

WAP-based Mobile GIS

by

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ABBREVIATIONS AND NOMENCLATURES

BMP	Bitmap
CASE	Computer-Aided Software Engineering
DBMS	Database Management System
DVD	Digital Versatile Disc
ESRI	Environmental Science and Research Institute
GIF	Graphic Interchange Format
GIS	Geographical Information Systems
GPRS	General Packet Radio Services
GPS	Global Positioning System
GSM	Global System for Communication
GUI	Graphical User Interface
IT	Information Technology
JPEG	Joint Picture Expert Group
LBS	Location Based Services
MMS	Multimedia Messaging Service
PC	Personal Computer
PDA	Personal Digital Assistant
PHP	Hypertext Preprocessor
RAD	Rapid Application Development
RAM	Random Access Memory
SMS	Short Message Service
UTP	Universiti Teknologi PETRONAS
WAP	Wireless Application Protocol
WML	Wireless Markup Language
XML	Extensible Markup Language

CERTIFICATION OF APPROVAL

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Approved by,



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CERTIFICATION OF ORIGINALITY

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

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Certification of FYP Final Dissertation Submission

Herewith I, Noor Shira Binti Mohd Salleh, 3065, certify that I am responsible for the work submitted in this project, and I have done all the modifications according to my supervisor's advice.

Thank you.

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ABSTRACT

This project is focusing on introducing the use of mobile phone with WAP applicability to assist users in finding location. As mobile based services become popular nowadays, there is a growing demand for WAP-based Mobile GIS which provide an easier ways to utilize the map information by requesting for WAP technology in phones. Corresponding to the problems found with the source of map information which are quite limited to the static maps and World Wide Web (WWW), this project propose a solution for finding location through map browsing capabilities using WAP. The main idea of this project is users can request from the server for the map site which they want to find for the exact location of certain places. As an introduction, this project will cater for the Malacca town area looking at the tourism factors found there. The server which is connected with the Mapserver application and Internet will reply back by providing the map site containing the map with some extended function such as zooming. Various references and studies have been done regarding the successful WAP-based Mobile GIS applications implemented in foreign country that leads to the interest of doing this research on the implementation in this country. The scope also getting wide as the integration with PHP and Apache server is still new in GIS fields and lots of studies will be needed on it. Besides, the development and design terminology are also the crucial part and critical as it would reflect the whole WAP application development. Those issues related such as the user interface and design and deployment tools are the major point of studies which get attention from most of WAP application developer.

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CHAPTER 1

INTRODUCTION

Mobile technology grows fast thus providing information on fingers movement. The demand also increase for an immediate and correct data information due to high mobile flexibility and compatibility to provide various kind of application to cater needs of users and suit to the environment. The convergence of Internet and Media like Voice and video are opening a lot of services to the mobile user. This project extends the GIS application in mobile environment as if using the mobile approach to provide location based services to users. GIS is an important aspect of any location system. GIS provide the tools to provision and administer base map data such as man made structures; it also created to manage point of interest data such as location of restaurant. The development of GIS has been highly influenced by the progress of Information Technology. The emerging usage of mobile technology and thrust in wireless communications leads to a new breed of GIS systems. Realizing the increased usage of mobiles, wireless devices like Palmtops, PDAs, and smart cellular phones the GIS industry giants are shifting the paradigm towards a Mobile GIS. In this project, WAP-based Mobile GIS is establish to support and emphasizing the meaning of mobile users performing the almost same functionality as of Web GIS but in wireless and mobile environment. By using Wireless Application Protocol or WAP technology, it enables users to get location information in the form of map via mobile Internet regardless of limitation of operating system and wired link as of web.

1.1 Background of Study

The project on developing Wireless Application Protocol (WAP) based Mobile GIS is based on the objective to provide location information on hand via wireless and mobile environment. The study is focus on the two major parts. First, the web part which is the development tools will be basically the GIS tools while the second part will focus on the integration of WAP page in PHP/WML coding and its applicability to provide Internet connection for displaying map to user. The basic architectures of WAP framework is the user, using Mobile browser will request the URL from web server. Before it can reach the server, the request should be encoded via WAP gateway. After the web server identified and translated the page according to the protocol, the request turn back to users via decoded function in WAP gateway and the pages needed will be display in map form in the mobile browser specify the user needs.

1.2 Problem Statement

1.2.1 Problem Identification

Current GIS sources are very limited and do not reflect the actual services available. On the other hand, web services are an emerging technology that aims at integrating application distributed over wired environment. The limitations of web services encourage the needs of mobile GIS which brought up information in a faster and immediate way using wireless communication. This project then will demonstrate and discover how the location information is possible to be obtained by using mobile phones.

Several problems and circumstances have been identified with respect to this project that shows the need to have wireless computerized solution of getting location information:

- I. Currently, there is an application establish using SMS/MMS form but the map provided is dull and colorless due to the limitation of those services. So, despite of this intervention, WAP based will have more advantages on enriching the map displayed in mobile hand phone browser.
- II. Implement another model of Mobile GIS using WAP enable mobile phone
- III. The emergence of WAP technology increase demand of Mobile LBS (Location Based Services) in faster and innovative environment. Users' right now, needs information on hand which regardless of wired link and standard web based end.

1.2.2 Significance of the Project

The significance and importance of this project can be expressed as follows:

- I. This project will integrate WAP (Wireless Application Protocol) technology with GIS (Geographical Information System) which will aim on providing map and location information on mobile handheld device.
- II. It will provide and promote new method of finding location using WAP ways compare to the static map in web services and also hardcopy map.
- III. Minimize the limitation of map browsing services using wireless medium.
- IV. To provide an option to users to maximize the use of mobile mapping services using their own WAP enabled hand phones.
- V. To introduce a new way of integrate Mobile GIS with WAP using new development tools which are PHP based integrate with WML/XHTML language.

VI. It will prove that wireless and GIS can be successfully integrated to produce a reliable Mobile GIS services and promotes that location-based services has potential in future to become new trend of mobile services.

1.3 Objectives and Scope of Study

The technical objective are to develop and integrate in a single system innovative software components enabling the users to formulate advanced requests, to access information in dynamic modes, and to display the information in efficient mobile environment form.

The business objective is to prepare the way for innovative services offerings primarily for mobile users needing to access geographic information for their activity. Mobile users are the main, but not exclusive targets. It will also be applied to fixed users, being interested in geographic information.

Detailed objectives are;

- i. Study and develop advanced information technology components to improve information systems efficiency and user friendliness.
- ii. Study new methods to make efficient use of remote geographic information, in particular for mobile users.
- iii. Demonstrate the performance through a Tourism Information system because its requirements are very representative
- iv. Show possible extension to other information systems applications and define possible models for operation

- v. To introduce the new way of browsing a map using hand phone with WAP enabled technology.
- vi. To assist users, especially tourist to connect to the mapping services in a wireless environment.
- vii. To offer mobile users route descriptions and the ability to search their immediate location to straightly find their nearest attractions.
- viii. To enhance a WAP application that makes the mobile phone an essential portable companion to mobile users in finding the correct location.

1.3.1 The Relevancy of the Project

This study aims to establish and implement the development of Mobile GIS using WAP technology. It is based on the research done on the Mobile GIS component in wireless world. The final product is a prototype of WAP based Mobile GIS which design to provide mobile mapping services to specific mobile users including tourist. The rationale of this project is actually to emphasize the benefits and wide usability of WAP technology to integrate with Mobile GIS to provide spreading and easy access to IT spatial data. It brings different means from Web GIS and introduces the new interface of M-GIS. Analysis made is based on the actual architectures of WAP technology itself to be integrating in a more intelligent way with GIS. The structures focused on three basic components in WAP, which are mobile browser connecting with web server using WAP gateway and encoded also the decoded function. It will then reach the mobile users via their mobile browser client in their WAP enabled phone. This project promotes a new dimension of mobile services and will benefit mobile users. Besides, the system is very useful to the tourist or visitors that are not very familiar with Malaysia environment. Hence, it could provide a basis of new research studies on the importance of location-based services solution as well as the initial characteristics of a good and reliable Mobile GIS.

1.3.2 Feasibility of the Project within the Scope and Time Frame

This project and study are feasible to be conducted within the scope defined and the time frame given. The project is able to prove that Wireless Application Protocol (WAP) technology is capable to integrate with Mobile Geographical Information Systems (GIS). This project is feasible to come out with a prototype that able to display Malacca map image in WAP-enabled phone according to the research done on the functions of WAP as a Mobile Internet that can provide immediate access to spatial data and extends map function compared to the static one.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1. Introduction to Mobile Geographical Information Systems (GIS)

Mobile Geographical Information Systems (GIS) is basically an application development of GIS in mobile environment. The keyword of Mobile GIS is 'mobile Internet' or can be called mobile computing [2]. Mobile GIS or in an easiest word is M-GIS transform the conventional Web GIS into mobile environment. It moves from the old and static web content into dynamic mobile content which the user can view the information immediately by fingers clicking.

In the Geographical Information System (GIS) field, it has been described as a world map in the palm of our hand, wherever we are, whatever we doing and with no 'strings'

attached [10]. Taking an advantages of this situation, the implementation of Web content “on the spot” in a flexible form on a mobile phone is becoming important [1].

Through an integration of wireless devices with GIS application, it can helps users and consequently GIS users to access location information and information technology spatial data without using standard computing operation. Geographic data can be gathered immediately and better utilized.

2.2. M-GIS as one of location based experience

Location Based Services or LBS are one of the important areas in GIS field. It can offer wide range of usage and tremendous benefits to user due to the growing demand for location based application nowadays [3]. M-GIS were established as one way of mobile users and GIS application interconnection in distributing and sharing location based experiences. Mobile users can access information from the LBS by using their mobile terminals, which in this case is the mobile phones, in any time and any place. The technologies and various LBS application plays an increasingly role in a society which is always connected and needs faster information on hand [5].

Basically, the research shown that commonly they are two ways of M-GIS currently implemented in Malaysia even though the application is not popular enough to be use as the main choice. However, this technology is hopefully spreading across Malaysians and all mobile users client.

SMS/MMS-based Mobile GIS suitable for normal and standard mobile phones with sample system function. It only displays a limited graphical user interface which relies on phone pixel and screen resolution. Limitation of this application however becoming the major issues to major wireless developer experts and the idea of WAP-based GIS

finally came out as a result for better and richer friendlier presentation of spatial data for mobile phone [2].

Hence, in general, the author found that the relevancy of location-based experience in discussing potential application and reviewing the high level technologies of wireless GIS must have the strong interoperability [11]. The demand for interactive and attractive mapping information was still being discussed in mobile world. But as far as several developments were completely success in transforming the meaning of M-GIS, the author believes that the future of this technology will have more chances to grow as the needs for information itself.

2.3. Introduction to Wireless Application Protocol (WAP)

WAP or Wireless Application Protocol is defined as powerful, open and global application that enabled mobile users with wireless device to easily access and interacts with information and services in a faster way. As if we consent, in this new era of information age, more people are used WAP-enabled mobile phones which can have a connection with Internet.

It is a bear-independent international standard protocol that has optimized for mobile devices with limited display and small keyboards of mobile handsets and low bandwidth of wireless networks [2].

The WAP specifications are described as above;

- WAE - Wireless Application Environment
- WSP - Wireless Session Protocol
- WTP - Wireless Transaction Protocol

- WTLS - Wireless Transport Layer Security
- WDP - Wireless Datagram Protocol

Based on the research presented, Wireless Application Protocol (WAP), enable developers to build services in which future value can be added, building on WAP's time and location independent mobility. It is a proof that the usability of existing WAP services are enhanced along with new technology enablers including, GPRS.

2.4. Implementation of WAP-based Mobile GIS

As the discussion continues, the authors finally came out with the details of study done on the implementation of GIS in WAP world. WAP-based Mobile GIS allows mobile users the ability of performing the almost same functionality of Web GIS in a mobile environment, regardless of the limitation of operating system and wired link. It can be used at anytime, any place wirelessly.

Since mid 90's, the research on Mobile GIS based on WAP had been done by many researchers around the world concerning that it can create a new channel of business practices, and thousands of potential applications and services also can be developed [6].

As location-based services, used different means to communicate spatial information to people especially mobile client users. Mobile map differ in several ways from paper maps [7]. Considering, the users of mobile maps perceive information with their connection to Internet with their hand. The approach here, considered that WAPing the old dimensional Web brings user closed to the technology as information can be access using WAP-enabled devices.

The way the system approach is possible in those ways; [7]

- A client-server based architecture, exploiting any ubiquitous wireless communication network, like GPRS.
- A client-based architecture, deploying a local spatial database on handheld device.

The analysis came to the conclusion of the investigation of the possibility of designing and implementing a mobile system that able to visualize and manipulate geographical information. These satisfy the objectives of M-GIS which were established to allow the accessibility of spatial data using wireless approach.

2.5. Successful of WAP-based Mobile GIS application

Few could have imagined in the early 80s that cellular communication would enjoy the popularity that it does today. A cellular phone once thought of as a luxury is now considered by many to be a necessity. As of early 2001, one out of 10 people in the world (680 million) used a cellular phone. Many amateur radio operators have joined the ranks of cellular phone users and find they are legitimate devices to supplement amateur communication. This section includes WAPaprs background information and nomenclature. It describes some of the unique terminology of WML and the WAPaprs architecture. [6]

WML (Wireless Markup Language) was used to create WAPaprs. WML is a formatting language similar to HTML. It is defined as an XML (Extensible Markup Language) document that is optimized for small screens and memory size. Although WML is similar to HTML, WML cannot be displayed directly on a desktop web browser such as Internet Explorer or Netscape because these desktop browsers support HTML not WML. [6]

Another example is Mobile Mapping. The mobile applications could deliver the Map Information in different ways such as a) Text: Address and phone of nearest bank, driving direction, Job dispatch operations based on user's location. b) Image: The path to the service location, on a map. c) Voice: Driving directions, Job dispatch operations. d) Video: Fly-By movies, Traffic congestion Status. There are multifarious applications for Mobile mapping of which the most prominent applications are described below.

Routing applications also one of the sample of WAP GIS. Routing could be one of the most popular GIS based solution on mobile terminals. The mobile user could indicate his origin, destination and via locations to the mapping system. Some inputs can also be taken from the GPS device directly. With good transmission speeds (GPRS and higher), the mobile user can also have route guidance (If GPS device is used along with the mobile terminal) on the move. The mobile terminal would get the route result from the server in the form of a detailed way-description- the way description itself can be a text-based display or a voice based directions. The route can be highlighted on the map and shown on the Mobile Terminal. Routing applications can result in the following data being delivered to the Mobile terminal.

CHAPTER 3

METHODOLOGY / PROJECT WORK

3.1 Procedure Identification

The methodology being used in the development of the prototype is System Development Life Cycle (SDLC). SDLC refers to a methodology for developing systems. It provides a consistent framework of tasks and deliverables needed to develop systems. The SDLC methodology may be condensed to include only those activities appropriate for a particular project, whether the system is automated or manual, whether it is a new system, or an enhancement to existing systems. The SDLC methodology tracks a project from an idea developed by the user, through a feasibility study, systems analysis and design, programming, testing, implementation, and post-implementation analysis. Documentation developed during the project development is used in the future when the system is reassessed for its continuation, modification, or deletion..

Phase I – Initiation and Feasibility Study

Phase II – Project Planning and Functional Analysis

Phase III – Design

Phase IV – Programming

Phase V – Testing and Implementation

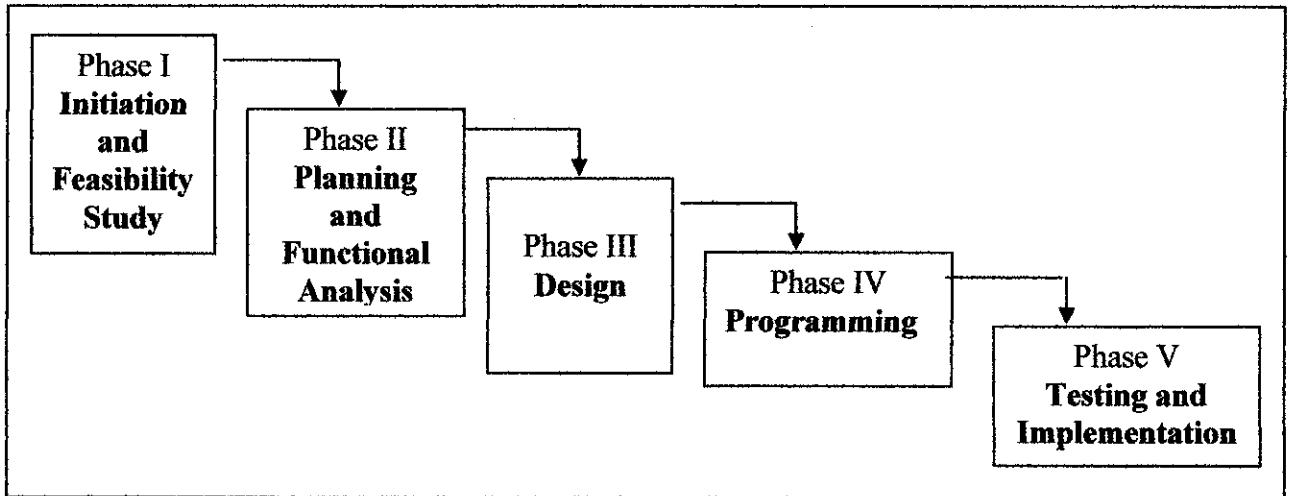


Figure 3.1: System Development Life Cycle Process

3.1.1. Phase I – Initiation and Feasibility Study

The main aim of the feasibility study activity is to determine whether it would be financially and technically feasible to develop the system. During this phase, the author came up with the analysis of the problem and collection of all the relevant information relating to the objective of this project such as the system input, the processing required the output data as well as the various constraints on the behavior of the system. The author had analyzed different problem related to this project. One was to have a dynamic map design and spatial data to be presented to user in a wireless way as the focus of this project which used WAP environment. The issue involved is how can the GIS data can be offer and introduce to user via mobile environment. The other approach is to show a good example of how a WAP application makes the mobile phone as an essential portable companion to distribute and spread IT spatial data compared to static web. The findings from those analyses were used as the solution strategies to come out with the prototype system of WAP integration with GIS which is going to be implementing in the

mobile environment. Throughout this phase, the author had conducted wide research on journals, white papers, articles and relevant web sites covering Mobile GIS on WAP which is needed to complete the project.

3.1.2. Phase II – Project Planning and Functional Analysis

The second phase more focus on the project specification and the analysis regarding the functionality of the prototype system. The author also identified the high level process decomposition that determines the functions of the prototype as well as the subjected area it will support. This project will focus on the implementation of WAP site which will display the map of Malacca area as the area of study. This map site will have zooming, snap, pan and moving function as it will enable the map to be used satisfactorily by the mobile users. The hardware and software specifications were also one of the major focuses of the author during this phase. The author has to ensure that the compatible hardware and software used fulfill the need of having a working prototype and demonstrate the prototype according to the objective as expected. Besides, the author has identified and enabled to come up with the potential users and possible cost and risk incorporated with the project and the time frame given.

3.1.3. Phase III – Design

In this stage, the outcomes from the analysis phase were reviewed and revised in terms of scope, objectives, data models and reports. Initial design using prototyping also was started. Based on findings of research and studies during analysis phase, the author had come out with system's framework, hence provides initial views on the workflows of the data transaction within the system. Furthermore, data gathering was done during this phase by collecting spatial data of Malacca in the form of digitized map and related

codes that could be used for construction phase. From the Malacca digitized map, only suitable layers were selected and chosen. The files obtained are in following format:

File Format	File Name	Support functions
.shp	Shape File	Used to call map image from PP GIS
.dbf	Database File	Used to support database file in PHP GIS
.gif	Graphics Interchange Format	Used with WAP page to display map image
.jpeg	Joint Photographic Experts Group	used on the Web for photographic images
.bmp	device-independent bitmap	Can be used in many platforms and support different image size.

Table 3.1: File Structure

Installation and configuration of software were also done during this phase including MapServer for PHP GIS part and ESRI ArcView 3.2. Software needed is for the phone simulator and WAP gateway for testing part. Nokia Mobile Internet Toolkit and Openwave SDK were chose as the perfect testing software emulator. The visual presentation of the Malacca digitized data is viewed using ESRI ArcView 3.2. This has given basic idea of what the system or prototype will look like when the construction starts later.

Initial interface has been drafted and designed according to WAP framework. This is to give the author more focus on the basic integration processes of PHP GIS and WAP in the system's prototype. The components tend to be data-intensive, so that the designs for

the basic components concentrate on user interfaces for displaying map on mobile phone. It is also for concentrating on user interfaces for the PHP part which will translate the web pages to WAP site compatible. The configuration on Map Server part is the most critical part as it will display the major input data for the system prototype.

3.1.4 Phase IV - Programming

This phase concentrated on the development of the system using design tools and generates codes using the code generator. For the PHP GIS part, the configuration of MapServer tools is used for displaying the correct map according to each layer presented in the digitized map before. The code is generated using the main code format which is .map format. The layer is configured carefully and following each layer required displaying full map format. The sample of the code can be getting from the Internet. All the layers than must be carefully configured and the parameter used for all the field is assure to be suitable to be display in WBMP format or mobile browser compatible. This including the image format and the size for the main map image resolution part. Before the actual and correct map layer can be presented, the Malacca digitized map was edit using ArcView tools which is used for editing map layer.

The WAP part will be concentrated on the development of WAP page which consist a detail coding of map element in PHP integrate with WML/XHTML code. This code type is required as to make the map page capable to be display in the mobile phone browser. The integration between the two major parts then is the critical part as it requires careful consideration and wide coding knowledge regarding the integration between normal web page and wireless. The author has to play with screen resolution and this is where the Adobe Photoshop software is needed as the image needs to be edit according to the real mobile phone screen browser.

3.1.5 Phase V – Testing and Implementation

Testing and Implementation phase involve implementation of fully functional prototype into real environment. The testing part is done using the phone emulator before uploading the website to Internet. Using the phone emulator and WAP-gateway on desktop basis is done using the Apache Web Server in Mapserver. When user request a web page which consist the map of the place which they want to know, WAP gateway plays its role to extract information from the server and search throughout the database and from Internet and finally the page requested will be display in the WAP browser containing information and the map image.

For the implementation part, the system is ensure as expected to function correctly and is capable of meeting the user requirements which is parallel with the main objective of this project.

3.2 Tools

As the system is a combination of GIS and wireless, various software are used in order to assist and facilitate the development process. Compatible hardware is configured to ensure that the system will run smoothly and integration will be successful.

3.2.1 Software Requirement

The main software used is MS4W - MapServer 4 Windows which consists of the following components;

- Apache Version 2.0.5.0
- PHP Version 4.3.10
- Mapserver CGI 4.2.1 & 4.4.1

- PHPMapScript 4.2.1 & 4.4.1
- OGR Utilities
- Mapserver Utilities
- OGR / PHP Extension 1.0.0
- OWTChart 1.2.0
- Chameleon
- Gmap
- Maplab
- Postgress – SQL

Map Server will be the main software in the development of PHP GIS. It will use the Apache web server as the main server to extract the map configuration function as to display the real map on web. The successful configuration on Map Server will produce high quality map information which come with specific zooming and adding data functions also the capability of redraw map.

ArcView 3.2 is used for the GIS part. This software is developed by Environmental Systems Research Institute (ESRI). It provides wide-variety of tools for analyzing, mapping, managing, displaying, and publishing geographic or spatial information. Besides, ArcView 3.2 also applies the use of Database Management System (DBMS) and offers user-friendly graphical user interface (GUI). It also provides tools for entering and manipulating spatial and geographic information as well as provides extensive mapping, data use, and analysis along with simple editing and geo-processing capabilities.

For the integration part, Microsoft Dreamweaver will be the tools for editing and creating the perfect coding needed for displaying the map page on hand phone. The

coding part will be basically the PHP coding integrates with WML and XHTML simple functions.

The use of phone simulator from OpenwaveSDK product is used for the testing part based on desktop environment. It provides all the tools needed such as the WAP gateway and phone emulator which can work similarly to the actual phone. The used of those tools is for the implementing WAP technology on desktop first before the real prototype using mobile devices can be done. It actually can assist the author in implementing the prototype based on the test result provided in the emulator.

3.2.2 Hardware Requirement

Hardware requirements are divided into two: Hardware for the system to function and hardware for developing the system. The hardware configuration is based on the configuration of author's computer and the configuration is not the minimum requirement. The hardware requirement is presented below in Table 3.2.

Hardware for functional system

Mobile phone with Wireless Application Protocol (WAP) features that serves as the Gateway and for end-users to retrieve the results.

Hardware for System Development

Processor : Intel Pentium 4 2.4GHz

Memory : 512MB RAM

Monitor : 15" with 1024 x 768 resolutions

Hard Disk Drive : 80GB

Media Drive : 54X CD Drive, 1.44MB Floppy Disk Drive

Operating System: Windows XP Professional Edition with Service Pack 2

CHAPTER 4

RESULTS AND DISCUSSION

4.1. Findings

This section presented all the findings result and several research done related to the project. The findings will be based on the Mobile GIS (M-GIS), working prototype of WAP basic framework and also the architecture of WAP-based Mobile GIS.

4.1.1. M-GIS

At present, Mobile GIS is mainly applied in city apart from some special fields. Mobile GIS:

- Position-determining components (PDEquipment) refer to components to determine the locations of the mobile devices in real time. They include hardware and software to identify and track the locations of mobile devices. These can be based on a cellular triangulation or GPS to discover position.
- Location information refers to content information about a geographic location. It includes reference information to a geographic location, such as a street file or a boundary file, and specific information about a particular location, such as Yellow Pages information.
- Information processing service components concern the network processing or analysis services of geographic information, that is, how to provide the location information in a usable way to mobile users.

- Gateway services are middle-ware between the information processing components and the mobile devices. The purpose of the gateway service is to make the services provided by the server (e.g., application server and Web server) compatible with the mobile devices.
- Mobile GIS relies on the wireless network to transport information.
- Mobile GIS requires Internet enabled mobile devices. This means that the mobile devices have to be able to access and display Internet services.

4.1.2. Description of research challenge

It has been predicted that the web and distributed mobile and wireless networks may eventually become the dominant form for accessing GIS. For instance, web GIS currently has the higher potential user base and the lowest cost per user. These technologies are also within the realm of "telegeoprocessing", a term coined by Xue et al. (2002) to encompass real-time update of spatial databases, analysis, and decision making via the integration of remote sensing, GIS, GPS, and telecommunications.

4.1.3 The comparison of MMS/SMS and WAP

Basically, the research shown that commonly they are two ways of Mobile GIS currently implemented. However, this technology is hopefully spreading across Malaysians and all mobile users client.

The table below is presented to show the comparison of SMS/MMS and WAP technology.

MMS/SMS	WAP
Unfriendly graphical user interface (GUI)	Richer information presentation
Poor information presentation	Friendlier GUI
Time consuming when waiting for reply and request	Can have more system functions
Restricted application fields	More application fields
Restricted carrying information	Can work on wide range of mobile devices
Unfriendly interactive mode	

Table 4.1: Comparison of SMS/MMS and WAP technology

SMS/MMS-based Mobile GIS is suitable for normal and standard mobile phones with simple system function. It only displays a limited graphical user interface which relies on phone pixel and screen resolution. Limitation of this application however becoming the major issues to major wireless developer experts and the idea of WAP-based GIS finally came out as a result for better and richer friendlier presentation of spatial data for mobile phone.

4.1.4 WAP basic framework

WAP is a different protocol which it using and taking the principle of wireless Internet in distributing information regarding places and tourist destination. The diagram below emphasizing the differences between WAP and normal Web browser. Figure 4.2 shows the architecture of WAP which include several layers connecting together. This WAP specifications are summarizes as below;

- Wireless Application Environment

- Session Layer - provides the application layer of WAP with a consistent interface for two session services.
- Transaction Layer - provide efficient request/reply based transport mechanism suitable for devices with limited resources over networks with low to medium bandwidth
- Security Layer - A security protocol based upon the industry-standard Transport Layer Security (TLS) protocol, formerly known as Secure Sockets Layer (SSL).
- Transport layer - protocol in the WAP architecture

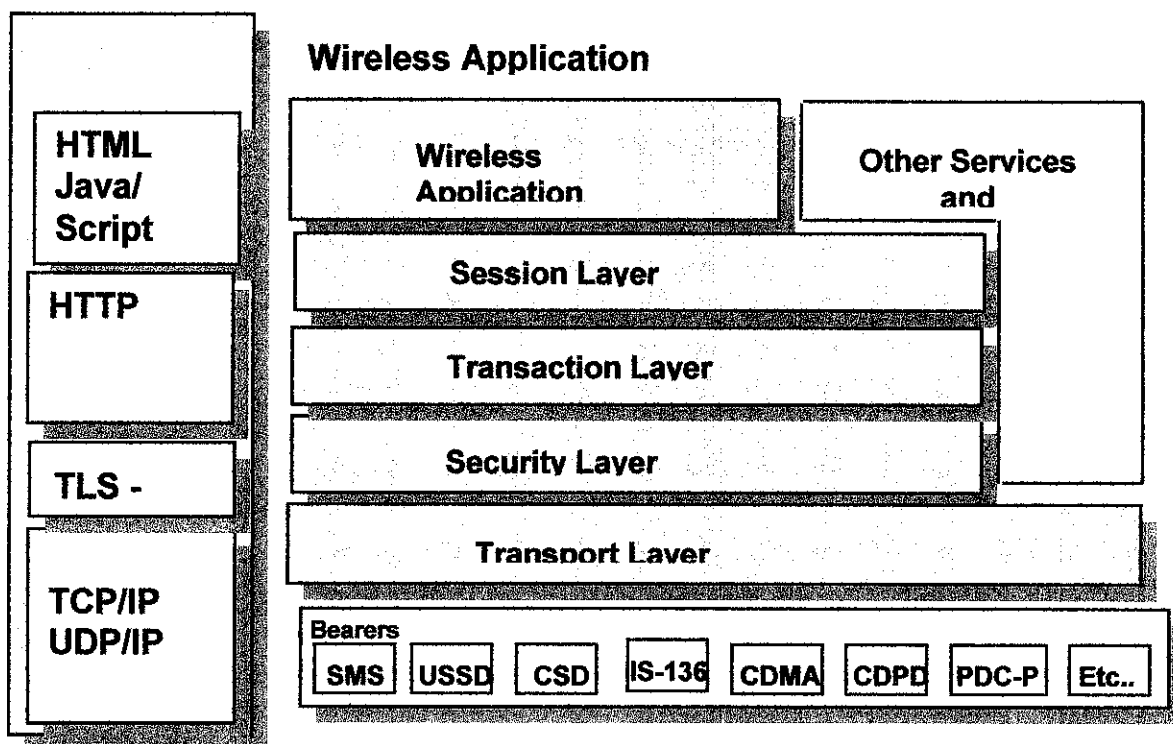


Figure 4.1: Framework for Mobile GIS

WAP is a bear-independent international standard protocol that has optimized for mobile devices with limited display and small keyboards of mobile handsets and low bandwidths of wireless networks, and permits applications and services to operate over all existing and foreseeable wireless networks such as GSM, CDMA, PHS, TDMA and

WCDMA (WAP Forum, 2002). The WAP specification encompasses a relatively simple and compact version of XML (eXtensible Markup Language) called WML (Wireless Markup Language), which makes it possible to make requests to a mobile service from a mobile terminal and return a map in the form of an embedded bitmap (e.g. WBMP). WAP-based Mobile GIS has richer information presentation, friendlier GUI, more system functions and more application fields than the former.

The rationale of WAP function is basically depends on the barriers involve in producing the excellent result on mobile browser. Here, briefly explain in the table provided below, it consist of transmission and barriers are varies between one another. This finding is basically to listing the normal environment which WAP has to go through the development life cycle of mobile environment.

Transmission type	Transmission speed
GSM Circuit Switched Data (CSD)	9600 bps or 14400 bps
GSM High Speed Circuit Switched Data (HSCSD)	57.6 kbps
EDGE	384 kbps
General Packet Radio Service (GPRS)	172 kbps
Universal Mobile Telecommunication System (UMTS)	2 Mbps
Wireless IP networks (3G)	10-100Mbps

Table 4.2: WAP barriers

4.1.5 An integrated system of WAP-based Mobile GIS

Here, the author presents an Integrated System of WAP-based. It can fulfill the above application requirement. The working flow of the integrated system is described below. For WAP request, Users input a WAP URL from mobile device to connect the WAP

connect server and then interact with it. WAP request is translated into HTTP request by WAP gateway. So any general web server can handle the WAP request if it was configured correctly. So the WAP-based application can be tackled by the same mode as WEB-based application. After getting request, Web server peels off the inside geographic information request and delivers to Map Server.

Map Server usually consists of a GIS component module. As a core of Mobile GIS, it is responsible for processing geographic information request at real time and generating the relevant response. The response may be a string of text or a piece of image, which interpreter geographic information to mobile user. Web server functions as converting Map server's response into WML (WAP Markup Language) format and send it to WAP gateway. WAP gateway is up to filter and compress the content from Web Server and to transfer the content to mobile device through wireless communication network..

4.1.6 Codes for Interacting with WAP Mobile Phone

As this system will be based on two major parts, the codes used are basically PHP, WML and XHTML codes. The sample codes for the PHP GIS are the only code that can be used is in .map format which needed to display all the layer of the map in Map Server. The sample code can be get from the Map Server site which provides the code used with their software product. In order to come out with the right map, the author has to modify the coding according to each map layer element. For the integration part, WAP site required the coding generator which can translate the map page into compatible WAP site. For translation and successful WAP page which can be displayed via mobile browser, the author came out with the sample code which consists of PHP, WML and XHTML element. The exact code or the sample one can be get from many coding site

from the Internet, but major modifications is needed as the codes will satisfy the need of map data as the system input.

**see appendix for sample of coding*

4.2. Discussion

Based on the findings, several issues and matters are taken into account that generates important indicators for the successful of this project. The issues are discussed in the following sections.

4.2.1 WAP service development tools

When building WAP applications one has to recognize that WAP applications, just as web applications, can have static or dynamic content, or a mixture between both. Static WAP content (information that is not updated very often) is written in WML (similar to HTML).

Dynamic WAP content (database stored information, for example news, stock quotes, timetables etc.) can be generated with CGI, ASP or JAVA servlets. For more advanced tasks comparable to those solved by using JavaScript in HTML, WAP provides a similar solution called WML Script.

The author had downloaded a WAP development tools and emulator that support development and testing of both static and dynamic WAP applications. For this project, the author used Openwave Developer and Nokia Mobile Internet Toolkit as the main phone emulator to test the WAP application. The WAP browser can support testing of both static and dynamic applications. Openwave Developer Phone Emulator also includes a web server for testing of WAP applications. Style guides and documentation are also important when designing WAP applications for specific WAP terminals. Nokia

6600 being used here also offer WAP Application Servers, which serve as a development and deployment platform for WAP applications. It provides tools and APIs that makes it less complex to design WAP applications. It enables the developer to create WAP applications that adjust the WML code to different WAP terminals.

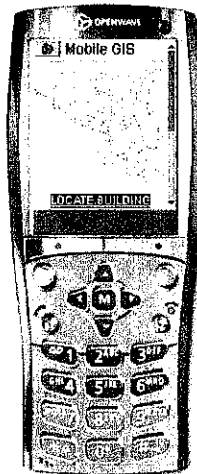


Figure 4.2 WAP page in browser emulator

4.2.2 WAP service design considerations

When it comes to designing part, the key is to gain acceptance and appreciation from users. Simplicity is even more important in a mobile environment since the user often needs to concentrate on other things as well as using the mobile device. For general usability of WAP services it is therefore important to keep information and text short and meaningful. The size of an image should not exceed 1.500 bytes. It is recommended to use images only to supplement text rather than replace it.

In designing WAP applications that integrate with GIS, it is important to consider the designing part as it will display the large map image which include the

4.2.3 User interface issues

Although the major hardware suppliers Nokia, Motorola and Ericsson all use the basic micro browsing technology, the display properties of the different phones are quite different in size. This means that the different phones display data differently. This resembles the well-known situation of fixed terminals with different display resolutions (VGA, SVGA etc.). The general browser display has two static sections: the Browser Area and the Header at the top. The Browser area is where the card content is presented to the user. The author used Nokia phone 6600 series as the main development tools, which corresponds to 176x208 pixels. Graphical components, text, and images are shown in the same order as they appear in the WML code. The issues here when designing WAP application integrated with GIS is the map area image which has to be in the perfect resolution so that it can be display clearly to the user and directly overemphasized the route and element in the map. Shows below are the screen snapshot that displays the application of Malacca map.

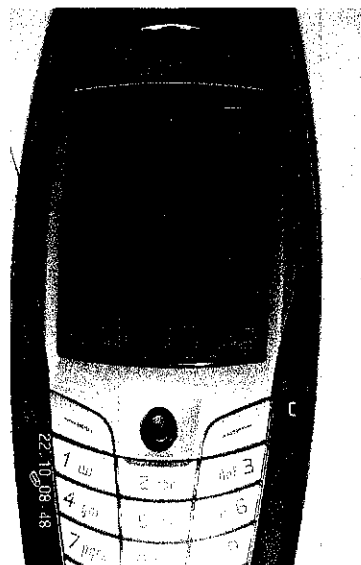


Figure 4.3 WAP page in Nokia 6600 browser

4.2.4. Wireless Application Protocol (WAP) in Mobile GIS Prototype

Based on the research and also studies done regarding the project framework, the author came out with working prototype of WAP framework which contains three basic components. As showed on Figure 4.1, this framework basically contains three main parts, Mobile browser, WAP gateway or WAP proxy and Web Server. The implementation of WAP starts as user request the information from the Internet, but before it can connect to the web server which has a connection with Internet, the requested URL must go through WAP gateway. WAP Gateway was required to handle the protocol interworking between the mobile client and the Web Server. As depicted in Figure 4.4, the WAP gateway consists of WML encoders and WMLscripts decoders. This is where the requested URL will be communicate using the WAP protocols through the WAP gateway, and communicates with Web Server through standard Internet protocols such as HTTP/HTTPS.

Once the WAP gateway receives WAP requests from the client or mobile users, it will translates the requests to HTTP requests, and send them to Web server. Once the web server processed the requested information (searching through existing databases and information resources such as web pages), it will sends back to WAP gateway using the HTTP responses and WAP gateway will encoded the web contents to reduces its size and number of packets for traveling over the wireless network and ready to display in mobile browser.

From the figure also, there is an Internet server which has a connection with Apache Web server itself. Behind this server, this is where the PHP GIS application lying down which using Mapserver software to display Web based map page in PHP script. For this project, the author use Malacca map as the study case.

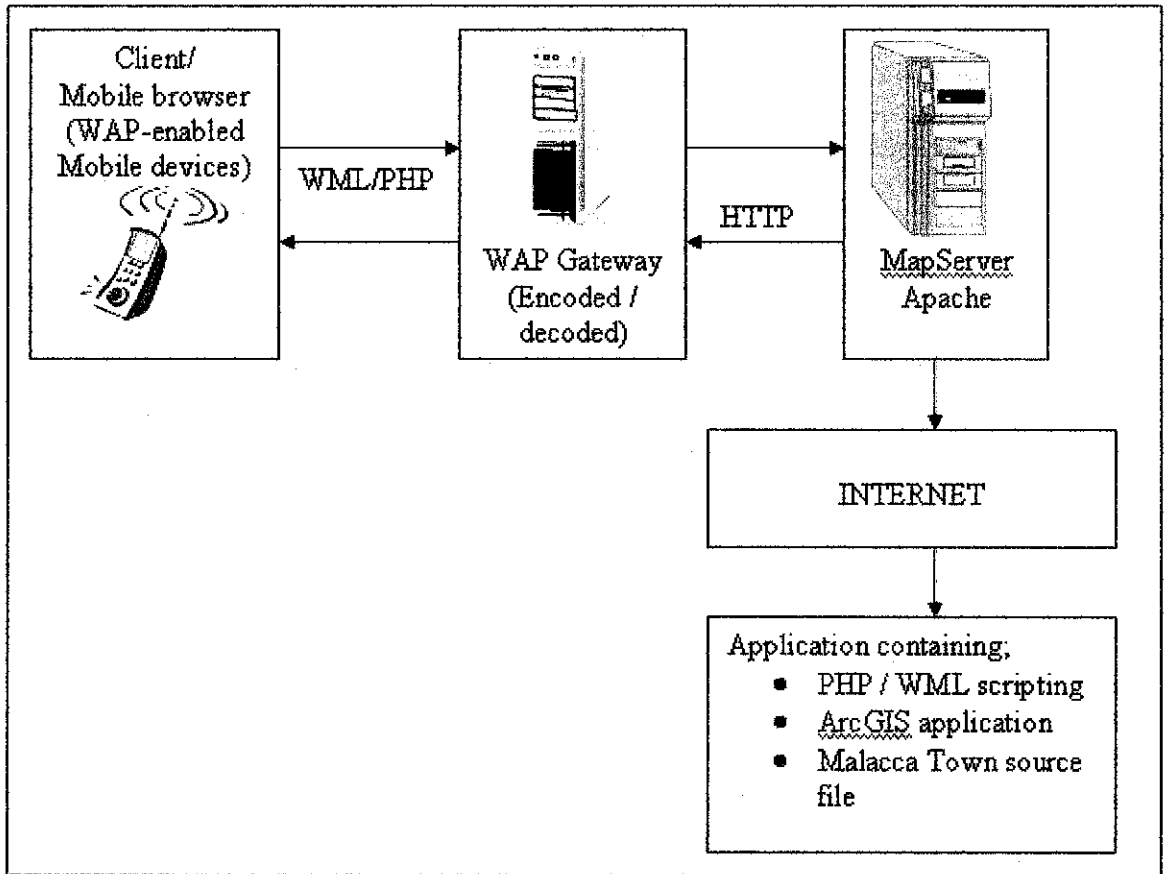


Figure 4.4: Framework for WAP-based Mobile GIS

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In a Mobile GIS environment or basically called as M-GIS, it is possible to access data anytime and anywhere without a fixed network. In this paper, the author discussed distributed spatial data transferring strategies and its possibility to improve the availability of Mobile GIS with such a technology. Due to the use of wireless network, M-GIS may have very low availability without the effectively transferring scheme and data storage strategies. This may lead inefficiency in data sharing and interoperation among mobile users. Throughout this paper, the author introduced the characteristics of Mobile GIS basic architecture. The basic framework and the environment of M-GIS are deployed in an integrated network.

By analyzing the distributed wireless data transferring scheme, it was found that it depends on both software and hardware technologies in order to improve M-GIS functionality and the ability to produce information to users. The possible solutions may include for example, spreading software protocol and employing new mobile equipments. It was found that in most circumstances, such as when the user needs immediate information regarding the tourist destination in the spot, they can go there by wireless. This is where WAP-enabled phone play its role as the technology evolve.

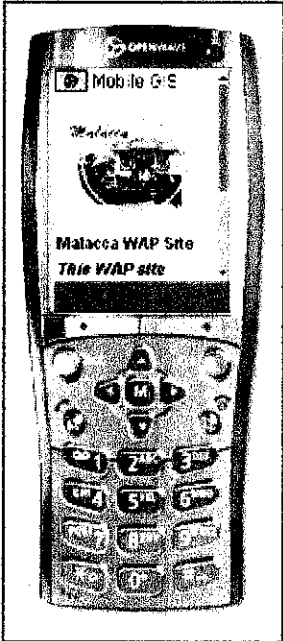
Nowadays, the wireless equipments become more and more excessive and Mobile GIS has been applied in many fields. For example, business, retail, medicine, etc. Spatial data transferring and storage in distributed wireless GIS is a challenge area to be further developed. More and more comprehensive GIS application with wired velocity, infinity freedom will be realized.

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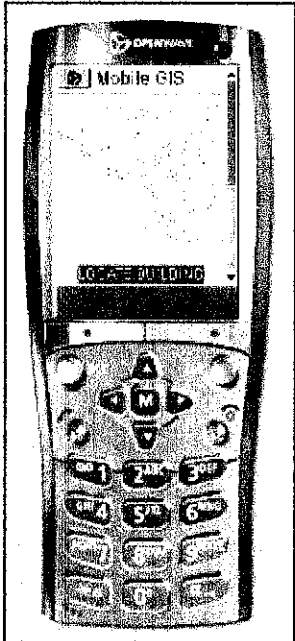
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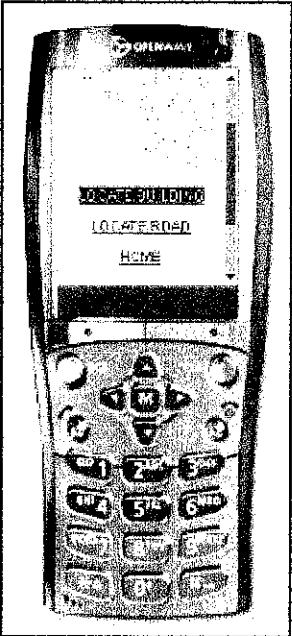
APPENDIX III: MAP FILE CODES (FOR PHP GIS)



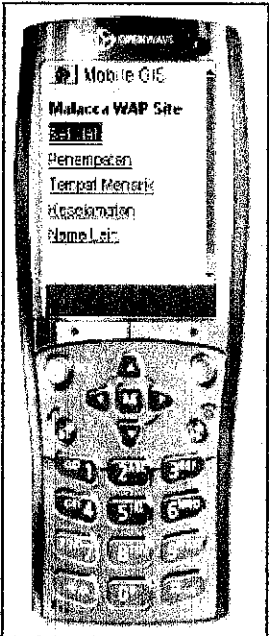
Welcome page



Main Map page



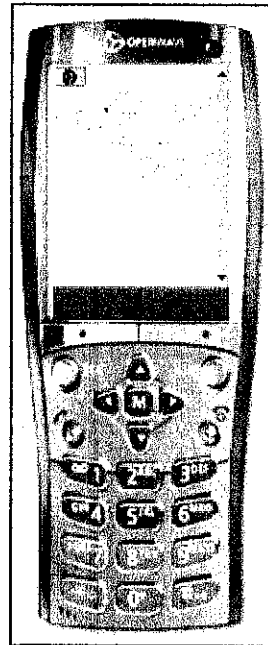
Map with Menu driven



Locate building page



Find Location page



Result page

APPENDIX II: SAMPLE PHP/WML CODES

- Index.php

```

<?php
if ( strstr($_SERVER["HTTP_ACCEPT"],"application/xhtml+xml") ) {
// user agent accepts XHTML explicitly
header("Content-type: application/xhtml+xml");
}
else {
// user agent may be a search engine, incompatible browser or validator -
// send incorrect MIME type to deliver at least some text
header("Content-type: text/html");

echo 'Browser not compatible';
exit;
}

// send XML declaration even if short tags <? are enabled
echo("<?xml version='1.0' ?>\n");
?>
?>

```

```

//$msisdn = $_SERVER['HTTP_X_UP_CALLING_LINE_ID'];
//if (substr($msisdn,1,3) == '6012'){
?
<!DOCTYPE html PUBLIC "-//OPENWAVE//DTD XHTML Mobile 1.0//EN"
"http://www.openwave.com/DTD/xhtml-mobile10.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en">
<head>
    <meta http-equiv="cache-control" content="max-age=0" forua="true"/>

    <title></title>
</head>
<title>Mobile GIS</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>
<body>

<table border="0" width="128">
<tr>
    <td><div align="center"> </div></td>
</tr>
<tr>
    <td><font face="Arial Narrow" size="-1"><strong>Malacca WAP Site</strong></font>
</td>
</tr>
<tr>
    <td><font size="-1" face="Arial, Helvetica, sans-serif"><em>This WAP site
enables you to find the building and road location in Malacca Town</em>
</font></td>
</tr>
<tr>
    <td><a href="map.php"><font size="1" face="Arial Narrow">SEE MAP</font></a>
</td>
</tr>
<tr>
    <td>&nbsp;</td>
</tr>
</table>
</body>
</html> <? /*} ?> <? */?>

```

APPENDIX III: MAP FILE CODES (FOR PHP GIS)

```
NAME MELAKA
STATUS ON
SIZE 400 300
SYMBOLSET ../etc/symbols.sym
EXTENT 466023 241006 477004 247007
# EXTENT 465560 240582 477105 247699
UNITS KILOMETERS
SHAPEPATH "./data"
IMAGECOLOR 255 255 255
FONTSET ../etc/fonts.txt

WEB
  MINSCALE 2000000
  MAXSCALE 50000000
#
# On Windows systems, /tmp and /tmp/ms_tmp/ should be created at the root
# of the drive where the .MAP file resides.
#
  IMAGEPATH "C:\ms4w\apps\maplab-2.2\tutorial"
  IMAGEURL "/ms_tmp/"
# LOG "/tmp/gmap.log"
END

#
# Start of reference map
#
REFERENCE
  IMAGE images/malaccakeymap.png
  EXTENT 465560 240582 477105 247699
  # EXTENT 465560 240582 477105 247699
  STATUS ON
  COLOR -1 -1 -1
  OUTLINECOLOR 255 0 0
  SIZE 120 90
END

#
# Start of legend
#
LEGEND
  KEYSIZE 18 12
  LABEL
    TYPE BITMAP
    SIZE MEDIUM
    COLOR 0 0 89
  END
  STATUS ON
END

#
# Start of scalebar
#
SCALEBAR
  IMAGECOLOR 255 255 255
  LABEL
    COLOR 0 0 0
    SIZE SMALL
  END
```



```
SIZE 150 5
COLOR 255 255 255
BACKGROUNDCOLOR 0 0 0
OUTLINECOLOR 0 0 0
UNITS meters
INTERVALS 5
STATUS ON
END
```

```
QUERYMAP
STYLE HILITE
COLOR 255 0 0
END
```

```
#
# Start of layer definitions
#
```

```
#1
LAYER
NAME frame
METADATA
"DESCRIPTION" "Frame"
END
TYPE POLYGON
STATUS ON
DATA existing
CLASS
NAME "Frame"
COLOR 255 255 255
OUTLINECOLOR 0 0 0
END
END # Layer
```

```
#2
LAYER
NAME mukim
TYPE POINT
STATUS OFF
DATA mukim
CLASS
NAME "Mukim"
COLOR 255 0 0
OUTLINECOLOR 0 0 0
END
END # layer
```

```
#3
LAYER
NAME nilaikontur
METADATA
"DESCRIPTION" "Contour"
END
TYPE LINE
STATUS OFF
DATA nilaikontur
CLASS
NAME "Contour"
SYMBOL 3
COLOR 128 128 128
```

```
    OUTLINECOLOR 0 0 0
END
END # layer
```

```
#4
LAYER
NAME district
METADATA
  "DESCRIPTION" "District"
END
TYPE POINT
STATUS OFF
DATA district
CLASS
  NAME "District"
  COLOR 128 128 255
  SYMBOL 'circle'
END
TOLERANCE 5
END #layer
```

```
#5
LAYER
NAME nama_hydro_lain
METADATA
  "DESCRIPTION" "HydroName"
END
TYPE POINT
STATUS OFF
DATA nama_hydro_lain
CLASS
  SYMBOL 'circle'
  NAME "HydroName"
  COLOR 0 0 255
  SIZE 7
END
TOLERANCE 5
END # layer
```

```
#6
LAYER
NAME road2
METADATA
  "DESCRIPTION" "Road"
END
TYPE POINT
STATUS OFF
DATA road2
CLASS
  SYMBOL 'circle'
  NAME "Road"
  COLOR 164 0 164
  SIZE 7
END
TOLERANCE 5
END # layer
```

```
#7
LAYER
NAME road1
METADATA
```

```
"DESCRIPTION" "Road 1"  
END  
TYPE LINE  
STATUS OFF  
DATA road1  
CLASS  
  NAME "Road 1"  
  SYMBOL 3  
  COLOR 145 0 0  
END  
END # layer
```

```
#8  
LAYER  
  NAME jln  
  METADATA  
  "DESCRIPTION" "Road 2"  
  END  
  TYPE LINE  
  STATUS OFF  
  DATA jln  
  CLASS  
  NAME "Road 2"  
  COLOR 0 0 0  
  SYMBOL 3  
  END  
END # layer
```

```
#9  
LAYER  
  NAME nama_sungai  
  METADATA  
  "DESCRIPTION" "RiverName"  
  END  
  TYPE POINT  
  STATUS OFF  
  DATA nama_sungai  
  CLASS  
  NAME "RiverName"  
  COLOR 60 185 156  
  SIZE 7  
  END  
  TOLERANCE 5  
END # layer
```

```
#10  
LAYER  
  NAME canal  
  METADATA  
  "DESCRIPTION" "Canal"  
  END  
  TYPE LINE  
  STATUS OFF  
  DATA canal  
  CLASS  
  NAME "Canal"  
  SYMBOL 3  
  COLOR 206 0 0  
  END  
END # layer
```

```
#11
LAYER
  NAME building
  METADATA
    "DESCRIPTION" "Building"
  END
  TYPE POINT
  STATUS OFF
  DATA building
  CLASS
    SYMBOL 'circle'
    NAME "Building"
    COLOR 224 148 5
    SIZE 7
  END
  TOLERANCE 5
END # layer
```

```
#12
LAYER
  NAME bgn
  METADATA
    "DESCRIPTION" "Building 1"
  END
  TYPE POLYGON
  STATUS OFF
  DATA bgn
  CLASS
    NAME "Building 1"
    COLOR 128 255 255
    OUTLINECOLOR 0 0 0
  END
END # layer
```

```
#13
LAYER
  NAME bg
  METADATA
    "DESCRIPTION" "Building 2"
  END
  TYPE POLYGON
  STATUS OFF
  DATA bg
  CLASS
    NAME "Building 2"
    COLOR 0 255 128
    OUTLINECOLOR 0 0 0
  END
END # layer
```

```
#14
LAYER
  NAME bangunanlain
  METADATA
    "DESCRIPTION" "Building 3"
  END
  TYPE POLYGON
  STATUS OFF
  DATA bangunanlain
  CLASS
    NAME "Building 3"
```

```
COLOR 255 255 147
OUTLINECOLOR 0 0 0
END
END # layer
```

```
#15
LAYER
NAME bangunan_lain
METADATA
  "DESCRIPTION" "Building 4"
END
TYPE POLYGON
STATUS OFF
DATA bangunan_lain
CLASS
  NAME "Building 4"
  COLOR 186 172 253
  OUTLINECOLOR 0 0 0
END
END # layer
```

```
#16
LAYER
NAME bangunan
METADATA
  "DESCRIPTION" "Building 5"
END
TYPE POLYGON
STATUS OFF
DATA bangunan
CLASS
  NAME "Building 5"
  COLOR 252 152 152
  OUTLINECOLOR 0 0 0
END
```

```
END # Map File
```