Intensive Driving Lesson System for Driving School

By

Nursyafina Daniel

Dissertation submitted in partial fulfillment of
the requirement for the
Bachelor of Technology (Hons)
Information and Communication Technology

JUNE 2006

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CERTIFICATION OF ORGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein has not been undertaken or done by unspecified sources or persons.

NURSYAFINA BINTI DANIEL

ABSTRACT

The focus of this project is to develop an Intensive Driving Lesson System for driving school that emphasize on aiding learning through 3D demonstration and interaction. The objectives of this project are to develop an intensive driving lesson system as a supplement to current driving lesson and JPJ's outline test, to incorporate the VR concept and giving information such as visualization in presenting the overview of road driving scenarios to the students in the system and to conduct a survey to evaluate system acceptance by the user. In order to achieve these objectives, the design method adopted to develop the system is based on Kulwinder Kaur's (1998). There are five (5) stages conducted in designing method; requirement analysis, task & domain analysis, design of VE, design of user support and navigation analysis and evaluation. The preliminary findings from the evaluation of the system showed that the completed system is able to compliment to the current driving lesson. Future recommendations and enhancements on the Intensive Driving Lesson system suggested that the use of 3D demonstration is refined further and implementation is applied with more details. The idea can be broaden by enhancing user navigation and interaction towards this features.

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CHAPTER 1
INTRODUCTION

1.1 Background of Study

Virtual reality describes a combination of computer hardware and software which creates "the illusion of immersion of the user in a computer-generated environment" [1]. Beyond this simple definition, virtual reality (VR) represents a new approach to the way people interact with computers. The goal is to replace current indirect interaction techniques, through the use of keyboard and pointing devices such as a mouse, with direct interaction, through movement, pointing, touching, speech and hearing.

A virtual environment application typically includes several elements which create the "illusion of immersion." The computer controlling the environment maintains a model of a three-dimensional dynamic environment, which can include static and dynamic elements, the viewpoint of the user, and even a representation of the user as a graphic object in the virtual world. The user sees a graphic image which is updated at a fast enough rate to sustain an illusion of continuous motion, and may hear sounds related to events or objects in the virtual environment.

Virtual Reality (VR) is emerging as a very powerful educational tool that has the potential to provide higher education establishments with a powerful and effective educational environment. The major advantage of a VR system is the way it will allow students to interact with educational orientated simulations. In a fast changing field such as VR it is important to fully understand the implications of the technology and in particular where and how it should be implemented in an educational curriculum. To address these issues it has been necessary to cast a wider net over the field rather than just deal with the hardware aspects of virtual reality.

This perspective will provide a greater and realistic insight into the opportunities a VR based educational environment will provide [2]. Virtual Reality is a powerful tool for education since people comprehend images much faster than they grasp lines of text or columns of numbers.

Virtual System provides the tools to visualize and manipulate abstract information, thus making it easier to understand.

1.2 Problem Statement

1.2.1 Problem Identification

The current outline of JPJ's driving test includes a written test on laws and road test which tests the students driving skills as well as the application of the road rules. The problem is most of the students could not apply the road rules in their driving test, causing them to fail to perform well and only succeed on the second or third try. One of the reasons identified is insufficient driving lesson learning tools.

1.2.2 Significant of the Project

This project creates an intensive driving lesson, which educates and allows the students to experience through a road test environment with several traffic signs based on the JPJ rulebook. Basic driving techniques will be given in order to teach the students to identify risk factors with proper anticipation to avoid accident. The student will be taught how to deal with possible road scenarios when driving. This project would be usable as a compliment to the written test of the JPJ outline as well as to give the students a chance to have a virtualization on road driving to the real environment prior to the actual road test.

1.3 Objectives

The aim of this project is to design and develop an Intensive Driving Lesson for Driving School. The project will focus on the use of VR system in overcoming few common problems of nowadays driving scenarios.

The objectives of this project development:

- To develop an intensive driving lesson system as a supplement to current driving lesson and JPJ's outline test.
- To incorporate the VR concept and giving information such as visualization in presenting the overview of road driving scenarios to the students in the system.
- To conduct a survey to evaluate system acceptance by the user.

1.4 Scope of Study

1.4.1 The Relevancy of the Project

This project is focused on the usability of virtual system in overcoming few common problems of nowadays driving scenarios.

The students will be given tips on basic driving techniques that covers; city and residential driving, the driver's exam, highway driving, safety tips for normal conditions, index of road signs and basic car maintenance.

The students will be provided with 3D illustration for better understanding of road scenarios for examples parking on hills and learn the rules of two lanes passing on the highway.

This project do not include any multiple question and road driving tests as this project as a supplement to the current driving lesson and JPJ's outline test.

1.4.2 Feasibility of The Project Within The Scope and Time Frame

The time allocated for this project is 26 weeks. The first 13 weeks is devoted to carry out research work. The remaining 13 weeks is allocated to system development. The project development was divided into several phases as illustrated by the project timeline in Appendix I.

CHAPTER 2
LITERATURE REVIEW AND THEORY

2.1 Definition of Virtual Reality and Virtual Environment

Virtual Reality (VR) is the term commonly used to describe a novel human-computer interface that enables users to interact with computers in a radically different way. VR consists of a computer-generated, multi-dimensional environment and interface tools that allow users to:

- immerse themselves in the environment,
- navigate within the environment, and
- interact with objects and other inhabitants in the environment.

Virtual Environment is an interactive, simulated environment (three dimensional multimedia applications) that allows the users to perform actions that give them more control over how the information is viewed. Being a medium for education, it allows an individual to project him or herself into a computer generated world and move freely within it. The term is used here to include a variety of the newer multimedia data-types that give the viewer more information and more control over how the information is viewed than traditional graphic, photographic or video elements [3].

The experience of entering virtual environment, this computer-generated virtual world is compelling. To enter, the user usually dons a helmet containing a head-mounted display (HMD) that incorporates a sensor to track the wearer's movement and location. The user may also wear sensor clad clothing that, likewise tracks movement and location. The sensors communicate position and location data to a

computer, which updates the image of the virtual world accordingly. By employing this garb, the user "breaks through" the computer screen and becomes completely immersed in this multi-dimensional world. Thus immersed, one can walk through a virtual house, drive a virtual car, or run a marathon in a park still under design. Recent advances in computer processor speed and graphics make it possible for even desk-top computers to create highly realistic environments. The practical applications are far reaching. Today, using VR, architects design office buildings; NASA controls robots at remote locations, and physicians' plan and practice difficult operations.

Virtual reality is quickly finding wide acceptance in the medical community as researchers and clinicians alike become aware of its potential benefits. Several pioneer research groups have already demonstrated improved clinical performance using VR imaging, planning and control techniques.

2.2 History of Virtual Reality

When someone enters Virtual Reality, he leaves the computer behind. No longer is the computer screening a window through which the world is watched. Now the user is completely inside the computer. The users can directly interact with the elements of the computer world, can move easily through this world and change it. To describe this phenomenon, the term Virtual Reality is used [4].

The history of Virtual Reality [4] is older than most people think. As early as 1966, Ivan Sutherland built a HMD which was connected to the computer. All that it showed was a simple wire frame cube which could be looked at using the HMD. This HMD was known as the sword of Damocles. This was due to the fact that it hung with bars from the ceiling. These bars were used to track the movement of the head and to support the enormous weight of the HMD. The HMD used small CRT's to display the monoscopic pictures.

In 1970, Sutherland further developed the HMD hardware at the University of Utah. The HMD was now no longer monoscopic but displayed stereoscopic images instead. By using gyroscopes on the HMD, it now felt more stable and less heavy. Besides the HMD, many improvements were made to the computer systems.

Around the same time, Myron Kreuger developed VIDEOPLACE. VIDEOPLACE is a form of Projected Reality. In VIDEOPLACE, Myron Kreuger used a big screen in front of the user. On this screen, a shadow of the user was displayed. The user could now finger paint in the sky. It was also possible to display multiple people on the same screen (perhaps the first form of Computer Supported Collaborative Work, CSCW [5]). It was also possible to introduce the outline of a little animal, CRITTER, in this environment. The CRITTER was used to allow the user to interact with the computer and his environment.

Around this, time Boeing was experimenting with Augmented Reality. The idea was to help the mechanic when he was working on the engines of a plane with some sort of X-Ray and references. He could see inside the engine and the computer would point out certain parts. This technique is still used to help mechanics with repairing complicated machinery.

The military quickly saw the advantages of Virtual Reality and developed it further. In 1982, Thomas Furness III developed a HMD with a very high resolution, 2000 scan lines (this is almost four times normal TV and two times most X-window terminals), by using small 1" CRT's. Using the helmet, the pilot saw a symbolic representation of the world. The military kept their Virtual Reality technology secret for a long time.

In the beginning of the 80's, the ideas of both Furness and Sutherland were put together at NASA Ames by McGreevy. He used Liquid Crystal Displays, LCD's, to build a HMD. A tracker from Polhemus was used to track the movement of the head. This was the first HMD using cheap technology (the HMD costs less than $2000). Up until now, Virtual Reality was costly. McGreevy showed that it was possible to use cheap equipment and still build a Virtual Reality setup. This was the breakthrough for Virtual Reality. Now more scientists could afford Virtual Reality.

After this, Virtual Reality took off. More and more people saw the possibilities of Virtual Reality and started to do research in it. In 1983 Zimmerman teamed up with Lanier to form VPL. VPL was one of the first companies to start building equipment for Virtual Reality. One of the first things they built was the DataGlove(TM).

After this, more and more small companies started to build equipment for Virtual Reality. Now it is possible to buy everything from just a single HMD, DataGlove or tracker, up to complete systems consisting of a computer, HMD, DataGlove and tracker.

As with most new techniques, it was very profitable in the beginning to sell just the hardware. After a couple of years, people started to build libraries which could be used to build an application. One of the best known and most widely used libraries today is the WorldToolKit from Sense8.

Up until now, most of the effort was put in creating hardware for VR. Some applications have been built but were mainly used to test the hardware. The availability of VR toolkits made it possible for other researchers to use VR for their specific tasks [6], [7]. Applications were now built to use VR for a specific task not to test the VR hardware. Following are some examples of applications built in VR.

In their paper, Bajura et al described the use of Virtual Reality to look at ultrasound imagery. The ultrasound imagery is projected in a HMD and the doctor is now able to look at the inside of the patient. Their idea is that this helps the doctor get a better overview [8].

At Chapel Hill, research is done using a Scanning Tunneling Microscope and force feedback. They use the force feedback to feel the images made with a Scanning Tunneling Microscope. The user is also able to shoot at the surface with a laser and see the change immediately [9].

At different locations, Augmented Reality has been tested to help with the repair of complex equipment. While looking at the actual object, the computer gives clues about the different parts and the inside of the object [10].

2.3 Overview of Virtual Reality Technology

The term "Virtual Reality" describes the experience of interacting with data from within the computer-generated data set. The computer-generated data set may be completely synthetic or remotely sensed, such as X-ray, MRI, PET, etc. images. Interaction with the data is natural and intuitive and occurs from a first-person perspective. From a system perspective, VR technology can be segmented as shown in ***Figure 1.***

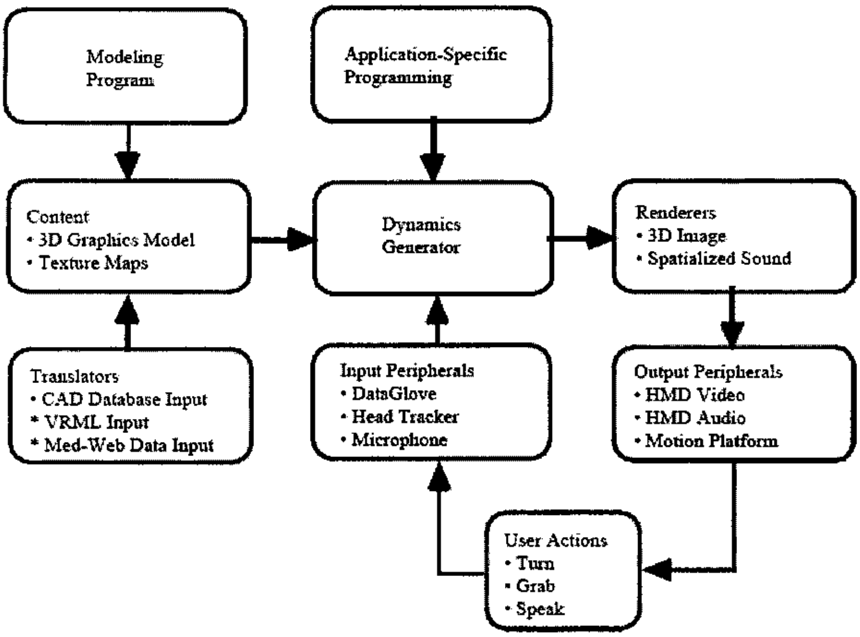

Figure 1: A Complete VR System

The computer-generated environment, or virtual world content, consists of a 3D graphic model, typically implemented as a spatially-organized, object-oriented database; each object in the database represents an object in the virtual world.

A separate modeling program is used to create the individual objects for the virtual world. For greater realism, texture maps are used to create visual surface detail. For example, to increase the reality of the flight simulator, texture mapping and light modeling could also be included [11].

The data set is manipulated using a real-time dynamics generator that allows objects to be moved within the world according to natural laws such as gravity and inertia, or to other variables such as spring-rate and flexibility that are specified for each particular experience by application-specific programming. The dynamics generator also tracks the position and orientation of the user's head and hand using input peripherals such as a head tracker and DataGlove. Powerful renderers are applied to present 3D images and 3D spatialized sound in real-time to the observer.

2.3.1 Instrumented Clothing

The DataGlove™ and DataSuit™ use dramatic new methods to measure human motion dynamically in real time. The clothing is instrumented with sensors that track the full range of motion of specific activities of the person wearing the Glove or Suit, for example as the wearer bends, moves, grasps or waves.

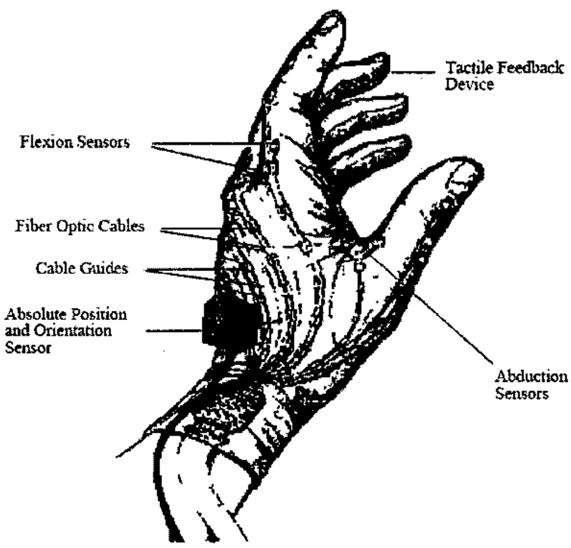

Figure 2: The DataGlove, a VR control device.

The DataGlove is a thin Lycra glove with bend-sensors running along its dorsal surface. When the joints of the hand bend, the sensors bend and the angular movement is recorded by the sensors. These recordings are digitized and forwarded to the computer, which calculates the angle at which each joint is bent. On screen, an image of the hand moves in real time, reflecting the movements of the hand in the DataGlove and immediately replicating even the most subtle actions.

The DataGlove is often used in conjunction with an absolute position and orientation sensor that allows the computer to determine the three-space coordinates, as well as the orientation of the hand and fingers. A similar sensor can be used with the DataSuit and is nearly always used with an HMD.
The DataSuit is a customized body suit fitted with the same sophisticated bend-sensors found in the DataGlove. While the DataGlove is currently in production as both a VR interface and as a data-collection instrument, the DataSuit is available only as a custom device. As noted, DataGlove and DataSuit are utilized as general purpose computer interface devices for Virtual Reality. There are several potential applications of this new technology for clinical and therapeutic medicine.

2.3.2 Head Mounted Display (HMD)

The best-known sensor or effectors system in Virtual Reality is a head-mounted display (HMD). It supports first-person immersion by generating an image for each eye, which, in some HMDs may provide stereoscopic vision. 3D Spatialized Sound

The impression of immersion within a virtual environment is greatly enhanced by inclusion of 3D spatialized sound Stereo-pan effects alone are inadequate since they tend to sound as if they are originating inside the head. Research into 3D audio has shown the importance of modeling the head and pinea and using this model as part of the 3D sound generation. A Head Related Transfer Function (HRTF) can be used to generate the proper acoustics.

2.3.3 Other VR Interface Technology

A sense of motion can be generated in a VR system by a motion platform. These have been used in flight simulators to provide cues that the mind integrates with visual and spatialized sound cues to generate perception of velocity and acceleration.

Haptics is the science of touch. Haptic interfaces generate the percepts of touch and resistance in VR. Most systems to date have focused on providing force feedback to enable users to sense the inertial qualities of virtual objects, and/or kinesthetic feedback to specify the location of virtual object in the world. A few prototype systems exist that generate tactile stimulation, which allows users to feel the surface qualities of virtual objects. Many of the haptic systems developed thus far consist of exo-skeletons that provide position sensing as well as active force application.

Some preliminary work has been conducted on generating the sense of temperature in VR. Small electrical heat pumps have been developed that produce sensations of heat and cold as part of the simulated environment.

2.4 Areas of Application in Virtual Reality

Virtual reality had been researched for years in government laboratories and universities, but because of the enormous computing power demands and associated high costs, applications had been slow to migrate from the research world to other areas. Continual improvements in the price or performance ratio of graphic computer systems, however, have made VR technology more affordable and, thus, used more commonly in a wider range of application areas. Applications today are diverse and represent dramatic improvements over conventional visualization and planning techniques. These include areas of entertainment, computer-aided design, military, architecture or construction, and data visualization.

2.4.1 Public Entertainment

Virtual Reality made its first major inroads in the area of public entertainment, with ventures ranging from shopping mall game simulators to low-cost virtual reality games for the home. Major growth continues in home VR systems, partially as a result of 3D games on the Internet.

2.4.2 Computer-Aided Design

Using Virtual Reality to create "virtual prototypes" in software allows engineers to test potential products in the design phase, even collaboratively over computer networks, without investing time or money for conventional hard models. All of the major automobile manufacturers and many aircraft manufacturers rely heavily on virtual prototyping.

2.4.3 Military

With Virtual Reality, the military's solitary cab-based systems have evolved to extensive networked simulations involving a variety of equipment and situations. All levels of the military now have the ability to practice as teams in a verity of complex simulation scenarios, practicing search and rescue missions, for example, using acquired details from target-areas modeled into virtual worlds.

2.4.4 Architecture or Construction

Virtual Reality allows architects and engineers and their clients to "walk through" structural blueprints. Designs may be understood more clearly by clients who often have difficulty comprehending them even with conventional cardboard models.

2.4.5 Data Visualization

By allowing navigation through an abstract "world" of data, Virtual Reality helps users rapidly visualize relationships within complex, multi-dimensional data structures.

2.4.6 VR in Education and Training

One of major areas of application for VR technologies is in education and training field.

In fact is it one of the fun and application are which made use of VR technologies evidence by the flight simulation training. The fundamental task of a flight simulator is image rendering. During navigation, the users can control the speed and the rotation angle of the plane through I/O devices, like 6 DOF mice. At each time frame, the program needs to recomputed the plane's position and viewing direction and redraws the image, so an efficient image rendering algorithm is very crucial to flight simulators. Usually, the objects in the model are specified in terms of world coordinates and so is flight's pose. However, to render an image viewed through the plane, all object coordinates need to be transferred into viewer's coordinate frame to perform the perspective projection. Since a lot of transformations are involved here, this is the next major task behind image rendering.

To increase the reality of the flight simulator, texture mapping and light modeling could also be included [11].

This is particularly important in financial-market data, where VR supports faster decision making. VR is commonly associated with exotic "fully immersive applications" because of the over dramatized media coverage on helmets, body suits, entertainment simulators and the like. Equally important are the "Window into World" applications where the user or operator is allowed to interact effectively with "virtual" data, either locally or remotely.

Today it has expanded to other fields such as training in medical field, military, formal education, fine drills training, plant training, just to name a few.

The reasons why a VR technology is well suited to these fields are:

- it allows trainees to practice in safe condition as appose to risky and impossible. For example, fire evacuation training.
- provide a similar environment to the real environment.
- provide an interesting and interactive, thus it is multi sensory feedback to the user.
- could create many scenarios for practice at the click of a button.

The key concept of training is learning by doing, using a combination of live, constructive, and virtual trainers [12]. The approach to achieving cost effective maintenance training is to offload training in expensive live equipment and constructive mockups onto low-cost VR desktop trainers, as illustrated by the Training Triangle in ***Figure 3***.

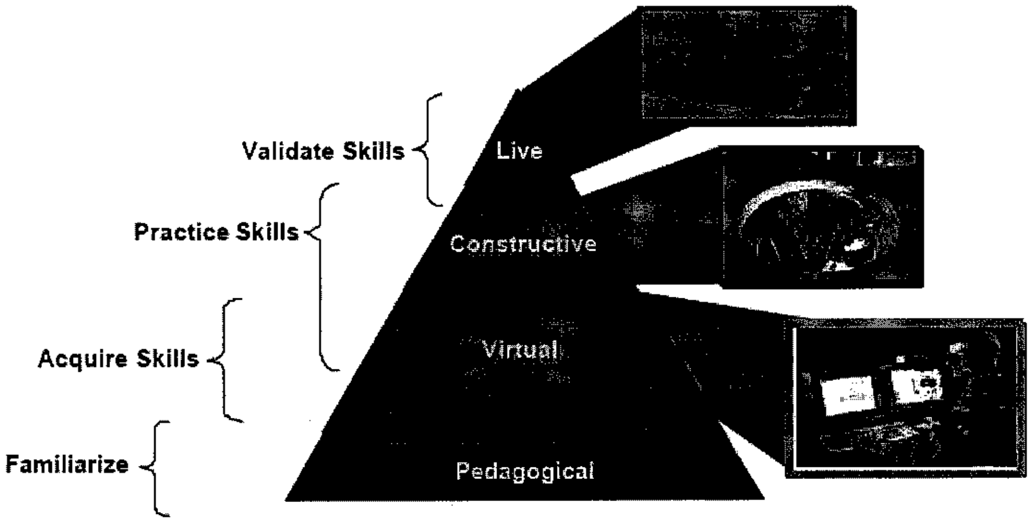

Figure 3: The Training Triangle depicts how to use appropriate live, virtual, and constructive training for different stages of learning [12].

A VR technology is widely used as a training tool in the military and medical area. Overviews of VR in these fields are discussed in the following paragraphs.

2.5 VR in Military Area

One of the earliest uses of simulators in a military environment was the flight trainers built by the Link Company in the late 1920's and 1930's. These trainers looked like sawed-off coffins mounted on a pedestal, and were used to teach instrument flying. The darkness inside the trainer cockpit, the realistic readings on the instrument panel, and the motion of the trainer on the pedestal combined to produce a sensation similar to actually flying on instruments at night. The Link trainers were very effective tools for their intended purpose, teaching thousands of pilots the night flying skills they needed before and during World War II.

To move beyond the instrument flying domain, simulator designers needed a way to produce a view of the outside world. The first example of a simulator with an outside view appeared in the 1950's, when television and video cameras became available. With this equipment, a video camera could be 'flown' over a scale model of the terrain around an airport, and the resulting image was sent to a television monitor placed in front of the pilot in the simulator. His movement of the control stick and throttle produced corresponding movement of the camera over the terrain board. Now the pilot could receive visual feedback both inside and outside the cockpit.

The logical extension of the video camera or television monitor approach was to use multiple monitors to simulate the entire field of view from the airplane cockpit. This method is still in use for transport aircraft simulators, where the field of view needs to be only about 180 degrees horizontally and 60 degrees vertically. For fighter aircraft simulators, the field of view must be at least 180 degrees horizontally and vertically. For these applications, the simulator consists of a cockpit placed at the center of a domed room, and the virtual images are projected onto the inside surface of the dome. These types of simulators have proven to be very effective training aids by themselves, and the newest innovation is a project called SIMNET to electronically connect two or more simulators to produce a distributed simulation environment [13]. Distributed simulations can be used not only for training, but to develop and test new combat strategy and tactics. A significant development in this area is an IEEE data protocol standard for distributed interactive simulations [14]. This standard allows the distributed simulation to include not only aircraft, but also land-based vehicles and ships. Another recent development is the use of head-mounted displays (HMDs) to decrease the cost of wide field of view simulations [13].

2.6 VR in Medical Area

The use of VR in medical applications provides for better image manipulation, improved image understanding, improved quantitative comparisons, and better surgical planning.

Healthcare's potential use of interactive 3D technologies is broad. To date, most of the media's attention has centered on two application areas: surgical training and planning, and computer-aided surgery systems. However, the possible uses are much broader.

The following categories represent current and emerging applications of VR in medical area. These include categories of medical or dental surgical training, pre-surgical training, Computer-aided surgery systems, Interactive 3D diagnostic imaging, Radiation Treatment Planning and Control, Medical Education, 3D Visualization for Telemedicine, Telesurgery, Rehabilitation and Sports Medicine, Disability Solutions, Neurological Evaluation, and Psychiatric and Behavioral Healthcare.

Application	Description
Medical / Dental Surgical Training	Training and rehearsing a surgical procedure using surgical instruments linked to a realistic simulation – may or may not include haptic feedback.
Pre-Surgical Planning	Using 3D radiological images and computer workstation tools to design and plan an operative procedure.
Computer-Aided Surgery Systems	Using 3D images overlaid in real-time on the operating field to facilitate surgery.
Interactive 3D Diagnostic Imaging	Tools for data analysis and quantitative comparisons- capturing and manipulating medical imaging data in a 3D format. Collaborative environments.
Radiation Treatment Planning and Control	Design of radiation treatment procedure to match patients' anatomy precisely. 3D design and control systems.
Medical Education	Case histories, 3D anatomy lessons and virtual Cadavers, procedure training, ER ward simulation, palpation training, etc.
3D Visualization for Telemedicine	Radiological image teleconsultation and second opinions, shared data for tumor review boards, remote patient examination, and specialty consults.
Telesurgery	Computer-assisted surgery at a distance. Predictive algorithms, 3D surgical planning.
Rehabilitation and Sports Medicine	Simulated environments for evaluation and rehabilitation - occupational therapy, physical therapy, ergonomics, orthopedics, and sports medicine

Disability Solutions	Augmented Reality environments for treatment of autism and other cognitive impairments. Environmental control systems.
Neurological Evaluation	Standardized simulated environments for evaluation of cognitive processing, stroke deficits, memory disorders, movement disorders, and higher-functions.
Psychiatric and Behavioral Healthcare	Evaluation and treatment of cognitive and behavioral disorders: phobias, anxiety, social affect disorders, ADHD, post-traumatic stress disorder, addiction treatment.

Table 1: An Application of VR in Medical [15].

VR technology attracts application over which require the user to visualize, interact and experience the training situation.

2.7 Overview of VR in Education Area

Virtual Reality is a powerful tool for education since people comprehend images much faster than they grasp lines of text or columns of numbers. Participation is critical to learning and VR offers multisensory immersive environments that engage students and allow them visualize information.

2.7.1 Training and simulation

Perhaps the most practical use of VR is in training and simulations. VR simulators are especially useful for training that would otherwise be too expensive or too dangerous. Different training scenarios can be constructed and simply altered for variety. The US Navy uses flight simulators to help train pilots for general navigation as well as special assignments. Battlefield simulations have been developed using real data from Desert Storm [16]. These types of simulations can be used for training as well as planning. A distributed simulation allows users in remote locations to participate in the same environment. Training tools can also be used for common citizens. For example virtual cars could be used for driver's education classes reducing the expense of cars and insurance and perhaps minimizing costly accidents by inexperienced drivers.

2.7.2 Classroom Activities

Traditional teaching involved text, oral and screen-based presentations which do not use a human's full capacity to learn. VR allows natural interaction with information. Instead of reading about foreign places or watching a videotaped program, students can explore new worlds such as foreign countries, ancient times or the human body. A current VR program for seventh-graders lets students act as part of algebra equations [18]. VR offers a learning experience that many children and adults find interesting, thus giving motivation to learn.

2.7.3 Virtual classroom

Telepresence offers remote learning with virtual classrooms. Students are not limited to classes that are taught at their school, in their town, or even in their nation. Teleconferencing has allowed for persons at different sites to form a virtual classroom with active class discussions. Telepresence has also allowed for remote students to work together on group projects which may be an important part of class participation and learning.

2.7.4 Abstract Representation and Visualization

Virtual Reality provides the tools to visualize and manipulate abstract information, thus making it easier to understand. For example flows of power and data communications traffic can be visualized dynamically in three dimensions. NASA has developed a virtual wind tunnel that allows the participant to use hand gestures to navigate around the virtual aircraft and view the air flows. Eastman Kodak engineers gained new insights using a 3D model showing the interactions of heat, temperature and pressure. Virtual environments can allow participants to experiment with physics concepts such as a virtual physics lab that allows students to control gravity, friction and time.

2.8 Scenario of Road Safety

2.8.1 Road Accidents in Malaysia

In 2001, an average of 16 people died every day as a result in road accidents. Of 11,302,545 registered vehicles, there were 265,175 road accidents which killed 5,849 people in 2001. The total number of accidents rose last year (2004) to 326,817 with a total 6,223 fatalities. The so called 'horror Crash' in Pulau Pinang and several others in the other parts of the country yesterday have left families distraught and many speechless. The high fatality rate of road users in the country is very disturbing and makes it imperative for the government to act swiftly and without any compromise[20].

The recent call of many including our Prime Minister, Datuk Seri Abdullah Ahmad Badawi, to reduce the number of road fatalities is demonstrated the significance of the issue. Every festive season, despite the numerous reminders from the media especially, the numbers keep piling up. In response to this problem, the government has proposed steps including limiting the operating hours of express buses and the prohibition of the operation of heavy vehicles as well as stiffer penalties [21].

2.8.2 The Current Scenario of Driving Lesson Nowadays

More practical driving test will be imposed to the driver candidates in future to strictly minimize the issued of license as increasing number of accident nowadays. This situation leads to the attention of Datuk Emran Kadir, Director of JPJ (Jabatan Pengangkutan Jalan) in improving the theory and practical requirement before any of the driver candidates issued driving licenses. Besides that the Prime Minister emphasizes that defensive technique to be introduced [19].

The road safety educational program will be taught in 7,601 primary schools nationwide beginning January 2007 as the government's long-term measure to reduce the high rate of accidents in the country. Transport Minister Datuk Seri Chan Kong Choy said the Level One programs involving Standard One; two and three pupils will be introduced in the Malay syllabus. The programme received the green light from the Cabinet Committee on Road Safety chaired by Prime Minister Datuk Seri Abdullah Ahmad Badawi here Monday. Chan said the programme was expanded after the pilot project held in Kelantan earlier was found to be effective in raising the awareness and knowledge among teachers and pupils on road safety [22].

2.8.2 The Necessity of Driving Lesson

Lessons on knowing the characteristics of the vehicle and how to handle it in response to an emergency must be taught before driving licenses are issued [20].

Driving or riding is an act, which carries a large responsibility. Many people do not realize that it is a mechanical monster that he or she is actually trying to control. According to most automotive engineering books, the actual percentage of human involvement in driving is only no more than 45 percent in average. This means that the amount of control the average human has over the vehicle is less than the other elements that are directly or indirectly involved in this process. These elements include weather, road, vehicle and traffic conditions. The inability to understand this leads to over confidence and therefore complacency. Humans instinctively believe that what he or she can steer or order, he or she has control.

The lack of such knowledge is the leading reason why our drivers are considered to be bad. Driving at night is actually a very dangerous thing as light conditions not vary from pitch black to sudden bright flashes from on-coming cars. This makes visibility very poor. According to John C. Dixon, the human response time constants (or rather the reaction time of a human) are typically 0.15 to 1 second. However, a typical car will react to any input within 0.2 second. Statistically, the most number of people would be in a center of a selected range thus making the average reaction time about half a second. This basically means that the car will react faster than the average human. Therefore, it is impossible to have 100% control of the car. People do not understand this and egotistically put themselves in very dangerous situations like tailing the car in front closely. The drivers who do this often do this at speed, making it even more dangerous [21].

2.9 The Relation of VR technologies in Driving Lesson

VR offers tools for increased student participation. Classroom activities will use VR tools for hands-on learning, group projects and discussions, field trips, and concept visualization [17].

This VR way of presenting information is compatible with the literature in education about differing learning styles. The literature on learning styles overwhelming asserts that different people take in information differently. Students learn best when they enjoy a rich, often multi-modal, experience of the educational material. Learning by looking at books or a computer screen, or listening to a teacher, is only partly effective. Students need to experience the concepts and principles contained in the content as much and as directly as possible. It is reasonable to expect that VR is capable of supporting intensive driving training lesson for example, giving a 3D illustration and presenting real time situation.

These advantages lead to the development of this project which it is also possible that that effectiveness of VR will vary according to how much knowledge of the subject students bring to their learning experiences in virtual environments.

CHAPTER 3
METHODOLOGY AND PROJECT WORK

The design method adopted to develop the system is based on Kulwinder Kaur's (1998) (see Figure 4).

3.1 Procedure Identification

The methodology started with requirement analysis stage which consists of information gathering. The stages will help the author to keep track and meet the requirement and system scoping during the development of this project in the future. It is also a tool used to gather important information needed to complete this project.

The second stage is the task and domain analysis. These stages involve combination of goal oriented task analysis and use case, and use scenarios. Task analysis is to describe the user activity while use case representing the interaction explicit. The use scenario is user will be exploring the actual road driving test.

The third stage is VE design where modeling and functions construction involved. The modeling part is created similar to real world roadways. Function construction is where the planning of interaction of VE with whole user interface is integrated.

The fourth stage is designing of user navigation and support. The stage involved navigating the movement of user that focus on design issues and user interaction.

The next stage is evaluation where product is evaluated and the results are analyzed. These stages are important because it will determine whether the application has achieved the aims and objectives of the project. The final phase is the results phase where a prototype is developed and a paper report will be delivered.

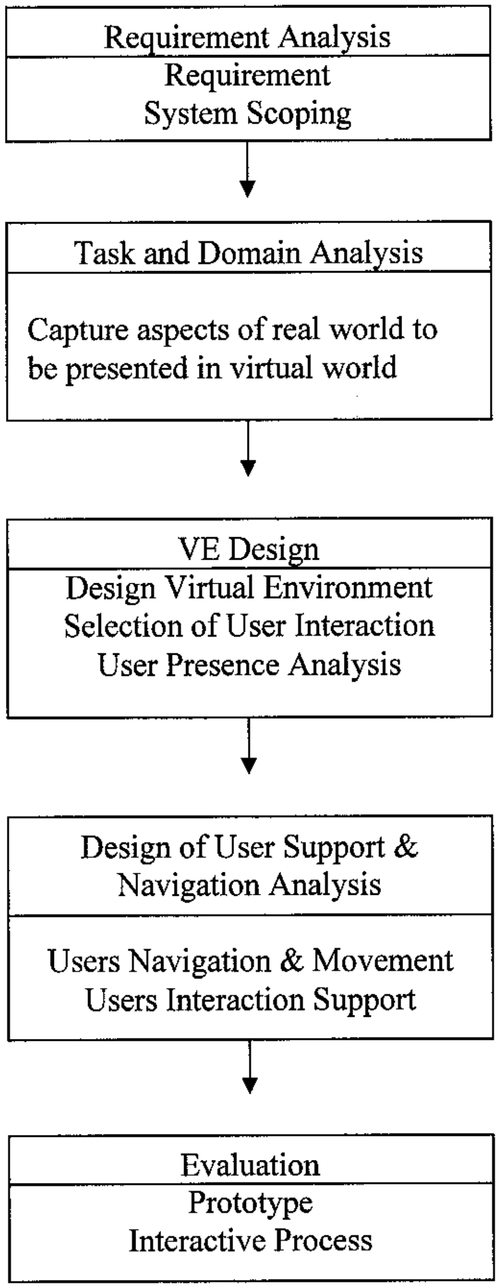

Figure 4: Project Framework adopted from Kulwinder Kaur's thesis design method (1998)

3.1.1 Phase 1: Requirement Analysis

Analysis phase consists of 2 important stages: system requirement and system scoping. In the system requirement stage, data and information gathering related to the field of study being gathered for references to meet system requirement.

There are two main issues being focused in gathering information for system requirement. The information gathered mostly is about facts of road safety in supporting driving lesson.

The stage is an ongoing process where it is being carried along throughout the project phases. Various methods are used to gather the information.

- Collecting facts, information and supporting research documents from Internet, journals, books, and etc.
- Observation on existing Virtual Reality application. This is to experience the feel of Virtual Reality application.

After the information has been gathered, the information was then analyzed and segregated. The selection of topic is also specified in this stage. This is done after the information is filtered and used the information available to aid the task and domain analysis phase.

3.1.2 Phase 2: Task and Domain Analysis

From here, detailed information gathered about VR technology to specify the task. Starting by locating the activity in particular parts of the environment and describing the tools involved.

The task to be carried out throughout this project should document the physical actions taker by user. The combination of goal oriented task analysis and use cases specify the user activities that relates to actual driving lesson while use cases is representing the interaction of user in the system. An HCI guideline is taking into account in order to verify user acceptance and effectiveness of the system to user.

The domain analysis focuses on capturing facts of the real environment of roadways during road driving test.

An overview of project flow is discussed in the following paragraphs. This project divided into there (3) sections which are topic selection, practice test and special features.

In the *topic selection* section, students are being on taught on basic driving knowledge which divided into 4 subsections:

- City and Residential Driving
- The Driver's Exam
- Highway Driving
- Safety Tips for Normal Conditions

In the *practice test* section, the students are exposed to few examples of road driving scenarios. 3D illustration and QuickTime movie are shown to help students to visualize and get the idea of what they are going to be evaluated during JPJ's driving test.

In the special features section, there are additional 3D illustrations on driving scenarios provided, state requirements for driving candidates, index of traffic signs and basic knowledge on car maintenance.

3.1.3 Phase 3: VE Design

This phase consist of two important stages that are modeling and algorithm development. The background of the virtual environment is created using 3D Studio Max and based on the real roadways with some modification to simply the processes. Objects are designed and navigation will be added in order to plan the integration of the system.

From here, the selection of modalities and interaction involve by specifying on users task and characteristics. This project is based on desktop VR; therefore GUI components interaction is desktop which is more familiar to the user (public people).

In designing user's presence, input of user action will be collected from the keyboard as the input data to allow user to navigate the system.

3.1.4 Phase 4: Design of User Support and Navigation Analysis

The viewpoint is control by single user, therefore 3D illustration and QuickTime movie will be focusing specified relate to the real driving situation where user will be able to visualize and experience.

In order to support user's interaction, the system has provided text description to guide user about action to be taken on the roads.

3.1.5 Phase 5: Evaluation Phase

At this point, evaluation is divided into three different stages. The stages are evaluation and data analysis.

In evaluation process, the questionnaire is used to gather and collect information, opinion and feedback for the research work. The prototype will be evaluated by the evaluators in determining user acceptance and effectiveness of the system.

After the evaluation process, data will be collected and tabulated into graphs and tables. The data has been used to prove the aims of this project which is to evaluate system acceptance by user.

3.2 Tools required

Tools and equipment are important in doing a project. The use of tools and equipment can help to make process easier. Tools used to carry out this project are 3D modeling software and also virtual environment software while equipments are the hardware used such as desktop and its specifications.

3.2.1 Software Requirements

The lists of software that will be used for developing the Intensive Driving Lesson system for Driving School are as follows:

- Adobe Photoshop 7.0
- 3D Studio Max
- Macromedia Flash MX
- QuickTime VR

3.2.2 Hardware Requirements

The lists of hardware that will be needed at least to fulfill this system are as follows:

- Windows XP operating system
- 1.8 Ghz processor
- 256MB RAM
- 8 MB of VGA
- Keyboard
- Mouse

CHAPTER 4
RESULT AND DISCUSSION

The prototype of Intensive Driving Lesson system as expected. The following paragraphs discussed on the result of system evaluation and system development.

4.1 System Evaluation

4.1.1 Predevelopment Survey

The predevelopment survey was conducted to establish the worth of the project. The survey was distributed to several driving schools in Shah Alam. The questionnaires (see Appendix II: Predevelopment Questionnaires) consisted of seven (7) questions. Sixty (60) sets of Questionnaires were sent. The target respondents for this Questionnaire were the driving candidates and instructors. Generally, all the users that responded to the distributed questions were very familiar with computer usage. Most of them also strongly agreed to experience virtual training process before going through a road test. Mostly agreed by all evaluators that the deliverable of the driving lesson with graphical images with user interaction is better rather than text based presentation.

According to the survey results, all respondents understand the usage of computer hardware and software as voted shown in Table 2. Majority of the respondents find that the current driving lesson can be enhanced and interestingly 86% of the respondent agreed that they would like to experience VR technology for the driving lesson as shown in Table 2 and Figure 5.

Results of Survey

No	Attributes	N	Min	Max	Sum	Mean
1	I understand the usage of computer hardware and software	60	2	5	250	4.2
2	How do you want the driving lesson to be delivered, graphical images with user interaction instead of text based presentation?	60	2	5	210	3.5
3	Based on car driving lesson, I can see how I could use VR in the teaching activities.	60	3	5	243	4.1
4	Do you think most of the students could not apply the road rules in their driving test could be caused by a lack of pre training or experience:	60	2	4	205	3.4
5	As VR technology becomes less expensive and more readily available, I would like an opportunity to experience a VR technology in education area:	60	3	5	240	4
6	Would you like to experience VR technology for driving lesson	60	2	5	257	4.3
7	Do you feel the current information related to road rules presented are clear and concise:	60	3	5	220	4.3
Valid n						**60**
Mean Overall						**3.97**
Range						**0.9**

Table 2: Statistics of Survey Results.

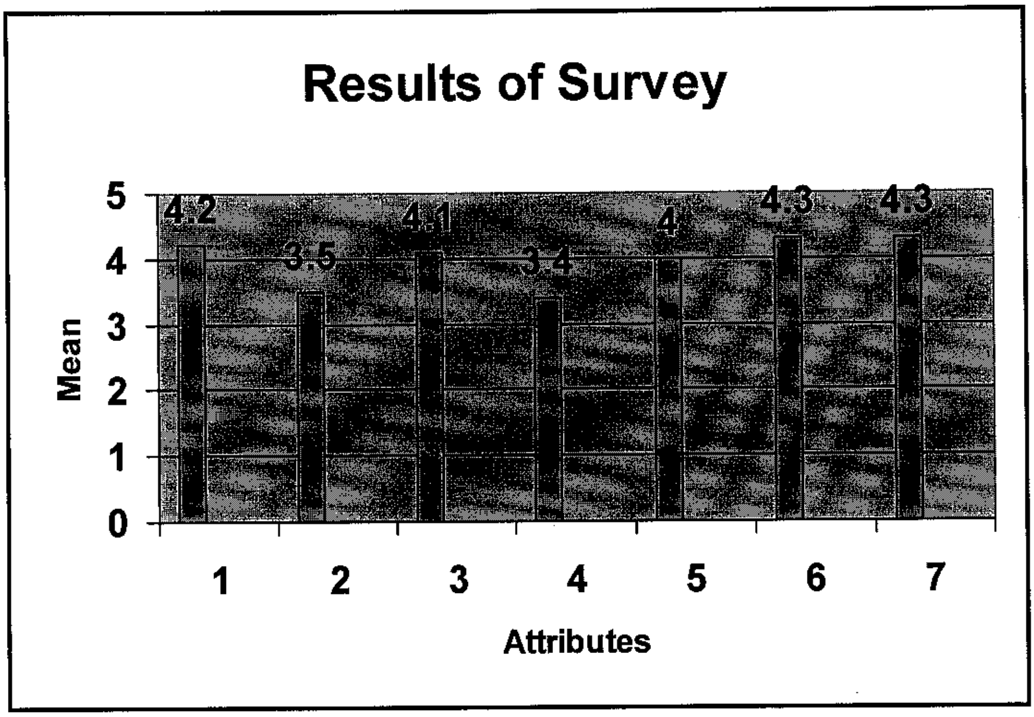

Figure 5: Histogram of result

The system is constantly and informally evaluated throughout the design phase to get immediate feedback from the user and provide improvement towards system development.

A set of questionnaires was designed to evaluate the completed system. The purpose of the questionnaires is to survey user acceptance on the system as a supplement to current driving lesson.

4.1.2 User Acceptance Survey towards Completed System

In this evaluation, the evaluators are asked to try the prototype and evaluate the prototype based on the checklist given. The evaluators are given 10 to 15 minutes to try the prototype. This survey focus on the user navigation and interaction with the system.

Table 3 and Figure 6 show the result of the evaluation. The data are converted to histogram chart for analysis. The checklist of the evaluation can be referred in Appendix III.

Table 3: Statistics of Evaluation: User Navigation and Interaction

Attributes	N	Min	Max	Sum	Mean
1. Able to compliment the current driving lesson	8	2	4	28	3.5
2. Effectiveness of lesson deliverables	8	2	4	27	3.4
3. Tendency of getting bored	8	2	4	27	3.4
4. Usefulness of 3D demonstration	8	3	5	31	3.9
Valid n					8
Mean Overall					3.6
Range					0.5

Table 3: Statistics of Evaluation: User Navigation and Interaction

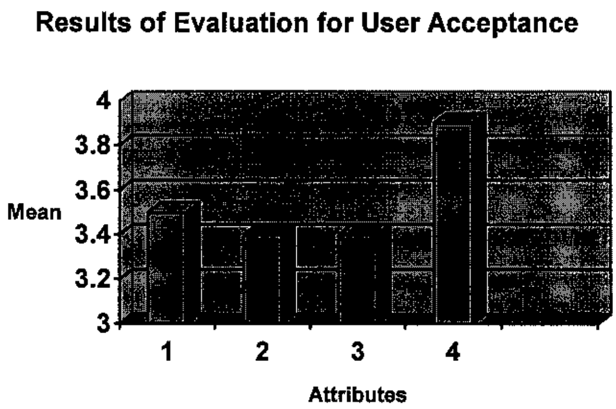

Figure 6: Histogram of result for User Navigation and Interaction.

Analysis of both results has proven that the system has satisfy the aimed of this project development which is to conduct a survey on user acceptance towards the system and proved that it is usable as a compliment to the current driving lesson and JPJ's test outline.

4.2 System Development

The following section will capture screenshots involved and describe what would be each interface does in the system. Figure 7 shows the screenshots of the Main Menu. It is the first page of the system. User needs to click on the button provided to browse through all section in the system.

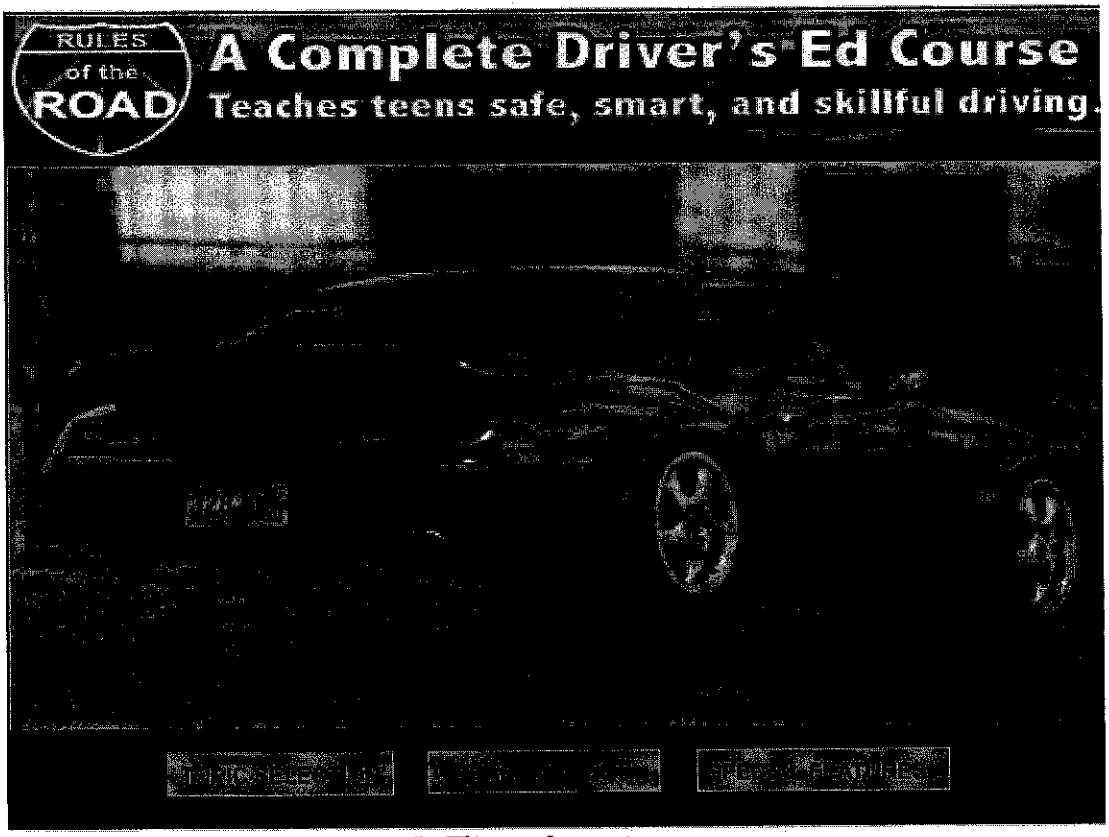

Figure 7: This is the main menu page.

The activity here is to link user to all sections in the Interactive Driving Lesson System.

Figure 8 shows the topic selection provided for basic driving knowledge. There are 4 main subsections of the system:

- City and Residential Driving
- The Drivers Exam
- Highway Driving
- Safety Tips for Normal Condition

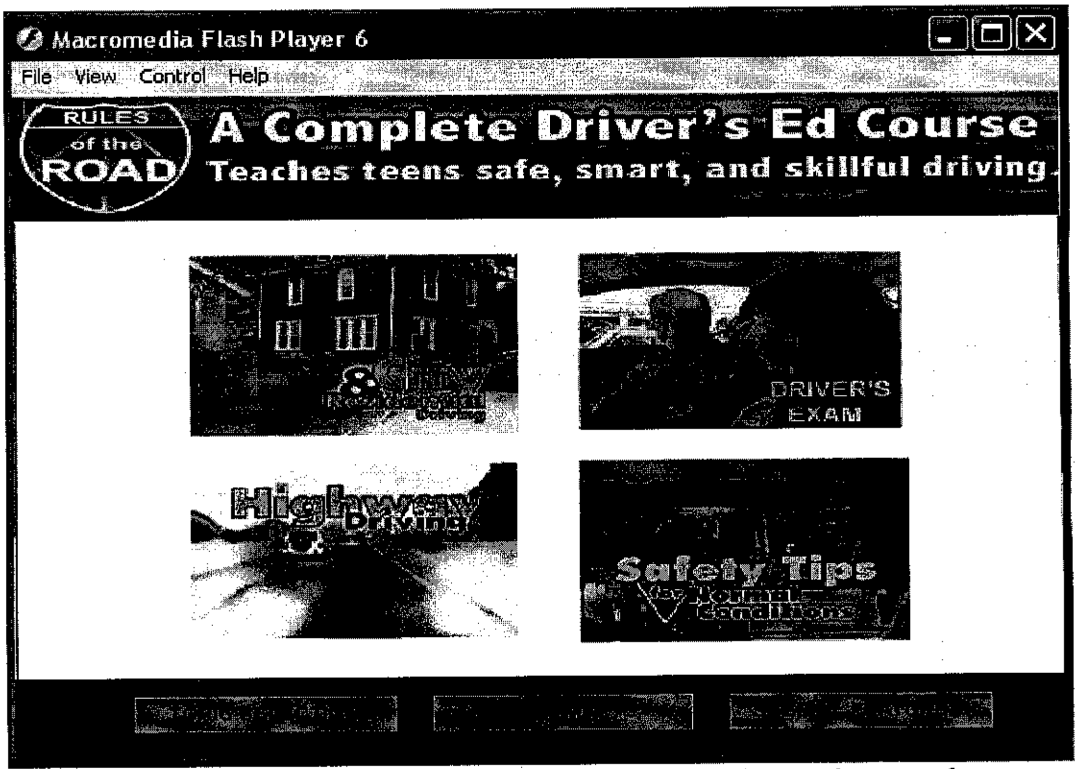

Figure 8: This section allows the students to learn driving basic techniques effectively.

When user clicks on the picture, user will be directed to selected topic and brief description will be given.

Figure 9 shows the screenshots of the 3D demonstration provided in the system.

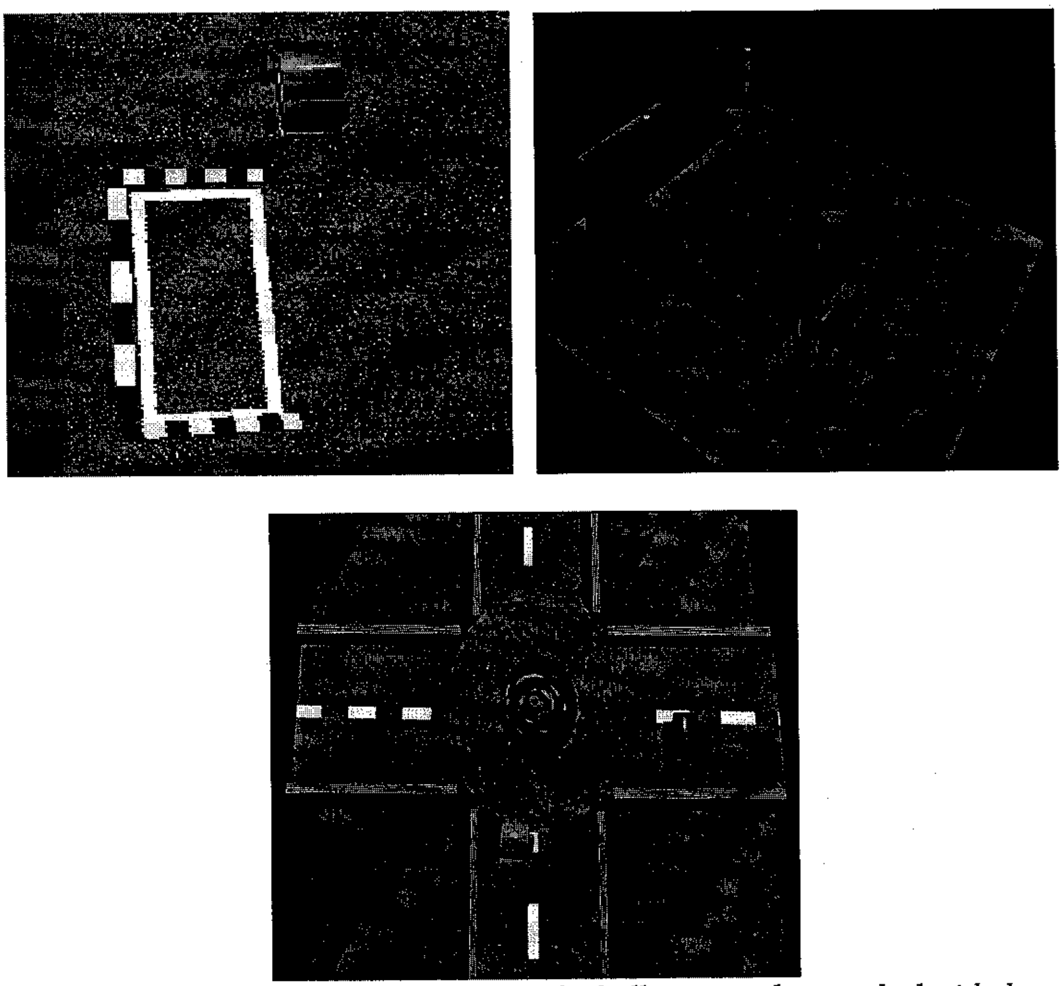

Figure 9: View the 3D demonstration which illustrating how to deal with the possible road driving scenarios.

As a complementary to the current driving lesson, this project has a lot to offer based on its features which satisfy the first and second objectives this project. It can be use as a supplement to the current driving lesson and JPJ's outline test before going to the real driving test.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

More studies are required to examine user opinions on the Intensive Driving Lesson System to function and improve its usability of interface design in providing an interactive and interesting learning experience.

The final system is yet to be tested and compared with students who take the driving test based on the current system and those based on this Intensive Driving Lesson System to see how they fare in the test outcomes. Based on the initial findings conducted and the literature survey, a positive outcome would be expected.

This project has achieved the initial aims and objectives drawn earlier. An Intensive Driving Lesson System with the following features; driving basic knowledge, car maintenance, 3D demonstration was developed to supplement to the current driving lesson and JPJ's test outline. New things are also learnt whereby with the VR technology approach, we can develop and refine a new learning environment. This learning environment can be entertaining and educational and the applications can promote facilitating sequential learning. Besides that, the studies of this project will be used to evaluate the acceptance of users towards VR technology and how user can use this system before experiencing the real road driving.

The preliminary findings from the evaluation of the system show that the completed system is able to compliment to the current driving lesson.

5.2 Recommendations

Future recommendations and enhancements on the Intensive Driving Lesson system can be defined and broaden into many different scope of study. Among possible scopes of study that can be done using this project are 3D demonstration, improved the interactivity and navigation from user.

Besides that, virtual character can be develop for user guidance which allows them to give a tutor to the user while they are using the system. This will make the system more presentable and interesting to the user as they can interact as it resembles human character and improvise the learning process.

Other than recommendations above, user control also can be added to the existing project. This is to enhance the interaction level between user and the system in giving them the overview of road driving beforehand. The key press control can be added in controlling the 3D demonstration from any angle of user view. By having this control, user can maximize their visualization on the road driving. The also can moves with objects and stop it on their own time.

The project also can be enhanced by allowing a simulation in order to allow user to experience virtual driving environment. This will increase the interaction and naturalism during the movements of cars in different situation.

Furthermore, this project can be enhance by making it available for the online system and accessible through the World Wide Web.

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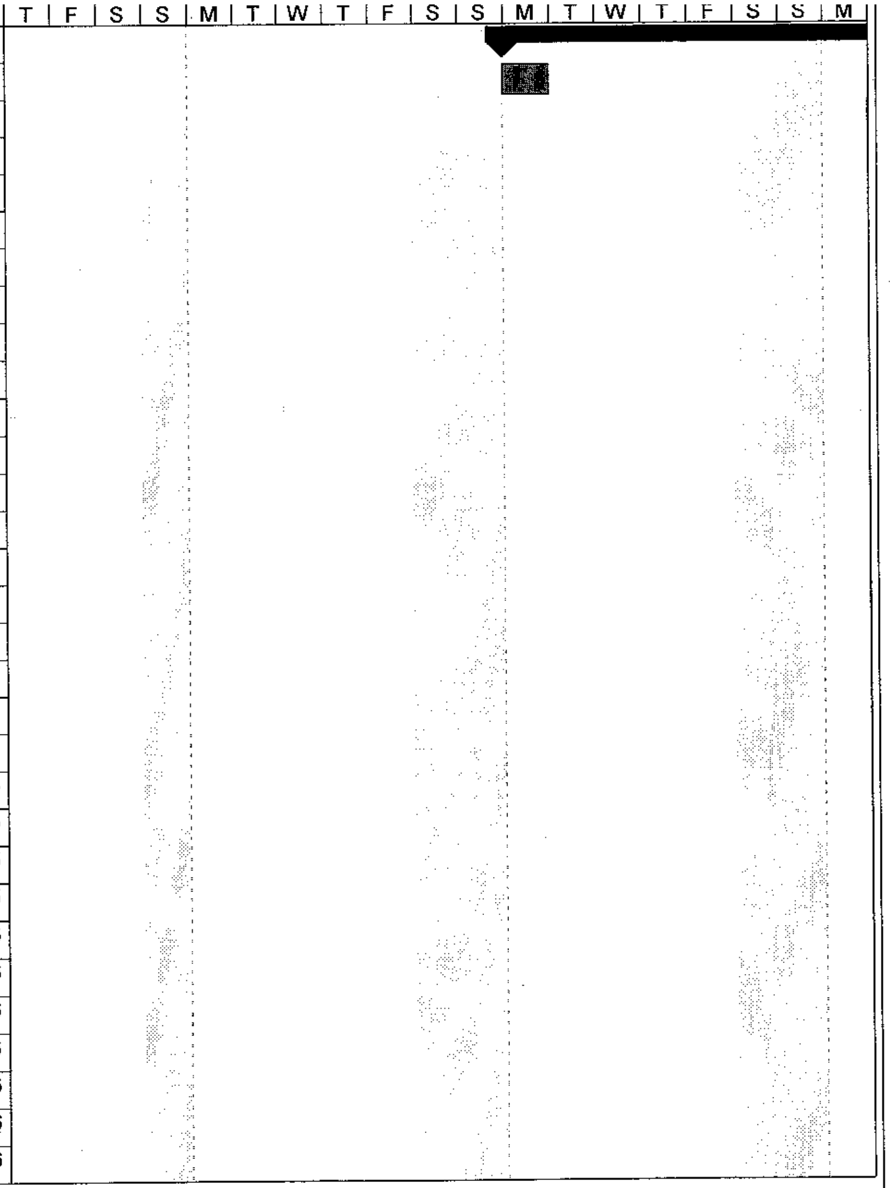
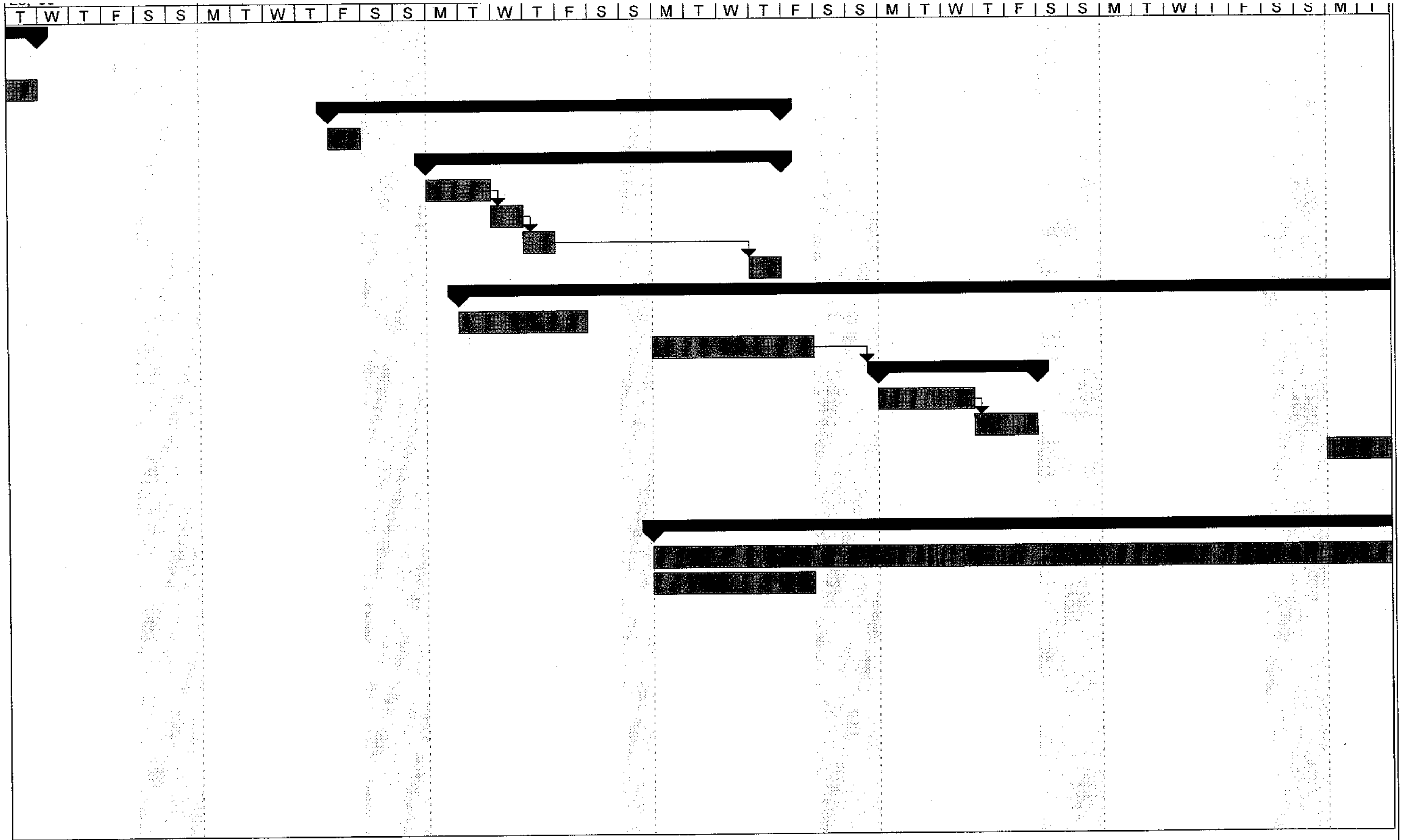
APPENDIX I – PROJECT TIMELINE

ID		Task Name	Duration	Start	Finish
1		**1. Project Initiating**	**7 days**	**Mon 9/19/05**	**Tue 9/27/05**
2		1.1 Propose topic	1 day	Mon 9/19/05	Mon 9/19/05
3		1.2 Topic assigned to student	1 day	Tue 9/27/05	Tue 9/27/05
4		**2. Project Planning**	**11 days**	**Fri 10/7/05**	**Thu 10/20/05**
5		2.1 Project Kickoff meeting	1 day	Fri 10/7/05	Fri 10/7/05
6		**2.2 Prepare Project Schedule**	**10 days**	**Mon 10/10/05**	**Thu 10/20/05**
7		2.2.1 Determine task resources ar	2 days	Mon 10/10/05	Tue 10/11/05
8		2.2.2 Create draff Gantt chart	1 day	Wed 10/12/05	Wed 10/12/05
9		2.2.3 Review and finalize Gantt Cl	1 day	Thu 10/13/05	Thu 10/13/05
10		2.3 Preliminary research work	1 day	Thu 10/20/05	Thu 10/20/05
11		**3. Project Execution**	**133 days**	**Tue 10/11/05**	**Wed 4/12/06**
12		3.1 Identify the flow of the system	4 days	Tue 10/11/05	Fri 10/14/05
13		3.2 Determine information requirement	5 days	Mon 10/17/05	Fri 10/21/05
14		**3.3 Analyzing system needs**	**5 days**	**Mon 10/24/05**	**Fri 10/28/05**
15		3.3.1 Tools and requirements	3 days	Mon 10/24/05	Wed 10/26/05
16		3.3.2 Task and Domain Analysis	2 days	Thu 10/27/05	Fri 10/28/05
17		3.4 Designing system flow	10 days	Mon 11/7/05	Fri 11/18/05
18		3.5 Developing and documenting syste	100 days	Mon 11/21/05	Fri 4/7/06
19		3.6 Evaluating the system	3 days	Mon 4/10/06	Wed 4/12/06
20		**4. Project Controlling**	**135 days**	**Mon 10/17/05**	**Fri 4/21/06**
21		4.1 Weekly report	135 days	Mon 10/17/05	Fri 4/21/06
22		4.2 Submission of Preliminary Report	5 days	Mon 10/17/05	Fri 10/21/05
23		4.3 First Oral Presentation	5 days	Mon 12/5/05	Fri 12/9/05
24		4.4 Submission of Interim Report	5 days	Mon 12/5/05	Fri 12/9/05
25		4.5 Submission of Progress Report	5 days	Mon 1/23/06	Fri 1/27/06
26		4.6 Exhibition	5 days	Mon 4/3/06	Fri 4/7/06
27		4.7 Submission of Final Draft	5 days	Mon 4/10/06	Fri 4/14/06
28		**5. Project Closing**	**12 days**	**Thu 4/13/06**	**Fri 4/28/06**
29		5.1 Prepare for Final Oral Presentation	2 days	Thu 4/13/06	Fri 4/14/06
30		5.2 Final Oral presentation	5 days	Mon 4/17/06	Fri 4/21/06
31		5.3 Preparation & submission of Projec	5 days	Mon 4/24/06	Fri 4/28/06



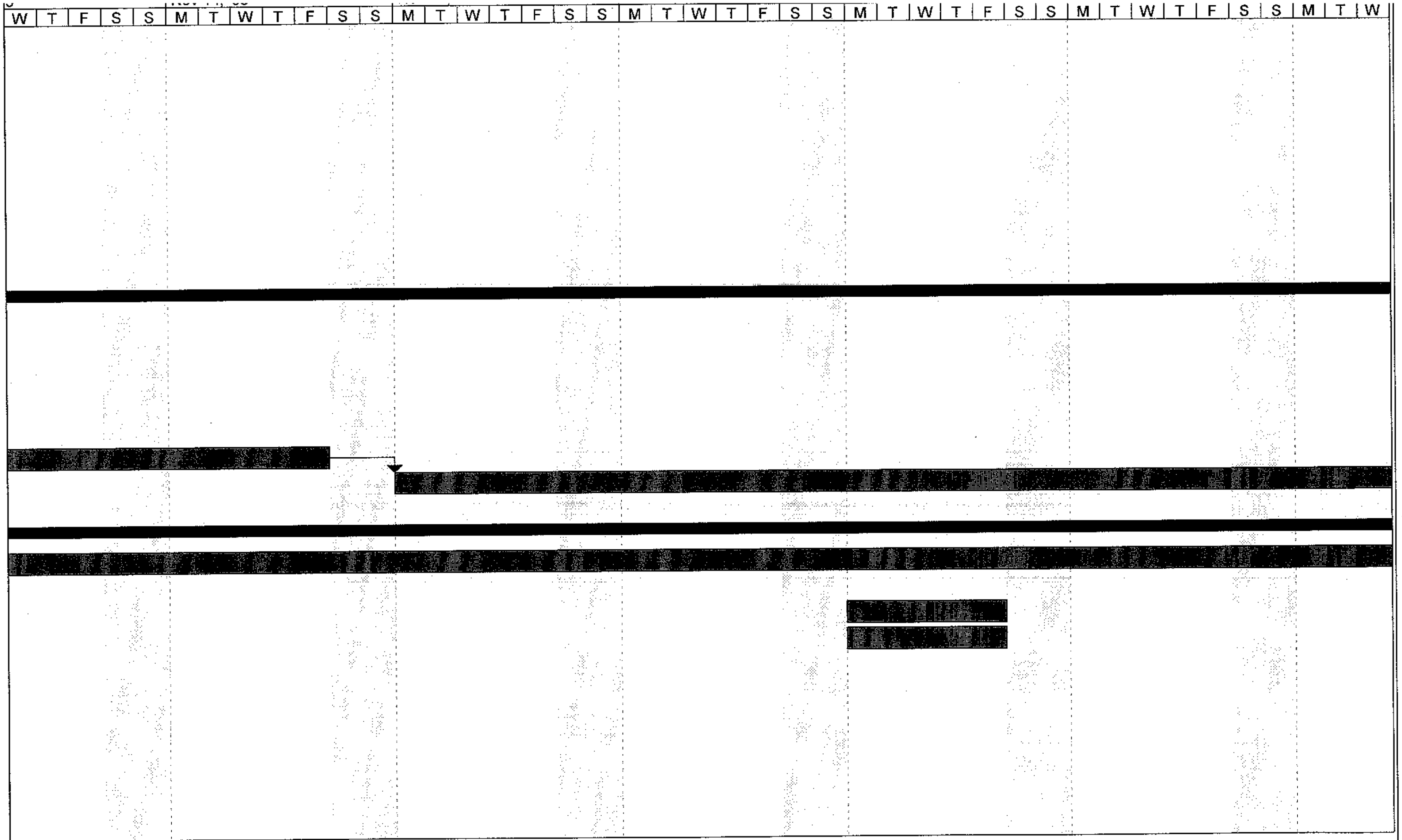
Project: gant chart nms
Date: Tue 6/20/06

Task | Split | Milestone | Summary | External Tasks | External Milestone



Task		Milestone		External Tasks	
Split		Summary		External Milestone	

Project: gant chart nms
Date: Tue 6/20/06



Project: gant chart nms
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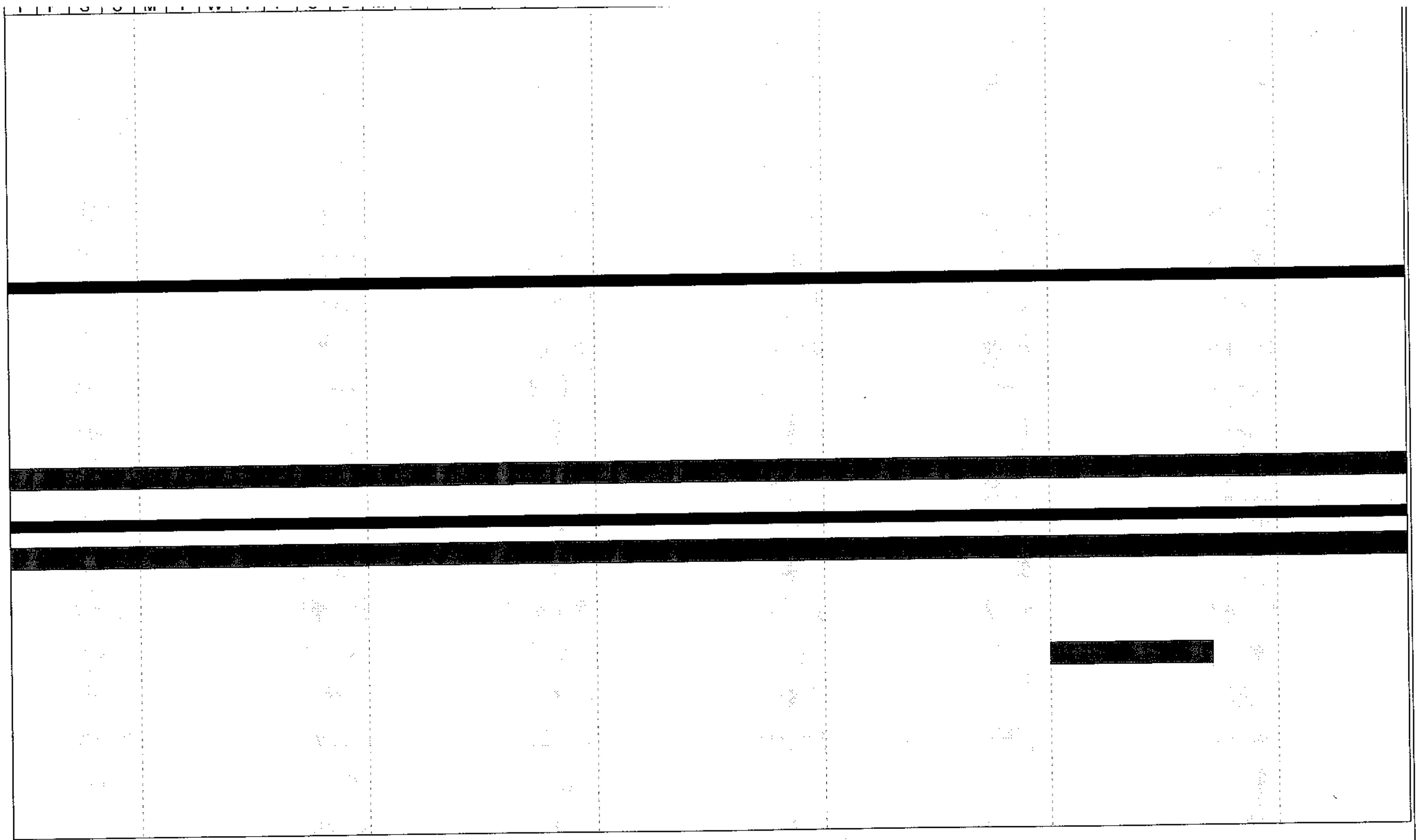
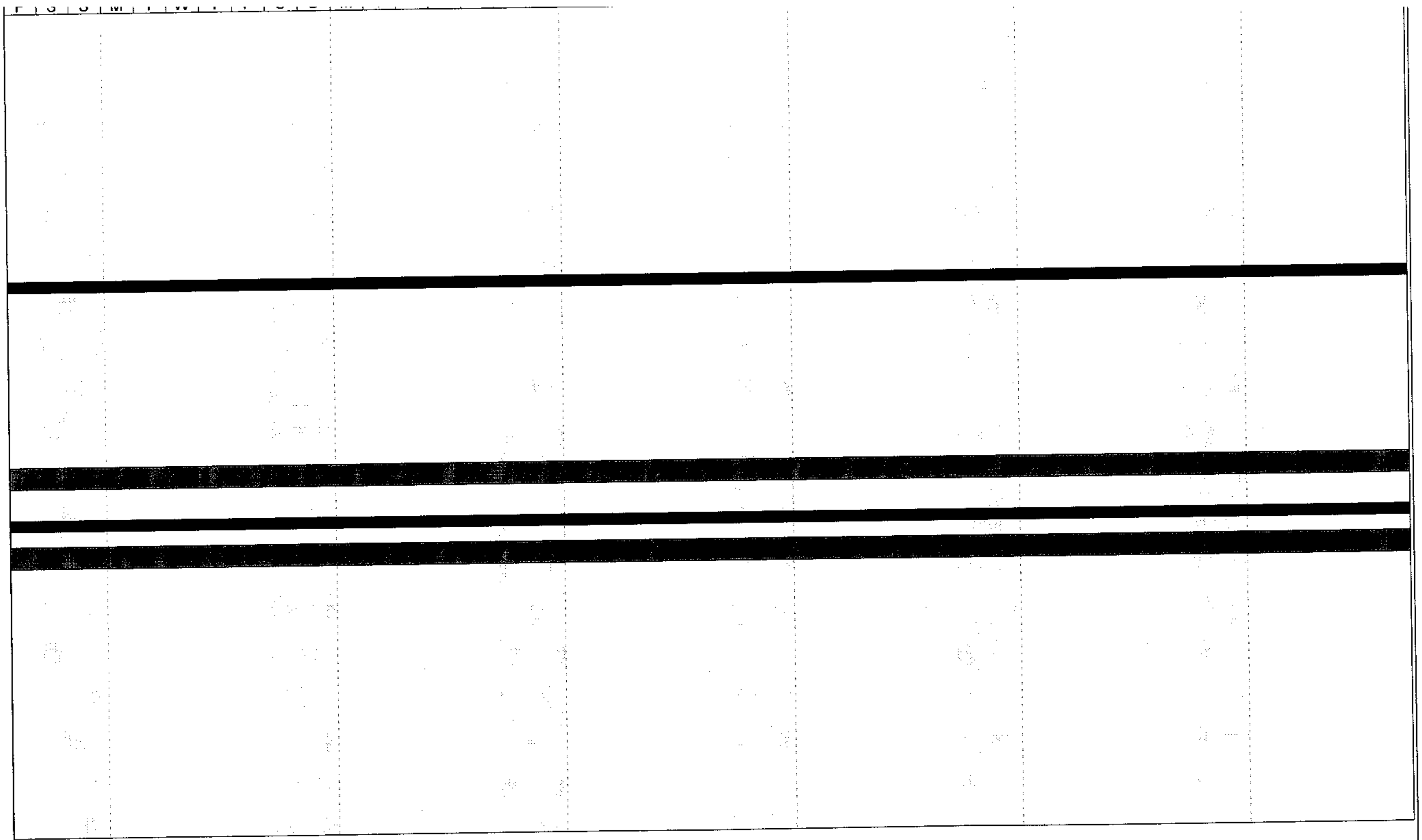
Split		Summary		External Milestone	



Project: gant chart nms Date: Tue 6/20/06	Task		Milestone		External Tasks
	Split		Summary		External Milestone
	Progress		Project Summary		Deadline



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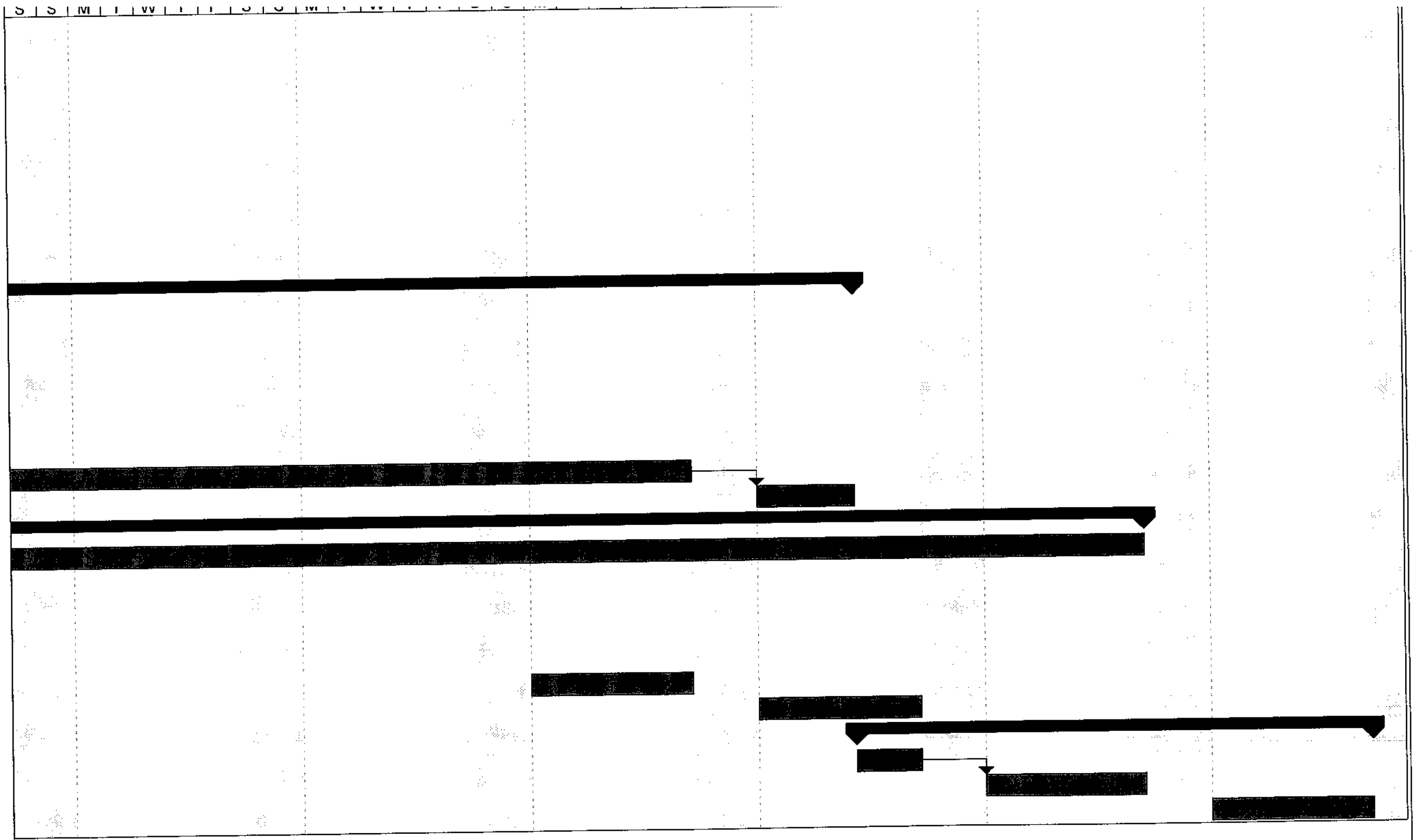

Project: gant chart nms
Date: Tue 6/20/06

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

Appendic II - Predevelopment Survey

Project Title: Intensive Driving Lesson for Driving Lesson.

Questionnaire

Questionnaire produced by Nursyafina binti Daniel, Information Technology (IT) Final Year Student of Universiti Teknologi PETRONAS, Tronoh, Perak regarding the Final Year Project.

Abstract:

This is a survey intended for research purposes. The target audience is driving school candidates and instructors. This questionnaire is used to gather and collect information, opinion and feedback for the research work. It is hoped that with the help of the result gathered from this survey, the author will come out with an effective car driving simulation system for driving lesson.

Kindly please answer all the appropriate question.

For all questions with a 1-5 scale associated with them:

1 is **Strongly Disagree** and **5** is **Strongly Agree**.

1. I understand the usage of computer hardware and software

   1 ○ 2 ○ 3 ○ 4 ○ 5

2. How do you want the driving lesson to be delivered, graphical images with user interaction rather instead of text based presentation?

   1 ○ 2 ○ 3 ○ 4 ○ 5

3. Based on car driving lesson, I can see how I could use VR in the teaching activities.

1 ◌ 2 ◌ 3 ◌ 4 ◌ 5

4. Do you think most of the students could not apply the road rules in their driving test could be caused by a lack of pre training or experience:

1 ◌ 2 ◌ 3 ◌ 4 ◌ 5

5. As VR technology becomes less expensive and more readily available, I would like an opportunity to experience a VR technology in education area:

1 ◌ 2 ◌ 3 ◌ 4 ◌ 5

6. Would you like to experience VR technology for the driving lesson:

1 ◌ 2 ◌ 3 ◌ 4 ◌ 5

7. Do you feel the current information related to road rules presented are clear and concise:

1 ◌ 2 ◌ 3 ◌ 4 ◌ 5

Thank you for your cooperation.