TRAFFIC INFORMATION SYSTEM KUALA LUMPUR

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Abstract

Traffic Information System (TIS) Kuala Lumpur is a web based system that providing traffic information to the road user. Besides, road user can retrieve road info depend on their need from the web site in order to avoid traffic congestion in Kuala Lumpur City. The main purpose of this TIS is to let road user know the traffic condition in any time from the internet before begin their trip to Kuala Lumpur city, rather than go towards Kuala Lumpur City without knowing traffic info in particular area.

TIS will help user avoid traffic jam in certain areas and save their precious time. When they know traffic jam I particular area, they can find alternative way to their destination. A registered user can conduct more functionalities like preset their info in the website after login.

Literature review had been done in various topics about Traffic Information System. Existing System Studies were done to survey the requirement and some related info from the systems. The ways to obtain info are informal interview, reading material, researching through internet and etc.

The overall system development strategy of TIS is Unified Software Development Process (USDP). Diagram like Use Case, Collaboration, Class and etc. are use to model the TIS. The web server of TIS is Internet Information Server (IIS) and database server is SQL server. Active Server Pages .NET (ASP.NET) is the main programming language technology to develop the system based on the system requirement.

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1.1 Introduction

Now is year 2003, the world is progressing rapidly in single second. Malaysia as a developing country also follows the train of development. A surprisingly large number of vehicles are registered everyday especially in Kuala Lumpur. Capital of Malaysia. It makes the traffic congestion in Kuala Lumpur City become worse. Malaysia Government has made a lot of efforts to reduce vehicles entering to Kuala Lumpur City. These efforts included building more roads in Kuala Lumpur, Building Light Rail Transit in various parts in Kuala Lumpur area and Restructure bus system. But, the traffic problems in Kuala Lumpur city still out of control. Therefore, Online Traffic Information System (TIS) in Kuala Lumpur (KL) is needed to help road user know the condition of the road.

Internet becomes not only one of the useful place to search resources and data but also for communication and entertainment. Many services are provided in the Internet. Traffic Information System is one of the web based services that provide to the internet users to retrieve information about the traffic in Kuala Lumpur. It is convenient to the drivers who require passing through roads in the Kuala Lumpur City especially going to work as well as after working.

Traffic Information System lets road users who wish to enter Kuala Lumpur city obtain information about condition of the road in every moment. By accessing the TIS, road user will know when and where will be having road work. They will try to avoid these road works or estimate time to reach destination because of this, so TIS users can arrive at destination or working site on time. When there are incident of accident and cause heavy traffic jam. TIS will show the areas that are in heavy traffic jam. By doing so, TIS users will avoid by passing through that road by using

alternative way. Furthermore, users also can choose to use other mode of transportation like LRT to reach destination on time.

In addition, scheduled road work or scheduled event that causing closing of the road will be displayed in the TIS. By doing so, road users will notice the impact of closing road, they can plan their journey in advance to avoid unwanted traffic jam. They also can try not to go that area if unnecessary. Therefore, it will decrease number of vehicles struck in that area.

1.2 Necessity of TIS

Due to the high traffic volume in the Kuala Lumpur city, road users face problems before TIS is introduced. TIS is needed to settle many problem of road users in Kuala Lumpur. These are the problems:

i. Road users do not know about the condition of the road. They go to Kuala Lumpur city without knowing how jam is the road. It will make the current traffic problem in Kuala Lumpur city more serious.

ii. They can not plan their journey probably because they do not know the road condition before the trip start. They can only try their luck whether traffic jam or not in that area.

iii. Before the TIS, Users do not know the road condition. Because of it, road users still toward to the same road. It will make the traffic jam more serious.

iv. Currently, road users only can get information about the traffic by radio. It depends on the specific time of announcing traffic condition. If because of some circumstances, road users miss this announcement, they will not know the state of the road.

v. Road users wasting much precious time in the road just because they do not know about the condition of the road.

vi. Road users can not estimate time of reaching destination, even it is only short distance. Maybe estimated time is 5 minutes but because of traffic jam they need 20 minutes to reach the destination.

vii. Road users become frustrated when jam in the traffic. They will under stress when long hour in the queue and will become inpatient. They will try to release their pressure by overtaking other vehicles or squeeze in to narrow way between vehicles. It will easily cause road accident.

1.3 Objective

The main objective of The Traffic Information System:

1. To develop a well structured, easy use web based information system that providing traffic information needed in Kuala Lumpur. Even beginner of internet user will feel easy to use this TIS.
2. To help road user to know condition of the road in Kuala Lumpur before they begin their trip to Kuala Lumpur City. So those users can choose alternative way to Kuala Lumpur to avoid unwanted traffic jam.
3. Users may need just a moment to review road condition in Kuala Lumpur to avoid maybe half hour or more time for jamming in the long queue.
4. To provide road information to the user. The TIS will be updated frequently, so that user can get real time information about the road.
5. To provide a useful website for the internet user for getting information about traffic in Kuala Lumpur City.

1.4 Scope

Scope is to define the boundaries of a project. There is few areas cover in this project. Each parts of project need to be studied, designed, constructed, implemented and ultimately improved.

a. Services:

i. Searching

Users can search by location to know the information of the road whether it is in traffic jam, high traffic or smooth traffic as well as description.

ii. Administrator

Administrator can add traffic info easily to the database. Administrator also requires authorization to enter database to perform the task.

iii. Assigning Road Info to Registered users

Registered users can assign the favorite road that they pass through everyday. After signing in user can refer to the information about specific road.

iv. Road Work

When have scheduled road work and road closing. TIS will notice user in the website. By doing so, road users can plan their trip in advance.

v. Incident

When accident or car breaks down in a specific road, TIS can notice user in the website about the condition of that road.

vi. Condition of the road

Users can check the roads in condition of Kuala Lumpur in the map. TIS will display notice about the condition of the road.

b. Quality

i. Build a well arranged website.

ii. Latest details about roads condition in Kuala Lumpur, so that TIS become useful to those need it.

iii. Using suitable graphic or picture that make TIS can run faster

c. Resources

i. Reference book

ii. Website

iii. Magazine

1.5 Limitation

There are few limitations in the Traffic Information System.

i. This system can not describe the condition of the road in Kuala Lumpur in the real time. It depend on the information are gathered. When the road users provide info about road condition in Kuala Lumpur but it still consider delay few minutes.

ii. There is no road scanner to scan whether road is in high traffic, traffic jam or smooth traffic.

iii. Details in the system will become outdate easily, because road condition changes every moment. Updating details of the TIS is done manually.

iv. Cameras are not used in this TIS, so that can not show the real road information to the user. Camera can give information about the traffic in Kuala Lumpur City to the users every moment.

v. Websites of TIS is presented in English Language. Users who do not know English language will not understand in the TIS.

vi. This is a web based services, so for those who do not have internet can not access to review traffic information system.

1.6 Statement of Expected Outcome

These are the statements that expected outcome for the project Traffic Information System:

i. This Traffic Information System will be a convenient website for those who working or people who wish to enter Kuala Lumpur City everyday. They can obtain information about condition of the road.

ii. This web page will also an easy use and well structure for every stage of peoples who need it. Even for the beginner users also feel that the TIS is easy to use.

iii. Design easy use website, so that users can switch from an interface to another interface easily.

iv. This website is a well arranged information site, so that TIS user will feel easy to search information. It will save time for the users. Users only need a moment for retrieving information from the TIS.

v. This TIS can be a stable system, so that can provide information to the road users everyday and fulfill the need of TIS users. Besides, TIS also can endure high volume of users accessing this website at the same time.

vi. Efficient of the system also important. Speed of TIS needs to fast to let the users confident to the TIS.

vii. TIS also maintainable. TIS are modular, easy to understand, well documented and which adhere to established standards are easier to maintain. This is because, TIS may need to undergo modification for changes requirement.

1.7 Project Schedule

Time or duration for completion of this project is from June 2002 to January 2003. To ensure success, this project is managed properly. This requires proper management of activities, time and task. Table below is a Project Timeline:

Table 1.1: Project Timeline

	2002							2003	
Activities	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Requirement									
Literature Review									
System Analysis									
System Design									
Proposal Finalization									
Coding									
Testing									
System Integration									
Report Documentation									

1.8 Summary

After Objectives and Scope of TIS had been defined, it is important to carry out some survey and research to meet the objectives. Next chapter consider some literature review that related to TIS to ensure the system will development in smoothly way.

2.1 Introduction

This section is to explain on the studies had been done for the Traffic Information System. These studies included analysis, synthesis, section by section for TIS as well as details of all survey involved. It covers the survey on current system. This chapter also describes several methods and consideration on the programming, tools needed, database, implementation, operating system, sever, internet, web and also other technologies that related to TIS.

Review of literature is a background study about the knowledge and information gained to design and develops this project. The purpose of this review of literature is to get a better understanding on the development tools that can be used to develop a project and also to get a better knowledge on the development methodologies used while developing a project. Apart from that, the review of literature also enables the developer to do comparison on the past developed project and study the strength and weakness of it. It will also give an overview of how to improve the weakness and fulfill the requirement needed.

2.2 Approach

A system is a collection of related parts of information details treated as a unit where its component interact. Therefore, to develop TIS, a lot of information is needed to be gathered about the system and procedure involved in developing the system. The methodologies are used to develop the system. This information can be obtained from various media or sources. Each source that is used will be given different information and facts about a particular aspect, depending on the searching for the source are being done.

This information can be obtained from the system users, computer program, procedure manuals and report, form and document. Among all the data gathered, system users are the most important person that will give us an exact idea of what is needed. They are the one who will judge whether a system is useful in helping the daily operation of an organization. Therefore, the requirement of user is a very important view that needs to be considered.

There are several ways for gathering information from the users. These ways included interview, questionnaires and direct observation of user activities and behaviors. Interview and direct observation of user activities and behavior plays a major role in finding information for the project. This approach is chosen because it can give us an idea of what user really need and aspect the system.

Computer programs can be used to determine the details of data structure or processes and procedure manuals specify how a system functions. These manuals can be used to detailed system design. Reports show us the output that is needed by users. Forms used in the business process and other printed documentation are useful sources of information about the system dataflow and transactions. If these sources are being used, the most recent and relevant forms and document must be obtained and examined [Hawrzkeiwyz, 1998]

Many reference books and few previous done thesis also are the guide. Information and idea of developing the system also can be obtained from here. Besides that, the Internet is a huge data warehouse, almost all topics can be found from the Internet. Search engine is the most popular tool that provides individual finding information. Among popular search engines are AltaVista Search, Yahoo Search, HotBot Search, MSN Search, and Excite Search, these really helpful for developer.

As mentioned earlier, all the information gathered for this project can be divided into 3 approaches that are direct approach with users, printed electronic resources. Direct approach with the users will include interview and observation of user activities and behavior of TIS. Printed resources are inclusive of books while electronic resources include sites which are found using specific keywords in the Internet.

2.2.1 Existing System Studied

When browsing through the internet and website looking for Traffic Information System, found that various type of presenting information for traffic in different country. Analysis and survey on existing system are needed to know the actual system requirements. Analysis is done based on few existing web sites of Traffic Information system available.

- Identifying the need of road users and minimum requirement.
- Identifying target users who will use the traffic information system.
- Survey the way of presenting information to the users.

There is a growing requirement for the improvement of the efficiency of urban traffic in order to ensure the sustainability of many modern cities in various countries. It is now recognized that this objective needs not only the improvement of traffic monitoring and management schemes in traffic control centers but also the provision of traffic information system for ordinary road users. The former measure has been widely adopted by many urban traffic control centers and the latter is currently the subject of intensive research and development on current information system. .

2.2.2 Survey on Existing System

2.2.2.1 Real-Time Traffic Information

This was developed by Jabatan Pengangkutan Bandar Dewan Bandaraya Kuala Lumpur (DBKL)

http://www.jpbdbkl.gov.my

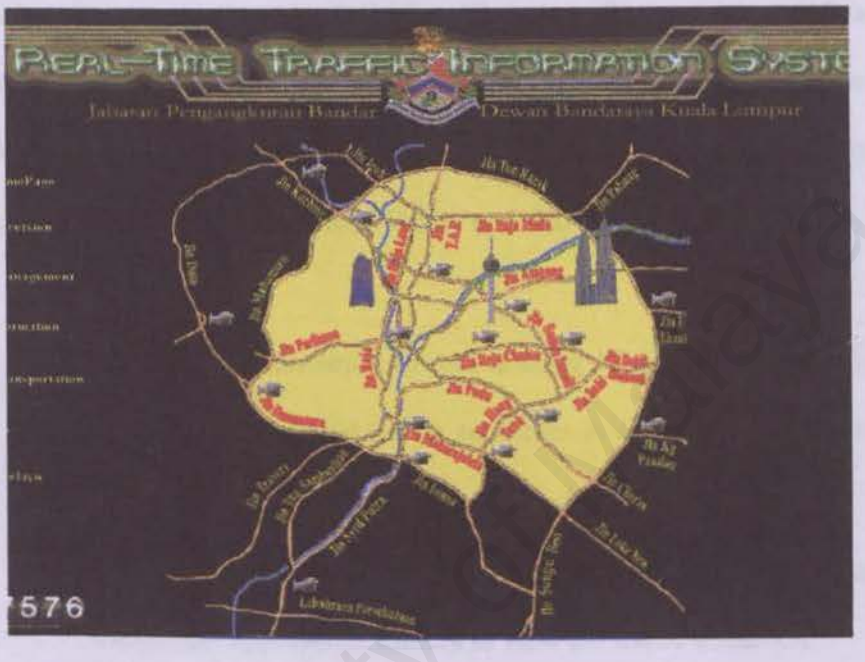

Figure 2.1: Real Time Traffic Information System of DBKL

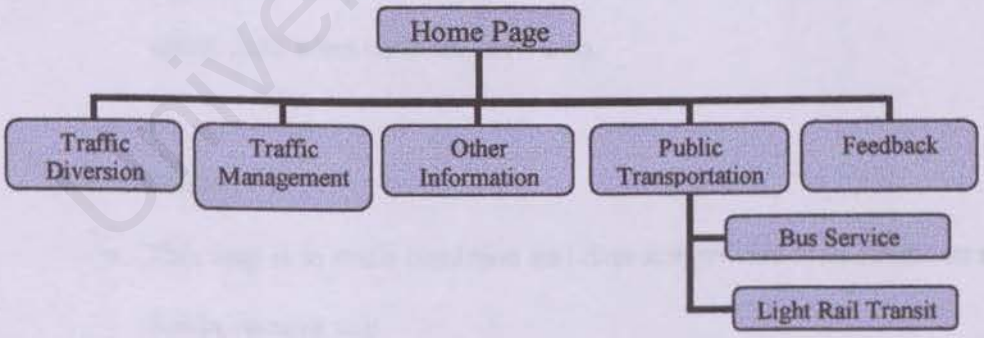

Figure 2.2: Functional Requirement Chart of Real Time Information

This website is developed by Jabatan Pengangkutan Bandar, Dewan Bandaraya Kuala Lumpur (DBKL). The prerequisite for the development of traffic application is the availability of real time traffic data. The system reported here makes use of the telemetry data underlying the operation traffic in Kuala Lumpur. This system shows traffic diversion which road closure in the city. Besides, traffic information show upgrading work in the KL area. This system also has other information about the installation of some facilities to let road users know these disturbing. Mode of public transportation also is displayed in the system by providing details about buses in Klang Valley and also Light Rail Transit.

Advantages:

- This traffic information system is using 15 video cameras to let road users view the actual traffic condition in some main roads in Kuala Lumpur City.
- These cameras are displayed in Kuala Lumpur map, thus users can choose the appropriate camera to view the traffic condition.
- The system is straight forward so that easy to use.
- The system no needs to update information every moment but only update info when obtaining new info.

Disadvantage

- This map is in static condition and does not provide road condition in Kuala Lumpur city.
- This system has not provided any information about other main road instead of just showing traffic in camera only. Users may not know

road condition in certain main road. The visible are of a camera is limited.

- This system is not update frequently. Information that shows in the Traffic Diversion, Traffic Information and other information outdated and still in the web site.
- This website is not stable to provide info. Most of the time the system can not show the view of camera.
- The functional Requirement of the system are list the top of the main page. So that users will easy to choose the appropriate information they need.

[Transport Department of Kuala Lumpur City Hall, 2000]

2.2.2.2 Traffic Smart Land Transport & Authority Singapore

http://traffic.smart.lta.gov.sg/index.html

Figure 2.3: Main Page of Traffic Smart

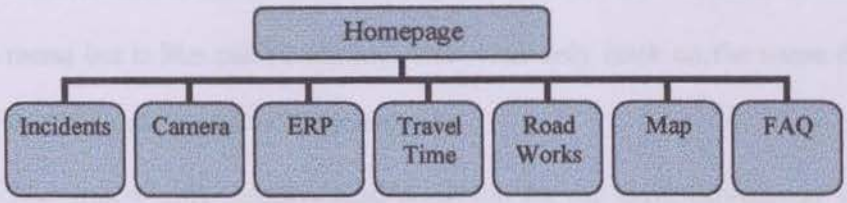

Figure 2.4: Menu of Traffic Smart Chart

This traffic smart system is developed by Singapore Government. The main page has few modules which are shown in the figure.

Advantages:

- This main page is simple and easy to use.
- Map in the system can be zoomed to view the more specific by the user.
- There is a sign in the map to show road work in specific road.
- There is a estimate travel time for a place to a destination in the main road.
- There is a snapshot of traffic condition at the Singapore Expressway that is showed in the map in various colors.
- Sign of heavy traffic is showed in the map to let user know the specific road is in heavy traffic.
- Sign of vehicle breakdown is showed in the map to let user know there may be traffic jam due to this breakdown.
- There is a list to show that all incident of heavy traffic and vehicle breakdown with some description and time. So that can alert road users in this road.

Disadvantages:

- Pictures that show in the main page can not be click to enter to the menu but it like can be clicked. Users can only click on the name of the menu on the top of the main page.
- The system only displays road condition for the main expressway in Singapore.
- Colors on the menu in main page remain the same after click on the menu, but different color at the bottom website.

[Land Transport Authority Singapore, Transport Technology Department, 1997]

2.2.2.3 Traffic Incident Information Page

from Los Angeles by Los Angeles Communication Center

http://cad.chp.ca.gov

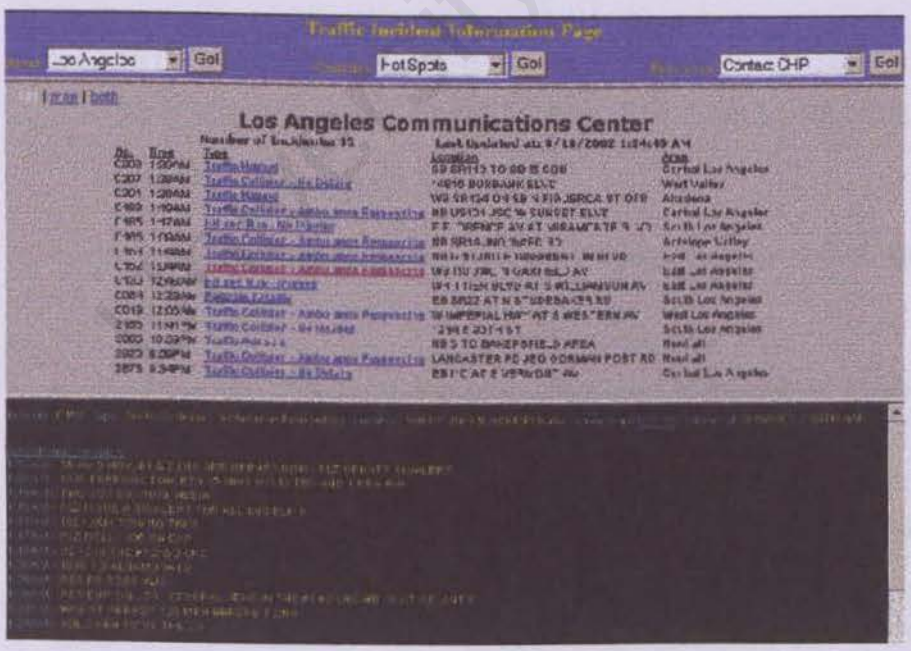

Figure 2.5: Traffic Incident Information Page of Los Angeles

This system is traffic information in the United State that can provide road information for various areas. One of the areas is Los Angeles that provided information by Los Angeles Communication Center.

- This system is to display traffic incident that happen in area of Los Angeles. These incidents are sort by time begin from the latest.
- Every incident has date, type, location and area.
- This system easy because simple graphics in the website.
- User can click on the word at the type of every incident to retrieve more information. After clicking on the sentence of the type, the sentence from blue color changes to red color. This will let user know what incident that had view.
- This information system also can let user know ambulance respond for the incident.
- Road user also can view the map only for the area as well as details and map at the same page.
- This information system covers 24 areas. These can be choosing at the left hand side at the top of the website.
- User also can search for hot spot, custom region, most recent, quick search and SIG Alert.
- User can also choose other menus which are Filed Incident, Cities, STAMP, KIM, CHP Phone Book, Glossary, FAQ, Links and Contact CHP.
- The details of incident page have two scrolling bars to scroll the information at the bottom of the lists.

[Los Angeles Communication Center, 2000]

2.2.2.4. SA Bay Traffic.info

This is web based information system that is developed for San Francisco Bay area.

http://sfbaytrraffic.info

Figure 2.6: Incident Map of SF Bay Traffic.info

This system included My Alert, Traffic Incident, Incident Map, Public Event and Weather. This system can provide timely road traffic information in San Francisco Bay area.

- Data and sources are highly trusted because these info are provided by the California Highway Patrol (CHP), the Traffic Observation Service and etc.
- This website also can provide personalized road traffic alert on the users' email, mobile phone and pager. Users need to pay monthly fee for using these services.
- Information is not well arranged in this system. User may find hard to use this system because a lot of words in the system.

- There is little info provided in a page. User may find confuse when using the system.
- The title of the main page is quite big and lots of unneeded description. Lots of info in a main page and users need to scroll a long page to view the info at the bottom.
- The map incident page is big enough to view the whole area. Map display most of the main expressway.
- When the mouse place over incident icon in the map, there is a details about the incident. The details are presented as below.

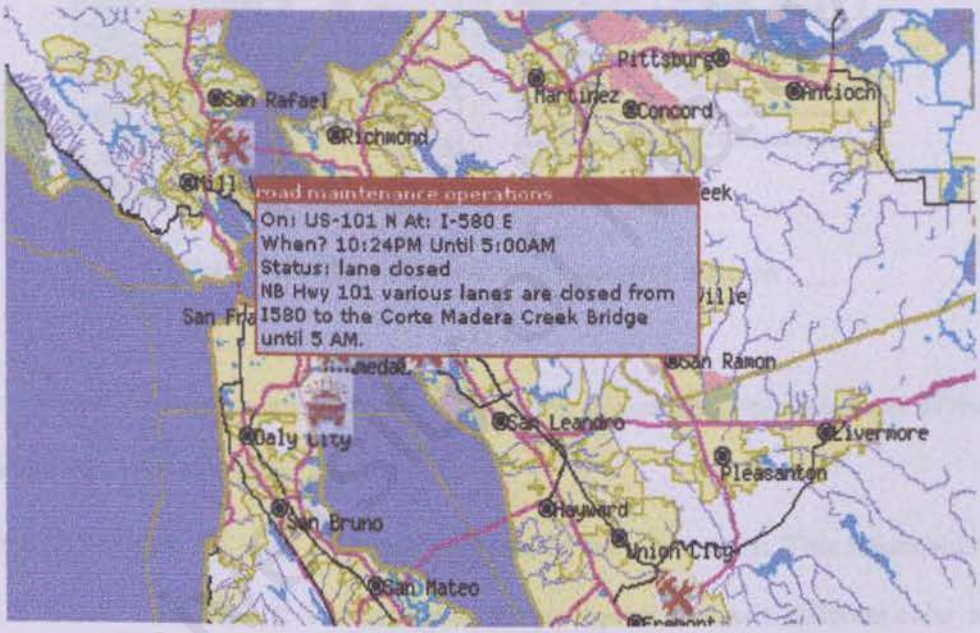

Figure 2.7: Details of a Map in SF Bay Traffic.info

[San Francisco Bay Traffic, 2001]

2.2.2.5 Puget Sound Traffic Camera

This is web site is from Washington State Department of Transportation

http://wsdot.wa.gov

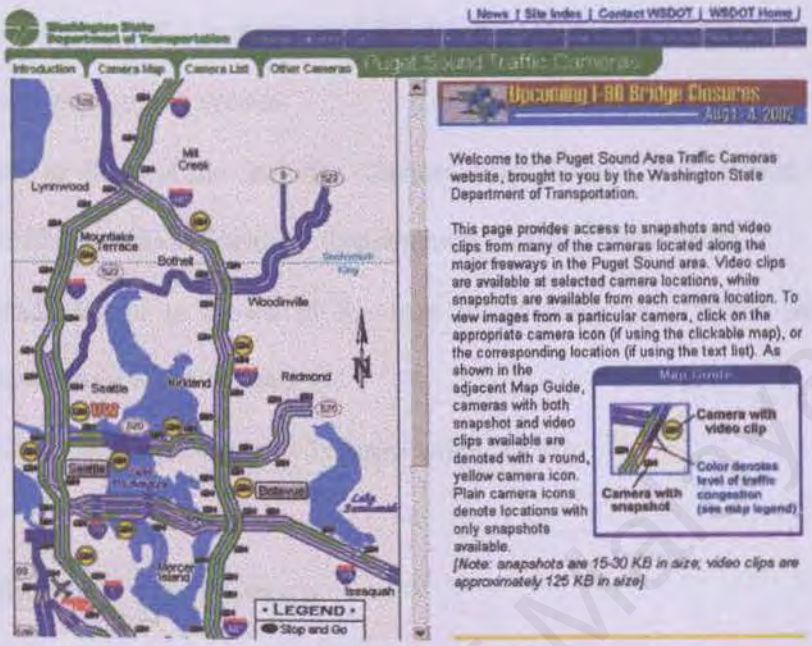

Figure 2.8: Main Page of Puget Sound Cameras

Puget Sound Cameras is a web based information system that provides most of the information in the interactive map.

- By viewing the map, users can get most of the information. This information is road conditions in certain time which are represented with different color in the map. Black means Stop and Go, Red means Heavy, Yellow represent Moderate, Green mean Wide Open, Grey is No Data and Blue mean No Equipment.
- There are many cameras in the most of the expressway especially in the center of the Washington. User can click on the camera icons in the map to view the camera.

- System is reloaded in every 3 minutes so that information in the map up to date.
- The main page is divided into two sides. Right hand of the page is a map that shows the traffic condition of Washington. Left hand side of the page is description of the system.
- Info in the website included Camera Map, Camera List, Other Cameras, Traffic Condition, Incident, Construction, Travel Time and etc.
- Road closure is shown in the map to let user know which part of the expressway will be closed.

[Washington State Department of Transportation, 1996]

2.2.3 Analysis Target Group

Target group is the group that will use this TIS for their benefit. For the TIS, this group will be the car owners who work in Kuala Lumpur (KL) City or intend to go to KL city almost every day. They will use at least part of the roads in Kuala Lumpur City where these roads are in traffic jam almost every day during peak hours. Peak hours are about 8am-9.30am, 12pm-2pm and 4.30pm-6.30pm from Monday to Friday as well as 8am-9.30am and 12pm-3pm on Saturday. Sometimes, traffic in Kuala Lumpur out of control due to the serious accident in none peak hour. In addition, during festival, local city hall DBKL may close some of the main roads for the celebration purpose or just cause to increase the amount of vehicles entering city during this time.

Besides, DBKL also had to close some of the main roads to upgrade current road system as well as some private companies like Tenaga Nasional Berhad, Telekom Berhad, Water Department and etc also need to close part of the road to

upgrade existing system or just install new facilities. All of these reasons will cause traffic jam in KL area any time. If the road user not aware these road work or events, they simply enter KL city. This will cause traffic congestion more serious.

Before these target users go to work, they will view road condition in KL through the TIS to know the latest information about the road they will go through. By doing so, they will avoid major traffic jam by choosing alternative way to reach destination. On the other hand, some users may just wish to enter KL city for some purposes like shopping, attending seminar, having meal, meeting with customer and etc. These users do not enter KL city frequently, they do not know traffic condition of KL city. TIS can help this group to obtain information they need before going to KL city.

Every month, a surprisingly large number of vehicle register not only in Kuala Lumpur, but also in Selangor State. This group of vehicle owner is a potential road user in Kuala Lumpur. It is mean that road user in Kuala Lumpur City indirectly increase every month. And users of Traffic Information will also indirectly increase. [Ministry of Transport, 2000]

Some group may just wish to visit in KL city. They can clarify traffic condition in KL by using TIS. By doing so, they will plan their journey in advance and also consider peak hour in their plan. If there are 10% of road users use TIS, these users may choose alternative way to their destination. Thus, they will avoid traffic jam and decrease road users jam in the current traffic.

Table 2.1: Total Registered Vehicle until 31 July 2001

JENIS KENDERAAN	KENDERAAN PERSENDIRIAN		KENDERAAN PERKHIDMATAN AWAM		KERETA SEWA PANDU SENDIRI	KENDERAAN BARANG
NEGERI	MOTORSIKAL	MOTOKAR	BAS	TEKSI		
Perlis	31,740	8,633	156	164	0	1,585
Kedah	393,087	137,956	2,737	2,900	272	28,321
Pulau Pinang	693,224	416,893	3,932	2,496	377	37,897
Perak	697,470	330,996	3,774	3,960	54	47,415
Selangor	630,955	596,788	4,380	3,870	188	87,357
W/Persekutuan	728,467	1,239,921	10,906	18,896	7,103	149,034
N/Sembilan	281,397	150,961	2,219	1,709	12	28,946
Melaka	229,202	126,699	1,698	1,424	59	17,712
Johor	835,578	559,273	6,896	10,031	162	84,766
Pahang	249,063	154,233	1,744	2,429	10	30,144
Terengganu	144,358	76,304	897	965	17	15,800
Kelantan	214,160	110,525	1,583	1,963	12	20,298
Sabah	78,930	210,317	5,850	3,997	1,394	83,335
Sarawak	305,285	253,463	2,484	1,576	363	47,560
JUMLAH	**5,512,916**	**4,372,962**	**49,256**	**56,280**	**10,023**	**680,170**

Figure 2.9: Amount of Registered Vehicle from Year 1995-2000

2.3 Studies on Development Methods

2.3.1 Architectural Overview and the related component

At the speech to the southern California Client/Server User Group, Zachman noted that architecture with accompanying models is absolutely necessary for client server applications because it is too complex to comprehend other wise.

2.3.1.1 Client/Server Computer System Architecture

The client/server model is based on the concept that each application consists of two functional parts. One that initiates peer-to-peer communication is considered the client, whereas the process that responds to the initial request is considered the server. In a simplified saying of the whole process is: The server waits for incoming communication requests from a client, performs the requested actions for the client, and return the result to the client, then the client retrieve data from the server. The 1990s Version of distributed systems has been the client/server systems.

Therefore, the client/server computing has been described as a logical extension of modular programming [Swank,m & Kittel,D, 1996], because the fundamental assumption of that is a large and complex piece of software can be separated into a set of constituent modules, each of which is designed to handle a limited set of functions. "Binding" is the process where by the association between the client and server occurs. Binding may be dynamic which mean that the client finds the appropriate server through the network directory service of the server is registered, or binding may be provided directly also if the client knows the IP address of the server. [Tonnesen, A.S, 1995]

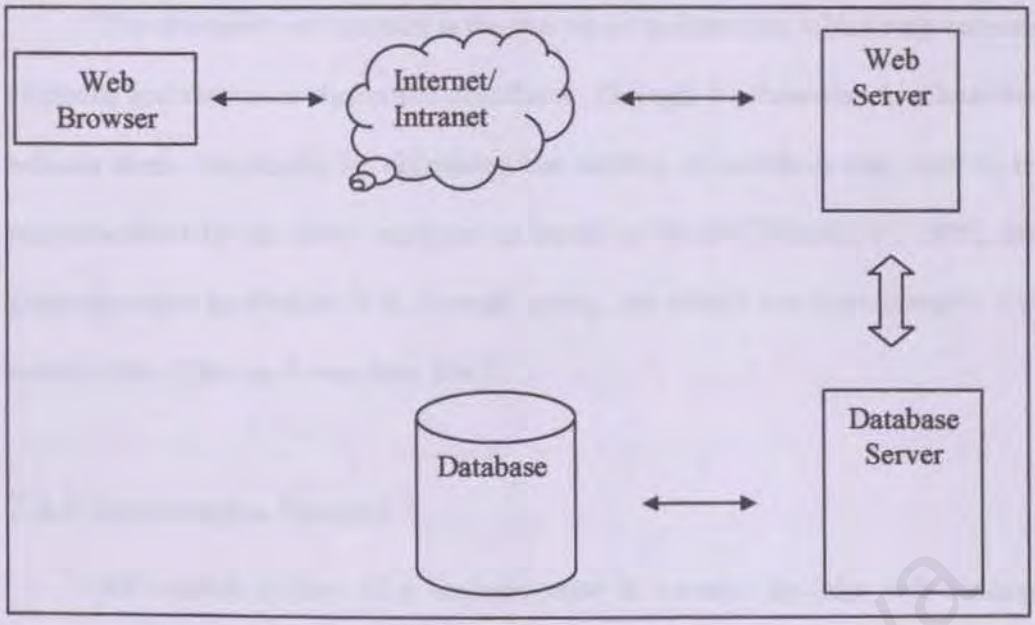

Figure 2.10: Simple Dynamic Web Page

2.3.1.2 Three-tiered versus Two-tiered Architecture

The trend in client/server is toward a three-tiered architecture, notes Woolfe [Woolfe, R, 1995], a British researcher at Wentworth Research. Tier 3 is the 'superserver', perhaps a mainframe. It I connected directly to the client/server system network via a server or two. This latter option allows companies or organizations to include their legacy application in client/server systems. Short lived and fast changing data, as well as their corresponding integrity rules, are also stored at this 'superserver' level so they can be shared tier 2 holds specialized server, some of which are dedicated to Traffic database, software eases connection between client and server. Data specific to a particular section or workgroup is stored here too, as is data that does not change often yet needs rapid access. Whereas, tier 1 has the client either desktop or portable computer, connected via same sort of network.

The alternative architecture is the two-tiered architecture, which only consists of clients and servers or clients and mainframe. Through the three-tiered architecture reduces client complexity by decreasing the number of interfaces that need to be accommodated by the client machines as noted by Woolfe [Woolfe, R, 1995], but there are some drawbacks of it. Overall saying, the clients are more complex and access to tier 3 data is slower than Tier 2.

2.3.2 Information System

Information system of a business view is covered by "the web changes everything." [Business Week, 1995] The information system affected nearly all aspects of human endeavor, but the section emphasizes their use for managing information. First know as business data processing and later as management information system, the field is now called information system [Lazon, Z.P & Holfelder, P, 1997]. The operative word is system, because it combines the technologies, people, processes and also organizational mechanisms for the purpose of improving organizational performance [Mc Nurlm, B.C & Sprague, R.H.Jr, 1994].

According to the Korfhage [Korfhage, R.R, 1997], any Information System has at its hearts collection of data about reality. The first abstraction principle is in any Information System, the "real world" is represented by available to the system. The second principle is a user information need. Whether for production, storage or retrieval of information is abstracted into a form that is commensurate with the information system to be used. Firms reasoned that if they managed their data by implementing computer based DBMSs, they would effect mange ant other resources ate still prevalent and represent a positive approach to computer use [Ein-Dor, Philip & Seger, Eli, 1998]. Information is one of the main types of resources and can be

managed just as any other types of resources, as well as the interest in this topic stems from two influences. First and foremost is business has become more complex and second, the computer has achieved improved capabilities [McLead, R.J, 1998].

2.3.3 Real Time Simulation

The main idea of the real time simulation is to offer the use of real-time traffic measurement as a input data to microscopic simulation. In this context, various non-measured traffic parameters that can be deduced from micro-simulations are deemed to be a good approximation of the reality by virtue of being based on the actual measurements. Although the prototype system makes use of the specific microsimulator (HUTSIM) and the urban traffic control system (SCOOT), the approach is applicable to any traffic control system that giving real-time data.

Besides, the basic data gathered through the traffic telemetry systems is the lane-occupancy data from detectors embedded in the road surface. Every detector provides information about the presence or absence of a vehicle in a discrete location. The rest of the information about traffic condition must be derived from the general knowledge of system layout, statistics of the traffic patterns and the estimate of vehicles in dynamics. In a simulation model all these factors are methodically combined. The simulation model provides also an engine for creating hypothetical traffic situations and for deriving higher order measures to be used by traffic information services.

The actual traffic data from the detectors, simulation model generates vehicles on a statistical basis. Ideally this should be accurate enough to produce reliable average measures i.e. in off-line simulation mode. However, in real-time operation average measures are not always relevant, so the micro-simulation model

is made realistic by replacing the time headway distribution with real-time arrivals. Since the simulation model is to mirror the operation of the actual traffic control system it requires also the real-time signal status data.

The real-time simulation approach postulated here extends significantly the monitoring capabilities of telemetry systems by extrapolating the traffic occurrences in discrete locations through to the simulation of realistic traffic flows in the whole of the network. [Kosonen, Iisakki, 1999]

2.3.4 The World Wide Web and the Internet

In this context, to make perfectly clear, the World Wide Web is not the Internet and vice versa. However, they are closely related to each other. The internet, also know as the Net, this is a network of various computer network [Parsons & Oja, 1994], which work together become now comprise a community. Members from this community are nearly every country all over the world. It provides a lot of standards, services, and protocols that allow individual to access the huge number of sources available on the Net from the world. The Internet provides the network architecture and the www provide the method for storing and retrieving its document according to Mc. Lead [McLead, R.J, 1998]. The Internet is a network in every sense of the word whereas the web is not simply a network, but rather suitable to define as a distributed set of communications applications and systems software with the following characteristics

- Typically employs the TCP/IP network protocol.
- Understands Hypertext Markup Language (HTML)
- Typically resides on the internet hosts and clients

- Follow the client/server model of bi-directional data communication, information collection and resource serving.
- Employ document and resource addressing via the Uniform Resource Locators (URLs)
- Allow a client program to access information composes of a variety of media types such as text audio and video. Although not restricted for using graphical based client programs or browsers, these are by the most popular in use on the web today [Swank, Mark & Kittel, D, 1996].

2.3.4.1 The Conceptual make up of the web

The World Wide Web also called web, www or w3, is a information space on the Internet where hypermedia document are stored and can be retrieved by means of a unique addressing scheme [McLead, R.J, 1998]. Technically saying, the web is nothing more than 'distributed hypermedia system'. Among the variety of system that constitute the www which there are primarily, three [December, J & Randall, N, 1994]:

- The first is hypertext
- The second is the Internet itself
- The third is that the most overused of terms, multimedia

2.3.5 Web Application and the Development

2.3.5.1 Web Application

Web Application has wide range of meaning. In this context, this topic covers wide range of sub-topic also, but their overall definition is the uses of the web including all types of tasks being undertaken on the web. Among the primary web application are graphical design of information, dissemination of research, client and customer support, browsing and ordering of products, electronic commerce and display of creative arts [December, J & Randall, N, 1994].

2.3.5.2 Advantages of Web Application Development

Web Application Development simply means that to develop application using web related technologies and this application can be accessed via the web browser. Web applications development holds many advantages over the traditional information system and end users application on an intranet or external users on the World Wide Web.

From the users' perspective, web application development provide many benefits to end users that are not readily achievable using traditional system tools including Graphic User Interface, browser customization, abstraction application and query languages, quick and easy access information, whereas from the developer's perspective, the web technologies really provide web developer with a number of advantaged over the traditional development tool. For instance, standard technologies, cross platform compatibility rapid Graphic User Interface development, ease of integrate etc.

2.3.5.3 The 'Bridge' between the web and Database

The web-to-database integration has become central to the jobs of web based information system. Users hope to access database via web browser with the same functions as provided by normal database application software. Making database information available to web users requires covering it from this database format to markup language such as HTML or XML. Database package store information in files optimized for quick access by front end programs. When the web server sends information to a client, the internal database format must converted to HTML so that it is displayed correctly [Reichard, K, 1996]. A 'bridge' between the web and the database needs to be built to maintain the functions in an information system. This bridge lets the web browser replace the front end program normally used to access the database. That is mean for a web based information system, this bridge maintains the relationship between an interactive any dynamic web site (accessed via web browser) and the underlying web database in the web server. The following section tells you what an interactive system is.

2.3.5.4 Interactive system

As its name indicates, an interactive system supports bi-directional communication, from the user to computer system and vice versa. The functions in a mean that it enables the system to follow pace and directional of the users' activities, such as pressing button, painting and clicking with a 'mouse' or typing a text. The system then reacts accordingly by performing some useful services as a respond. These actions take place via the system's use interface some useful part of the system that provides access to the computer internal resources. The most crucial property of any interactive system is its support for human activity [Newman, W.M & Lamming,

M.G., 1995]. This is what makes it worth having this. An interactive system require for a web based enabled system. Uses can retrieve information from the system based on their information need. For a web based system, the user interface of the interactive system. There is no doubt that the websites which can be accessed via web browser easily. A web site of an information system is not a static HTML site, but it is a totally interactive and dynamic site, which enables the cost effective communication and support users' activities and business.

2.3.5.5 Content Management Tips and Tricks

Content Management for a web based enabled Information System. There are large sites and content heavy sites, use dynamic page generation systems to automate much of the work of content management [Morris, C, 1999]. There are a couple of techniques that can streamline the grunt work, and all these techniques are related to topic of Dynamic System, Searching and Server Slide included Cold Fusion, Active Server Page (ASP), Netobjects, Vignette, Php, Lotus Domino and many others all perform various dynamic page generation tasks [Morris, C, 1999]. Besides dynamic system, a good search and replace tool is, considered the first weapon in content management arsenal. Most windows application includes this kind of tool for use within a document and it is wise to become proficient with it. In order to change common page elements like logos or navigation bar, there is a need to have facility to search and replace across multiple files.

On the server slide of the street, the server side includes (SSL) is such a handy tool. With SSL, Ones can insert a link to a file into a webpage. When the webpage loads, that file is inserted at the desired place in the file and it can include any text. SSL can also be used to run a script or program which select a file at

random or base on certain parameters. It can be used to create a rudimentary and banner rotation system. SSL allow printing of variables that are set by the server. It is built into all the most popular server packages, such as Apache, IIS (Microsoft Internet Information Server), Website, Netscape and others. NCSA HTTP allows users to create documents which provide simple information to clients on the fly. Such Information includes the current date, the file lost modification date, and the size of other files. In its more advanced usage, it can provide a powerful interface to CGI.

2.3.5.6 Incorporating Database into web-based Information System

According to the studies conducted by Liu [Liu, G, 1997], exponential growth of the web is the world's largest information repositories make it impossible to locate document of Internet. Therefore, a way to solve this problem is to introduce the advantages database to the web servers that allowing users to search a document details on the server and also can find information in a very organized way.

With the unprecedented growth of resources in the web, it is no longer adequate to rely on the conventional file technology for organizing, storing, accessing large amount of information on the web. Thus, it is believed that the integration of the web and database. Technology will bring many opportunities for creating advanced information management application [Feng, A & Lu, H, 1998]. This information management application is the Information System. The underlying database is the core element of a web based Information System because all the data of the Information System from a various sources are stored in the database. It is much more complicated that these diverse data sources must be queried and updated [Carriene, J & Kazman, R, 1997]. The methods, techniques, and tools are in great

demand to bridge the gap between the web and the database application so that smooth, interactive, and integrated web-to-database application are made possible [Frey, A, 1990]. A wide range of tools and philosophies had been proposed for connecting and incorporating the web and database to make web based Information System a success. It become reality and believes that web based application architecture using different interfaces and integrality methods have much impact on the web application of performance. [Lazon, Z. P & Holfelder, P, 1997]. More details information regarding the web to database connecting technologies and middleware will be discussed in the topic of architecture overview.

2.3.6 Data Access Technology Consideration

There are many types of data access technologies. These included VB SQL, Open Database Connectivity (ODBC), Data Access Object (DAO), Remote Data Object (RDO), ActiveX Data Object (ADO) and OLE-DB.

Open Database Connectivity (ODBC)

Open Database Connectivity (ODBC) is a method that used by Visual Basic to communicate with client/ server databases. It is a component of Microsoft's Windows Open System Architecture (WOSA). ODBC is a standard or open application programming interfaces (API) for accessing a database. It was designed to allow the programmer to use a common set of routines to access the data stored in databases, regardless of the type of database in which the data stored. This means that once the programmer connecting to the database using ODBC, they can manipulate the data without thinking exactly where the data are stored or even which type of database are being stored.

By using ODBC statements in a program, users can access file in a number of different databases which are Access, dbase, Oracle, SQL Server and DB2. In addition, a separate module or driver is needed for each database to be accessed for ODBC. ODBC is based on and closely aligned with the open Group Standard Structured Query Language (SQL) Call-Level Interface. It allows programs to use SQL requests that will access database without knowing the proprietary interfaces to the databases. ODBC handles the SQL request and converts it into a request the individual database system understands. ODBC communicates directly with relational database and supports application or component that is written to use ODBC or data object interfaces that use ODBC. ODBC is designed to work with relational database (such as in SQL Server) only, although there are limited ODBC drivers available for some non-relational data sources.

The steps for accessing a database from a web page are:

- Define the data source and the ODBC driver to the ODBC driver manager
- Use a form on an HTML page to request information from the user
- Create a script to process the form and access the database

2.4 Summary

After doing some literature reviews related to the TIS and gathering information needed. The next chapter is Methodology which justification on the proposed methodology.

3.1 Introduction

Methodology is very useful in System Development Lifecycle. A methodology may be defined as a collection of procedures, techniques, tools and documentation aids. These procedures, techniques, tools and documentation aid assist software developer to speed up and simplify the software development process. A methodology may consist of phases that in turn may consist o f sub-phases. Phases can guide the developer for the techniques that are suitable. These methodologies also can helps developer to plan, manage, control and evaluate this information system.

Different methodologies may have different objective. So, developer require to choose appropriate methodologies for the system and may need to take steps for consideration some of many of the aspects of methodologies in order to build a successful information system.. A successful system is depends on evaluation of the system and also a satisfied overall requirements of the system.

The developer must know the requirement of the system in order to choose appropriate methodologies. These methodologies include:

- Structured System Analysis and Design Methodology (SSADM)
- Object-oriented Analysis and Design (OOAD)
- Rapid Application Development (RAD)
- Information Engineering (IE)
- Soft Systems Methodology (SSM)
- Effective Technical and Human Implementation of Computer-based Systems (ETHICS)

3.2 System Model

The overall system development strategy for Traffic Information System is Unified Software development Process (USDP) which is Object Oriented Analysis and Design. This model presents a clear view of a system and the phases that included in the development.

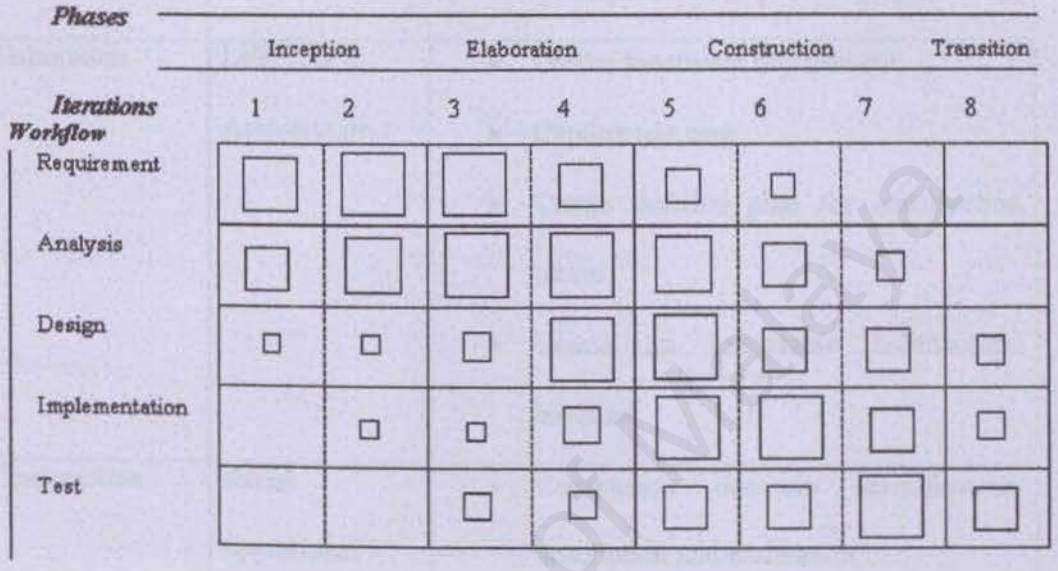

Figure 3.1: Phases of Unified Software Development Process

The USDP lifecycle is divided into a sequence of 4 phases. Each phase may include much iteration, the exact number of iterations per phase depends on the size of the project, one iteration per phase for small projects. Each phase we will consider:

- The goal of the phase
- The focus in term of the core workflow
- The Milestone at the end of a phase

Every phase concludes with a major milestone. These phases are:

Table 3.1: Phases

Phase	Milestone	Description
Inception	Lifecycle Objective	• Define project scope and objective • Capture key requirement • Establish feasibility of the project
Elaboration	Lifecycle Architecture	• Define functional requirement • Capture use case • Create detailed plan for construction phase • Create an executable architectural baseline
Construction	Initial operational capability	• Completing use-case identification, description and realization • Finish analysis, design, implementation and test • Maintain the integrity of the system architecture • Build a system that is capable of operating successfully
Transition	Product Release	• Roll out the fully functional system • Correcting defects • Modifying system to correct previously unidentified problems.

3.2.1 Unified Process Phase

Controlled iteration has many benefits for the system development:

- It can reduce the cost risk by limiting possible expenditures in the process to just for the current iteration/increment costs.
- It can reduces the risk of failure by allowing problems to be identified early
- It can speed up the tempo of effort by reducing conceptual loading to a small subset of the whole task
- The acknowledges the fact that just can not solve a big problem all at once

The models of the software architecture in the USDP are employed:

- Use case model showing use cases and their relations to users
- Analysis model which refines use cases and allocates behavior to objects
- Design model with static structure of classes and interfaces and use cases realized as collaborations
- Implementation model providing system components implementing behavior
- Deployment model mapping system components to physical nodes

3.2.2 Use Case Driven

A system has many types of users. Each type of user is represented as an actor. An actor can be a human, an external system, or an external hardware, takes a coherent set of roles when it interacts with the system. A physical user may act as one or several actors. Use case is a sequence of actions that the system performs to offer some results of value to an actor.

A use case specifies a sequence of actions, including variants that the system can perform and that yield an observable result of value to a particular actor. Finding

the use cases by looking at how the users use the TIS to satisfy their need. Each such a way of using the system that adds value to the user is a candidate use case. USDP offers a systematic way to find the use cases of the system. [Scott, Kendall, 2001] Use-case driven means a development project proceeds through a series of workflows that are initiated from the use cases.

- A use case model with all uses cases and their relationships to users.
- An analysis model which defines the use cases in more detail and make an initial allocation of the behavior of the system to a set of classes.
- A design model that defines static structure of the system as subsystems, classes, and interfaces and the use cases realized as collaborations among the subsystems, classes, and interfaces.
- An implementation model included components and the mapping of classes to components.
- A deployment model which defines the physical nodes of computers and the mapping of components to nodes.
- A test model which describes the test cases that verify the use cases

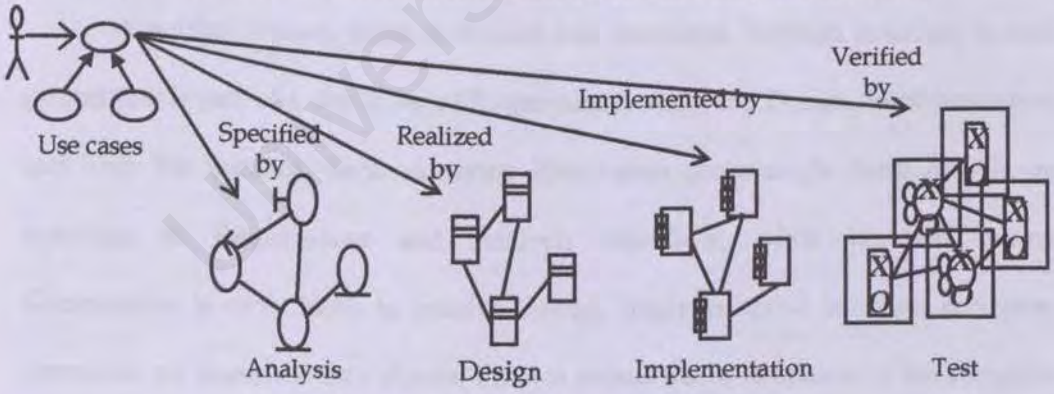

Figure 3.2: Model of Unified Process

3.2.3 Architecture Centric

Architecture-centric means describing the architecture based on the information obtained in that phase and defining the architecture as early as possible. Every product has both function and form. These forces must be balanced. Function means use cases and form means architecture. Architecture grows out of the needs of the enterprise and is influenced by the platform the software is to run on, reusable building blocks available, deployment considerations, nonfunctional requirements, etc. Architecture must be designed in order to allow system to evolve.

By the way, it also defines the architecture of the system. It creates a rough outline of the architecture and starting with the part of the architecture that is not specific to the use cases. It can define the use cases that represent the key functions of the system, work out the detail of each use case and then realize each use case in terms of subsystems, classes, and components. As the use cases are specified and mature, more of the architecture is discovered, and in turn, leads to the maturation of more use cases.

3.2.4 Iterative and incremental development

A unified Process phase is divided into iterations. Iteration is simply a mini project that is part of a workflow of Requirement, Analysis, Design, Implementation and Test. For instance, iteration during Elaboration phase might focus heavily on activities of Requirement and Analysis workflow, while iteration during Construction is more likely to involve Design, Implementation and Test activities. Iterations are organized into phases. Process means that a definition of the complete set of activities needed to transform user's requirement in to system and also a template for creating system. [Scott, Kendall, 2001]

Each iteration causes in an increment. This is a release of the system that contains added or just to improve functionality over and above the previous release.

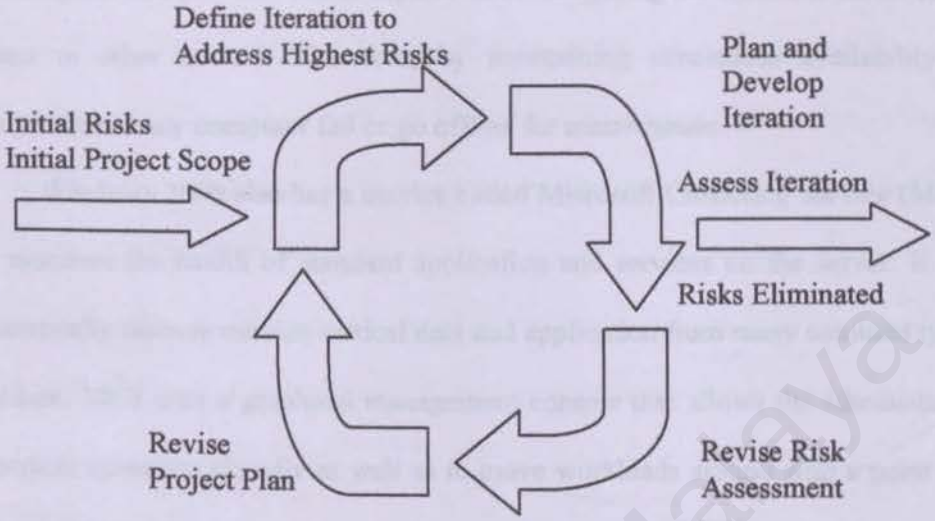

Figure3.3: Iterative and Incremental Development

3.3 Operating System

3.3.1 Windows 2000

Windows 2000 is available in a number a different version, each serving different features in the server operating system market. Windows 2000 Server provides the few important features that make it suitable to run a web server, which are comprehensive clustering for scalability and availability. It also support for large SMP server.

Windows 2000 is a high performance application with Microsoft Transaction Server (MTS) which is clustering for scalability and availability. It has clustering features that enable it to distribute incoming traffic across up to 32 servers, transparently to the client that using a single virtual address. This make it deals for

high volume of web services which are e-commerce and so on. Windows NT's support for clustering enables administrator to scale their performance as needed to the mirror demands mode on the site. This feature is called the windows NT load Balancing Service (WLBS) and is capable of reconfiguring the cluster to direct client request to other servers. Therefore, by maintaining continuous availability of network should any computer fail or go offline for maintenance.

Windows 2000 also has a service called Microsoft Clustering Service (MCS) that monitors the health of standard application and services on the server. It can automatically recover mission-critical data and application from many common types of failure. MCS uses a graphical management console that allows the administrator to monitor resources visually as well as to move workloads around with a point and click interface.

Windows 2000 Server is also capable of Symmetric Multi Processing (SMP). This is able to run systems with up to 8 processors and in special versions the support is extended up to 32 processors. This gives the administrator a powerful upgrade path for enterprise applications that need to handle more users and data as the system grows larger.

High performance application with Microsoft Transaction Server (MTS) makes the development easier and deploys high performance, scalability and robust enterprise, as well as internet and Intranet application. It defines an application programming model for developing distributed component based application and also run the infrastructure for deploying and managing theses application. MTS has a new client configuration utility, support for coder type libraries and bug fixes via a server pack update.

3.3.2 Windows XP Professional

Windows XP Professional integrates the strengths of Windows 2000 Professional, such as standards-based security, manageability, and reliability. With the best business features of Windows 98 and Windows Millennium Edition, such as Plug and Play, simplified user interface, and innovative support services. Windows XP Professional offers robust security features to help businesses protect sensitive data and provide support for managing users on the network. One of the features available in Windows XP Professional is the use of Group Policy objects (GPO). GPOs allow system administrators to apply a single security profile to multiple computers or take advantage of smart card technology to authenticate users.

3.4 Web Database

Database server is similar to database management system; a web database is where the data will be stored. A web database can be information repository that can be accessed via a query language. Unlike conventional database system, access the web database is not performed using instructions typed at a command line or issue through interfaces that are custom made for the use on a specific computer platform.

Web database is accessed via other web application. Specification for application that are developed using standardized HTNL tags, ActiveX control and client side script. Using VB Script and Java Script. Using facilities available in HTML, application programmed on the web server are accessed through server side program via Common Gateway Interface (CGI), server-specified interfaces such as Microsoft's Information Server Application Programming Interface (ISAPI) or server side scripting environment such as Internet Information Server's application that integrate database functionality and provide access to organizational data repository on behalf of web client (a user or browser).

In addition, application can be designed for the purpose of querying a database and returning specific information. The application also can use the information retrieved from a database to support more comprehensive application. The capability of integrating a database into application that can be accessed by users using a web browser is what makes a database a web database. [Mark Swank, et al, 1997]

3.4.1 Microsoft Internet Information Server (IIS)

Microsoft Internet Information Server (IIS) is the World Wide Web server that is tightly integrated with the Microsoft Windows NT server operating system and is designed to deliver a wide range of Internet and intranet server capabilities. IIS equally as intranet web server or a public web server program. The Microsoft's IIS is exclusively as part of the Windows 2000 Server operating system. Microsoft has improved the configuration and setup to enable multiple machines to share the load and deliver more reliable web services in order to result in faster web page serving..

IIS has various security enhancements as well. Microsoft has consolidated security tips in its documentation under Administration, Server Admin, Security, and IIS Security Checklist. These include restricting guest accounts and setting appropriate file permissions. IIS v5.0 is expanded support for several emerging standards including which are Fortezza (a new U.S. government security standard), Transport Layer security using SSL v3.0, Digest Authentication, and replacing NT LAN Manager Authentication with the stronger Kerberos v5.0 authentication protocols used in Windows 2000.

IIS is Web-based Distributed Authoring and Versioning (WebDAV) which is an emerging standard designed to simplify the construction of intranets and enable

multiple users to publish documents to a common Web server. The Reliable Restart feature is installed by default and will automatically restart Internet Web and FTP services if the Inetinfo.exe process terminates abnormally, or if Windows Task Manager or Kill.exe is used to stop Internet services.

3.5 Web Application

3.5.1 Active Server Pages (ASP)

ASP is an HTML page that includes one or more scripts (small embedded program) that are processed on a Microsoft Web Server before the page is sent to the user. ASP is a concept of processing application logic on the web server and connecting to external server from the web server. The capability to create dynamic HTML by sending information to an executable file existed before the emergence of ASP through the Common Gateway Interface (CGI). An ASP similar to a server side includes or CGI application which involve programs that run on the server, usually on a page for the user. Typically, the script in the web page at the server uses input receive as the result of users' requests for the page to access data from the database and then build or customize the page on the fly before sending it to the requestor.

ASP is a feature of Microsoft Internet Information Server (IIS), but since the server-side script is just building a required HTML page. It can be delivered for almost any browser. Most of the Internet Information Server expended connectivity features are result of the processing of logic in ASP. ASP is text based files comprised of a combination of HTML tags and Active Server scripts. The server scripts whether written in VB Script, JScript, or your own script-compliant language, are interpreted by Active Server engine. The Active Server script usually contains

variables, operators and statement of control the application logic processed by the server. [Walther, Stephen, 1998]

Microsoft recommends the use of the Server-side Asp rather than Client-side Script, where is actually a choice. This is because the Client-side Scripts (like Java Script) may not work as intended as older browser.[Johnson, Scot et al, 1997]

3.5.2 Active Server Pages. NET (ASP.NET)

ASP.NET is one of the latest Microsoft's .NET technologies which had attracted a great deal of press when first release to the world. ASP.NET was written from the ground up to meet the requirement that would not be provided by ASP. It not only can solve many problems of ASP, but also provides great extendibility and brings great tool support.

ASP.NET is freely available, so still can continue to use current editor of choice (come on, admit it –it's Notepad). This gives us access to everything possible with ASP.NET, including multi-language support.

ASP.NET is not just only a new version, but a whole new idea and way of programming web application. In many areas, it compatibility with ASP has been broken, but in long term this is a good thing. ASP.NET can provides much stronger platform for developing application and gives many benefits.

For richer environment, Visual Studio.NET is used to get the drag and drag support, colored code, context-sensitive help and tool tips and all of the usual great editing features that Visual Studio has brought in the past. A personalized portal is a sample portal application, allowing user login, content delivery, user preferences, configuration, and so on. It is extremely good example of the use of user control, which are reusable ASP.NET pages.

ASP.NET has four main goals. It can make a code cleaner than before. It also improves deployment scalability, security and reliability. Besides, it provides better support for different browser and devices as well as enable new breed of web application.

A Class Browser Application shows how to browse through the hierarchy of classes and objects. Not only is this useful from a learning point of view, but it cab also shows how the classes are queried by run-time code. This is one of the great new features of the framework. The .NET framework supports multiple languages so developer can uses whichever language those feel comfortable. Microsoft support VB.NET, C#, J# and Jscript and there are a number of third party language that we can use such as managed C++. [Garrett, Chris, et al, 2002]

ASP.NET introduces a declarative server based model for controls. This is where the concept may seem alien to ASP programmer, this is because the control is declared on the server which can be programmed against on the server, but can be event driven from the client. This sound pretty weird but quite simple to use.

3.5.3 Hyper Text Markup Language (HTML)

Markup language is for displaying text, images and multimedia. HTML provides instruction to web browser in order to control document in the page. The way documents are viewed and how these documents related to each other. For all of this simplicity, HTML is a very powerful language. HTML allow individual elements on the web to be brought together and presented as a collection of text, images, multimedia and others. This document can be package together using HTML [S. Arpajan, 1996].

3.5.4 Visual Basic Script (VB Script)

Visual Basic Scripting Edition or VB Script is Microsoft Scripting language for the Internet. The ability to provide a scripting, automation and customization capability for web browser is a major feature of VB Script. VB Script embedded into HTML files extends HTML into something more than a page formatting language. Pages with VB Script can change every time when loading into the web browser. These also can respond intelligently to user action. VB Script is both a Client-side and Server-side programming language. A client-side programming language is a language that can be interpreted and executed by a web browser. A Server-side programming language is a language that executes on the server. This can be served a web site files [Stephen Walther, 1998]

3.5.5 Java Script

Java Script is a interpreting programming language or script language from Netscape. Java Script is another scripting extension to HML, extends the ability to respond user event without the need for Client-Server communication. Java Script eliminates much of the client-server communication by shifting responses to the use events such as use click and form activities to the client. Due to the network transmission is not needed, the process goes faster. In addition, fewer loads is incurred on the server.

3.5.6 Visual Basic.NET (VB.NET)

Visual Basic.NET is the next generation of Visual Basic 6.0. This tool is easy to use and implement for software development. It has many functions like controls

button features, database connection to SQL and other relational database. Applications will now run using the Common Language Runtime (CLR). All .NET applications will use this same runtime environment which allows Visual Basic applications to run on equal ground with other languages. CLR allows Visual Basic to provide inheritance and free threading whose absence created two glaring limitations to Visual Basic Applications.

Visual Basic .NET is object-oriented. Thus everything is now an object, and every object is inherited from a standard base class. VB.NET, propagating code from one module to another is now possible while only overriding the behavior that needs changed in the child class, thus improving maintainability. Another benefit of the CLR is a common type system, which means that all programming languages share the same types. This greatly increases interoperability between languages. Visual Basic .NET promotes new web applications. Web services allow objects to be located anywhere on the Internet and to be called from any application across the Internet and need not to get DCOM configured. These extending applications across the Internet will increase security risks. The .NET Framework has many security features built-in to it to protect the applications. [Grundgeiger, Dave. 2002]

The IDE for VB.NET will look very familiar. That is because the new Integrated Development Environment (IDE) used for VB.NET has integrated the best ideas from VB 6.0 and InterDev environments to provide a more effective way of getting work done. The cosmetic improvements in the new IDE are multimonitor support, tabbed forms, better layout for the toolbox, expandable code and live interactive help. [Wakefield, Cameron, et al. 2001]

Now VB.NET instead of compiling directly to hardware specific machine code, the compilation is performed to Microsoft Intermediate Language (MSIL). The

syntax of MSIL is similar to machine code, but any EXE or DLL containing MSIL will need to be reinterpreted after it is deployed to the destination machine.

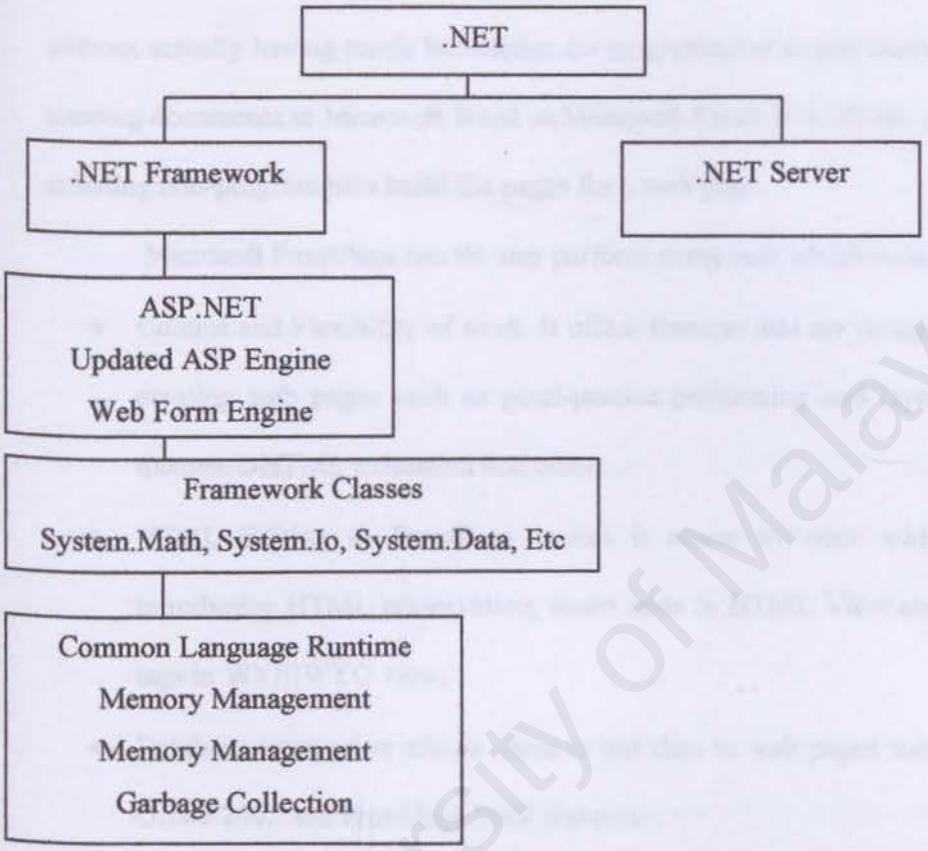

Figure 3.4: .NET Architecture

3.6 Web Application Development Tool

Microsoft FrontPage 2002

Microsoft FrontPage 2002 is the latest version of Microsoft FrontPage. It is a Microsoft's tool for creating and designing web pages. It let users create web pages without actually having much knowledge on programming or just like in the way of creating documents in Microsoft Word or Microsoft Excel. It is HTML editors aimed at letting non-programmers build the pages for a web page.

Microsoft FrontPage can let user perform many task which include:

- Control and Flexibility of work. It offers features that are designed to help in creating web pages such as pixel-precise positioning and layering, custom themes. DHTML animation and others.
- HTML Editing in FrontPage makes it easier to work with HTML by introducing HTML preservation, insert code in HTML View and see HTML tags in WYSIWYG view.
- Database Integration allows users to put data in web pages using Microsoft Office 2002 and FrontPage 2002 features.
- Web Technology Support of FrontPage 2002 supports the latest web technology such as editing HTML, DHTML, script, ASP and XML.
- Extensibility and Programmability. Microsoft Visual Basic can be used to build powerful FrontPage based solution and extend them across Microsoft Office application.

3.7 Database

3.7.1 Microsoft Access 2002

Microsoft Access is an easy to use database for managing data and also sharing data. New version of Ms Access not only provides traditional broad range of easy management tools but also adds increased integration with the web for easier sharing of data across a variety of platforms and user level. This has additional ease of use enhancements to assist with personal productivity. It also can build powerful Data Access Pages that enable user to easily open, view, and update live data within a web browser in the office or on the road.

User can quickly publish Access reports to the web using Internet-standard XML and Extensible Style sheet Language (XSL), allowing users to view reports within a web browser that supports HTML 4.0. User can create SQL Server-specific objects for the solutions using the graphical Query Designer and Stored Procedure Designer.

Ms Access is used as a prototyping database. The database can be exported to Microsoft SQL Server. The most advantage of Ms Access is let user easy to use and find information and also web enabled information sharing. This is also powerful solution for managing information in the server. Ms SQL Server has Interoperability and administration tools, hyperlink handling, drag and drop to excel and many other features. [Microsoft Corporation, 2001]

3.7.2 Microsoft SQL 2000

SQL Server 2000 is a high performance database management. This has user defined function which one or more Transact SQL statements that can be used to encapsulate code for reuse. Besides, it also has distributed partitioned views, so that allow user to partition tables horizontally across multiple servers. By doing so, users can scale out one database server to a group of database servers that cooperate to provide the same performance levels as a cluster of database servers.

The SQL Server 2000 Query Analyzer is not only a great tool for developing and debugging Transact-SQL code, it is also a great tool for performance tuning Transact-SQL code. In this section we will take a look at what the Query Analyzer can do, and also learn a little about how it can be used to help identify and resolve performance problems. And like many of the more advanced SQL Server 2000 tools, you need to have a fairly good understanding of Transact-SQL to get the most out of this tool. Let's take a look at some of the key features included with Query Analyzer that can be used to help performance tune Transact-SQL code. [Patton, Robert. A. et al, 2001]

SQL Server 2000 Enterprise Edition on the Windows 2000 Data Center can support up to 32 CPU and up to 64GB physical memory (RAM) on a computer. On the other hand, SQL Server 2000 can use XML to insert, update, and delete values in the database, and database engine can return data as Extensible Markup Language (XML) documents.

3.8 Interface Design Tool

3.8.1 Adobe Photoshop version 6.0

Adobe Photoshop 6.0 is a tool that can be used to design graphic and also enhance existing picture to make it more suitable to put on the web site of Traffic Information System. It can help to design the interface in the Traffic Information System in order to make this web site clear. Photoshop can save the graphic or picture in various normal files like .BMP, .GIF, .JPG, .PDF, .TIF and etc. Normally pictures are saved as .JPG file for interface in web site, this is because storage size of JPEG is small compare to others.

Most of the graphics like background, button, logo, border and templates in the system are designed by using Photoshop. It is useful for back end and front end. There are many features that can be use in the Photoshop like cloning, filter, lasso tool, crop tool, eyedropper tool and etc.

3.9 Summary

This chapter is important to identify methodology and development tools for TIS. Various may use in the system for development Purpose. Next chapter is System Analysis to survey on requirements of the system.

4.1 Introduction

System Analysis is an essential and important phase that is used to determine clearly of the entire necessary requirement for TIS. Installation a system without proper planning and analyzing leads to changes of failure and may cause the system to fall into disuse.

System Analysis enables developer to specify system functional and performance indicates system interface with other system elements and establishes design constraints that the system must meet. A complete understanding of system is essential to the success of a system development effort. No matter how well designed or well coded, a poorly analyzed and specified system will disappoint the user and bring grief to the developer. System Analysis is done for Traffic Information System in order to analyze system thoroughly for the Functional Requirement, Non Functional Requirement, Hardware Requirement and Software Requirement.

In designing new system, the analyst must consider the requirement of the major user and other user as well as determine the extent of their dependency. A new system seldom meets the requirement of all users. In determining the users' requirement on understanding must be reached as what can be expected of the system.

It is important to draw out the TIS requirement to provide guideline for developing the system. A requirement is a feature that will be offered by the system and also description of something that the system is capable of doing in order to fulfill the system's purpose.

4.2 Functional Requirement

The functional requirement describes an interaction between the system and its environment. It also describes how the system should behave given on certain stimuli. The important things are that the questions addressed by the functional requirement, meet the answers that are independent of an implementation of a solution of the problem. The functional requirement for TIS is split into two main groups of user.

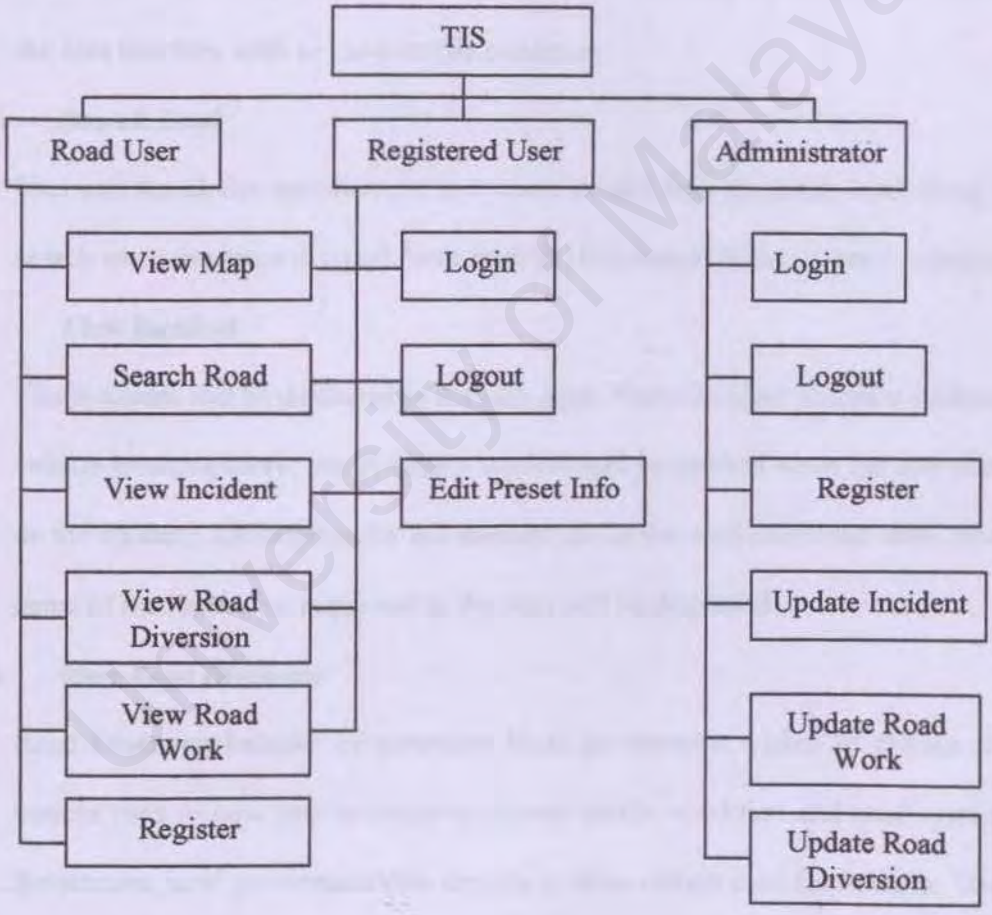

Figure 4.1: Functional Requirement Chart

4.2.1 Public User (Road User)

Modules can be performed by the public user in the Traffic Information System.

i. ***Registration***

A user is optional to register as member for the Traffic Information System. Extra Functions will be indicated for the member. User is given a web form to fill up details for registration as member. User will be requested to choose a username and password to login to the web page in the next time.

ii. ***View Map***

A Kuala Lumpur map is in the TIS. User can view the map information to choose the area that they wish to know traffic condition.

iii. ***Search Road***

User can search the specific road to retrieve details info about the road. Road is search when the name is typed. User need to click search button to start searching.

iv. ***View Incident***

The incidents will be displayed in the web page. These incident included accident, vehicle breaking down, etc. A details incident will be showed when the user click on the incident. Description for the incident about the road condition, date, time, name of road and what happened to the road will be displayed.

v. ***View Road Diversion***

Road Diversion because of sometime local government wishes to change the current road to new way to improve current traffic condition and road system. Sometimes, local government also intends to close certain road for function. User can view this kind of traffic info in this web page. User can click on the appropriate Road Diversion for the description of it.

vi. ***View Road Work***

Road Work of installing new pipe or electric equipment on the road, upgrading current road and etc. Sometimes, contractor may close part of the road for this purpose. These road works may cause traffic jam. User can click on the Road Work to get the details description it.

4.2.2 Registered Public User (Member)

A registered public user can perform the functions that are given to the public user who has not registered as a member. This group of user has more function to use.

i. ***Login***

The registered user need to login to website to use the extra functions in the web site. A user has username and password to login for the web site.

ii. ***Logout***

After getting information needed in the web site, user can logout for the web page to protect the info that in the database.

iii. ***Edit Preset Info***

After login to the web site, users can set the traffic info in the web site. As a member, users can preset this info. By doing so, users need not to search the same area every day. They can view this traffic condition in particular area immediately after login.

4.2.3 Administrator

i. ***Register***

An administrator needs to register in the web page.

ii. ***Login***

If administrator want to perform any function such as Update Info, he/she need to login to the web site. Administrator is requested to choose username and password when registering. Authentication of username and password is needed before entering to system. Administrator has the right to edit, delete info about the traffic in the web site.

iii. ***Logout***

After administrator login to the web site and perform any function. Administrator can logout web site for protecting info in the web page.

iv. ***Update Incident***

Administrator can update incident after getting info about any accident, vehicle breaking down, etc. and state the road condition for that road. Administrator will update info according to the time of event. These are sorted by time. Administrator also requires adding description to the Incident. Administrator can delete unwanted incident data from the web page.

v. ***Update Road Work***

Administrator can update road work after getting info about equipment installation along the road, piping, upgrading road, etc which will has impact to the road user. Administrator will update info according to the time of road work. Administrator also needs to add description to the Road Work. Administrator can delete outdated data from the web page.

vi. ***Update Road Diversion***

Administrator can update road diversion after getting info about road closure in certain road. Administrator will update info according to the time of this event. Administrator also needs to add description to the Road Diversion. Administrator can delete Road Diversion info that outdated from the web page.

4.2.4 Use Case Diagram

Use Case is a sequence of action that an actor performs within the system to achieve particular goal. Actor represents a user can play role to system. Actors in TIS include Administrator, Road User and Registered Road User (Member). TIS is modeled into Use Case Diagram to improve understanding for the system. A good use case is expressed from the viewpoint of the actor. The total set of use cases within that model should capture the entire functional requirement of the system. [Scott, kendall, 2001]

Administrator Use Case Diagram

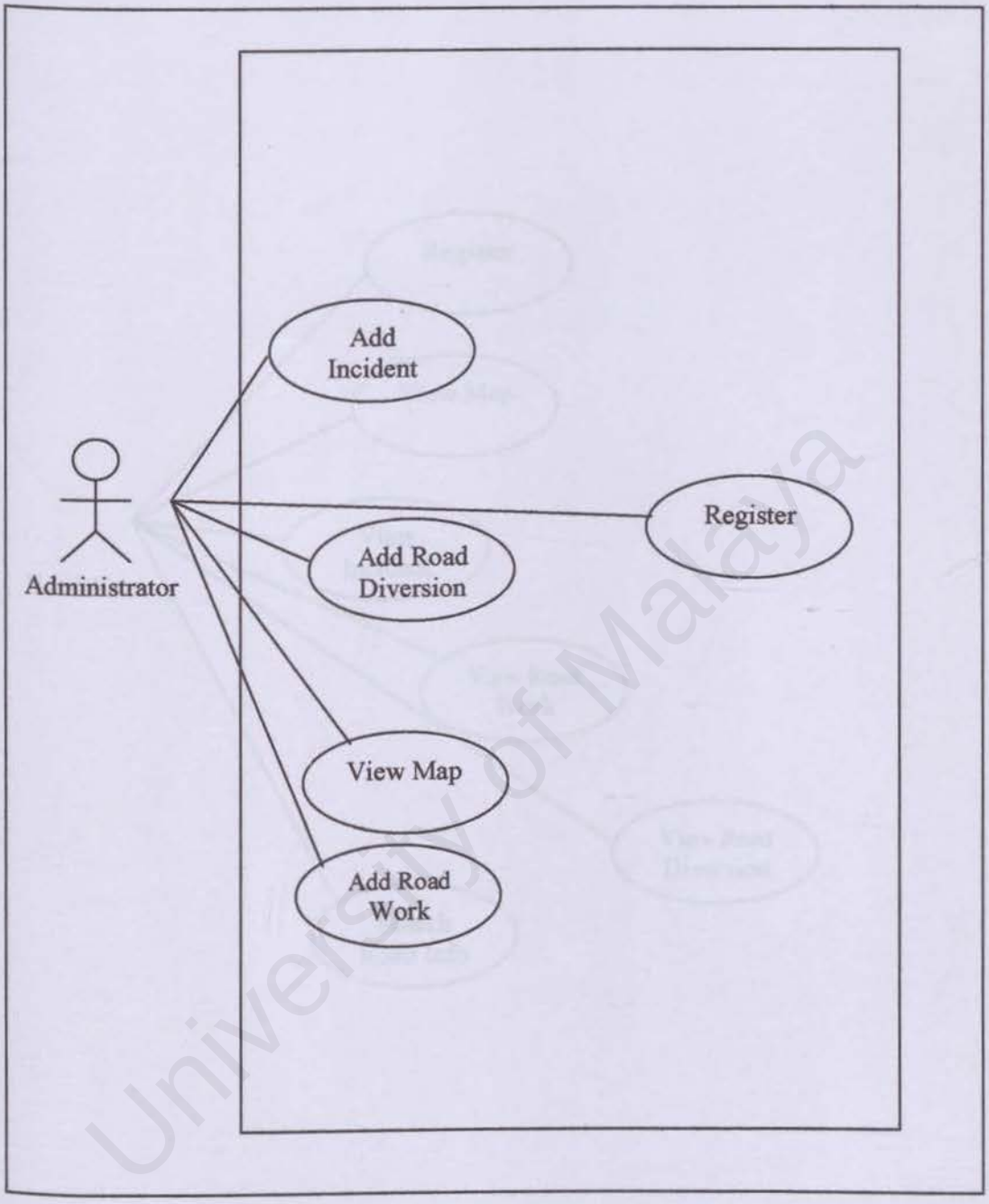

Figure 4.2: Administrator Use Case Diagram

Road User Use Case Diagram

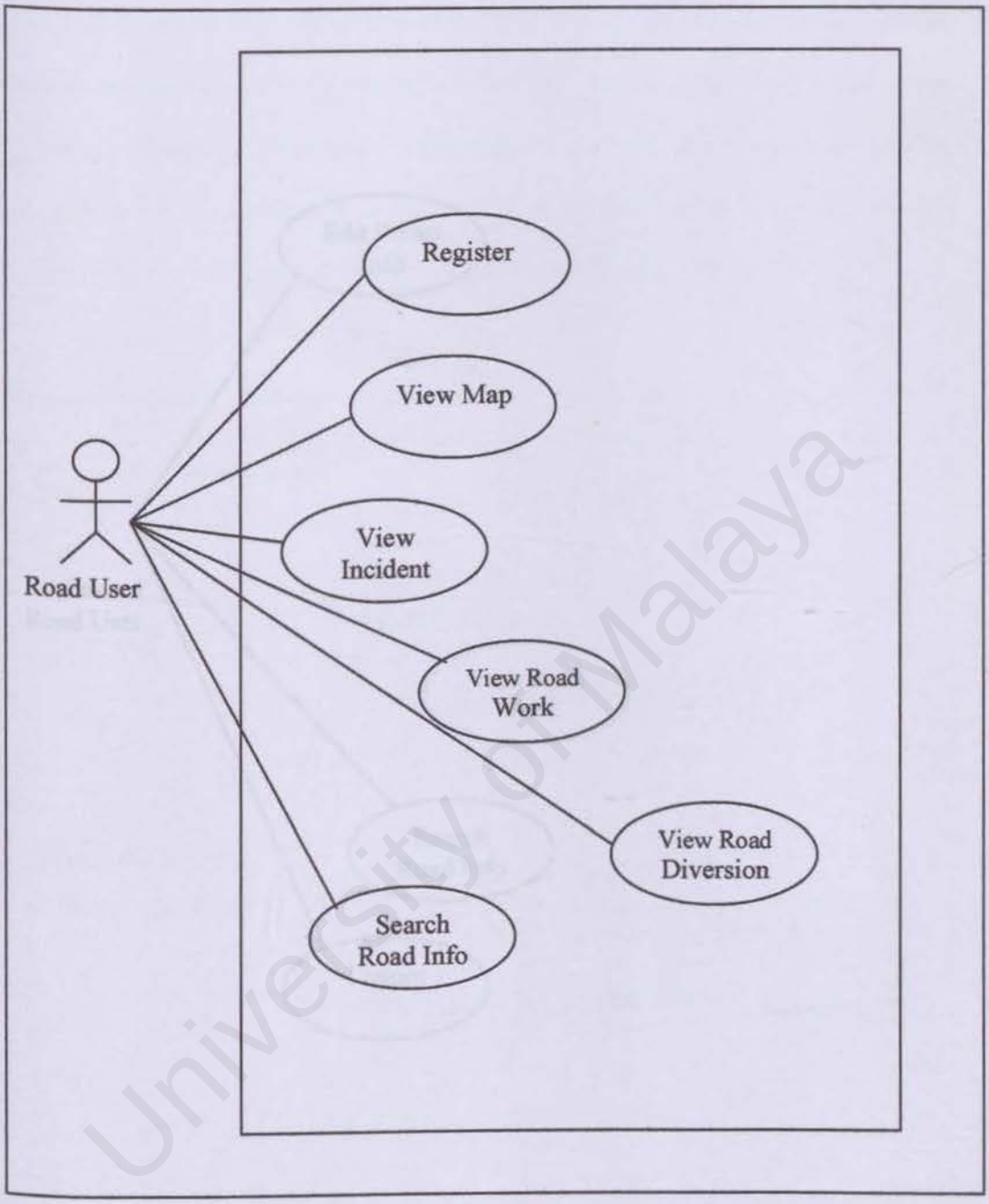

Figure 4.3: Road User Use Case Diagram

Registered Road User Use Case Diagram

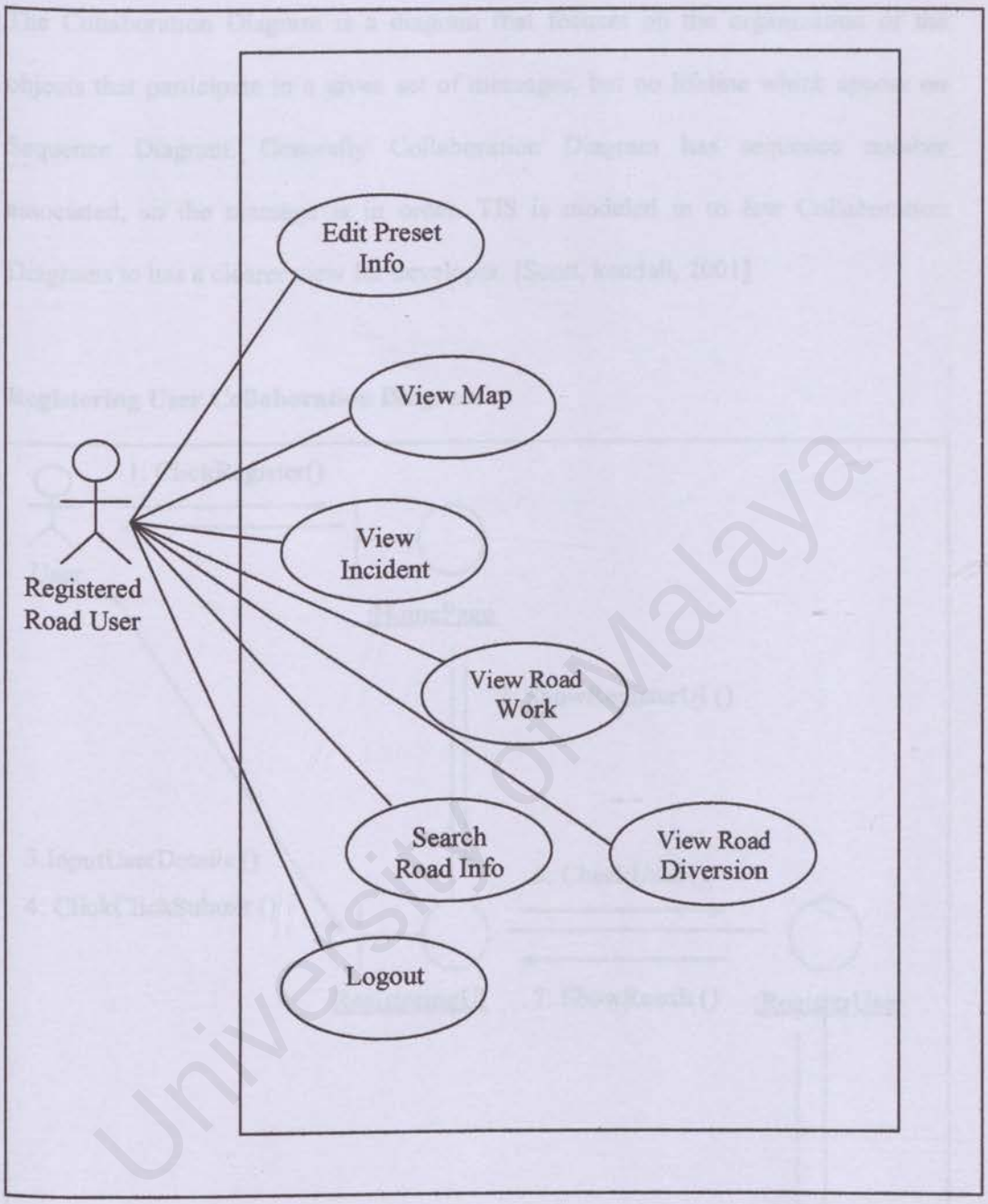

Figure 4.4: Registered Road User Use Case Diagram

4.2.5 Collaboration Diagram

The Collaboration Diagram is a diagram that focuses on the organization of the objects that participate in a given set of messages, but no lifeline which appear on Sequence Diagram. Generally Collaboration Diagram has sequence number associated, so the message is in order. TIS is modeled in to few Collaboration Diagrams to has a clearer view for developer. [Scott, kendall, 2001]

Registering User Collaboration Diagram

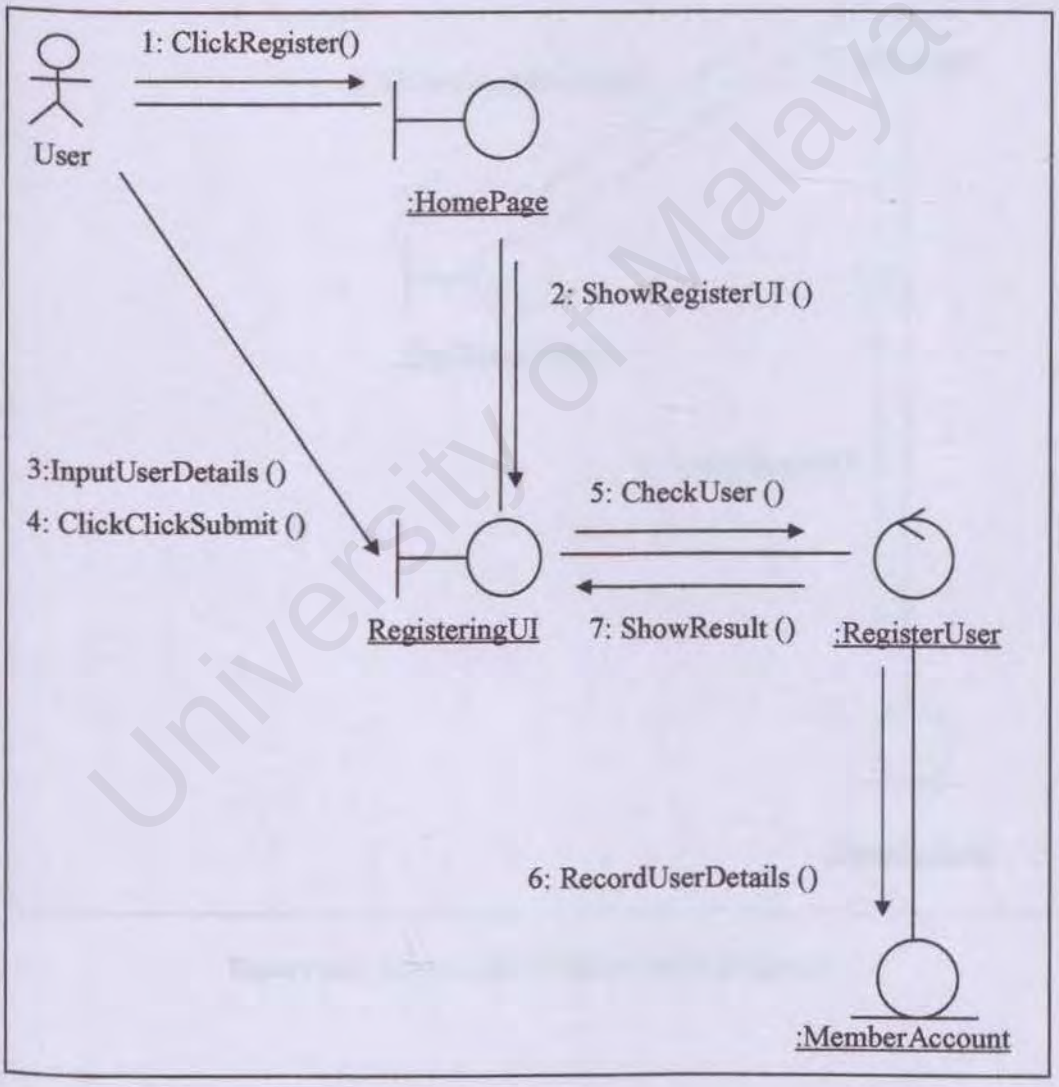

Figure 4.5: Registering User Collaboration Diagram

User Login Collaboration Diagram

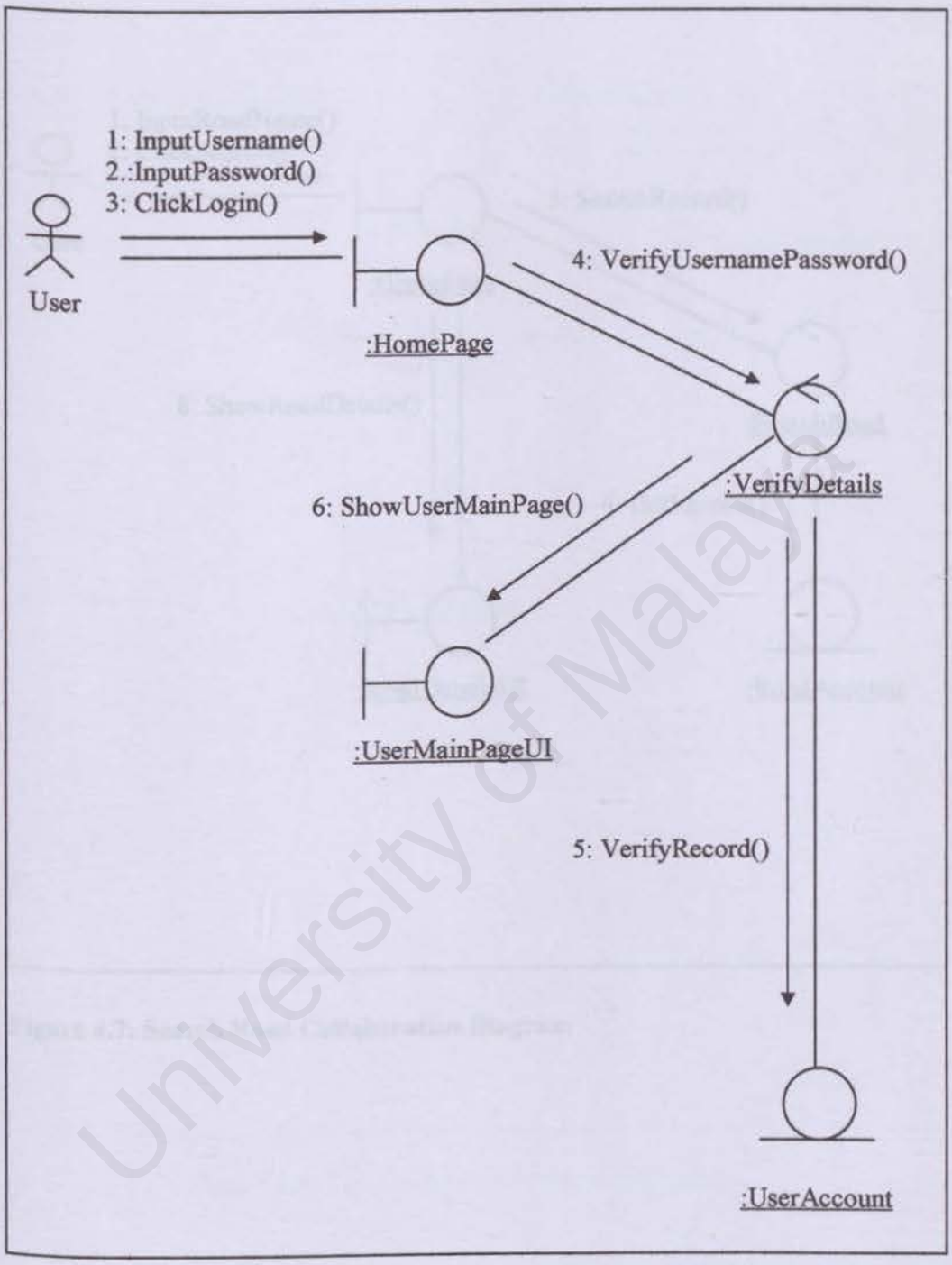

Figure 4.6: User Login Collaboration Diagram

Search Road Collaboration Diagram

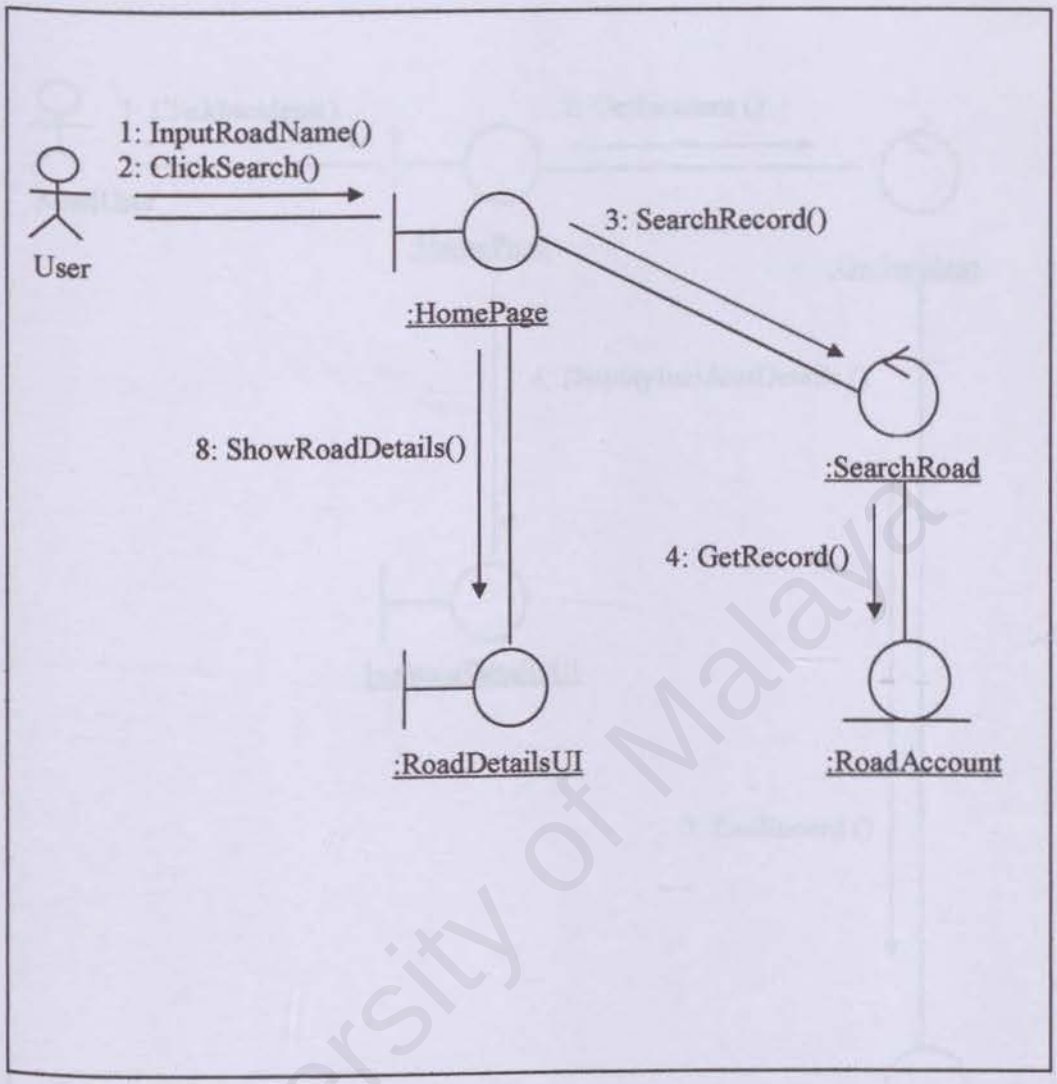

Figure 4.7: Search Road Collaboration Diagram

View Incident Collaboration Diagram

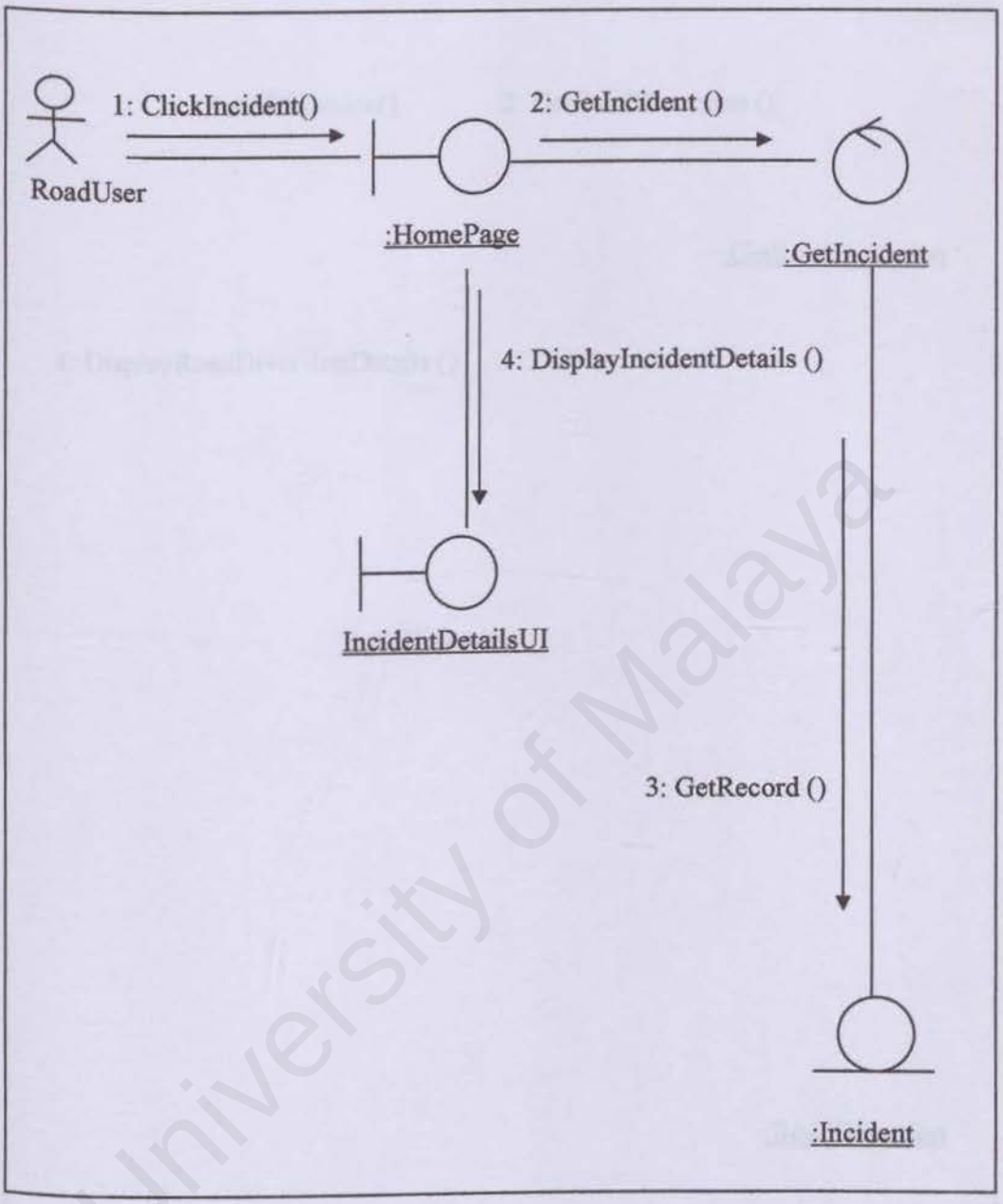

Figure 4.9: View Incident Collaboration Diagram

View Road Diversion Collaboration Diagram

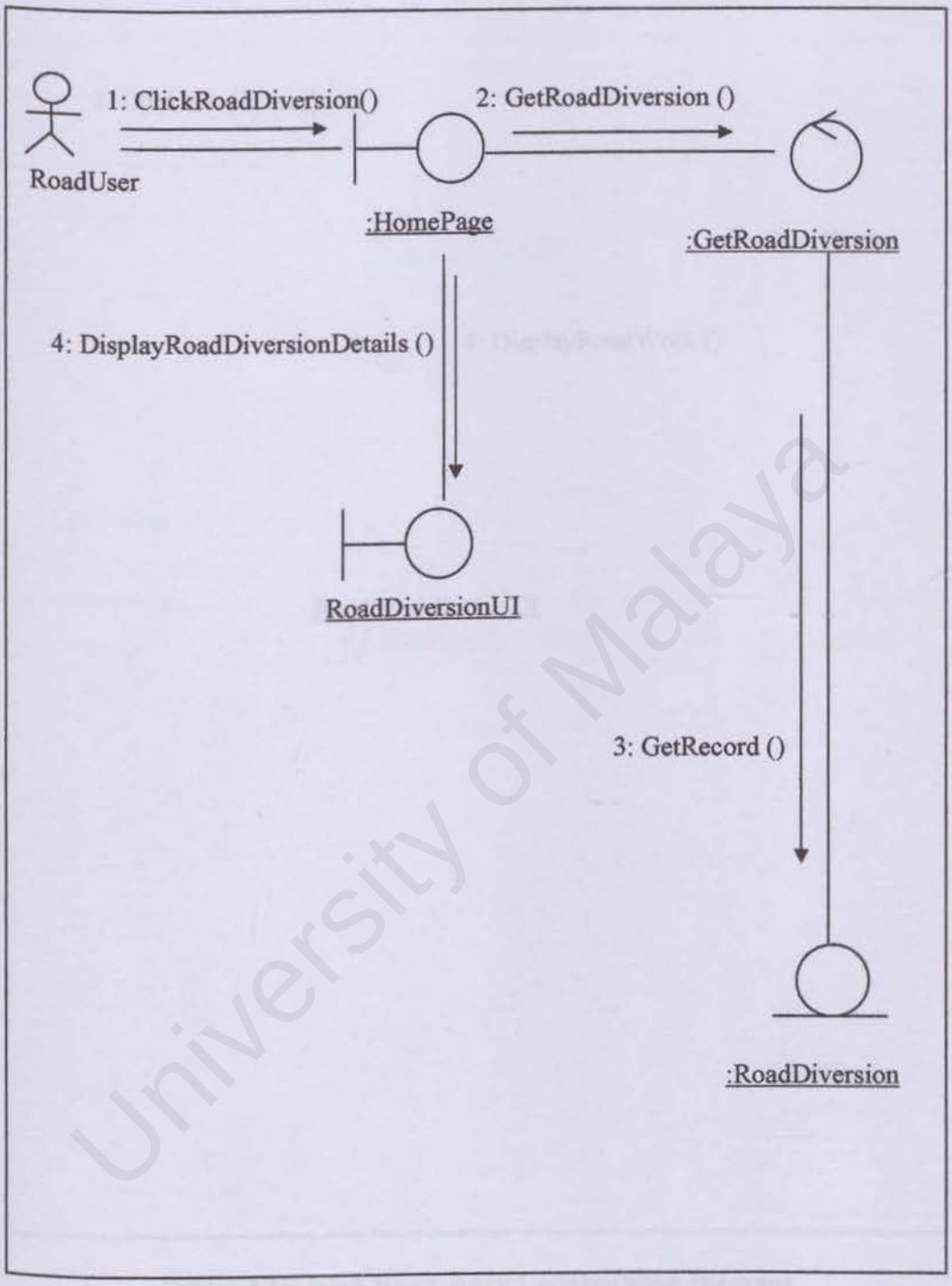

Figure 4.10: View Road Diversion Collaboration Diagram

View Road Work Collaboration Diagram

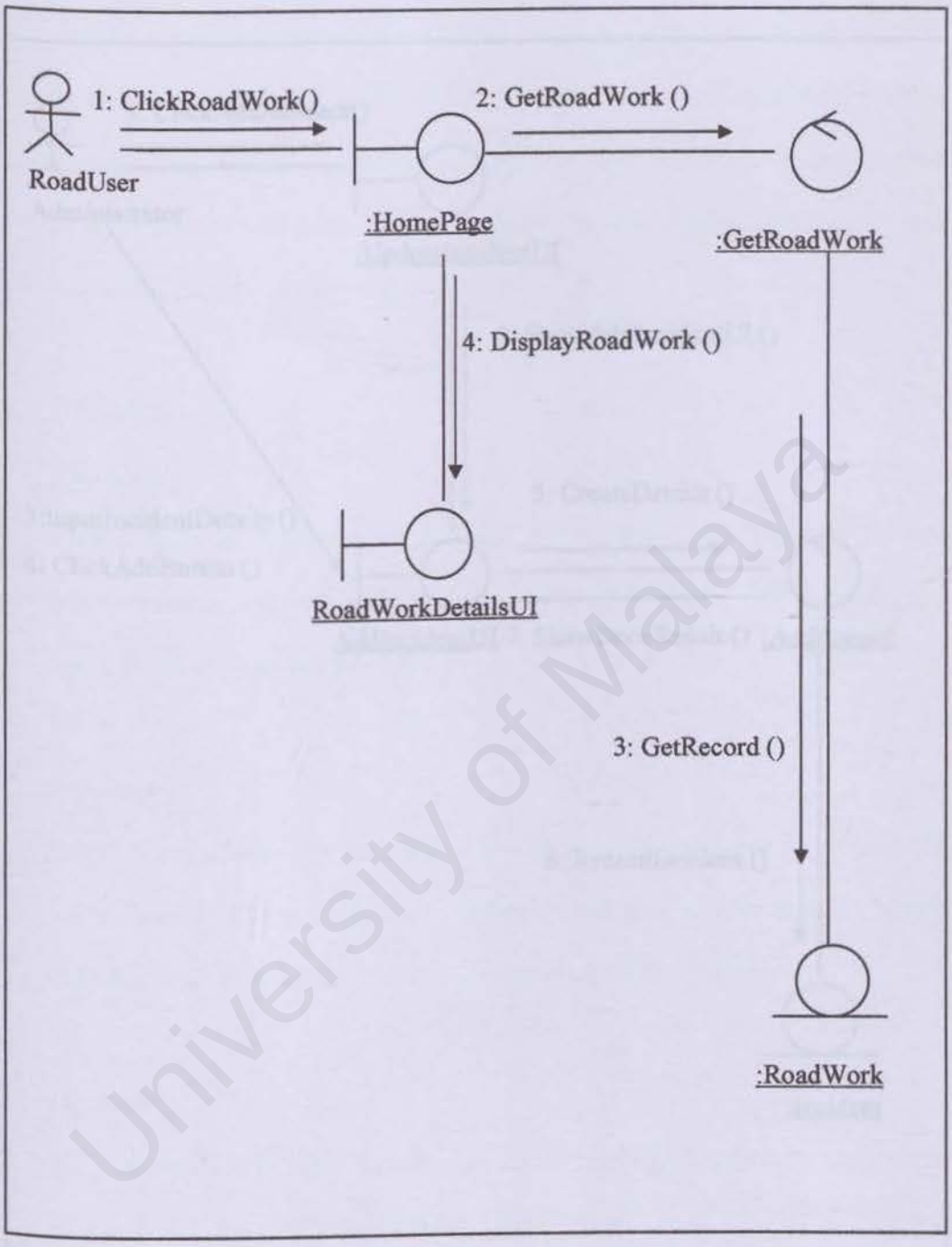

Figure 4.11: View Road Work Collaboration Diagram

Add Incident Collaboration Diagram

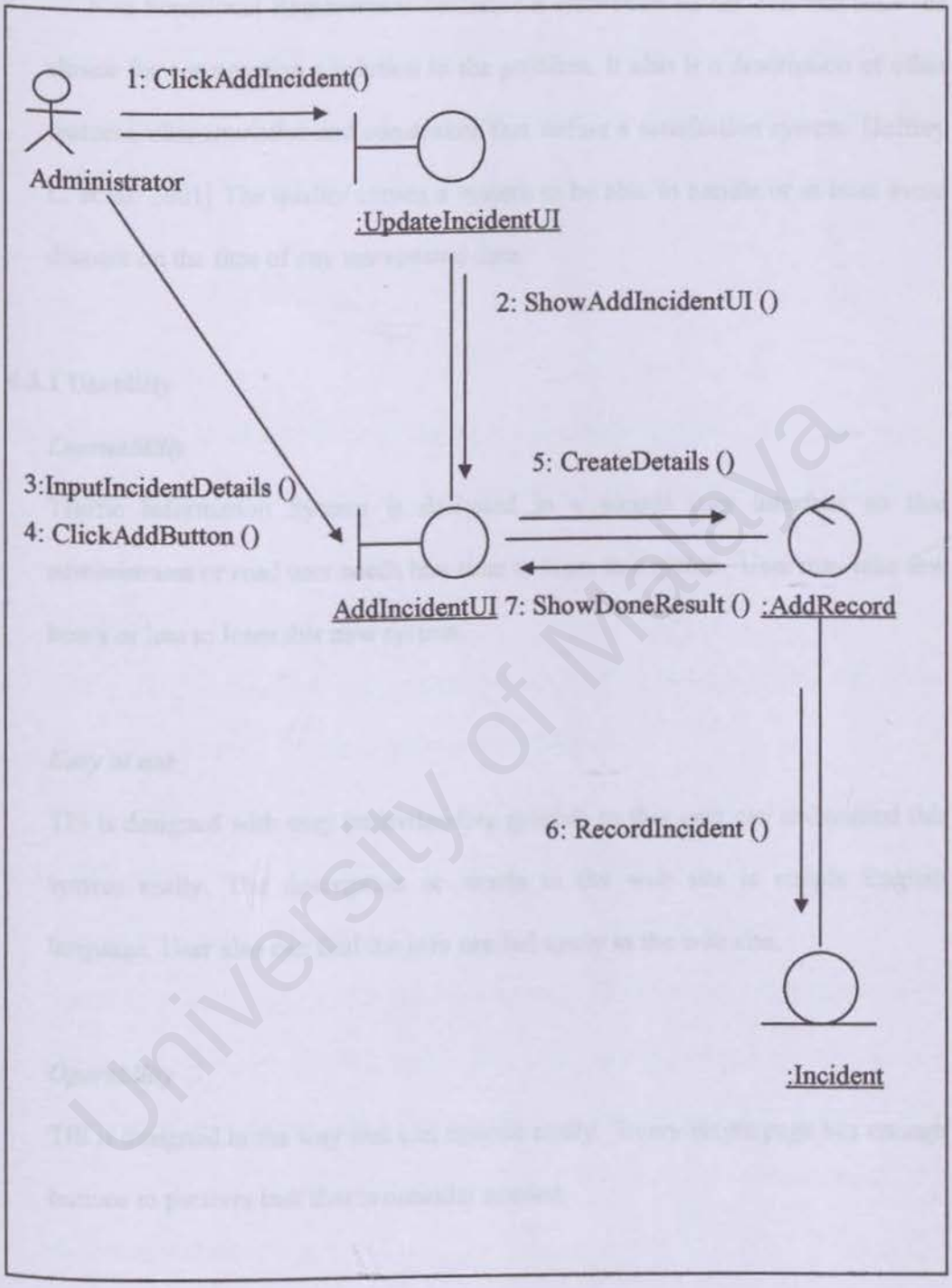

Figure 4.15: Add Incident Collaboration Diagram

4.3 Non Functional Requirement

Non Functional Requirement describes a restriction on the TIS that limit the choice for construction a solution to the problem. It also is a description of other features, characteristics and constraints that define a satisfaction system. [Jeffrey L, et. al. 2001] The quality causes a system to be able to handle or at least avoid disaster on the face of any unexpected data.

4.3.1 Usability

Learnability

Traffic Information System is designed in a simple user interface so that administrator or road user needs less time to learn this system. User may take few hours or less to learn this new system.

Easy to use

TIS is designed with easy understanding graphic so that user can understand this system easily. The description or words in the web site is simple English language. User also can find the info needed easily in the web site.

Operability

TIS is designed in the way that can operate easily. Every single page has enough buttons to perform task that is consider needed.

4.3.2 Reliability

Recoverability

Administrator can recover data that deleted from the web page accidentally.

High Performance

Reliable of a system is defined to be the ability of the system to behave consistently in a user acceptable way when users intend to use TIS. It is related to the performance of TIS. High performance system is needed to ensure all the user can use TIS with satisfaction no matter how many user access TIS at the same time.

Fault Tolerance

Becoming a reliable system, TIS need to have fault tolerance so that percentage of fault is minimized. By the way, a simple fault will not influent this web site.

Availability

TIS is ready in any time for the user to connect for obtaining traffic info. Dead link and broken link will not appear in the web page.

4.3.3 Efficiency

Faster Processing (Speed)

Speed for a transaction in TIS is very important because major end users are the worker who based in Kuala Lumpur city, they wish to perform any task in very short period. TIS is designed in the faster way to process a request.

Resource Behavior

System efficiency refers to the level at which the system uses scarce system resources. Type of these resources included machine cycles, memory, disk space, buffer and communication channel. [Davis & Mark, Alan. 1993]

4.3.4 Maintainability

Stability

Stability is important for any system which include TIS. The system can perform perfectly without any error or with minimum errors. Besides, system will not be hanging in a certain page only.

Testability

The system can be test for retrieving or discover any error in the web site.

4.4 Hardware Requirement

Client Hardware Requirement

Table 4.1: Hardware Specification for Client (User of Internet)

Hardware	Minimum Requirement
Processor	Intel Pentium 166Mhz
Memory (RAM)	16MB
Hard Disk	2GB
Display (Monitor)	VGA/SVGA Graphic Adapter Best Viewing 800x600 pixels
Network (Internet)	Network Card/ 56K Modem
Pointing Device	Mouse and Keyboard

Server Hardware Requirement

Table 4.2: Hardware Specification for Server

Hardware	Minimum Requirement
Processor	Intel Pentium 566Mhz
Memory (RAM)	128MB
Hard Disk	30GB
Display (Monitor)	VGA/SVGA Graphic Adapter Best Viewing 800x600 pixels
Network (Internet)	Network Card/ 56K Modem
Pointing Device	Mouse and Keyboard
Drive	CD-ROM

Development Environment Hardware Requirement

Table 4.3: Hardware Specification for Development

Hardware	Minimum Requirement
Processor	Intel Pentium 566Mhz
Memory (RAM)	128MB
Hard Disk	10GB
Display (Monitor)	VGA/SVGA Graphic Adapter Best Viewing 800x600 pixels
Network (Internet)	Network Card/ 56K Modem
Pointing Device	Mouse and Keyboard
Drive	CD-ROM

4.5 Software Requirement

Client Software Requirement

Table 4.4: Software Specification for Client (User of Internet Access)

Software	Requirement
Operating System	Windows 98, ME, 2000(Any version), XP
Web Browser	Microsoft Internet Explorer 5.5 Microsoft Internet Explorer 6.0

Server Software Requirement

Table 4.5: Software Specification for Server

Software	Requirement
Operating System	Windows 2000
Web Browser	Microsoft Internet Explorer 5.5 Microsoft Internet Explorer 6.0
Web Server	Microsoft's Internet Information Server (IIS)
DBMS	Microsoft SQL Server 2000

Development Software Requirement

Table 4.6: Software Specification for Development

Software	Requirement
Operating System	Windows 2000
Web Browser	Microsoft Internet Explorer 5.5 Microsoft Internet Explorer 6.0
Web Server	Microsoft's Internet Information Server (IIS)
DBMS	Microsoft SQL Server 2000 Microsoft Access
Graphic	Adobe Photoshop 6.0
Documentation	Microsoft Word
Development	Microsoft Visual Studio .NET Framework

4.6 Summary

After System Analysis for the requirement of TIS, functional requirement and non functional requirement had been identified. The next chapter is to discuss on the system design.

5.1 Introduction

In this chapter, the details of how the system meets the requirements are identified during requirement phase. User requirement is transformed into a working model, so that can be used as guidance before developing the complete system.

System Design that involve in this phase include:

- To transform requirement of TIS into a working system
- To determine a set of components and inter component interfaces that satisfy a specified set of requirement for TIS
- To model database into class diagram
- To draft database design and table of database

System design involves architecture design, database design and graphical user interfaces design. The architecture design decomposed a system into subsystem. Each subsystem is further decomposed into modules. The database design identifies the way the data may be stored in the database. The graphical user interface design specifies the use of the user interfaces controls to implement the architecture.

5.2 System Architecture Design

Traffic Information System will be using the three-tier client server architecture which based on few reasons. First, this type of application usually road user (client) needs not access the data storage system directly. Secondly, it allows for any part of the system to be modified without having to change the other two parts. By doing so, the system can operate at its highest efficiency, no matter how the load on the system.

Three tier Client Server Architecture

In the TIS, the frontier will be the application tier consists of all the necessary application. In this layer, the main application component that appears to user is the Internet Explorer or other web browsers. This layer will provide the user interface. HTML or ASP.NET (Web Application) is used to activate the application layer. The application always resides within the web application server.

The following is the middle tier which is known as functionality or service tier. The communication between this tier and the frontier depends on the Hypertext Transfer Protocol (HTTP) for the web pages transfer. The functionality tier consists of the components that are created to support the TIS such as password verification and others. The Internet Information Server in this tier will process the request from the client and produce the result in web pages format. This server will also process any data request of the user by linking to the database server which contain in the bottom tier.

At last, the bottom tier is the data repository for TIS. The data repository is built up by the SQL database which is the main database for the system. The component in the middle tier is connected with the SQL database in the bottom tier through the combination of the Structured Query Language (SQL) and JDBC

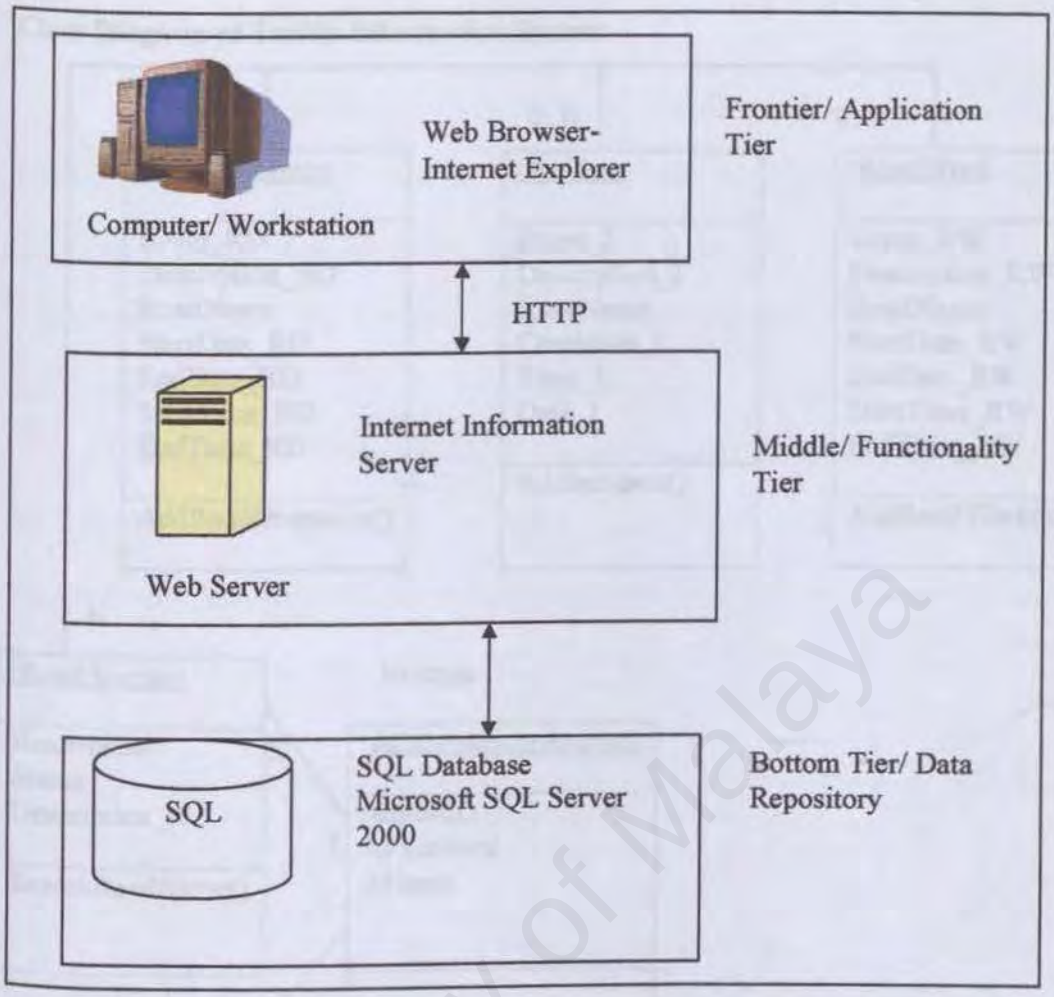

Figure 5.1: TIS Three Tier Client Server Architecture

5.3 Class Diagram

Class Diagram is used in TIS. A class is a collection of object that has same characteristics. A class has identified in the form of human readable name that is unique in a particular context. An object name, if it is human readable, it may include the name of the class to which the object belongs. A class does not have state like an object class. The top compartment contains name of class, second compartment contains the attributes that belong to class and the bottom compartment contains operations of class.

Class Diagram of Traffic Information System

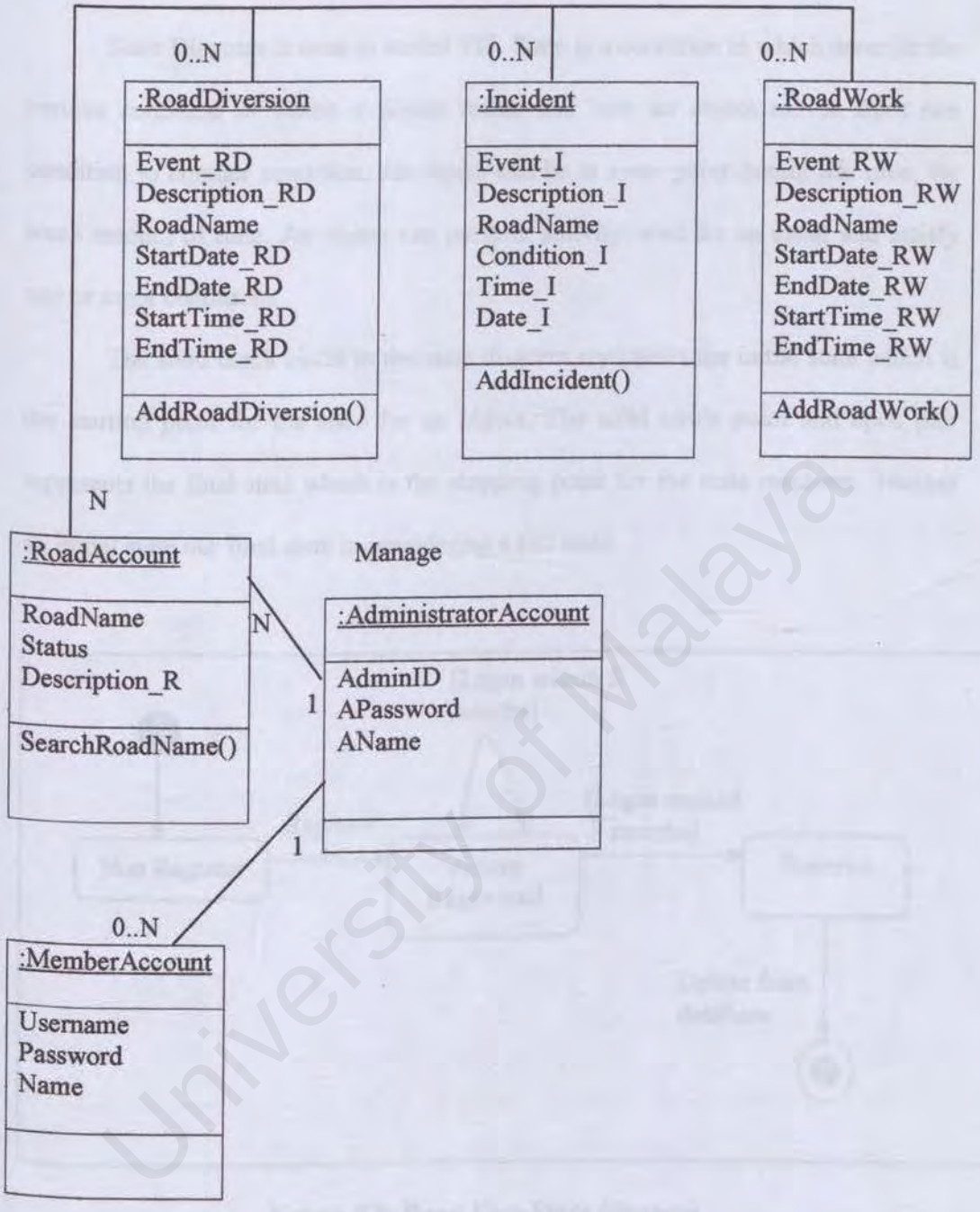

Figure 5.2: Traffic Information System Class Diagram

5.4 State Diagram

State Diagram is used to model TIS. State is a condition in which describe the various condition in which n object reside and how an object moves from one condition to another condition. An object can be at some point during life time, for some amount of time. An object can perform activity, wait for an event and satisfy one or more conditions.

The solid block circle in the state diagram represents the initial state which is the starting point for the state for an object. The solid circle point and open pair represents the final state which is the stopping point for the state machine. Neither an initial state nor final state is considering a full state.

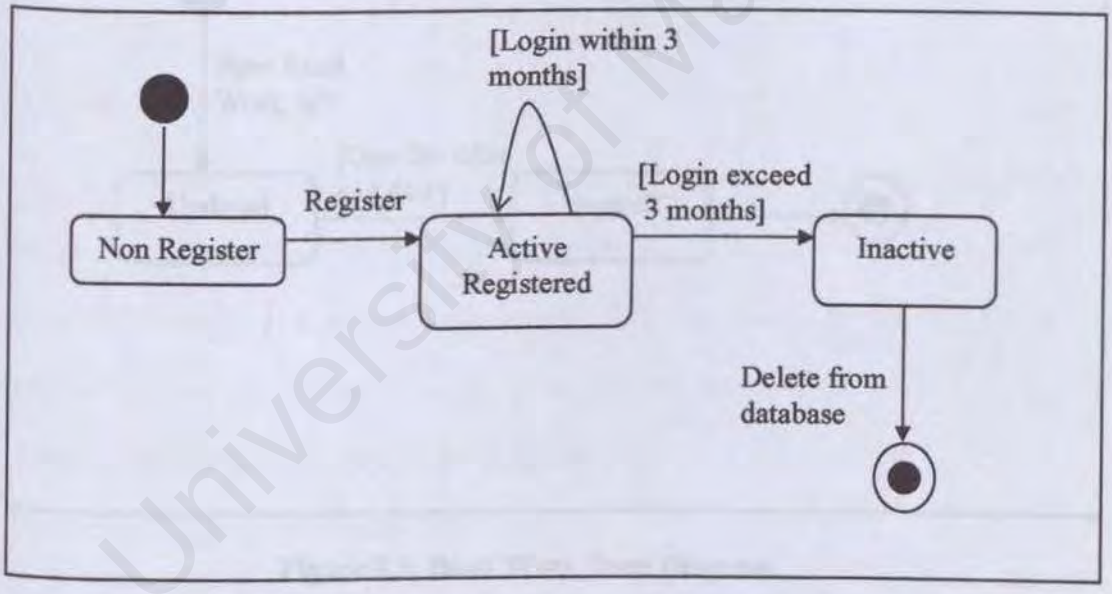

Figure 5.3: Road User State Diagram

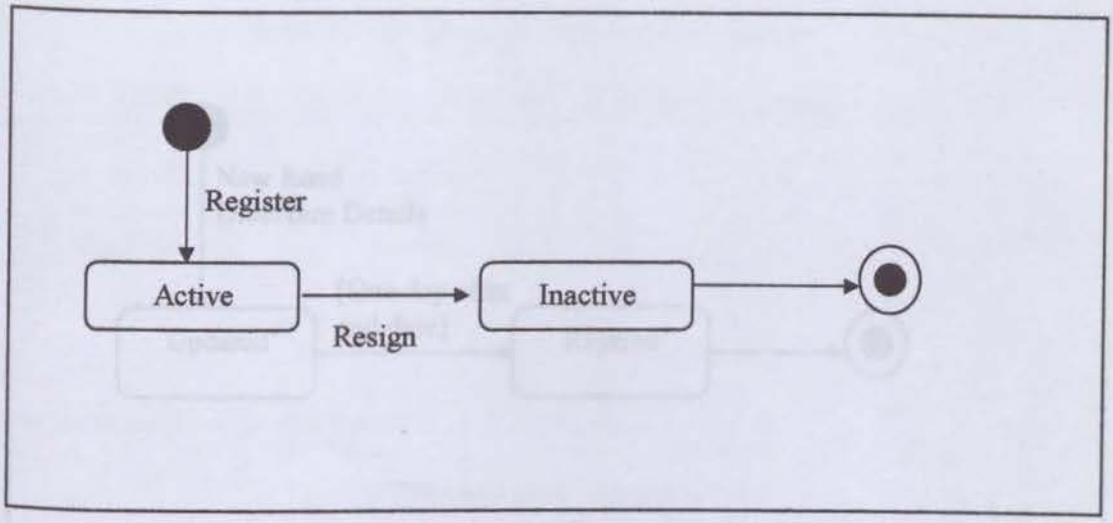

Figure 5.4: Administrator State Diagram

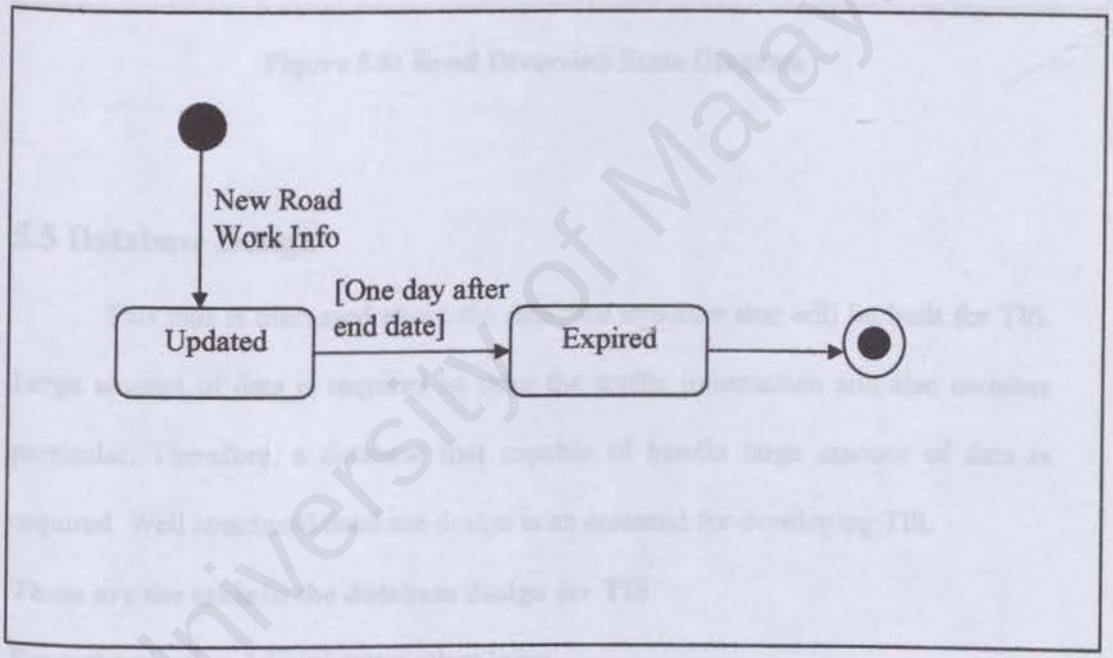

Figure 5.5: Road Work State Diagram

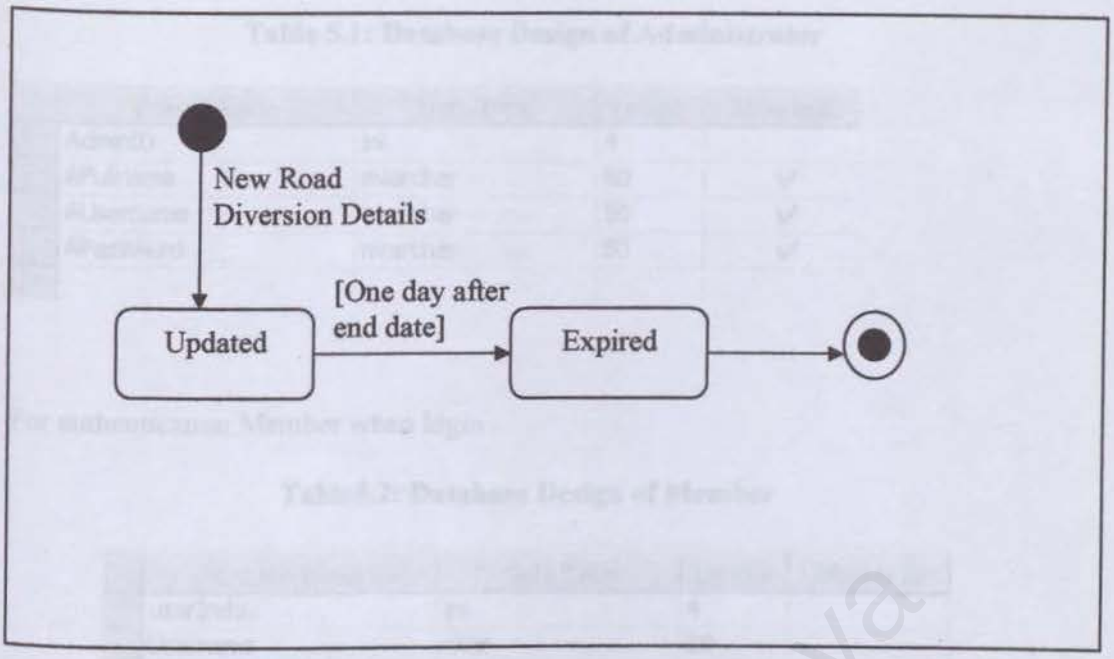

Figure 5.6: Road Diversion State Diagram

5.5 Database Design

This part is discussed about the database structure that will be built for TIS. Large amount of data is required to store the traffic information and also member particular. Therefore, a database that capable of handle large amount of data is required. Well structured database design is an essential for developing TIS.

These are the table in the database design for TIS

For authentication Administrator when login

Table 5.1: Database Design of Administrator

Column Name	Data Type	Length	Allow Nulls
AdminID	int	4	
AFullname	nvarchar	50	✓
AUsername	nvarchar	50	✓
APassword	nvarchar	50	✓

For authentication Member when login

Table5.2: Database Design of Member

Column Name	Data Type	Length	Allow Nulls
userIndex	int	4	
Username	char	20	
Password	char	12	✓
Title	char	5	✓
Name	varchar	30	✓
Gen	char	6	✓
AgeRange	varchar	6	✓
BirthDate	smallint	2	✓
BirthMonth	char	3	✓
BirthYear	int	4	✓
Address1	nvarchar	50	✓
Address2	nvarchar	50	✓
Postcode	char	5	✓
State	varchar	20	✓
Telephone	char	11	✓
Email	char	30	✓
Occupation	char	30	✓

Table 5.3: Database Design of Road

Column Name	Data Type	Length	Allow Nulls
RoadID	int	4	☐
RoadName	varchar	80	
Status	varchar	100	✓
Description	varchar	1000	✓

Table 5.4: Database Design of Incident

Column Name	Data Type	Length	Allow Nulls
CategoryID	int	4	☐
InID	int	4	
RoadName	varchar	80	
Event_I	varchar	200	✓
Description_I	varchar	1000	✓
Condition_I	varchar	100	✓
Time_I	datetime	8	✓
Date_I	datetime	8	✓

Table 5.5: Database Design of Road Work

Column Name	Data Type	Length	Allow Nulls
CategoryID	int	4	
RwID	int	4	
RoadName	varchar	80	
Event_RW	varchar	100	✓
Description_RW	varchar	1000	✓
StartDate_RW	datetime	8	✓
EndDate_RW	datetime	8	✓
StartTime_RW	datetime	8	✓
EndTime_RW	datetime	8	✓

Table 5.6: Database Design of Road Diversion

Column Name	Data Type	Length	Allow Nulls
CategoryID	int	4	☐
RdID	int	4	
RoadName	varchar	80	
Event_RD	varchar	200	✓
Description_RD	varchar	1000	✓
StartDate_RD	datetime	8	✓
EndDate_RD	datetime	8	✓
StartTime_RD	datetime	8	✓
EndTime_RD	datetime	8	✓

5.6 ER Diagram

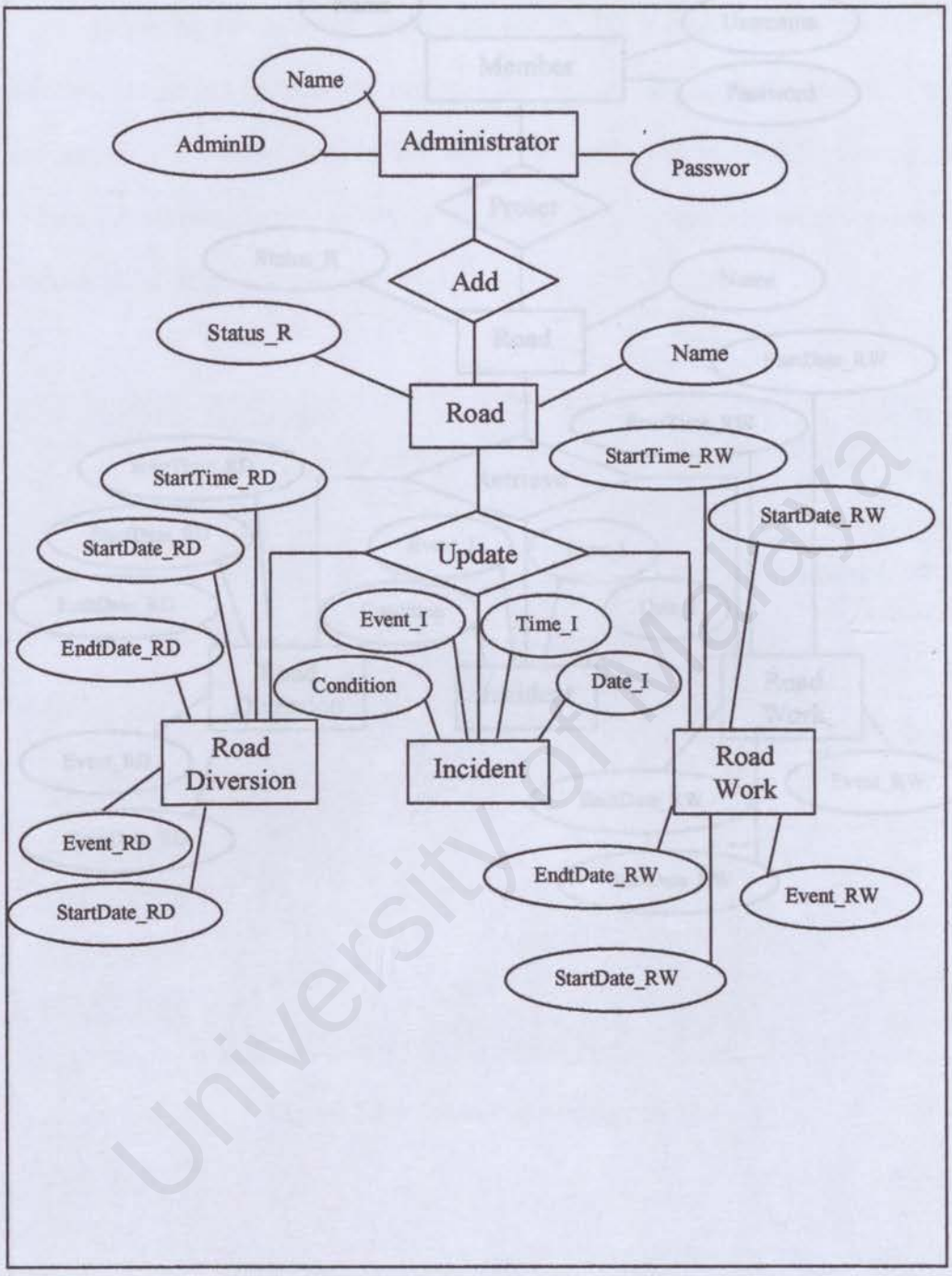

Figure 5.8: Administrator ER Diagram

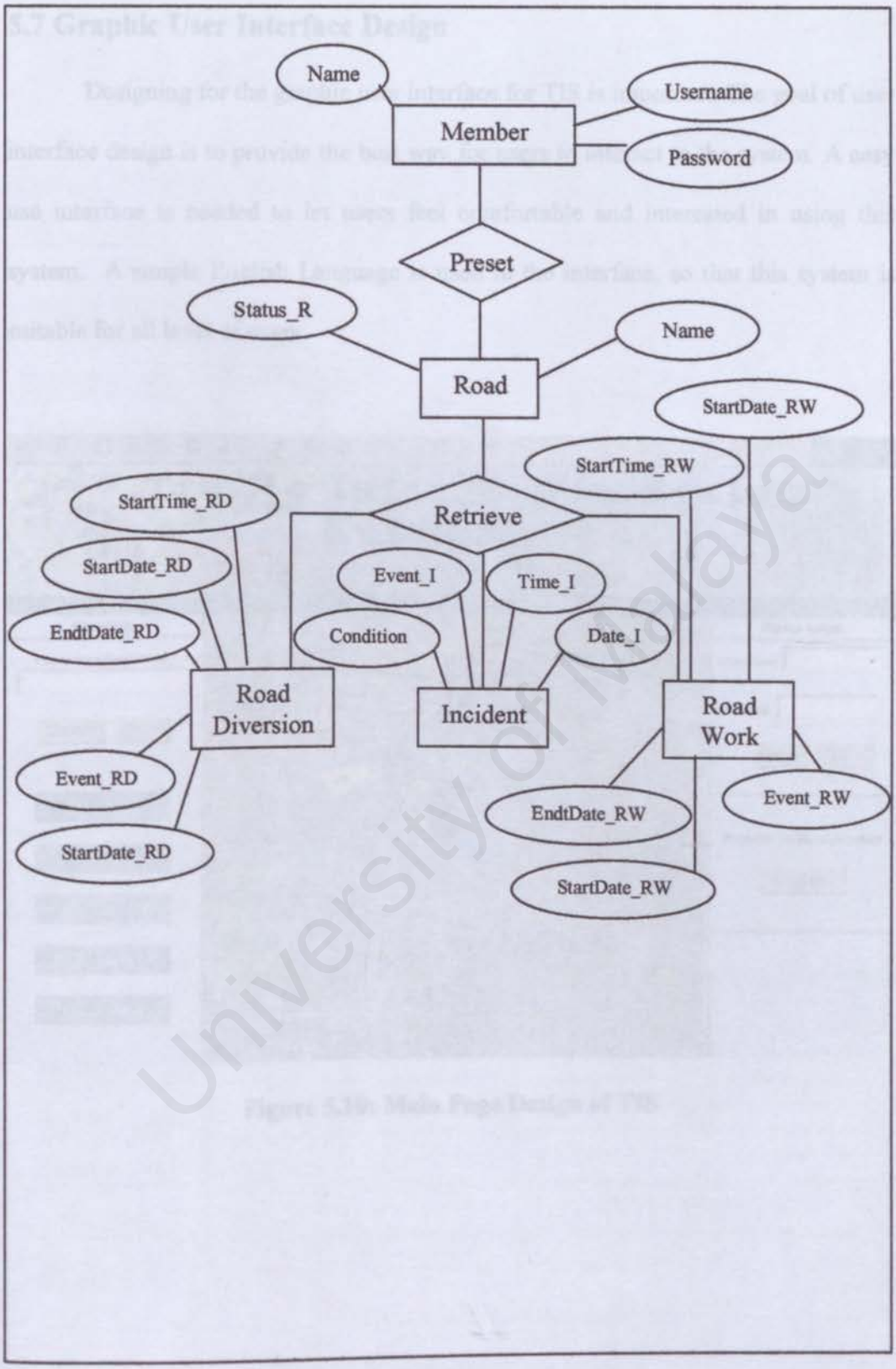

Figure 5.9: Member ER Diagram

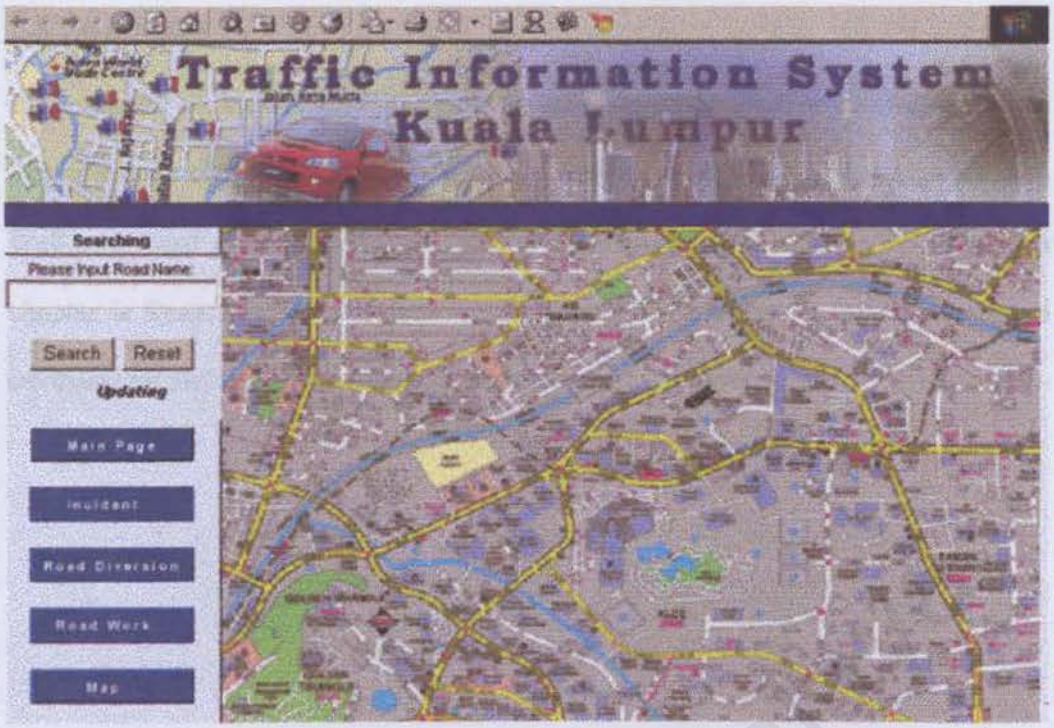

Figure 5.11: Administrator Main Page Design

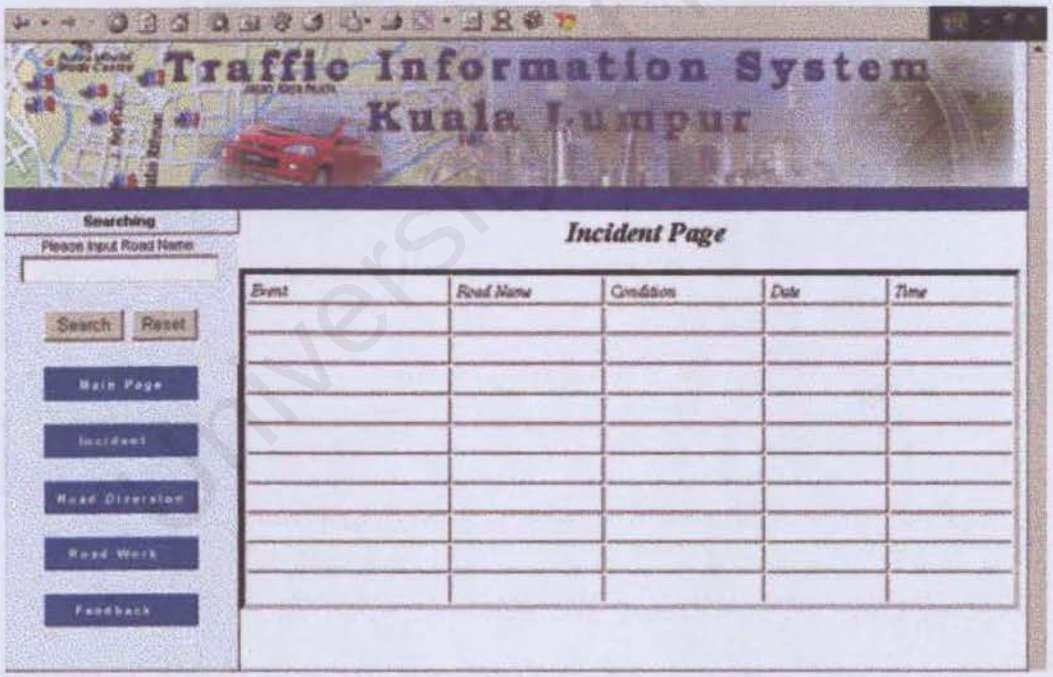

Figure 5.12: Incident Page Design

5.8 Summary

This chapter is system design. This chapter covered system architecture, class diagram, state diagram, database design and graphical user interface design for TIS. Well structured design system should meet the goals of developing TIS. The next chapter is System Implementation which the way of system implements to actual environment and how the system developed.

6.1 Introduction

In this chapter is about System Implementation. System implementation in a nutshell is the construction of the application and the delivery of the application into the 'production phase'. It is a phase that integrating the designed modules or functions to develop a system based on the given requirements. System implementation includes building and testing its contained modules and sub-modules, involving system requirements and design into programs codes. In order to achieve that, appropriate tools and languages are needed to code the system. Software was chosen in this case. This phase at times involves some modification to the previous design. This project was also developed using bottom-up-approach, which involves building the functions and procedures and then the high-level software modules.

6.2 Development Environment

The usage of dynamic and suitable hardware and software can help accelerate the development of construction of system. The overall tools used for the development of this project are:

6.2.1 Hardware Development Environment

The hardware configuration of this system development is listed below:

1. IBM compatible computer – 256 MB RAM, Intel® Pentium III 667 MHz processor
2. 50X speed CD-ROM driver
3. 15" Monitor
4. 20 GB Hard Disk

5. Standard floppy disk drive, printer, scanner and standard modem for Internet connection.

6.2.2 Software Development Environment

Below is the list of software tools used in the development of this system.

1. Operating System: Windows 2000 Professional
2. Web Server: Internet Information Service
3. Web Database: SQL Server 2000
4. Program Coding:
   I. User Interface Creation - Hypertext Markup Language (HTML)
   II. Server Side Scripting – Active Server Pages .NET (ASP.NET), VB Script
   III. Client Side Scripting- VB Script
5. Graphic creation: Paint, Adobe Photo Shop 6.0
6. Browser: Internet Explorer 6.0
7. Web Application Development Tools: Microsoft Visual Studio.NET Framework.

Operating System

Through all the development of this project, Windows 2000 Professional was used as the development platform. It is a powerful and stable operating system. It is suitable for web development. It is designed especially for small business and professional users as well as to the more technical and larger business market for which the NT was designed. The Windows 2000 operating system provides many enhanced

features for its users. Besides that, Internet Information Services, which is web server for this project has been tightly integrated with this operating system.

Web Server

As mention above, Internet Information Server 5.0 (IIS 5.0) was used as web server for this project. IIS is built-in in the Microsoft Windows 2000 Professional. IIS transmits information by using the Hypertext Transfer Protocol (HTTP). IIS is tightly integrated with the Windows 2000 Professional in a number of ways, resulting in fast web page serving. It's very efficient and simple to use. The additional functions of this web server make the progress of development for this project faster. Web server can be set to display default page when the web site address is called.

Database Server

SQL Server 2000 was chosen as the web database for this project. It is used for database design, construction and implementation for data storage and manipulation. The storage of this database is bigger and more suitable for this project. SQL Server 2000 has many functions such as auto-grow features, new storage engine, complete row level locking and so on.

Graphic Creation

To make this web site look attractive, a header of banner was designed, button and images were used. Adobe Photo Shop 6.0 was used to create the banner and images..

Program Coding

Active Server Pages.NET (ASP.NET) is chosen as web programming code for this project. ASP.NET is almost as efficient as writing code directly to the server's

application program interface, and it's a lot more efficient, it runs as a server and can take advantages or multithreaded architectures.

For the server side scripting, VB Script was used to script the code while for client side scripting, VB Script was chosen as scripting code. For user interface creation such as form, table as well as Hypertext Markup Language (HTML) was also used to develop TIS.

Browser

Internet Explorer is used for information about existing similar system and source codes references. Internet browser need to preview the actual size of design and also run the application.

Web Application Development Tools

During the whole development of this project, Microsoft Visual Studio.NET was used as main development tools. Any text editor in Microsoft Visual Studio.NET can be used to create ASP.NET code in Web Form. Microsoft Visual Studio.NET will provide a nice highlight, wizards and also help files.

Besides this, Macromedia Dream Weaver and Macromedia Firework were also used to. Microsoft Visual InterDev 6.0 was sued mostly for ASP coding as it is originally developed for ASP coding. While the other development tools were used to create the effect of animation for button and pop-up-menu.

Table 6.1 Summary of software tools for development of this system

Software	Usage	Description
Microsoft® Windows 2000 Professional	Development Environment System Requirement	Operating System.
Microsoft® Visual Studio.NET Framework	System Development	Prototype module coding and interface design.
Microsoft® SQL Server 2000	Database Design	Database design, construction and implementation for data storage and manipulation.
Microsoft® Internet Information Service	Web Server	Intranet or the Internet information publishing
Adobe Photo Shop 6.0	Interface Design	Interface images, banner and button creating.
Internet Explorer 5.0	System Development and Interface Design	Web page running and preview.

6.3 System Coding

After each function is done, testing will be conducted to check whether it is function. Besides, error checking will be inserted to make sure that if errors occur, it can be detected.

6.3.1 Coding Approach

This project was developed modularly, mainly by using the bottom-up- approach. This approach develops the functions and procedures before proceeding to the higher-level modules.

i. Coding for Connect to Database

In ASP.NET, to connect to a DSN, it is needed to have a database server which the code connects to the Database Management System, DBMS of this system is Microsoft SQL Server 2000.

Example:

```
Dim myConnection As New
SqlConnection(ConfigurationSettings.AppSettings("ConnectionString"))
Dim myCommand As New SqlCommand("insert_UserProfile",
myConnection)
```

ii. Coding to Get Data from the database

When the user needs the data, data will be retrieved from the database by using command in the class and use store procedure.

Example:

```
Dim parameterUsername As SqlParameter = New
SqlParameter("@Username", SqlDbType.Char, 20)
parameterUsername.Direction = ParameterDirection.Output
myCommand.Parameters.Add(parameterUsername)
```

iii. Coding to Store Data From the Form

After the user has submitted the form, the data must be processed and inserted to the database. Store Procedure is used to insert data from the form to the database.

Example:

```
myCommand.CommandType = CommandType.StoredProcedure
Dim parameterUsername As New SqlParameter("@Username",
SqlDbType.Char, 20)
parameterUsername.Value = username
myCommand.Parameters.Add(parameterUsername)
```

6.3.2 Coding Style

Good coding practice is needed to avoid or detect errors easily

i. Import Files

Some command need to import a file or library to complete the task.

Example:

```
Imports System.Web.Security
Imports System
Imports System.Configuration
Imports System.Data
Imports System.Data.SqlClient
```

ii. Indent codes

Although it is not necessary to indent the code to ensure that the code works correctly, but if will be easier to read and detect error if the codes are indented. It will be most useful in code, which uses many control structures.

iii. Comment Code

Commenting the code will make it easier for other people to understand the coding. Sometimes, it also helps ourselves to understand what we wrote few months ago and it will help to enhance the system by others. In ASP.NET, VB Script, the single quotation mark is used to add comment.

iv. Use Class

Class is used in the system. By doing so, command of VB Script in a page will call a class for a function to add data, retrieve data and others. It helps to make the code well arranged and also script in a page will not be too long.

6.3.3 Scripting Languages

As mentioned above, Java Script and VB Script were chosen as the scripting language for client side and server side.

i. Client Side Scripting

For the client side, Java script is a powerful language for displaying animation. In this context, Java Script was used to display the welcome message at the main page of the system.

ii. Server Side Scripting

On the server, VB Script was used together with ASP.NET code. Method and keyword in VB Script were used to create a complete and efficient function for this system. There are many useful VB functions and keywords that can be used.

6.4 Creating SQL Database Server

A SQL server needs to set up to store data in the system. Web Database Server was chosen is Microsoft SQL Server 2000. After user performing adding data task, data will be stored to the database server. These data will be retrieved by user when they need from the database with store procedure.

The operations in the SQL Server include:

- Creating a new database and name the database
- Creating new table for the system and name the table
- Creating data name, data type and length of data for the table
- Insert data to the table
- Formatting data in the database
- Creating store procedure

6.5 Current Enhancements

During the system development, a few changing are made in order to achieve system objectives and improve system performance.

- **Interface Changing**

The system interfaces, which are designed during system design phase, is modified and changed in order to achieve good effect and impression. The user interfaces are modified to be more attractive and easy use.

- **Platform Changing**

During system development, Windows 2000 professional is used with Microsoft SQL Personal Server 2000. In the faculty, due to the software problem, Windows 2000 Server and Microsoft SQL Server 2000 is used.

- **Database Table Changing**

The structure of several database tables has been changed during system coding and implementing. Some table had been modified.

6.6 Summary

This chapter has precisely described the system implementation phase for this system. System implementation is a phase that integrating the designed modules or functions to develop a system based on the given requirements. This phase includes the building and testing its contained modules and sub-modules, involving system requirements and design conversion into program code.

The usage of suitable hardware and software tools can help to achieve the development objectives for system. In the Development Environment section, the hardware and software tools that were used for this system development are listed and explained clearly. During this phase, some modifications of design have been done to make the system more usable and powerful.

In the next chapter, the System Testing will be carried out. The objectives of testing and types of testing that has been done will be precisely explained.

7.1 Introduction

This chapter is about system testing. System testing is the major quality control measure during prototyping. It is a critical phase of quality control and assurance. Testing is performed to ensure that the programs are executed correctly and confined to the requirements specified. It represents the complete and extensive review and challenge on the application design, specifications and codes. It provides a method to uncover logic errors and for testing system reliability.

The objectives of testing are stated below:

i. Testing is a process of executing a program with the intent of finding an error.

ii. An effective test case is one that contains unexpected testing record sets with a high probability of finding and detecting an as-yet-undiscovered error during the program design and development phases.

iii. A successful test is one that constantly provides new challenges to its programmers over time.

Testing can be done even during the software development phase – to debug design-time errors, and then continued during the testing and integration phase – to uncover run-time bugs. During the development phase each function, procedure and control event procedure must be independently developed and thoroughly tested within its contained module until the entire module is challenged. The testing phase consists of test case design and testing strategies.

7.2 Test Case Design

Before testing is done, a method should be chosen to follow. These methods provide a systematic approach to testing. More important, methods provide a mechanism that can help to ensure the completeness of test and provide the highest for uncovering errors in software

Two types of test case, which are White-box testing and block-box testing were used during the testing for this system.

7.2.1 White-Box Testing

White-box testing. Sometimes called glass-box testing, is a test case design method that uses the control structure of the procedural design to derive test cases. Using white-box testing methods, the developer can derive test cases that:

1. Guarantee that all independent paths within a module have been exercised at least once.
2. Test all logical decisions on their true and false sides.
3. Test all loops at their boundaries and within their operational bounds.
4. Test internal data structures to ensure their validity

This testing was carried out at the early stages of the testing process to ensure that the internal operations of the system perform according to specification.

7.2.2 Black-Box Testing

Black box testing assumes that the logic structure of the code is unknown. It is a "black box". This is the point at which the function of module is tested.

Black-box testing, also called behavioral testing, focuses on the functional requirements of the software. That is, black-box testing enables the software engineer to derive sets of input conditions that will fully exercise all functional requirements for a program. Black-box testing is not an alternative to white-box-techniques. Rather, it is a complementary approach that is likely to uncover a different class of errors from those uncovered by white-box methods.

Black –box testing attempts to find errors in the following categories:

i. Incorrect if missing function.
ii. Interface errors.
iii. Errors in data structure or external database access.
iv. Behavior or performance errors.
v. Initialization and termination errors.

7.3 Types of Testing

The testing process is implemented throughout the development of this system. It is implemented in stages because the system itself is composed of modules. Testing conducted include unit testing, integration testing and system testing.

Bottom-up testing strategy was used where testing starts with the fundamental components, and later works up the hierarchy of modules until the final modules is tested.

Validation testing is done throughout the various tests. Validation is accomplished by executing a real-life function. For example, under the unit testing, the testing of a

single program, or unit or code by the developer of the unit, validates whether the software is perform as designed.

7.3.1 Unit Testing

Unit testing focuses on verification effort on the smallest unit of software design such as the software component or module. This is the basic testing necessity for any software. Unit testing tests individual components to ensure that they operate correctly. For web base system development, these components include functions and subroutines. Each component is tested independently, without other system components.

The unit testing involves:

i. Testing the interfaces to ensure that the information flows properly into and out of the program unit.
ii. Testing the boundary conditions to ensure that the component is operating correctly at boundary values.
iii. Make sure that all independent paths in a control structures are tested at least once.
iv. Testing all error handling paths.

Throughout the development of this system, unit testing was done after the development of each component and not at the end of development of the whole system. Testing was done with all sorts of ways to check for errors, if it was tested to be functioning correctly, development of the next function will be carried out. Else, debugging is carried out to identify the error before having it tested again. This is to

ensure the components are operating correctly and without errors. Many tests were involved during the unit testing.

For this system testing, all of independent modules were tested and error that encountered were debugged and corrected. After the source codes of a module is completed, reviewed and verified for correct programming syntax, its programmer designs unit-testing cases to challenge its strengths and to ensure it will operate as intended.

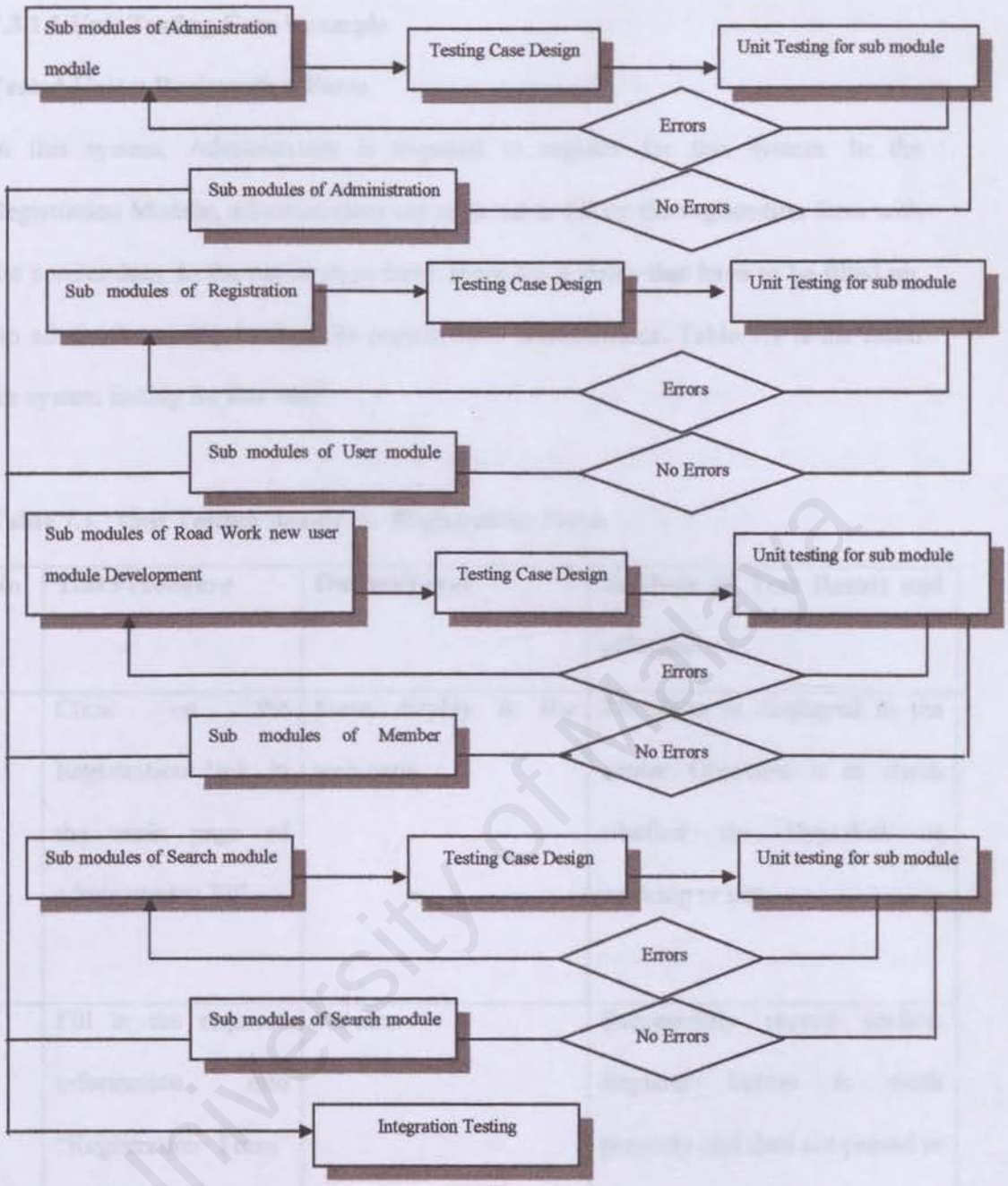

Figure 7.1 System Development Unit Testing Stage

7.3.1.1 Unit Testing Case Example

Tested Unit = Registration Form

In this system, Administrator is required to register for this system. In the Registration Module, administrators are required to fill up the registration form with the correct data. In the registration form, there are 4 fields that have to be filled up. An administrator require login to register new administrator. Table 7.1 is the result for system testing for this unit.

Table 7.1 Unit Testing Result for Registration Form

No	Test Procedure	Output/Error	Analysis of Test Result and solution
1	Click on the Registration link in the main page of administrator TIS.	Form display in the web page	The form is displayed in the center. Objective is to check whether the Hyperlink is working or not.
2	Fill in the required information into "Registration Form" completely and press "Register" Button.	No error.	Successfully record update. Register button is work properly and data are passed to another page. Let administrator know that register successfully. Objective is to determine whether the inserted information was passed and inserted

			successfully into database or not.
3	Fill in the form incomplete. Press "Register" Button.	Required field error. Could not insert data into database because of blank fields. 4 of the fields are required. Password and Confirm Password must be matched.	Blank fields from the form cannot be processed. An error message is displayed and asks the user to fill up the required information. Objective is to make sure the users fill in the required information and do not send an empty form into the database.
4	Enter an existing Administrator ID or password into "Registration Form".	No error	Checking must be done to check the duplication of the Administrator ID. Form will be brought to user and an error message will be displayed. (When user clicks the Register Button, VB Script will look for the same Administrator ID in the database records). Objective is to prevent Admin ID duplication

Tested Unit = Add Record for Road Work, Road Diversion and Incident

In the Update Module of TIS, Add Record of Road Work, Road Diversion and Incident are similar. The data flow and function of these units are similar, so the same testing techniques are used to test these units. Table 7.2 is one of the examples for these testing techniques.

Table 7.2 Unit Testing Result for Add Record for Road Work, Road Diversion and Incident

No	Test Procedure	Output/Error	Analysis of Test Result and solution
1	Click on the appropriate item menu at the left hand side of the page.	Form display in the web page	The form is displayed in the center. Objective is to check whether the add button is working or not.
2	Fill in the required information into form completely and presses add Button.	No error.	Add button is work properly and data are passed to the database. Successfully add record. A message tells user that record is added successfully in to database. Objective is to determine whether the inserted information was passed and inserted successfully into database.

3	Fill in the form incomplete. Presses add Button.	Database error. Could not insert data into database because of blank fields.	Blank fields from the form cannot be processed. An error message is displayed Objective is to make sure the users fill in the required information into the database.

The above testing is to make sure that the user has inserted the needed information completely to prevent database error.

7.3.2 Integration Testing

Integration testing need to be done after all objects, components and individual sub modules have passed local unit tests. System with integrated sub modules and modules must go through integration testing to ensure valid linking and dynamic relationship establishments between modules of whole system and between sub-modules contained in all individual modules is no different. It is a systematic technique for constructing the program structure while at the same time conducting test to uncover errors associated with interfacing. The objective is to take unit-tested modules and build a program structure that has been dictated by design.

Testing specific features and interface of two modules and sub modules explores how they interact which each other. Variables passing, parameters passing are all tested during this phase. Previously developed unit test scripts can be combined to build few of integration test cases, without much additional effort. As this stage, record manipulation and traversing processes are also explicitly tested. All SQL

commands are tested through the developed system and validated through execution from the SQL Sever 2000 query runs. The programmer tests SQL commands with parameter or record sets request with the largest variety of test cases possibly through of.

The bottom-up integration technique was used during the integration of system modules. Bottom-up integration technique, as its name implies, begins construction and testing in small segments, where errors are easier to isolate and correct. In addition, interfaces are more likely to be tested completely.

7.3.2.1 Integration Testing Case Example

In this integration testing, the system modules were tested to detect the system error and mistake. There are five main modules in this system, Administration Module, Member Module, User Module and Search Module.

From table 7.3 to 7.7 is the result for the integration testing for these modules.

Tested Module: Administration Module

Table 7.3 Integration Testing Result for Administration Module

No	Test Procedure	Output/Error	Analysis of Test Result and solution
1	Type the URL of administrator page of TIS to login as an administrator.	Login page for administrator is displayed.	Make sure URL is valid and display the login page for administrator. Objective is to prevent the failure of URL for administrator page.
2	Insert the correct Administrator ID and password of system administrator and press Login Button.	Administrator requires filling correct administrator ID and password to enter system.	Login button is working properly. Objective is to determine whether the inserted information match the database data correctly to navigate to another page.
3	Click on the "Register" hyperlink in the menu.	No error. Registering new administrator form is displayed.	An register form is displayed. Hyperlink is working properly.
4	Input completely the information into register form and press Register	No error. A short message is showed that the task is completed.	Register button is work properly and data are passed to database successfully. A message

	Button.		was displayed that register successfully. Objective is to determine whether the information was added successfully into database.
5	Click on the Incident Button at the menu of the page to add new incident.	No error add incident form was displayed.	An add Incident form is displayed. Hyperlink is working properly
6	Input all the needed information into Incident form and press Add Button.	No error. A short message is showed that the task is completed.	Add button is work properly and data are passed to database successfully. A message was displayed that add information successfully. Objective is to determine whether the information was added successfully into database.
7	Click on the Road Work Button at the menu of the page to add new	No error add road work form was displayed.	An add Road Work form is displayed. Hyperlink is working properly

	incident.		
8	Input all the needed information into Road Work form and press Add Button.	No error. A short message is showed that the task is completed.	Add button is work properly and data are passed to database successfully. A message was displayed that add information successfully. Objective is to determine whether the information was added successfully into database.
9	Click on the Road Diversion Button at the menu of the page to add new incident.	No error. Add Road Diversion form was displayed.	An add Road Diversion form is displayed. Hyperlink is working properly
10	Input all the needed information into Road Diversion form and press Add Button.	No error. A short message is showed that the task is completed.	Add button is work properly and data are passed to database successfully. A message was displayed that add information successfully. Objective is to determine whether the information

			was added successfully into database.
11	Click on the Logout Button on the menu.	No error. A successfully logout page was displayed.	Logout Button is work properly. A successful logout page was displayed. Objective is to determine whether administrator logout successfully.

Tested Module= User Module

Table 7.4 Integration Testing Result for Registration Module

No	Test Procedure	Output/Error	Analysis of Test Result and solution
1	Click on the "Register Now" button at the main page of TIS.	Registration Form was displayed.	Button can function. The hyperlink is working. Objective is to prevent the failure of hyperlink for Registration button.
2	Input all the needed information to the registration form and press Register Button.	Registration Form was displayed.	Register Button is working. Objective is to determine whether the task of Register button is achieved or not.
3	Fill in the required information into "Registration Form" completely and press Register Button.	Register successfully page was displayed and a short message is showed that the task is completed.	Successfully record was added. Able to add record successfully. A successful register page was displayed to tell user that update successfully. Objective is to determine whether the inserted information was passed and added into database or not.
4	Click on the Incident Button at the main page of	No error. An Incident page was successfully	Incident button is working. Objective is to determine whether the task of Register

	TIS	displayed.	button is achieved.
5	Click on the Road Name of the appropriate column.	A details page of Incident was successfully displayed	Data hyperlink is working. Objective is to determine whether the task of Register button is achieved.
6	Click on the Road Work Button at the main page of TIS	No error. A Road Work page was successfully displayed.	Incident button is working. Objective is to determine whether the task of linking is achieved.
7	Click on the Road Name of the appropriate column.	A details page of Road Work was successfully displayed	Data hyperlink is working. Objective is to determine whether the task of linking is achieved.
8	Click on the Road Diversion Button at the main page of TIS	No error. A Road Diversion page was successfully displayed.	Incident button is working. Objective is to determine whether the task of linking is achieved.
9	Click on the Road Name of the appropriate column.	A details page of Road Work was successfully displayed	Data hyperlink is working. Objective is to determine whether the task of linking is achieved.
10	Click on the Map Button at the main page of TIS.	No error. A map was successfully loaded.	Map button is working. Objective is to determine whether the task of Map Button is achieved.

11	Click on the LRT hyperlink at the middle of map.	No error. A LRT map was displayed.	LRT hyperlink is working. Objective is to determine whether the task of Map Button is achieved.
12	Click on the Back Button at the middle of LRT map.	No error. The map was displayed again.	Back Button is working. Objective is to determine whether the task of Back Button is achieved.
13	Point to the "Info" in the map.	No error. A short message was shown when pointing the "Info" word	Info is working properly. Objective is to determine whether the task is achieved

Tested Module = Member Module

Table 7.5 Integration Testing Result for Member Module

No	Test Procedure	Output/Error	Analysis of Test Result and solution
1	Input the correct Username and password of member and press Login Button.	No error. Member page is displayed.	Login button is working properly and data are passed to another page. Member page is brought to member. Objective is

			to determine whether the inserted information was checked correctly.
2	Select a road name from Dropdown list and press Add Button.	No error. Road name is successfully added in to list.	The details page for login entrant is displayed. Hyperlink is working properly. The Session object is working correctly.

Tested Module = Search Module

Table 7.6 Integration Testing Result for Search Module

No	Test Procedure	Output/Error	Analysis of Test Result and solution
2	Input a road name into the text box and press Search Button at the main page of TIS.	No error. A detail of result was displayed at the result page.	Search button is working well. The query was sending correctly to another page Details result was retrieve. The simple search task was achieved and completed.

7.3.3 System Testing

System testing is a series of different tests whose primary purpose is to fully exercise the computer-based system. It is designed to reveal bugs not possible to individual components or to interactions between components and modules. Although each test has a different purpose, all work to verify that system elements have been properly integrated and perform allocated functions.

System testing is carried out on the entire integrated system as one unit to ensure that the entire system is validated. Its activities include testing of system performance, configuration sensitivity, usability, data integrity, error handling and recovery. The

objective here was to ensure and verifies this system is functioning properly and all design and development objectives are met. Several steps were carried out to test this system, include function testing, performance testing and acceptance testing.

A stress test was conducted on this system and the result was as expected. Two groups of end-user were selected to test this system. From the result, 100% from the respondent said that the system is ease-to use and user friendly. The system also has fulfilled their expectations. The system modules have effectively completed the users requested. The system testing will be elaborated in following sections.

7.3.3.1 Function Testing

System testing begins with function testing. This focuses on system functionalities. Each function can be associated with system components that accomplish it. Effective function testing contains high probabilities to detect system bugs and errors. This system employs several guidelines for function testing:

i. High fault detection probabilities.
ii. Know and anticipate expected actions and output.
iii. Test all valid and invalid input types.

7.3.3.2 Performance Testing

This testing addresses the non-functional requirement of this system after function testing is completed. System performance is measured using performance objectives set by potential users as highlighted in the non-functional requirements section as guidelines. During this testing, the effective of data manipulations, query speeds such as record retrieval, searching and sorting, inter-module communication speed and also images file-loading speed from the database are examined.

7.3.3.3 Acceptance Testing

After completing functional and performance testing, system is determined to be able all requirements specified during initial stages of its development. This testing is carried to determine that the system is really usable and is capable of meeting user's performance expectations.

7.4 Summary

During this testing phase, several steps are carried out. Unit testing, integration testing and system testing are planned and executed. Unit and integration testing focus on functional verification of component and incorporation components into a program structure. System testing is designed to reveal bugs not possibly attributed to independent components or units. It is used to validate software once it has been incorporated to larger system. This testing is carried out on the entire integrated system as one unit. Three steps are carried to complete this testing include function testing, performance testing and acceptance testing. The objectives of this testing is to detect and debug the uncover errors.

Testing is done throughout the development of this system. Testing can be done even during the development phase or the testing and integration phase. When error is detected, the process debugging will be carried out to track down the cause of the error for further corrections based on the error logs.

In the next chapter, the System Evaluation for this system will be carried out. This evaluation is done by the end user for this system to ensure the system is capable and usable. It will also clearly describe the problem encountered and solution during system during, system strengths, system constraints, current and future enhancements for this system.

8.1 Introduction

In this chapter is about system Evaluation. System Evaluation is to evaluate this system whether the expected outcome meet the requirement. System Evaluation is to know that the programs are executed correctly and confined to the requirements specified. User requirement is in the system, so that can be used to know the performance of the system.

This evaluation is done by the end user for this system to ensure the system is capable and usable. It will also clearly describe the problem encountered and solution during system during, system strengths, system limitation and future enhancements for this system.

8.2 Problem Encountered and Solution

During the development of the system, few problems were encountered.

Table 8.1: Problem Encountered and Solution

No	Problem	Solution
1	Platform of development computer and faculty computer are different.	Used the operating system that provide by Faculty. Used Windows 2000 Server to replace Windows 2000 Professional.
2	PC is shared by few students at the same time at faculty. Setting of SQL server likely to change. This will cause the system can not connect to SQL Server.	Take notes of the SQL Server. Change setting back to suite the system.

3	Button at the system can be disabled automatically and it will cause the malfunction of the button.	Double click the button few times at the design view of Microsoft Visual Studio.NET Framework.

8.3 System Strength

The strength of the system included users can register as member to assign the sudden road. By doing so, member can get the information about the road that was selected earlier. Other web sites are not providing this service to users.

Furthermore, details of incident, road work and road diversion are provided to the user, they will know more details about the road info. They can know what is happening on the road and plan their way in advance. This information is provided although the road is not show in the map.

A map is shown to the user with most of the road in Kuala Lumpur. Any incident happened at the road can know easily by pointing to the "Info" word at the map. The map needs not to zoom because the size of map is suitable to view, user can scroll up and down. By the way, a plan of LRT station and trail is provided when the users feel that is needed after knowing the incident happened at the road.

The system can provide different information to let user get appropriate info easily in few ways. For instance, user can know the road condition by searching on the main page of TIS, view the road condition from map or just view the incident, road work and road diversion page to get information.

This system is developed by ASP.NET with VB Script by using Microsoft Visual Studio.NET Framework. The system can be upgraded easily for future enhancement.

8.4 System Limitation

There are few limitations for the system. These included the details of the incident, road work and road diversion is not link to the map. When the user needs to know the actual location, the user needs to refer to the map manually.

There is no link camera or road scanner to measure actual situation of the road. It depends on the information get from the public or DBKL road system camera. By doing so, it will cause the information not updated or delay a moment.

The map in the system can not be zoomed to view the road clearly. Besides, the map is not link to the road account. Map can only be viewed to know the information about the road.

The incident, road work and road diversion are not deleted automatically according to end date. It may cause the information in the system outdated easily and need more human resource to delete it.

Search result of road information is not link to incident, road work and road diversion. Search result only display road condition, road name and description.

Administrator need to a new login page to login as an administrator, administrator can not login at the main page of Traffic Information System Kuala Lumpur. Administrator has only a character in the system. This system does not differentiate super administrator or ordinary administrator. It may cause any administrator can register for new administrator. Currently, administrator can only add incident, road work and road diversion.

8.5 Future Enhancements

This system still needs to do few enhancements to make this system better. This system can not edit profile of the member. Edit profile page needs to be added to let user edit personal profile and update personal info.

In addition, administrator needs to be categorize to super administrator who can perform add or delete new administrator function and also ordinary administrator who just can only update information of the system as well as simple function.

For the incident, road work and road diversion, these can be link to road account and the actual location of the road can be viewed in the details page of incident, road work and road diversion.

8.6 Summary

This chapter has precisely described the evaluation phase for this system by the end user. System evaluation is documentation to describe the system strengths, system limitation and future enhancements for this system. Evaluation is done through the system to know the about the system and convert it to the documentation. Problem encounter and solution during the developing also describe in this chapter. Limitation may cause the system can not be run as expected or perfect. Few functions need to be upgraded in future to make the system better.

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