Historical Places In Malacca (Enhancement Of Maps Manipulation Capability Through The Website) Using MySQL

by

Nur Marziana Binti Zawawi

Dissertation submitted in partial fulfillment of

the requirements for the

Bachelor of Technology (Hons)

(Business Information Systems)

DECEMBER 2005

Universiti Teknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

Perak Darul Ridzuan

t
G
70·2
.N 974
2005
1. Geographic information systems
2. IT/IS -- Thesis

CERTIFICATION OF APPROVAL

Historical Places In Malacca (Enhancement Of Maps Manipulation Capability Through The Website) Using MySQL

by

Nur Marziana Binti Zawawi

(3002)

A project dissertation submitted to the

Information System Programme

Universiti Teknologi PETRONAS

In partial fulfillment of the requirements for the

Bachelor of Technology (Hons)

(Business Information Systems)

Approved By,

....

(Mr Justin Dinesh Devaraj)

Universiti Teknologi PETRONAS

Tronoh, Perak

DECEMBER 2005

CERTIFICATION OF ORAGINALITY

This is to certify that I am responsible for the work submitted in the project, that the originality work is my own except as specified in the references and acknowledgement and that the original work contain herein have not been undertaken or done by unspecified sources or person.

.................../........................

Nur Marziana Binti Zawawi

LIST OF FIGURES

ACKNOWLEDGEMENT

TABLE OF CONTENTS

ABSTRACT

The motivation to be involved with the field of study regarding GIS, has been emerging in a fast pace in these few years. Much research had been done and performed, giving tremendous and beneficial results towards this field. But most of the GIS applications were developed using the vendors own proprietary database, in which, this could promote many problems. Geographic Information Systems also known as GIS, are all about gathering data and then building layers upon layers of this data and then displaying them on a computer screen. The aim and the objective of the study done through this paper would be in using MySQL for developing a GIS application, thus showing MySQL's ability for supporting GIS-based data, or in the other word, the spatial data. While the main objective in doing the study and developing the particular system is mainly using MySQL in managing the spatial data, the other integral objectives which comes along with this project are, providing better features and quality spatial data features from the system for the users and also enhancing the capability of manipulating the maps, which are provided through the system. The Methodology being used in developing this project is according to the RAD Methodology, which involved the stages such as Requirement Planning, User Design, Construction, and Implementation. These stages would be further discussed through Chapter 3 of Methodology and Project work. And as for the Conclusion, which could be derived from the entire project, from the research being done, it could be seen that, MySQL is able to support in the development of any GIS – based application through the new released of its database which also included the spatial data management ability.

CHAPTER 1

INTRODUCTION

Geographic Information Systems also known as GIS, are all about gathering data and then building layers upon layers of this data and then displaying them on a computer screen. According to http://gislounge.com/library/introgis.shtml, GIS is being defined as "*GIS is a rapidly growing technological field that incorporates graphical features with tabular data in order to assess real-world problems*" [1]. What is now the GIS field began around 1960, with the discovery that map could be programmed using simple code and then stored in a computer allowing for future modification when necessary. This was a welcome change from the era of hand cartography when maps had to be painstakingly created by hand; even small changes required the creation of a new map. The earliest version of a GIS was known as computer cartography and involved simple linework to represent land features. From that evolved the concept of overlaying different mapped features on top of each other to determine patterns and causes of spatial phenomenon. The capabilities of GIS are a far cry from the simple beginnings of computer cartography. At the simplest level, GIS can be thought of as a high-tech equivalent of a map. However, not only can paper maps be produced far quicker and more efficiently, the storage of data in an easily accessible digital format enables complex analysis and modeling not previously possible. The reach of GIS expands into all disciplines and has been used for such widely ranged problems as prioritizing sensitive species habitat to determining optimal real estate locations for new businesses. The GIS technology today is based upon technology that has been developed in the Information Technology Industry. The GIS industry was born from the Information Technology Age and the Information Technology Industry is now benefiting from having GIS. The reason that GIS is important to IT and IS is because the growth of IT and IS is dependent upon people and industries using IT and then inventing new ways of putting IT to good use. When new problems are created and IT and IS are used to solve those problems, then the benefits of using IT and IS becomes clearer. When the benefits of using IT and IS are clear more people and industries are more apt to use IT and IS to solve their problems. So the fact that GIS have become very successful tools for mapping the world we live in is based on

the success that IT and IS have had in revolutionizing the way that data is turned into information.GIS continues to be a tool within the larger and more advanced business information systems used today. As information technology (IT) managers and users require the use of GIS-related, geospatial data, the industry will continue to move toward a systems integration environment of all computing resources. In other words, IT users are finding GIS to be a significant tactical tool for identifying product niches by geography, facilitating presentations, improving comprehension, identifying logistical problems, and developing marketing strategies.

1.1 Background of Study

Basically, the entire study would be focusing upon the capability of MySQL itself, in supporting GIS-based data and also applications. Nowadays, from the observation being made, it could be seen that, the development of GIS-based applications, is becoming really vital and important. Such applications are becoming popular and important in the areas such as defense, store and retail planning and even in managing the environment (naming a few examples). This particular project, aims in developing a GIS-based application, using MySQL. In elaborating more upon the development of this application, MySQL would be the chosen relational database, in storing and managing the involved spatial data. Basically, this application is a website, serving the purpose of the tourism field, of the Malacca city. The end user would be able to request the map of a particular historical place (for example the A Famosa) by supplying the information such as the name of the place or the street's name. The map obtained could then be viewed with the abilities such as enlarging or minimizing the map.

1.2 Problem Statement

1.2.1   Problem Identification

Most system applying and integrating the Geographical Information System (GIS), offers limited capabilities in helping the site users. This scenario of poorly designed system integrating GIS in it, still could be seen here in Malaysia.

The development of system along with the usage of GIS with it, is vital enough, in helping to promote areas such as Tourism, here in Malaysia. Malaysia is gifted with various historical places, which are able to attract tourists, thus helping in boosting the economy.

But, what could be seen nowadays, systems developed in promoting this area of Tourism, were being developed in a poor manner.

Maps integrated and displayed through the system, are not effective and interesting. The best that it could be doing is plotting the points, showing the location of the interesting places, without any additional information to it.

Looking into the technical aspect, of developing those GIS applications, the trend are that, using the applications from vendors like ESRI and MapInfo (in naming a few), would promote the usage of the vendor's own proprietary database. Part of the disadvantages which could be highlighted here would be, the intention of locking the data in and providing access only through the vendor's own API.

1.2.2 Significance of the Project

Basically, this project and the development of the application would be bringing some importance, which are listed as follows:

i. First and foremost, this entire project aimed in demonstrating the ability of MySQL itself, in being the supporter of spatial data. This is to take advantage on the ability of supporting the spatial data, offered by MySQL (MySQL 4.1, to be exact).

ii. This project would be regarded as significant, as part of the objective of this project is to help in enhancing the ability of maps and spatial data manipulation.

1.3 Objective and Scope of Study

1.3.1 Objective of the Study

Basically, the main objective of this study, would be in introducing the capability of MySQL itself, in providing the support for GIS-based data with the integration of other core business data.

The other integral objectives of the study would be as follows:

i. Providing better features and quality spatial data features from the system for the users.

ii. Enhancing the capability of manipulating the maps, which are provided through the system.

1.3.2 Scope of the Study

Looking into the scope of the entire study, it would basically be focusing upon the mission of using MySQL, as the database/data warehouse in storing and managing the spatial data, also with the collaboration of using other software such as Macromedia, with the objective of producing a GIS-based application. This particular project, aims in developing a GIS-based application, using MySQL. In elaborating more upon the development of this application, MySQL would be the chosen relational database, in storing and managing the involved spatial data. Basically, this application is a website, serving the purpose of the tourism field, of the Malacca city. The end user would be able to request the map of a particular historical place (for example the A Famosa) by supplying the information such as the name of the place or the street's name. The map obtained could then be viewed with the abilities such as enlarging or minimizing the map.

1.3.3 Feasibility of the Project within the Scope and Time Frame

From what being observed and analysed, this project is being considered as able to be completed throughout the given semester. This is due to the ability of the software themselves, taking the examples such as MySQL and Macromedia to be obtained and configured easily .From here it could be seen that, the available time frame could be spend towards developing the GIS-based application, rather then in focusing upon the issue and the hassle of difficult configuration.

From some trials and research being done before, the issue of configuration, would be a hassle in cases involving the database such as Oracle, in which the integration between Oracle and any other application, such as AutoDesk (naming one example) would require many steps for the configuration of the integration between those database and application. Thus, in those cases using the database/data warehouse of Oracle, a longer time frame should be given and spend in handling the issue of configuration and integration of the given software and application.

For this particular application's development, most of the time would be needed in focusing upon the problems which could be occurring from the editing of the maps/spatial data given. The rest of the time frame is expected to be dedicated towards the development of the GIS-based application.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 Geographical Information System (GIS)

GIS is a rapidly growing technological field that incorporates graphical features with tabular data in order to assess real-world problems. This area of GIS began and started around the year of 1960, with the discovery that maps could be programmed using simple code and then stored in a computer allowing for future modification when necessary.

Before the discovery being made, maps are being created painstakingly with hand, an era known as the hand cartography, where any new changes to be made, would force the creation of a new map. This imposed many hassle and difficulties in the creation and the editing session of maps during those eras.

The earliest version of a GIS was known as computer cartography and involved simple linework to represent land features. From that evolved the concept of overlaying different mapped features on top of each other to determine patterns and causes of spatial phenomenon. At the simplest level, GIS can be thought of as a high-tech equivalent of a map. However, not only can paper maps be produced far quicker and more efficiently, the storage of data in an easily accessible digital format enables complex analysis and modeling not previously possible. The reach of GIS expands into all disciplines and has been used for such widely ranged problems as prioritizing sensitive species habitat to determining optimal real estate locations for new businesses.

The key word to this technology is Geography - this usually means that the data (or at least some proportion of the data) is spatial, in other words, data that is in some way referenced to locations on the earth. Coupled with this data is usually data known as attribute data. Attribute data generally defined as additional information, which can then be tied to spatial data. It is the partnership of these two data types that enables GIS to be such an effective problem solving tool [1].

2.2 Spatial Data Transfer Standard (SDTS)

Basically, the Spatial Data Transfer Standard, or SDTS, is "a robust way of transferring earth-referenced spatial data between dissimilar computer systems with the potential for no information loss". It is a transfer standard that embraces the philosophy of self-contained transfers, i.e. spatial data, attribute, georeferencing, data quality report, data dictionary, and other supporting metadata all included in the transfer.

The purpose of the SDTS is to promote and facilitate the transfer of digital spatial data between dissimilar computer systems, while preserving information meaning and minimizing the need for information external to the transfer. Implementation of SDTS is of significant interest to users and producers of digital spatial data because of the potential for increased access to and sharing of spatial data, the reduction of information loss in data exchange, the elimination of the duplication of data acquisition, and the increase in the quality and integrity of spatial data. SDTS is neutral, modular, growth-oriented, extensible, and flexible--all characteristics of an "open systems" standard.

The SDTS provides a solution to the problem of spatial data transfer from the conceptual level to the details of physical file encoding. Transfer of spatial data involves modeling spatial data concepts, data structures, and logical and physical file structures. To be useful, the data to be transferred must also be meaningful in terms of data content and data quality. SDTS addresses all of these aspects for both vector and raster data structures.

The components of SDTS are being listed here, (without further elaborations) in which its components consist of 6 parts which are (each part having its own roles and tasks); Logical Specifications, Spatial Features, ISO 8211 Encoding, Topological Vector Profile, Raster Profile , Point Profile [2].

2.3 Spatial Database

A spatial database management system aims at the effective and efficient management of data related to a space such as the physical world, for example geography, urban planning and astronomy (naming a few examples).

The field of spatial database research has been an active area of research for over two decades, resulting in many new discoveries. The results coming from this research is for example the spatial multi-dimensional index which is being used in many areas nowadays.

Looking upon some commercial examples of spatial database management system is for examples; Informix, Oracle's Universal Server with either Spatial Data Option or Spatial Data Cartridge and ESRI's Spatial Data Engine (SDE). While for the research prototype examples of spatial database management system would be Postgres, GeO2 and Paradise. The functionalities provided by these system include a set of spatial data types such as point, line- segment and polygon and a set of spatial operations such as inside intersection and distance [3] .

2.4 Spatial Database Services for Location-Aware Applications

As for the introduction, it is vital to know the aim of having a spatial database management system, thus proceeding with looking into the responsibility of this spatial database management system in supporting Location-Aware Applications.

Basically, spatial database management systems aim to make spatial data management easier and more natural to users or applications such as urban planning, utilities, transportation, and remote sensing. Even though traditional database technology has been evolving for the last thirty years, managing spatial data with database system poses many challenges.

The basic and common operations being performed through the traditional database would be such as simple arithmetic and logical operations such as addition, subtraction, less than, greater than, etc. This limited set of data types and operations makes the modeling of real-world spatial applications extremely difficult.

Databases are traditionally used in business and administrative applications. In such applications the common data types encountered are integer, float, character, monetary-unit and date.

Recent research had been focusing upon providing the ability of storing and managing the spatial data in an effective manner through the database and data warehouse, which this spatial data is more complex compared to the common data types found and handled through the database before this [4].

2.4.1 Location aware application framework

The explosive growth of the use of intelligent mobile devices (mobile phones and PDAs) opens up new possibilities for delivering location information to the mobile devices, and delivering services to the mobile devices that are customized and tailored according to their current location. The PDAs are acquiring advanced wireless communication capabilities; and the mobile phones are getting more computation and Internet access features. In the near future most appliances will also have network interfaces and remote management capabilities. These advances, together with inexpensive position sensing devices will make location-aware applications popular. However, due to the lack of an appropriate "location-aware application development framework", many basic services will be implemented in each of the applications and cooperation between different location-aware applications will be difficult.

But the problem nowadays is, applications today do not take into account the location information of the clients or the service providers. The solution could be obtained by providing an infrastructure that captures the mapping of services in an area of interest and also a mapping of clients in the regions, applications can aggregate the location

information from a variety of remote sensing technologies and provide a single, seamless interface to it. With this type of information it is feasible to enable innovative location-aware applications. Delivering location-dependent services to mobile devices requires the following components: storage of location information and delivery of spatial data to mobile devices [4].

2.4.2 Locating and organizing location dependent services

Providing services to mobile devices is more than just converting Web information to match the capabilities of the device (small screen, low bandwidth, etc.). A typical Web portal, as provided by companies such as Yahoo or as provided internally by corporations to their work force, is loaded with as much information as possible, usually in the form of jumping-off points to other information repositories. This approach is too limited once one considers mobile devices that, by definition, can be anywhere. However, once one adds the capability for the Web server to recognize the geographical location of a mobile device, the server can then adapt it self and provide services or information that are relevant to the current location.

Extending this model, one can see that large number of services can then be built all with content that is more or less local to specific locations: for example, a service monitors local buses and trains, while another monitors inter-city trains and commuter airline traffic. The model can extend to local restaurants advertising their menu, hotels with room availability, theaters that have last-minute tickets for sale, etc. Further along the line, services could themselves be physical devices that just advertise their availability: public printers on a campus, ATMs, vending machines, etc. Clearly, in such a model, the number of services potentially relevant for a given location can grow enormously and be very dynamic, with new services appearing and disappearing constantly.

The current line of thought and concern now is to associate services with geographical areas or "regions". A region can of course be defined as a member of a hierarchical structure (country, state or province, county, city or municipality, district, street, etc.). However, this model is too simple to represent the reality, where regions are likely to be defined in more flexible ways, crossing over the hierarchical boundaries. Examples can

be metropolitan areas that spread over state or country boundaries, or company-specific sales areas that cover areas over multiple counties. The services provided by the spatial database can be used to define new service regions based on some spatial and non-spatial attributes. For example, a spatial union operator can be used to combine multiple existing service areas into a new service area. The spatial buffer operator can be used to construct a new service area based on some distance metric [4].

2.5 GIS Portal

Basically, a GIS portal is a single point of access to spatial information, regardless of the location, format, or structure of the data source. A successful portal connects desktop users with disparate data holdings and applications.

A GIS portal supports; collaboration, searching and also categorization. In which these are being elaborated more as follow;

Collaboration is a situation in which a GIS portal allows users to publish, share, and disseminate data and GIS Web services across the enterprise. Searching, is where a situation allowing a user to discover GIS data and Web services for a geographic area in the desired context, whether the search is defined spatially and/or thematically. Metadata stored in the portal catalog contains the knowledge on how to connect and utilize distributed geospatial databases and applications. And as for categorization, this is where a portal catalogs GIS data and Web services for delivery to the user within the context needed.

A GIS portal is a key component in supporting geographic intelligence, which is inherently distributed and loosely integrated.

This vision has been in existence for more than a decade and has been the underlying concept for a National Spatial Data Infrastructure (NSDI) or a Global Spatial Data Infrastructure (GSDI). These concepts are in general use today, not only at national and

global levels but also within states and local communities. This concept is collectively referred to as a Spatial Data Infrastructure (SDI) [5].

2.6 Implementing Internet GIS with Java based Client/Server Environment

As an introduction, the Internet is client/server based where the client sends a request for service and the server processes the request and returns information to the client. The Internet, unlike other Client/Server based networked applications, is constrained by the network size, speed and administration. The Internet is not just a computer network, but it is based on open standards that define low-level communication protocols such as transfer control protocol/Internet protocol (TCP/IP), state distribution protocols such as file transfer protocol (FTP) and hypertext transfer protocol (HTTP), document content standards like hypertext markup language (HTML), extensible markup language (XML) and image formats like GIF and JPEG.

The integration of GIS and Internet technologies is allowing easy access to information and data without using any specific GIS software. The growing capability of the Internet has created increasing demand for applications that use GIS. The Internet makes sense for an organization centralizing the maintenance of GIS software services and data. Using the Internet, software can be easily updated, and users can gain access to the applications and information they need for specific tasks.

There are two basic approaches for deploying GIS or any other complex, data-driven application on the Internet; those are server-side and client-side applications. In a server-side Internet GIS application, a Web browser is used to generate server requests and display the results. An Internet GIS server usually combines a standard Web (HTTP) server and a GIS application server, and the GIS databases and functionality reside completely on the server(s). Server–side application can comply with Internet standards, because all the large GIS databases remain on the server. This is an advantage for simplified application development, deployment and maintenance of data.
In a client-side Internet GIS application, client-side applications require users to install a

14

complete client application. In either case client-side application require software of some kind (other than browser) to be transferred to the user. In client-side Internet GIS, the client is enhanced to support GIS operations. The primary advantages of client-side solutions are the abilities to enhance user interfaces, improve performance and implement solutions using vector data [6].

2.7 Capabilities of MySQL

MySQL is a Relational Database Management System. A relational database adds speed and flexibility, by storing data in separate tables rather than putting all the data in one area. These tables are linked by defined relations making it possible to combine data from several tables upon request.

While 'SQL' stands for "Structured Query Language" which is the most common standardized language used to access databases. MySQL is Open Source software and it means that the source code can easily be manipulated and modified by anyone and is very simple to be used.

MySQL is very fast, reliable, and easy to use, having a very practical set of features developed in close cooperation with its users. It is also Open Source and therefore freely accessible. MySQL is used to access databases on the internet due to its connectivity, speed and security. It was originally developed to manage large databases at a much faster speed than the solutions that previously existed. MySQL has for several years, been thriving in the challenging areas of production.

Some advantages in using MySQL are for examples; Fully multi-threaded using kernel threads, that means it can easily use multiple CPUs if available, works on many different platforms such as C, C++, Eiffel, Java, Perl, PHP, Python and Tcl APIs and also supports several different character sets, including ISO-8859-1 (Latin1) and more [7].

15

2.7.1 MySQL Clustering

Basically, MySQL Cluster is the high-availability version of the world's most popular open source database which provides "5 nines" availability. MySQL Cluster was developed in close cooperation with one of the largest telecom equipment vendors in the world to meet the high availability, throughput, and response-time requirements of telecom providers and network operators. MySQL Cluster implements a distributed, highly fault tolerant architecture with no single point of failure. Using MySQL Cluster, organizations can deliver the scalability, reliability and performance to run the most demanding applications in the world.

Part of the advantages found in MySQL Cluster is upon the unique parallel server architecture that enables MySQL Cluster to achieve 99.999% availability, which this in turn translates into less than 5 minutes downtime per year including regularly scheduled maintenance operations.

Furthermore, in case of disaster (fire, earthquake, flood), MySQL Cluster enables entire clusters to be replicated across geographies, to other sites to ensure system availability. To recover from system failures, MySQL Cluster uses a checkpointing protocol to commit all transactions to disk ensuring success [8].

2.8 Relational Database

The relational model was based on mathematical set theory. It served a couple of purposes such as abstracted the representation of data from its physical storage and strived to manipulate data using this abstract model, tries to minimize on redundancy of data by breaking data into distinct non-duplicating sets that could then be related an infinite number of ways to produce an infinite number of representations and also increasing the consistency of data.

And later a language called SQL (also developed by IBM) was created to generate reports and update data in this new relational model.

The relational model and SQL gave birth to other models such as Object databases, Object-Relational, Spatial Database, OLAP databases and very recently XML databases.

Looking more upon the Spatial Database, it was developed to correlate data in space.They use a dialect of SQL called Spatial Features Structured Query Language (SFSQL) which simply adds spatial functions to SQL such as distance, touches, centroid, inside, area, extent.

Examples of spatial databases which could be listed here would be as follows; Oracle Spatial (which sits on top of Oracle) , ESRI Arc SDE (which can sit on top of a Microsoft SQL Server or Oracle database), PostGIS (sits on top of PostgreSQL), DB2 Spatial Extender which adds spatial functionality to IBM DB2 databases, and even MySQL is providing limited functionality for Spatial data in its upcoming 4.1 version [9].

2.9 PHP

Basically, the word PHP stands for Hypertext Preprocessor, in which PHP is a server-side scripting language, like ASP. The PHP scripts are being executed on the server and PHP would be supporting many databases such as MySQL, Informix, Oracle, Sybase, Solid, PostgreSQL, Generic ODBC (naming a few examples).

When it comes to the integration between PHP and MySQL, they are on the basis of a cross platform meaning that the development could be done in Windows and be served on a Unix platform.

The usage of PHP, would be promoting some advantages in which, PHP could run on different platforms such as Windows, Linux and Unix. PHP is also compatible with all servers being used nowadays such as Apache and IIS. The best part for a starter would be, PHP is easy to be learned and runs efficiently on the server side [10].

2.9.1 Accessing spatial data and metadata using ArcIMS and the open source language PHP

This paper presents the integration and access of spatial data and non-spatial metadata using ArcIMS and PHP, an open source server-side scripting language. The project "Data Center for Nature and Landscape" of the Swiss Federal Research Institute for Forest, Snow and Landscape WSL, Switzerland has the aim to develop a comprehensive storage and retrieval system for environmental data in a process oriented database model. This model reflects the lineage or history of data sets. Combining ArcIMS and PHP allows to access and visualize metadata such as PDF documents, images, etc. via the internet in a user-friendly and effective manner [11].

2.10 The Apache Web Server

With the name taken as a tribute to the Native American Apache Indian tribe, in which this is a tribe well known for its endurance and skill in warfare, an Apache Web Server is a public domain open source Web server developed by a loosely knit group of programmers. The first version of Apache, based on the NCSA, was developed in the year of 1995.

The core development of the Apache is being performed by a group of about 20 volunteers programmers, called as the Apache group. In many respects, the development of the Apache is similar with the development of the Linux operating system.

The original version of Apache was being written for Unix, but there are now versions that run under OS/2, Windows and other available platform [12].

CHAPTER 3

METHODOLOGY/PROJECT WORK

3.1 Procedure Identification

The methodology being chosen to be used throughout this study and the development of the application, is known as the Rapid Application Development, better known as RAD.

According to Professor Clifford Kettemborough of Whitehead College, University of Redlands, he defines RAD as "an approach to building computer systems which combines Computer-Assisted Software Engineering (CASE) tools and techniques, user - driven prototyping, and stringent project delivery time limits into a potent, tested, reliable formula for top-notch quality and productivity. RAD drastically raises the quality of finished systems while reducing the time it takes to build them."

In short, it is a process through which the development cycle of an application is expedited. RAD would thus enables quality products to be developed faster, saving valuable resources.

RAD compresses the step by step development of conventional methods into an iterative process. The RAD approach thus includes developing and refining the data models, process models and prototype in parallel using an iterative process. User requirements are refined, a solution is designed, the solution is prototyped, the prototype is being reviewed, user input is provided and the process begins again.

In the RAD arena, prototyping is used to help users visualize and request changes to the system as it is being built, allowing application to evolve iteratively.

The structure of the RAD lifecycle also, is thus designed to ensure that developers built the systems that the users really need. The lifecycle, through the following four stages, includes all of the activities and tasks required to scope and define business requirements and design, develop, and implement the application system that supports those requirements.

The stages are:

i.   Requirements Planning

Also known as the Concept Definition Stage, this stage defines the business functions and data subject areas that the system will support and determines the system's scope.
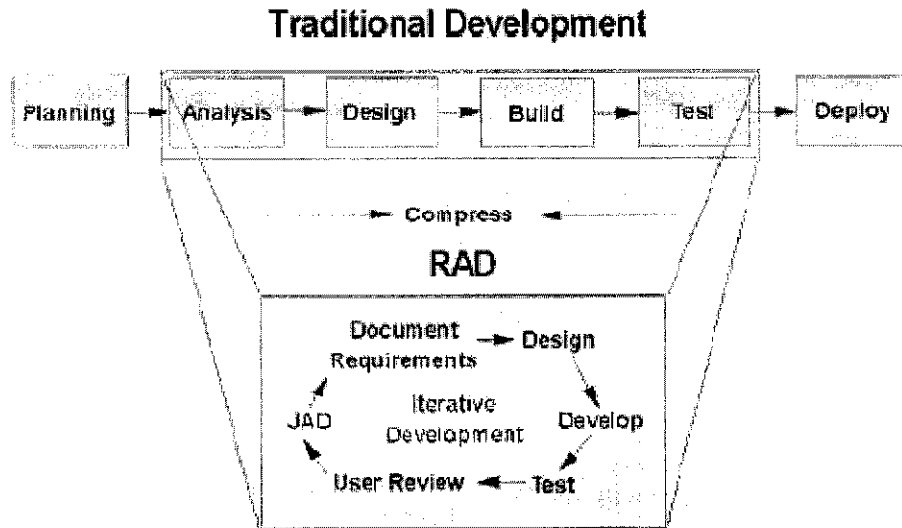
ii.   User Design

Also known as the Functional Design Stage, this stage uses workshops to model the system's data and processes and to build a working prototype of critical system components.

iii.   Construction

Also known as the Development Stage, this stage completes the construction of the physical application system, builds the conversion system, and develops user's aids and implementation work plans.

iv.   Implementation

Also known as the Deployment Stage, this stage includes final user testing and training, data conversion and the implementation of the application system.

Traditional Development

Planning → Analysis → Design → Build → Test → Deploy

← Compress →

RAD

Document Requirements → Design

JAD   Iterative Development   Develop

User Review ← Test

Figure 1: The RAD Methodology

What follow is the elaboration on how the RAD Methodology is being implemented and used throughout the development of this project.

Through the Requirement Planning, this is where the analysis regarding the system scope is being performed. During this stage, information regarding on how the system should be able to be and how the system interfaces should be like, were being gathered. This information were being gathered through face to face discussion made with the responsible supervisor, supervising the development of this project, and with a numbers of individuals which have the potential to be the system end user in the future. During this stage, the functionality of the system also was being clarified. These above steps were important as it will help to determine the system's overall scope.

The User Design stage, would involve the modeling of the system's data and processes. Thus a few simple Data Flow Diagrams were being developed to give a clearer view of the system's data and the involved processes of the entire system. A working prototype also is being required to be developed during this stage. Thus, as fulfilling this requirement, a working prototype of the system, was being developed, in which a website

(which in this stage is not having the full functionality) was being developed. The aim of this prototype is to try in storing and managing the spatial data with the chosen relational database, MySQL. The prototype was also being developed as to be able to accept queries made by the end user and to be able to retrieve the required maps. Many prototypes were expected to be developed along the way, each having better and enhanced functions, and this development was continued until the prototype fulfilled the initial requirements made in the earlier stage.

During the Construction stage, the fully functional system is required to be developed and completed. Thus, the prototype being developed earlier was being refined, adding more functionality to it in order to make it functions according to the initial requirements obtained through the Requirements Planning stage. During this stage also, the interfaces of the system are being refined, making it more user friendly. The capabilities of managing the maps, such as in enlarging and minimizing the maps were also being focused during this stage as many difficulties were being faced before in doing this task.

The Implementation stage would be the stage of deploying the system. This is where the fully functional and complete system would be tested by the end user and any required training in using this system would be given towards the user.

3.2 Tools

During the development of this particular system, it will need and require a number of software and tools as what would be described as follows;

3.2.1 Software Requirements

Basically, the software which is needed in completing this particular project would be;

- **MySQL v4 1.2** ; an open source database from MySQL Inc. It can provide fast, multi-threaded, multi-user, and robust SQL (Structured Query Language) database server. With the new release v4.1.2, a "spatial component" has been added. This component makes it possible to have a relational database with latitudinal and longitudinal coordinates. This version of MySQL conforms to the Open GIS Consortium (OGC) Standards.

- **PHP Version 4** ; a server-side scripting language for creating dynamic Web pages. The pages are created with PHP and HTML. When a visitor opens the page, the server processes the PHP commands and then sends the results to the visitor's browser, just as with ASP or ColdFusion. Unlike ASP or ColdFusion, however, PHP is Open Source and cross-platform. Without any process creation overhead, it can return results quickly.

- **Macromedia Flash Player** ; The Macromedia Flash Player is not an open source product, as the above components, but it is available free from Macromedia for use with visualization.

- **Mapinfo Professional Version 8.0** ; To be used in plotting the longitude and the latitude upon the desired map.

24

- **Apache Server version 1.3.3;** a very popular open source server that dominates the servers market according to Security Space, which provides detailed Internet Research Reports. It states that 71.07% of servers surveyed in July 2004 are Apache Servers. It leads the server market, compared to number two, Microsoft.

3.2.2 Hardware Requirements

The hardware description needed in completing this particular project would be as follows;

- Intel ® Pentium ® III, IV or AMD-K6 ® III based PC, 450MHz or higher
- Microsoft ® Windows ® XP Professional, Windows 2000 Professional, Windows 98,Windows Me*, or Windows NT ® 4.0 (SP6 or later)
- 512MB RAM
- 500 MB free disk space
- VGA display 1024x200468
- Mouse or other pointing device
- CD-ROM drive

CHAPTER 4

RESULTS AND DISCUSSION
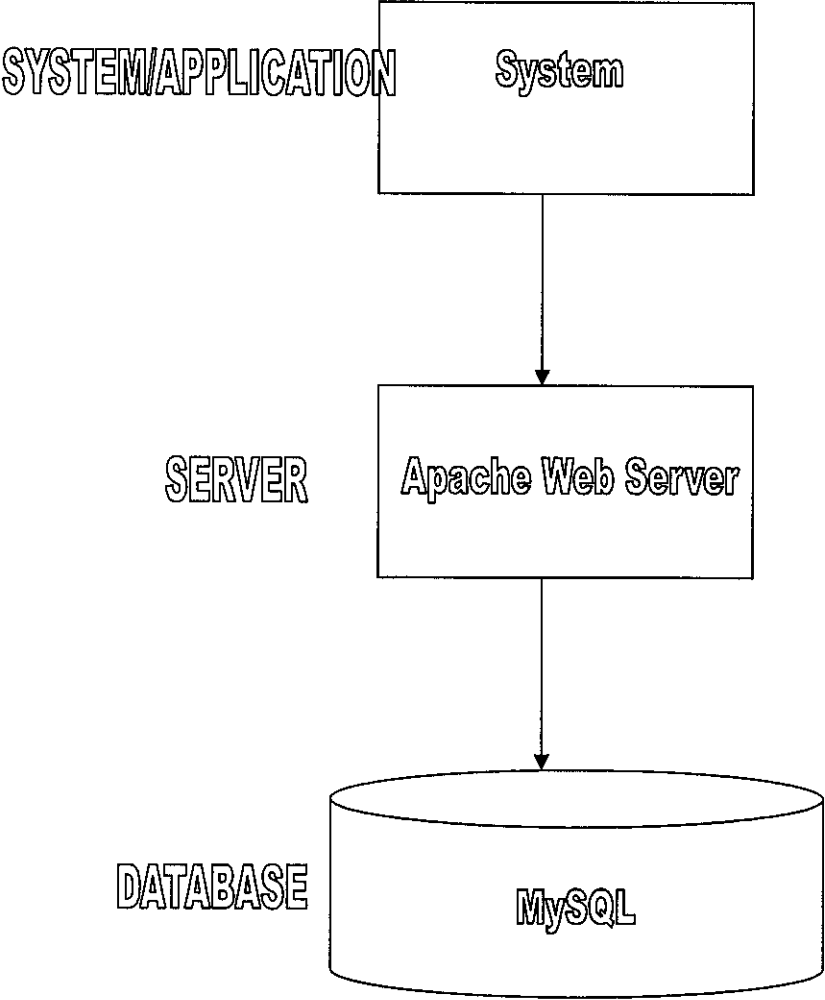
4.1 The System Architecture

In the first place, the system architecture was expected to be involving a component being called as GeoFlash Explorer, the innovative internet mapping solution. GeoFlash Explorer employs state-of-the-art Open Source components to achieve the same results that many other commercial web GIS products use. The Open Source components used by GeoFlash Explorer include Apache Server, MySQL, and PHP. In addition, it also uses Macromedia Flash Player.

But, due to the unavailability of the trial version of GeoFlash Explorer to be used in developing this application, thus this component was discarded from the initial system architecture.

Thus, the system architecture to be used as guidance in developing this application, would be as depicted through this following diagram;

SYSTEM/APPLICATION

System

SERVER

Apache Web Server

DATABASE

MySQL

Figure 2: The System Architecture

27

4.2 The Database

As being explained before, the desired database to be used for this application, would be MySQL Version 4.1.2. This version of MySQL had been released with the addition of spatial component, in order to have the capabilities of supporting and manipulating spatial data.

This component makes it possible to have a relational database with latitudinal and longitudinal coordinates. This version of MySQL conforms to the Open GIS Consortium (OGC) Standards.

The first step is to install and configure this database, for it to be running on the desired PC (for this particular development, only a laptop is being used). For the development of this application, the database of MySQL is being installed through NetServer 0.1 Beta 3. What follows is the screenshot showing the database running after its installation.
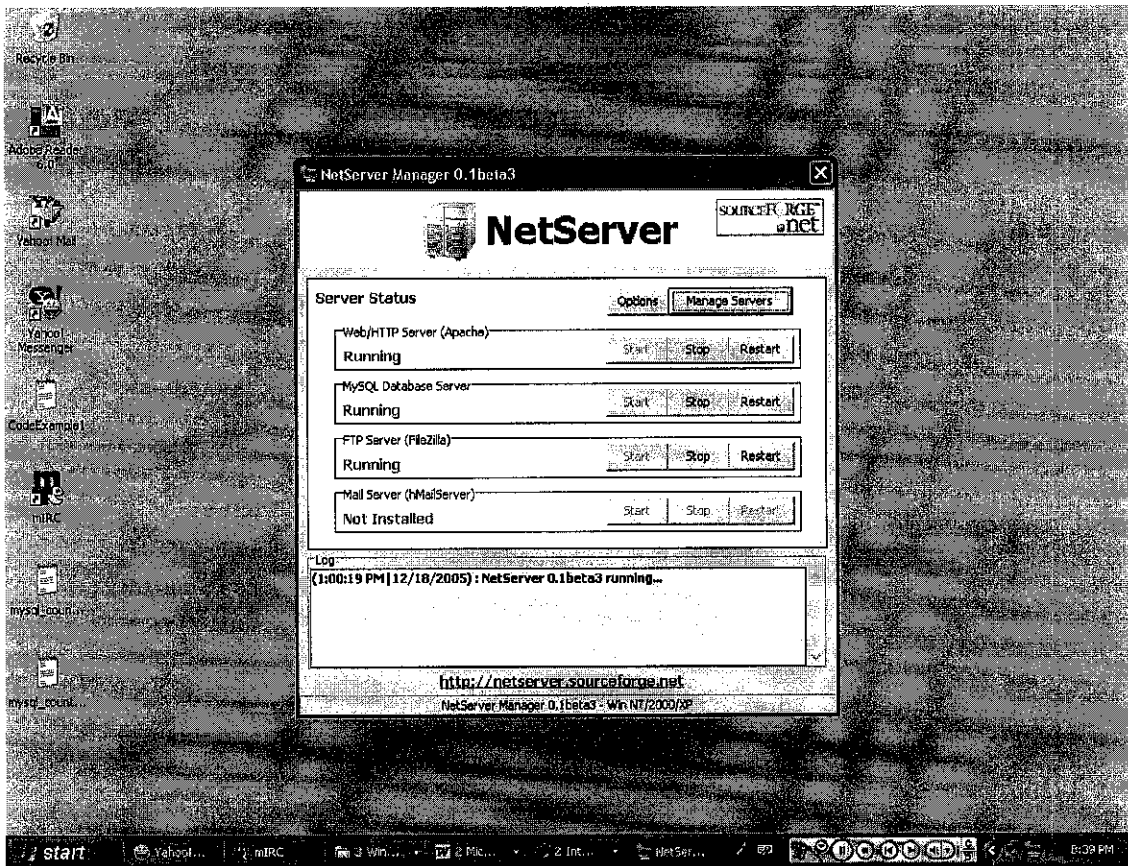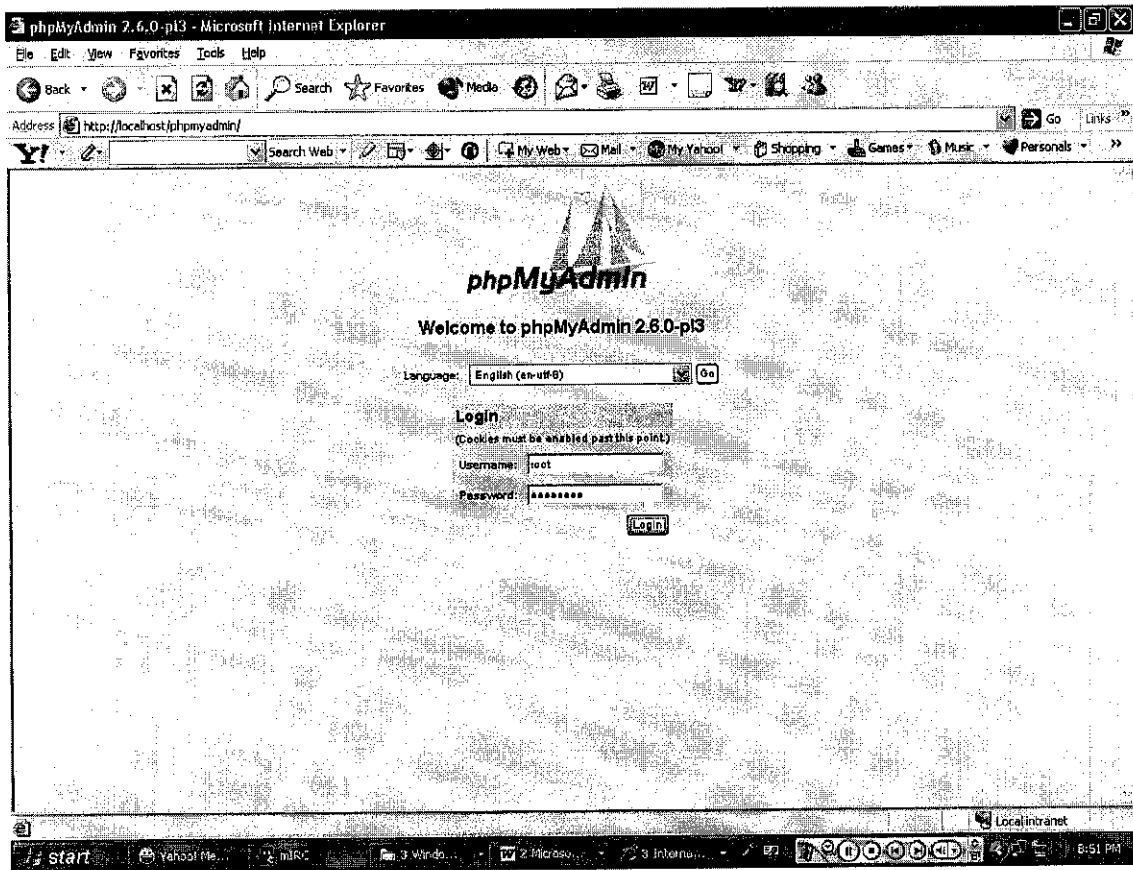
Figure 3 ; The Running of MySQL Database After The Installation

29

The next step is in inserting and storing the spatial data referring to the map of Malacca. The insertion and storage of this spatial data into the database of MySQL is being done through PhpMyAdmin. This step is being depicted through the following diagram;

Figure 4 ; Insertion of Spatial Data into the Database Through PhpMyAdmin.

Through the usage of PhpMyAdmin, a basic database needed to be named first, in this case, the database is being named as myfypdata. This is being followed by naming a basic table (thestadhuys) to store all those related attributes. The field being named through the tables are Place Name, Street Address, City/State/Zip Code and also the important field which is the Coordinate. Through these fields, the related spatial data would be stored.

4.3 The Server

The server being used in the development of this application is the Apache server as being explained before. The reasons in choosing this server are;

- It is being considered as more flexible to operate than any other system.
- Looking to the fact that more than 2/3 web hosting servers using Apache.
- The cost in using this Apache server is considered as low.

The first step in using this server is in setting it up. This server is also being setup through the usage of NetServer 0.1 Beta 3, along with the setting up of the MySQL database. What follows is the screenshot showing the running of the Apache server after the setup was successfully done.
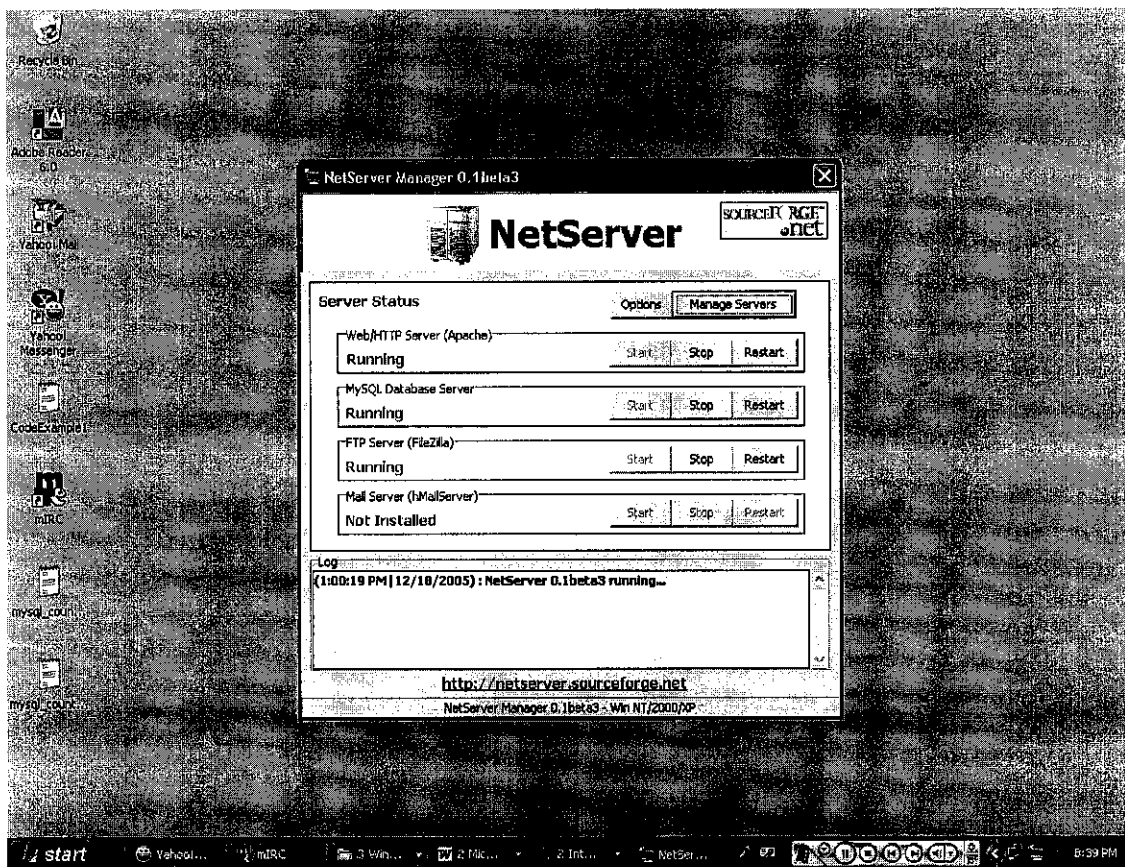
Figure 5 ; The Running of the Apache Server After the Installation.

4.4 The Map

Referring back to the field of the database, the field named as Coordinate, would be needing the data such as the longitude and the latitude of a particular location. For the map of Malacca, it needed to go through a process called as geocoding, as to translate the given location addresses into the related longitude and latitude.

There are basically a few free services out there which can be used to perform this geocoding process, such as the Geocoder.us(which already has a perl.API) and the GeoPostalCode(which will geocode zipcodes) . But through some research being made, it was learned that most of these free services being offered, would only be catering for the addresses and locations around the United States only. Thus, these free services were not able to be used to help in geocoding the addresses and locations of the selected location around Malacca.

To solve this problem, MapInfo Professional Version 8.0 was being used in geocoding the selected locations from the Malacca map. The following screenshot depicts the process of geocoding the map of Malacca;
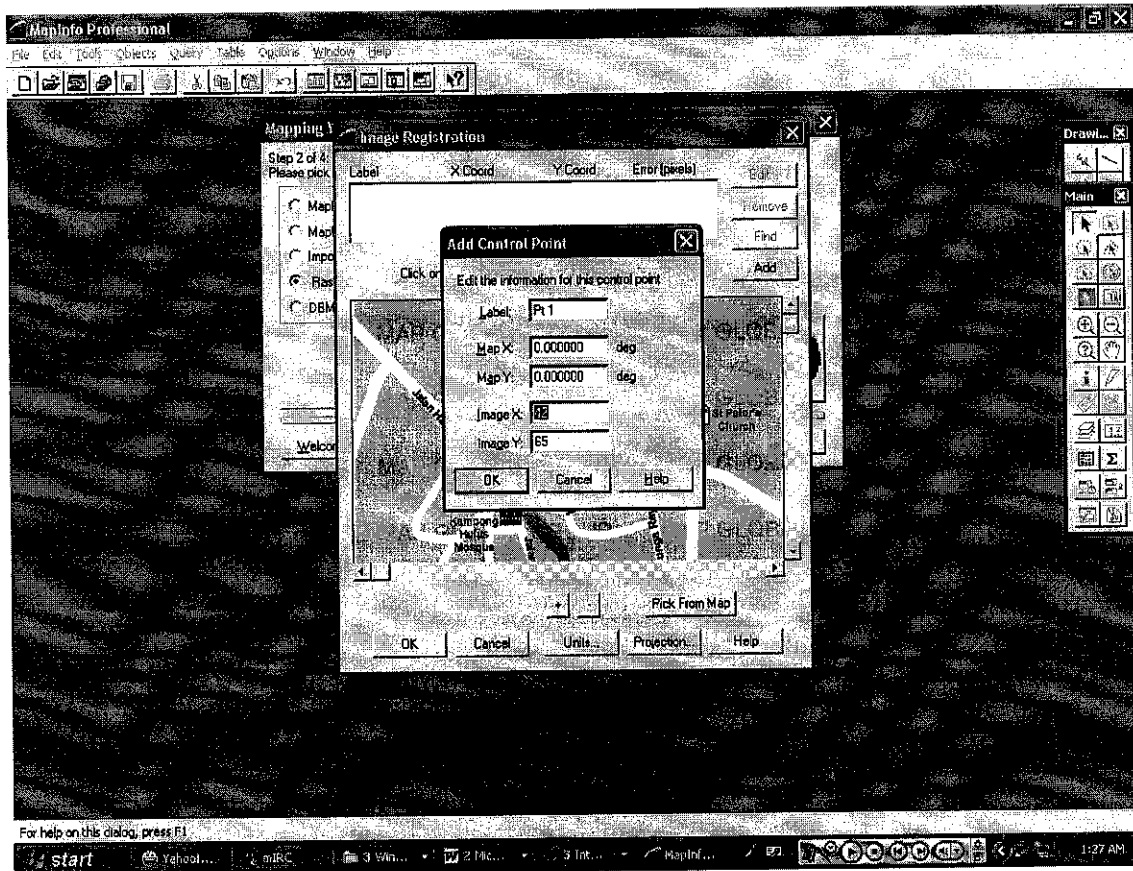

Figure 6; The Geocoding Process for the Malacca Map

4.5 The Interfaces of the Web Site

Basically, the interfaces of the web site were being developed using Macromedia Dreamweaver MX 2004. The interfaces were being developed with having the aim of making it user friendly.

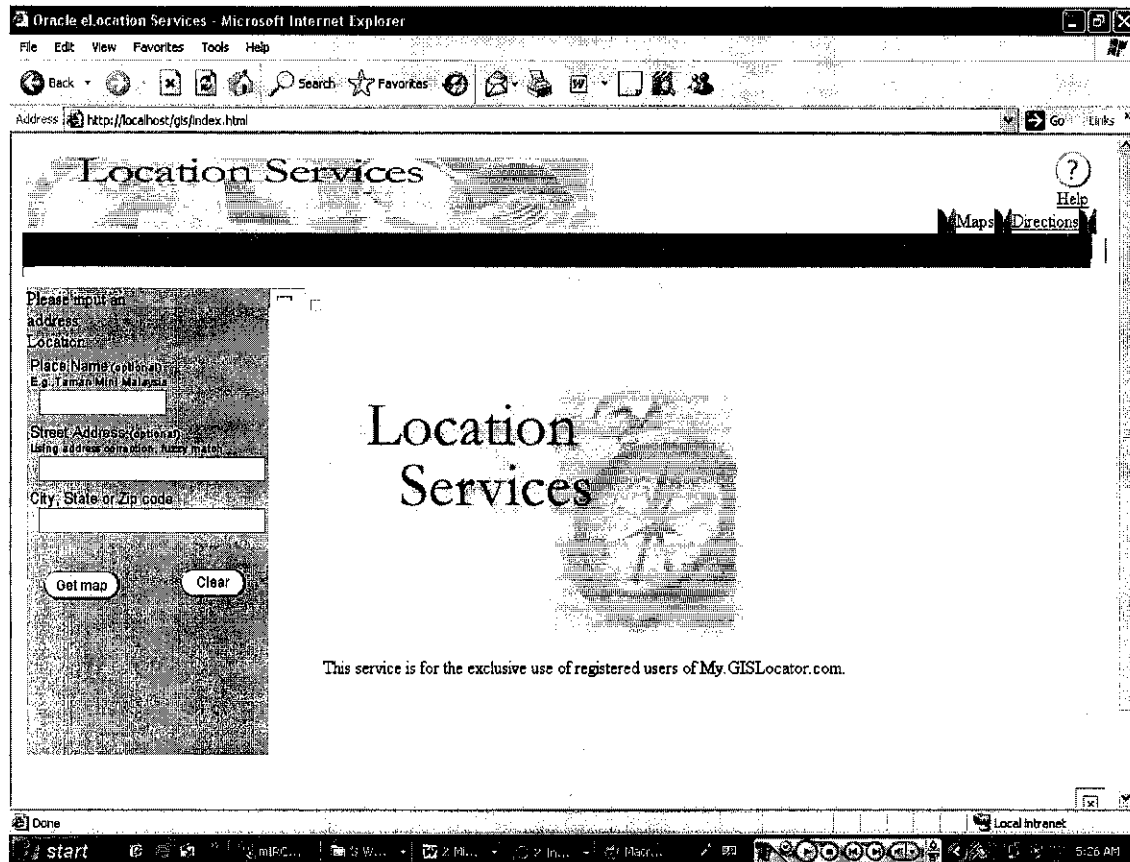What follows are the screenshots of the web site;

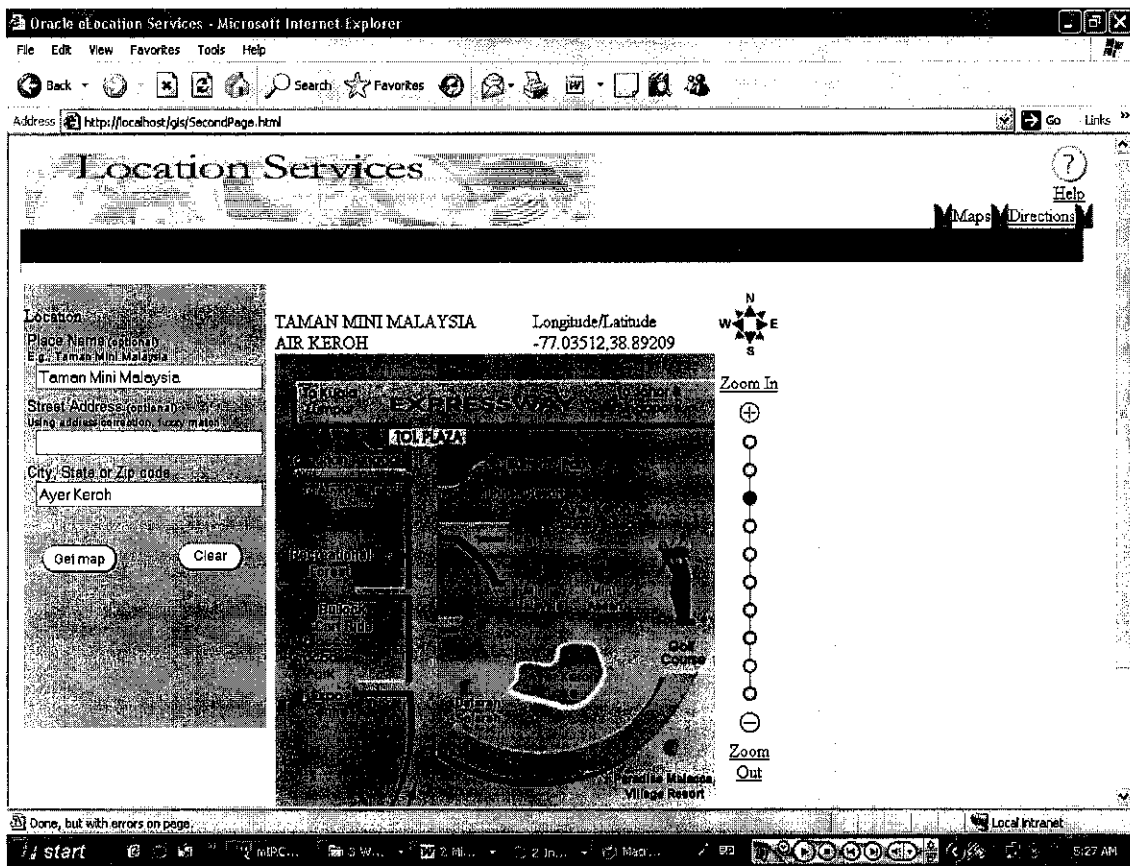
Figure 7; The Index/Main Page of the Web Site

Figure 8; The Second Page of the Web Site

4.6 The Result

Looking upon the database being used, the relational database of MySQL was expected to be able to handle the spatial data. In this case, the spatial data would be referring towards the details such as the Coordinate (in terms of the longitude and latitude).

Looking upon the integration issue, for this particular project, the whole development of this system, was particularly based on the usage of MySQL, PHP and also the Apache Web Server. No other integration was needed in developing this system.

Upon the completion of the system, the problems being faced are;

- In terms of the coding, to retrieve the map according to the queries, made by the end user of the system. This query, is suppose to retrieve the map, showing the particular location as being requested by the end user, along with its longitude and latitude. But, problems were faced in manipulating the coding, to retrieve back the geocoded map.

- In terms of the map storage, it was being learned that, through MySQL, it could only manipulate and support spatial data types, but not in term of image storage. Thus, the prototype of the system/application, sees that the map was stored locally in the PC running the prototype.

Basically, the system is being expected to be functioning as follows;
The system is able to obtained and accepts queries from the end user. This is for example, the user of the system is able to query a particular map, by first, providing the Place Name or the Street Address or even the City. After supplying this information, the user is required to click the Get Map button. Any corrections upon the supplied information could also be done by using the Clear button being made ready through the page.

By clicking the Get Map button, this will redirect the user to the next page, where this page would supply the map required earlier along with the corresponding coordinates (longitude and latitude) according to the information given before by the user. Through

this page also, the map could be enlarged or minimized, according to the user's preferences.

One specified performance problem of this system is, the map to be loaded, could take several seconds or minutes to fully appear through the page.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

From the research being done, it could be seen that, MySQL is also able to support in the development of any GIS –based application through the new released of its database which also included the spatial data management ability.

Using the database platform provided by MySQL, had given some advantages such as; it is fast, reliable and also easy to be used for any starters. It also has a very practical set of features to be used by its users. These listed benefits and advantages would also be the driving force in motivating new programmers or web developers in developing a GIS-based system/sites, which would not imposed much hassle now with the easiness provided through MySQL itself.

This had been proven through many successful projects and development of this particular application, which mainly could be seen rapidly happening in the western countries.

And as for the recommendation part, it is hoped that, even more capabilities in manipulating the images and the maps could be performed through the system in the future. It is also hoped that the retrieval of maps could be done not only upon the given data such as the place's name or zip code, but also according to the special features which belongs to that particular place, such as the keyword "historical" for places such as A Famosa and Stadhuys (naming a few examples).

It is hoped that, even though this study for the Final Year Project is being done in a smaller environment and scope, it could be beneficial in the future catering to the purpose of being a valuable reference and others.

REFERENCES

[1] What Is GIS , http://gislounge.com/library/introgis.shtml

[2] Introduction To SDTS, http://mcmcweb.er.usgs.gov/sdts/whatsdts.html

[3] S.Shekhar, S.Chawla, S.Ravada, A.Fetterer, X.Liu, C.T Lu; Spatial Databases, Accomplishment and Research Needs, http://pages.cpsc.ucalgary.ca/~alhajj/601.80/spatial/sp-3.pdf#search='spatial%20databases'

[4] Siva Ravada; Spatial Database Services for Location Aware Applications, http://www.gisdevelopment.net/technology/lbs/techlbs004pf.htm

[5] ESRI White Paper, GIS Portal Technology ; http://www.esri.com/library/whitepapers/pdfs/gisportal.pdf

[6] M.N Babu; Implementing Internet GIS with Java based Client/Server Environment, http://www.gisdevelopment.net/technology/gis/ma03230pf.htm

[7] MySQL Support White Paper; www.mysql.com

[8] A Guide to High Availability Clustering; www.mysql.com

[9] Databases; Past, Present and the Future; www.paragoncorporation.com

[10] PHP Scripting Language; www.php_intro.asp.htm

[11] Andri Baltensweiler; Accessing spatial data and metadata using ArcIMS and the open source language PHP,http://www.wsl.ch/

[12] Apache Web Server; http://www.webopedia.com/TERM/A/Apache_Web_server.html