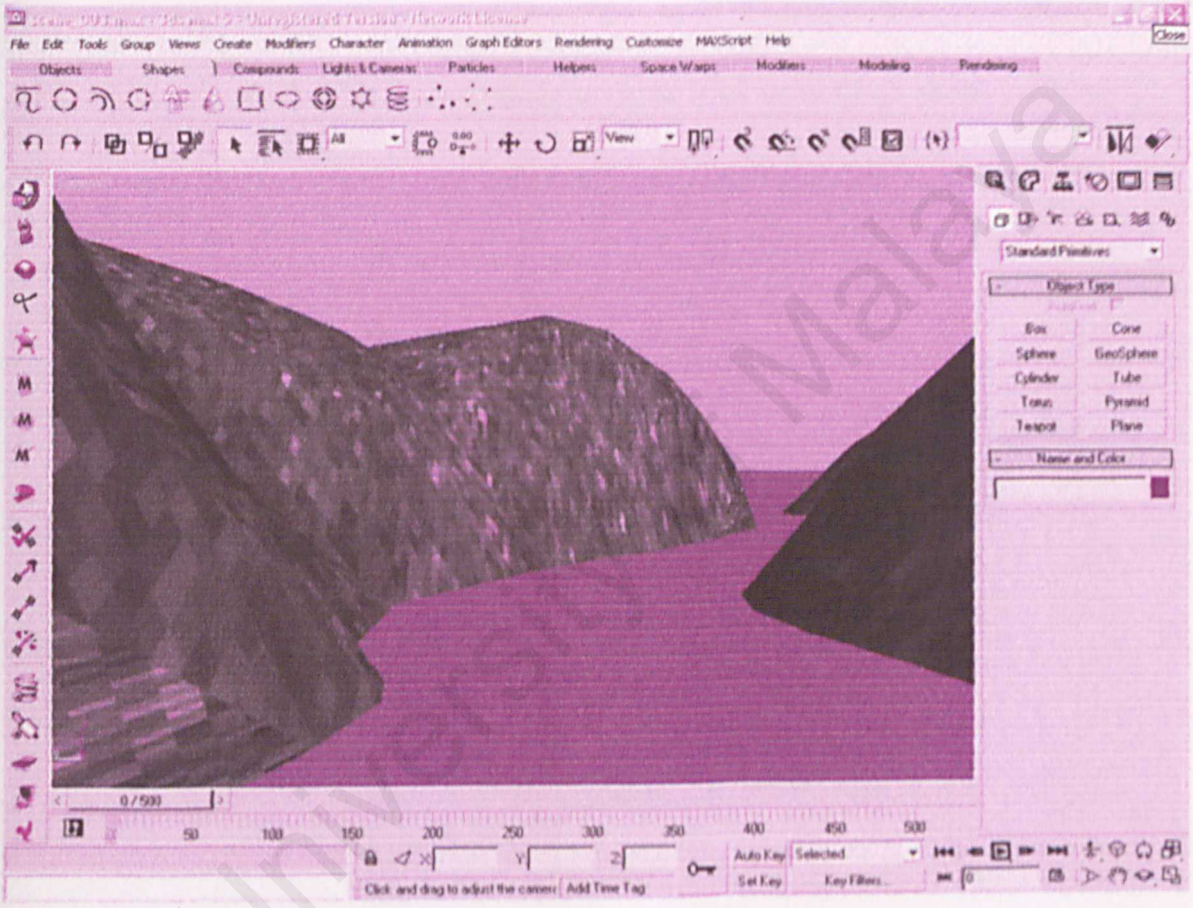


Figure 21: 3D Studio Max scene 3

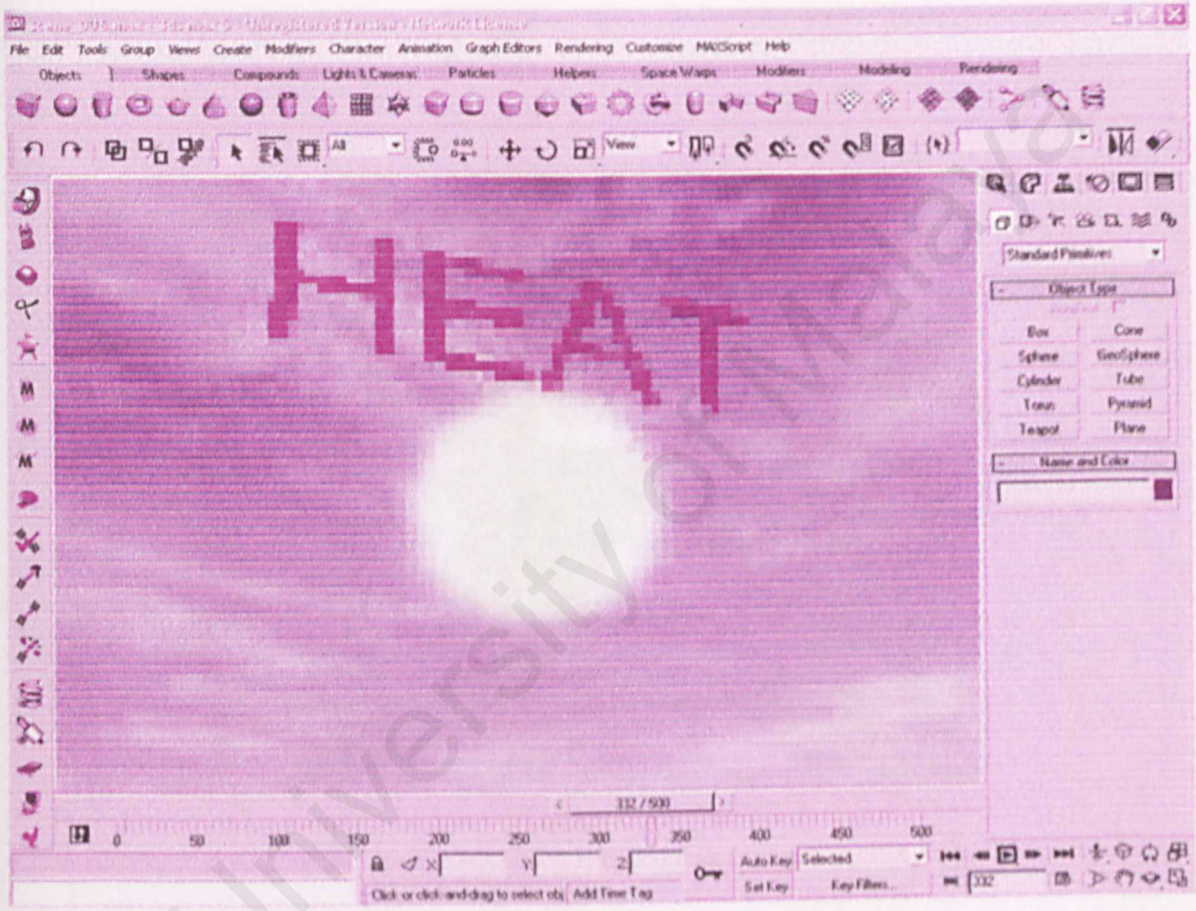


Figure 22: 3D Studio Max scene 4

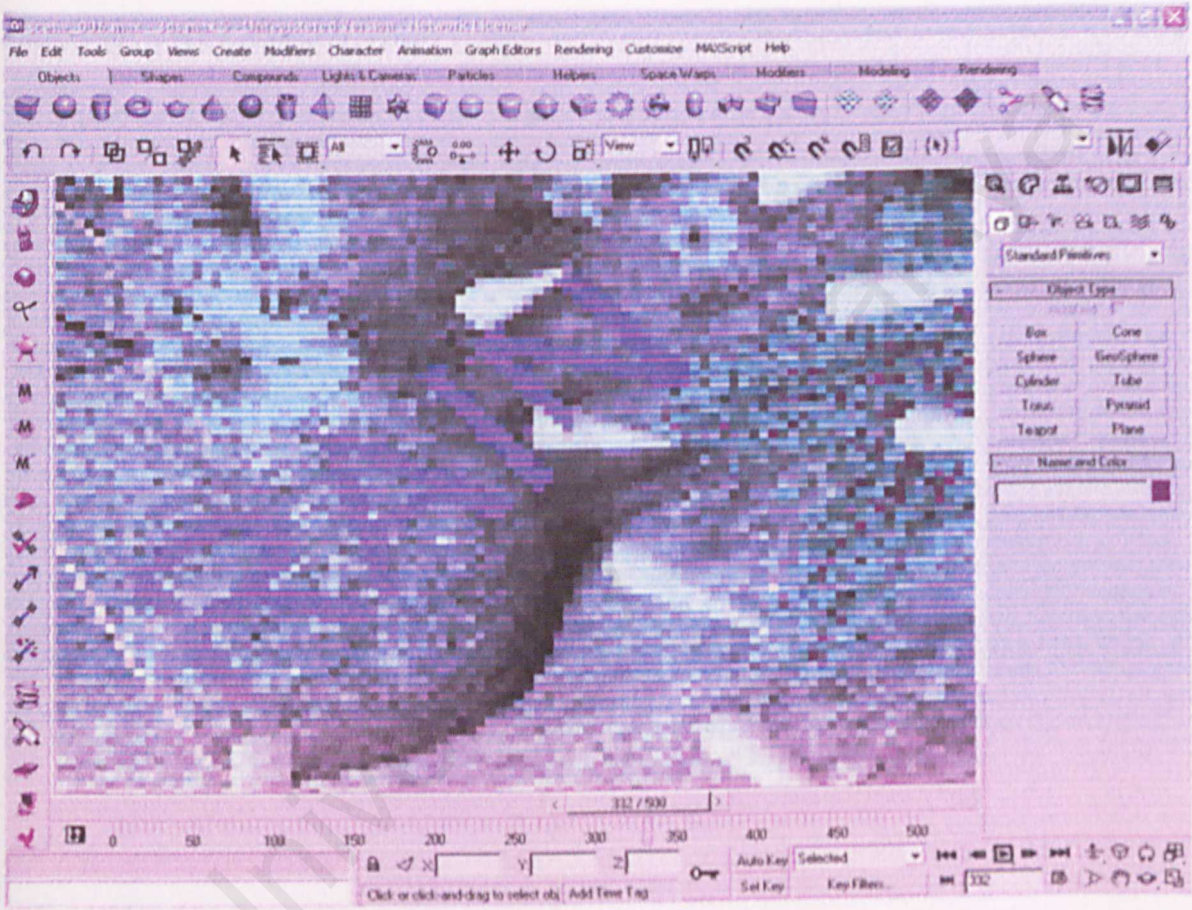


Figure 23: 3D Studio Max scene 5

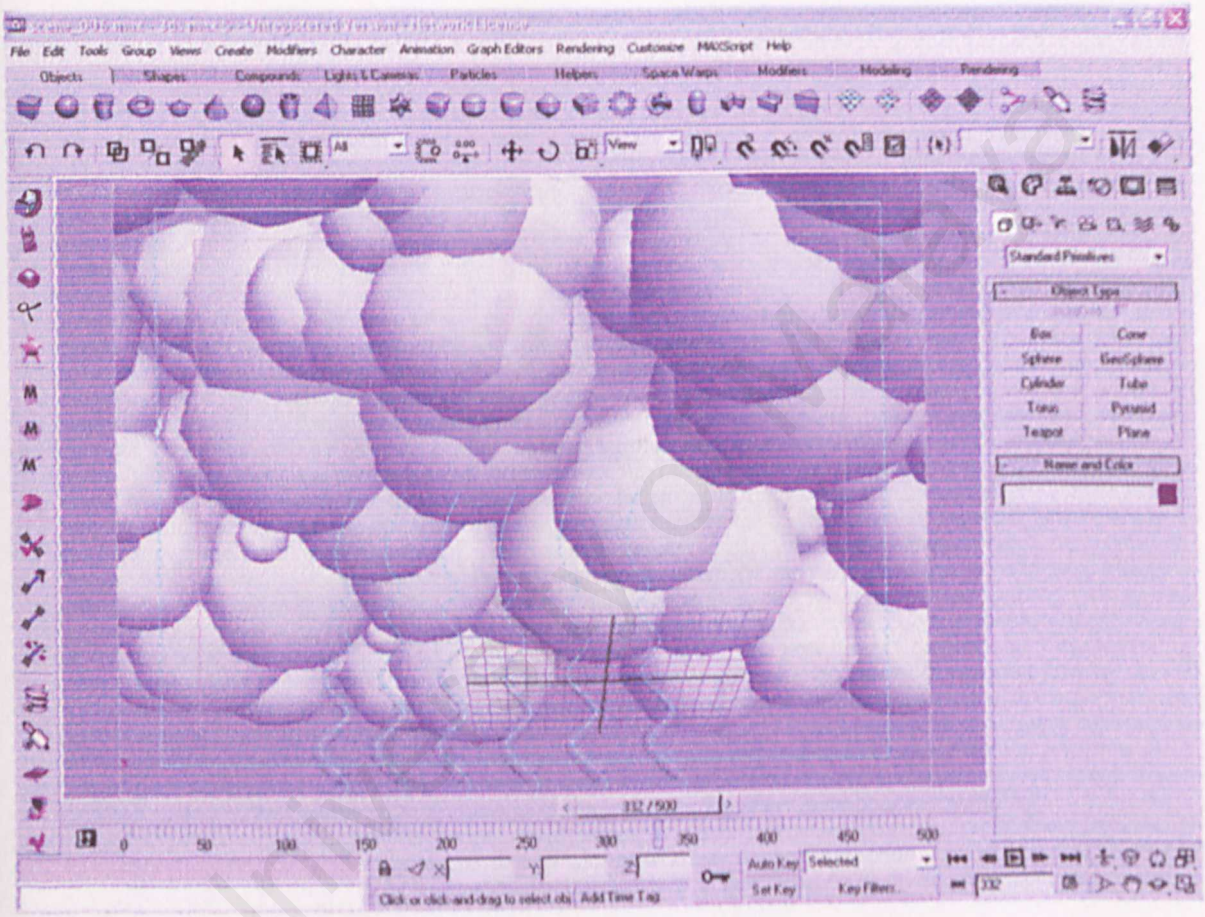


Figure 24: 3D Studio Max scene 6

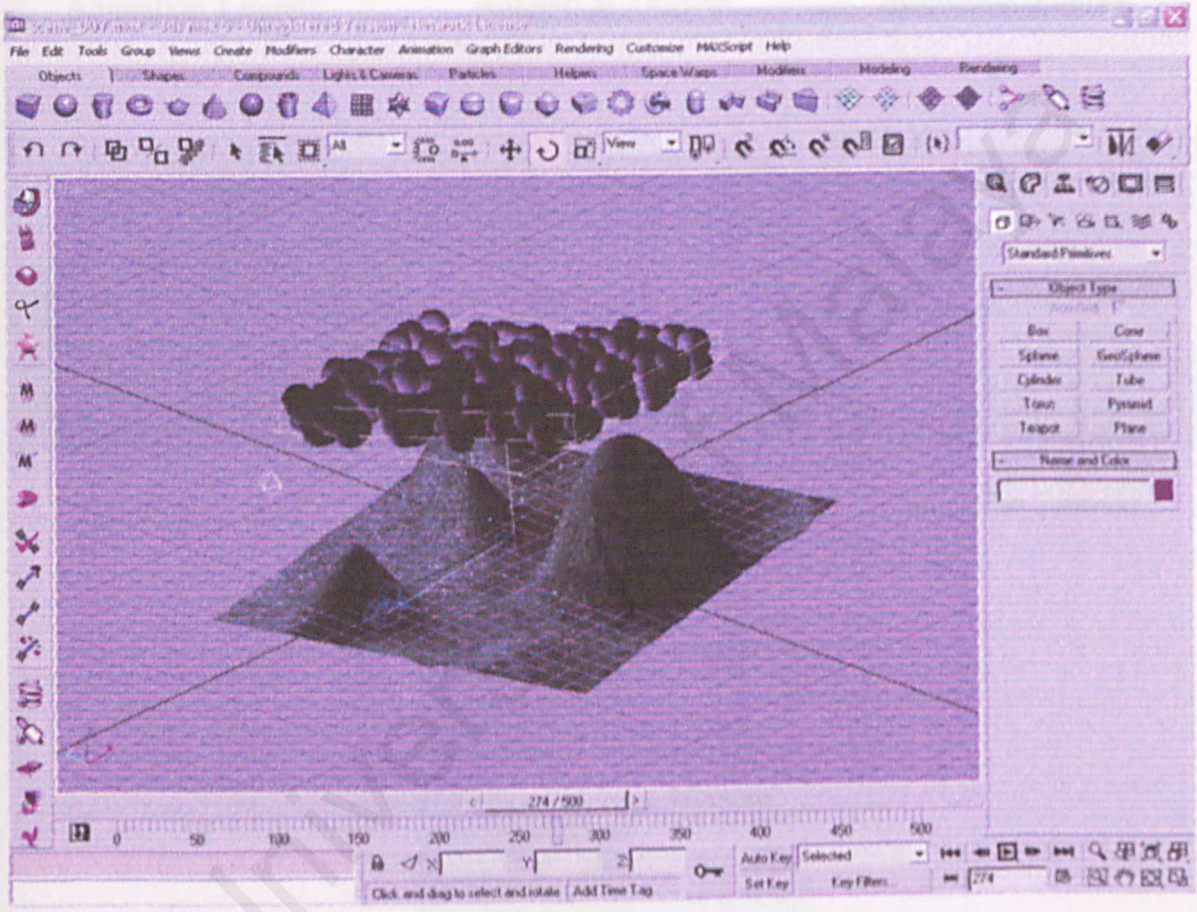
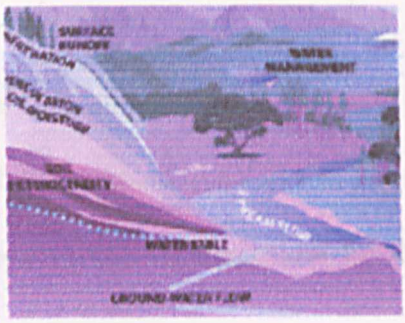
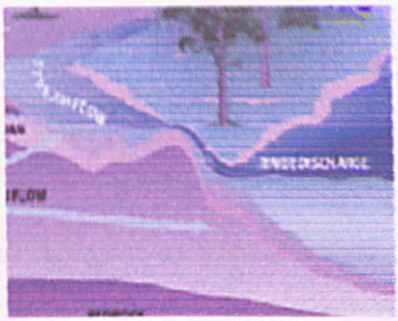


Figure 25: 3D Studio Max scene 7

Animation 1 movie



Animation 2 movie

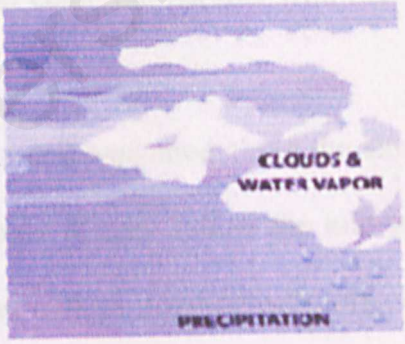


Animation 3 movie

Animation 4 movie

Animation 5 movie

Animation 6 movie



Animation 7 movie

Figure 26: Animation movie of Simulation

6.2 Interface Implementation

The interface of this animation was designed using flash MX tools. There are several layers that being created to make this Natural Water Simulation. Using flash MX is easier because this interface tool let the designer to import video, audio and many more.

The interface can be divide to three parts, there are as followed:

i) simulation video panel

ii) info text panel

iii) navigation buttons panel

The simulation panel is where the 3D Natural Water Cycle Simulation will be displayed to the user. This panel can be maximized or minimized (choose by the user).

Info text panel is the panel that displayed the info about that Simulation in text form. The text will come out parallel with the simulation and the explainer voice.

Voice explainer will explained about the simulation also had been added in different layer because it must follow the info text timelines. There are also background sound, that will be automatically play when the user click the play button.

Several buttons had been placed in the interface that will be as the navigation buttons. The navigation button are followed by stop button, play button, next button, forward button, rewind button, back button and including the simulation scroll-able sliding timeline.

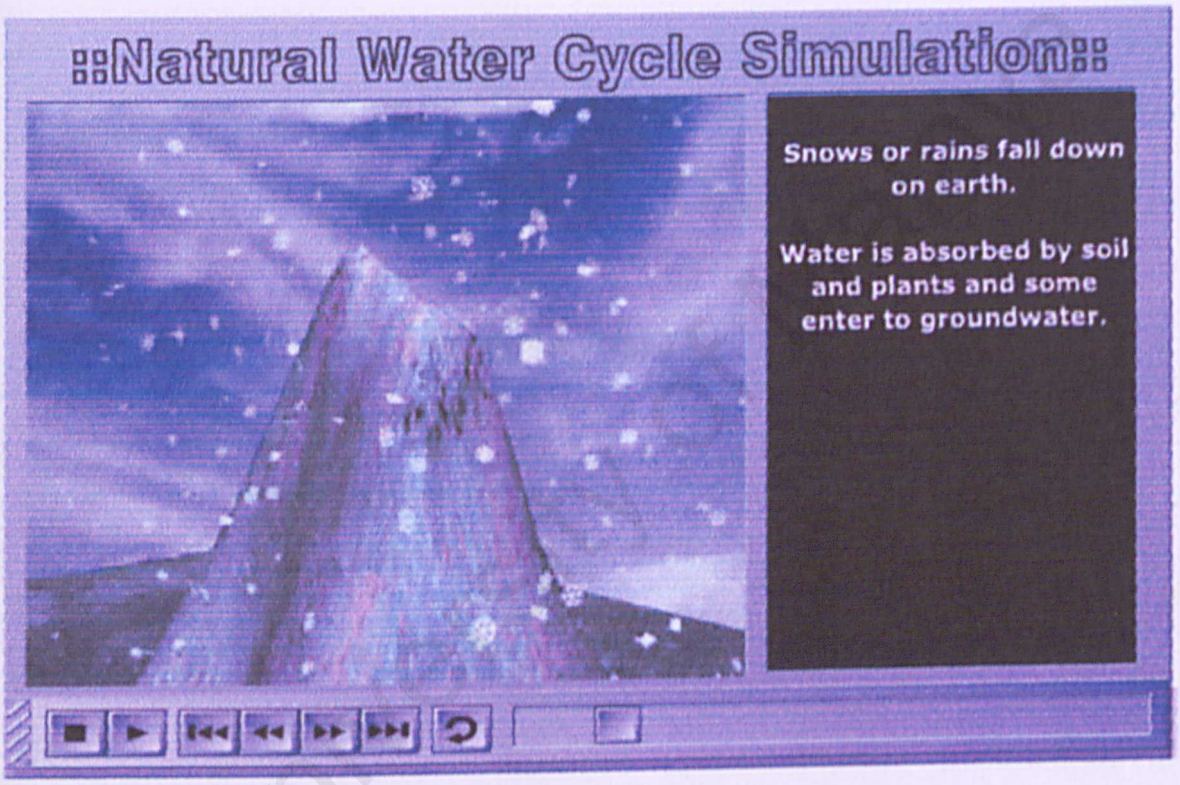


Figure 27: Natural Water Cycle Simulation Interface

Chapter 7: Testing

7.1	Unit and Integration Testing
7.2	System Testing
7.3	Acceptance Testing

Chapter 7: Testing

7.1 Unit and Integration Testing

This segment would test on whether the system fulfills the requirements earlier. For the Unit and Integration Testing there are two components that can be listed, those, those component are as followed:

i) Natural Water Cycle Animation.

ii) Interface for the Natural Water Cycle Simulation.

The Natural Water Cycle animation must be clear or realistic do that the user can understand the process clearly. Every stages of the Natural Water Cycle process must to be explained by info text and explainer voice. The sound must be played at the right place at the right time, that mean the sound of the narrator must synchronize with the animation.

While, the interface for the Natural Water Cycle Simulation must to be user-friendly navigation especially for the control buttons where the user used it whether the user want to stop, play, forward, rewind or repeat back the simulation and also the simulation sliding timeline. All the buttons icon are displayed in most familiar buttons such as play button are recognized by all user with the arrow shape. This is important to let the user of this simulation can noticed what the buttons action after they clicking on it.

7.2 System Testing

When function testing is complete, one is convinced that the system meets all requirements specified during the initial stages of software development. The next step is to se if the users concur any problem when viewing the site.

To do this, several users coming from secondary school were invited on the first prototype of this simulation. As a result, most of the user concluded that they are not familiar with the simulation. This is causing of, before this they just learned about the process of Natural Water Cycle from the textbook including from the lecture by their science teachers. They are also complained about the slow loading of the animation. Therefore, the animation in avi file format had to be change into mpeg file format because of the large size of avi file format.

Feedback from the students is very important in designing the animation and the interface of the simulation. However, some of the users suggestions and demands cannot be met. This is because first, there are limitations to what the 3D Studio Max (as the 3D modeling tool) and Flash (as the interface tool) can do and second, due to time constraint, further research on optimizing simulation performance is limited.

7.3 Acceptance Testing

Finally, when everything is running without any problem, acceptance testing is conducted. Acceptance testing examines how well the speed of response to the user actions that their make, accuracy of the animation and accessibility of the simulation.

Testing phases focus on optimizing its performance in loading time as well as its rendering performance. since the file for the animation video in avi file format is quite big and the huge amount of graphics processing and rendering, evaluation on time taken to load the animation file id of great concern. Even so, after the successfully load smoothly by converting the avi file format to mpeg file format.

Chapter 8: Evaluation

8.1	Overall Evaluation
8.2	Strength
8.3	Limitations
8.4	Recommendations

Chapter 8: Evaluation

8.1 Overall Evaluation

The system evaluation will focus mainly on both the Natural Water Cycle animation and the interface. The first evaluation is to determine if the following objectives were achieved.

Objectives	Achieved	Reason (if any)
Modeling 3D object and animation of the Natural Water Cycle Simulation. This would provide realistic view of the faculty to t he users. This 3D modeling object and animation will used in the simulation	Yes	The more realistic the Natural Water Cycle animation the more attractive to the user. Users fell excited to knowing about Natural Water Cycle processes.
The Natural Water Cycle Simulation should provide users with user-friendly control buttons that will direct the user to the scene that their want to view.	Yes	By these buttons, users can navigate on their desire.
The voice of simulation narrator must be synchronized with the animation and the info text.	Yes	Users will hear th\e narrator voice while reading about the info text, so there will be no lost information in their learning session.

Volume sliding controller that will let the user to increase or decrease the volume of narrator voice.	No	Due to the time constraint, but the sliding volume control is only minor thing. User still can control volume by using Windows volume controller.

8.2 Strength

The key features of the Natural Water Cycle Simulation are its interface and the Natural Water Cycle animation. The simulation presents to user a new way of learning especially to science subject. This simulation provided a sufficient animation for users to see the whole picture of Natural Water Cycle.

To add more flexibility, the will be provided a repeat buttons so that users are not need to press on the play buttons again whenever they want to see the simulation again. The simulation are also provided with narrator voice which is the user can just hearing to what the narrator explain about the Natural Water Cycle processes.

The info text panel is set to be display synchronized with the animation and narrator voice. By this panel, the users especially students can read the info text panel while view the Natural Water Cycle animation.

8.3 Limitations

The obvious limitation to this simulation system is the high requirements of the computer that being running the simulation. Although the total file size has been optimizing, loading time is still considered slow even running from high computer specification. Rendering of 3d models also consumes a lot of resources. This would explain the high minimum requirements by the simulation.

Another limitation for the simulation is the rigidity to control the volume of the narrator voice to be louder than background sound. This happened causing by limitation of Flash MX where it cannot setting the value of the background or narrator voice.

8.4 Recommendations

The recommendations for the future enhancement of the Natural Water Cycle Simulation focus on more optimization of the performance as well as increasing flexibility and functionality for users.

Incorporation of Macromedia's Flash files is recommended giving users more flexibility and understanding towards the purpose of the simulation. The Flash panorama images will enable users to rotate 360 degrees in a picture file. Users are able to understand more about the Natural water Cycle Simulation processes. A Flash file then can be loaded to give the user a real picture of what is behind the animation, not only that users are able to rotate 360 degrees to view the animation.

3D Studio Max version 6 can be recommended as 3D modeling tools for future enhancements where by using this version, 3D object modeler can modeling 3D object or scenes more realistic by importing 3D objects from 3D Studio Max 3D objects library. The 3D library is providing the modeler with already-made 3D objects. For extras, modeler can still modified the already-made 3D objects. There are also many 3D objects effects features in 3D Studio Max version 6.

Appendix I (Questionaire Form)

Borang Kajian Soal Selidik.
Fakulti Sains Komputer & Teknologi Maklumat.
Tujuan:Mengkaji sama ada pakej pembelajaran 3D dapat membantu pelajar-pelajar di sekolah.

Nama:_____ Jantina:_____

i) Nyatakan peringkat sekolah anda sekarang.
☐ Rendah ☐ Menengah Nyatakan:_____

ii) Nyatakan kawasan sekolah anda sekarang.
☐ PJ ☐ KL Lain-lain:_____

iii) Adakah anda tahu tentang multimedia?
☐ Ya ☐ Tidak

iv) Adakah anda memiliki komputer peribadi (PC) di rumah?
☐ Ya ☐ Tidak

v) Secara purata berapa lamakah anda luangkan masa menggunakan PC di rumah?
☐ 1 Jam ☐ 2 Jam ☐ > 2 Jam

vi) Adakah anda tahu tentang apakah itu 2D, 3D dan animasi 3D?
☐ Ya ☐ Tidak

vii) Adakah anda tahu tentang pakej pembelajaran 3D?
☐ Ya ☐ Tidak

viii) Adakah anda pernah menggunakan perisian yang melibatkan pembangun 3D?
☐ Ya ☐ Tidak

ix) Adakah anda bersetuju dengan pendekatan pengajaran yang digunakan oleh guru-guru di sekolah anda?
☐ Ya ☐ Tidak

x) Adakah anda bersetuju agar pakej pembelajaran 3D digunakan sebagai alat bantu pengajaran bagi menggantikan kaedah pengajaran yang sedia ada?
☐ Ya ☐ Tidak

xi) Mengapa anda berpendapat sedemikian?

_____

_____

xii) Nyatakan bahan-bahan rujukan belajar yang anda gunakan sekarang?
☐ Buku Rujukan ☐ Nota Guru ☐ CD Pembelajaran

Appendix I (User's Manual)

Following are the users manual to interact with the simulation:

Firstly to running this simulation, user's just clicks on the simulation file whether it is .exe files or .swf files. Then the interface will come out. The interface had provided with 7 control buttons with sliding animation timelines and two panel which are the simulation panel where the 3D animation processes will be displayed and the info text were info text will slowly come from the bottom of the panel synchronized with the narrator voice's.

About the control buttons, below are the list of what the action of the buttons when user click on it:

i) Stop button - To stop the simulation .

ii) Play button - Play the simulation, the narrator voices and text info will play automatically by clicking this button.

iii) Back button - To start back the simulation from beginning.

iv) Rewind button - To rewind the simulation wherever processes the user want to view. Narrator voices and info text to will follow current process.

v) Forward button - To forward the simulation wherever processes the user want to view. Narrator voices and info text to will follow current process.

vi) Next button - To end up the simulation to last simulation processes

vii) Repeat button - Allowed users to repeat the simulation continuously without clicking on the start button again an again.

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