WEB-BASED GIS FOR PUBLIC PARTICIPATION IN URBAN PLANNING AND MANAGEMENT
Case Study: Klang Valley Region

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ABSTRACT

Public participation in urban planning is needed as a means of improving information and to facilitate the adaptability of the system. In Malaysia, the preparation of the development plan called for participation as a value consensus mechanism, not only from the public at large but other agencies to allow data sharing and to ensure more informed decision. Geographic Information System data which were made accessible on the Internet by web-based GIS technology offered an effective medium for public participation. Its platform-independent and display-only map creation interface provides a good browsing facility for potential data consumers. The data conversion capabilities of GIS were used to demonstrate the possibility of sharing the data in different formats, particularly the Spatial Data Transfer Standard format. Presentation of spatial data using image maps allows users to reach particular data sets quickly and efficiently. These interfaces demonstrate the capacity to view, manipulate and distribute geographic data via WWW in an efficient, organised and user-friendly manner. Public can have access to these information and be more informed of the planning activities that are taking place. Other agencies can assist in developing a better database which consequently enhance the decision making process. The Web-Based GIS for Klang Valley region is now being developed to include tables and map based information for all the applications developed in the system. The web-based GIS developed consists 10 applications including Population and Socio-economic, Land Use, Tourism, Industry and Commerce, Environment, Traffic and Transportation, Utilities and Public Amenities, Green and Recreational Areas, Housing and Squatter Settlements and Geohazard. The operations offered a means for the users to display maps, submit query as well as display data sources and data structure base on selected maps. This application has several useful visualisation functions that are appropriate for Public Participation through interactive uses such like *Zoom In*, *Zoom Out*, *Pan*, *Hyper Link*, *Full Extension*, *Identify* and *Simple Query*.

1.0 INTRODUCTION

The Internet, a world-wide collection of interconnected networks of computers, has facilitated the accessing and sharing of information around the globe. The World Wide Web (WWW) is a project on the Internet that allows hypermedia information retrieval across the network. The multimedia capabilities of the WWW have made it a medium in which visual representations such as images, maps, diagrams, graphs and are as easy to implement as text. It has garnered far ranging interest from those interested in the representation and analysis of geographic information.

Geographic Information System (GIS) data were made accessible on the Internet by a Web-based GIS technology. It could maximise public access to mapping and GIS, and may be the most cost-effective means of providing people in marginalised communities and regions with analytical tools which would not otherwise be affordable. Further, familiarity with the user interface provided by the WWW may enhance usability. Users could focus on learning about the substantive use of mapping and GIS to solve problems, rather than struggling with an unfamiliar computer interface. It is expected to revolutionise public participation in planning by allowing anyone to access and use web GIS for capturing and manipulating spatial information with interactive sources and high customisation. Users can interact with GIS data and maps on the Web without having to own GIS software programs. It is also expected to provide interactive mapping and spatial analysis capabilities for enhancing public participation and collaboration in decision-making processes.

This paper focuses on the role of Web-based GIS as effective media for public participation. It explains the technical, practical and theoretical issues raised in providing access to database and GIS tools relevant to particular decision making problems. It also addresses the issue of public participation in Urban Planning and Management in relation to the implementation of the technology used to support community participation. The

paper contains two parts. The first part focuses on the investigation of theoretical and technical concepts for Public Participation Geographic Information Systems and web-based GIS. The second part will concentrate on developing web-based GIS technology, which could be used to widen public participation in a community setting. A case study will serve as the basis of the investigation. It is possible to use one community as a case study for Public Participation GIS because such a community can serve as the most basic level for participation in public affairs. The case study area in this paper is the Urban Planning and Management in Klang Valley.

2.0 PUBLIC PARTICIPATION IN MALAYSIA

The notion of Malaysian public involvement in planning can be traced to the Town Board Enactment of the Federated Malay States of 1927. It provides for the general town plan to be displayed to the public to make objections and propose recommendation on how to overcome the objections. Later the Town Board Enactment 1930 (which are still applicable in some parts of the country) provides similar arrangements for public involvement. In all these cases, the public was only allowed to participate after a draft plan has been completed.

The Town and Country Planning Act (TCP ACT), 1976 which succeeded the Town Board Enactment was the only significant planning legislation which covers all local authorities in Peninsular Malaysia. The rationale the TCP Act 1976 was basically to replace the Town Board Enactment which was considered extremely physical in approach and too rigid in accommodation changes in socio-economic needs for a country experience rapid development.

The 1976 Act essentially provide for public participation in these stages:

a) while preparing the structure plan policies
b) objection and representation to the structure plan
c) objection to the local plan

According to Kamalruddin (1994), the public participation exercise in Malaysia relied heavily on the following principles:

a) opportunities should be given to the public to involve themselves at the early stage of study;
b) public participation programme should involve all the people in the society;
c) public participation techniques must be suited to the various types of people directed at;
d) public participation could also be considered as an approach to educate the public concerning town planning based on the 1976 Act

Thus far, public participation in Malaysia has been quite successful in informing the public about the development plan of their respective area. However, more significant contribution from the public is desirable to improve the relationship between the authority and the public which would facilitate better development effort for the country.

2.1 Public Participation GIS (PPGIS)

The idea to have public participation using GIS was originated in mid-1990s by Onsrud, Schroeder and Lopez of the University of Maine who had planned a workshop on the subject of how to improve access to GIS among non-governmental organisations and individuals, especially those who have been historically under-represented in public policy making. The result from the workshop was that the phrase public participation GIS (PPGIS) has seen been used to describe a variety of approaches to come up with tools related to GIS and other spatial decision-making and accessible to all those with a stake in official decisions (Schroeder,1997).

A number of scholars (Aitken and Michael, 1995; Rundstrom, 1995; Curry, 1995; Weiner et. al. 1995; Obermeyer and Pinto, 1994; Obermeyer, 1995); Pickles, 1995) have noted that many groups are poorly represented in GIS nowadays. Average citizens have great difficulties in participating in ongoing policy debates. Individuals and citizens' groups without access to GIS and its cartographic capabilities may find it difficult to challenge any official reports released for feedback. In the end, the reports may end up to the advantage of those who earlier prepared the reports with minimum social impact.

Among social-political issues to be considered within the context of PPGIS are:

- Access to information and its complement of information confidentiality (Barndt, 1998);
- Power and control exerted through information access (Elwood and Leitner, 1998);
- The failure of traditional GIS to encode matters that concern to many stakeholders who were affected by decisions such as information about location and values(Schroeder, 1997);
- The limiting map-based metaphor that underlies GIS and makes it difficult to encode non-metric information (Harris and Weiner, 1998);
- The lack of access to GIS technology due to its cost and complexity (Barndt, 1998); and
- The importance of making PPGIS, a community-based activity. Various tensions that exist when GIS are introduced into local communities, particularly those that have traditionally been marginalised (Harris and Weiner, 1998).

Collaboration is another specific issue in PPGIS and has been considered primarily from practical rather than theoretical perspective (Roche and Humeau, 1999). Collaborative interaction on planning among stakeholders will advocate a group decision-making environment.

In order to strengthen the support on the development and implementation of successful PPGIS technology, it requires a conceptual framework which includes the design and assessment on its usage (Nyerges et al., 1997; Howard, 1998; Craig and Elwood, 1998). PPGIS focuses on helping users learn about problem contexts and end-up with collective decisions. A four suggested stages on collaborative public decision making process are:

- Preliminary assessment
- Problem definition
- Decision making
- Decision follow-up

The orientation of PPGIS may differ by locality due to both legal and cultural differences. The orientation in North America differs very much from those in Europe (Craig, 1998)

Although in Malaysia, public participation in planning has existed for along time to ensure public opinion has to be part in parcel before the go-ahead development can be warranted and monitored, the participation is still far behind compared to those in Europe, North America and Australia. The effort towards having PPGIS will soon be a reality in Malaysia when most of GIS applications are web enabled and the authorities are totally transparent on issues arise in planning.

The existing project AGISwlk as an example will soon be on the internet when ten existing GIS applications are web enabled. The users to this project will gradually open stage by stage for public participation. The immediate target users will be the identified stakeholders.

2.2 Web-based GIS and Web-based SDSS

Web-based GIS via internet will pave an increase number of users within a short period without being burden to undergo specific training and acquiring specific GIS software which is too costly for an individual.

The extra effort required by the initiator of GIS application is to have internet server, backup server, software tool to make the application web enable and disaster recovery programme.

In Malaysia, the only GIS application currently on web-based via intranet is NALIS, which is initiated by Ministry of Land and Cooperative Development, the usage is limited to authorised users which involved 14 government agencies. The focus activities are data collections (both spatial and non-spatial). The owner of the data has full responsibility on managing their own data. There will be 14 separate databases which are linked distributedly. The project is still in the first phase. SDSS will only be developed in the second phase which will begin in year 2002. Project AGISwlk which is initiated by BKWPPLK has full control of its data which focus information within Klang Valley, will soon be web enabled to allow their identified stakeholders benefit the existing applications in the project.

In most democratic societies, public involvement in decision making will be great especially when web-base SDSS is made available and is in open system. The public involvement may climbed through the public participation ladder (Figure 1) described by Wiedemann and Femers (1993).

The web-base collaborative and participatory SDSS, termed as Virtual Decision Making Environments (VDMEs), is based broadly around the ideas of Computer Supported Collaborative Working (CSCW) and Computer Supported Real Life (CSRL) and is encapsulated within the interactions between groups of individuals in cyberspace.

Partcipants can even explore the decision problem, experiment with choice alternatives and formulate one or more decision choices (Carver, Evans, Kingston and Turton, 1998).

Web-based SDSS are gaining its foot on the internet. The notable examples are:

- The East St. Louis Action Research Project (ESLARP) – is a local participatory planning system(ESLARP, 1996);
- Geographic Mediation System (GEOMed) – is aimed at improving ways to distribute heterogeneous geographical information and GIS (GeoMed, 1996).
- Open Spatial Decision Making (OSDM) website – which focus on the controversial problem of where to dispose of nuclear waste in Britain (Carver et al., 1996; 1997).

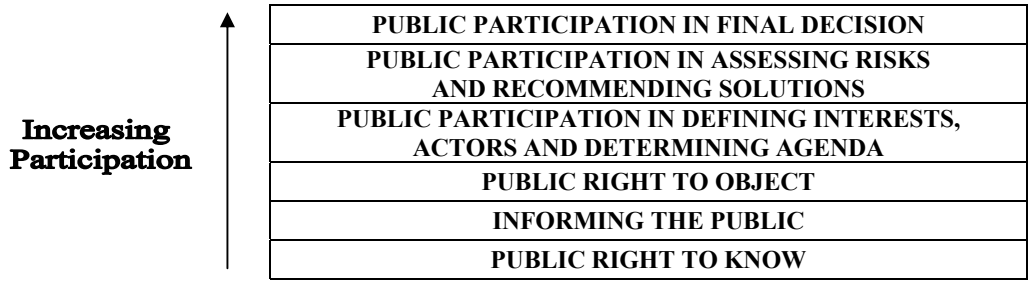

Figure 1: The public participation ladder (Wiedemann and Femers, 1993)

3.0 DEVELOPMENT OF WEB-BASED GIS

State of the art Web-based GIS are built on integration of multi-related technologies that include Object-Oriented Language, GIS package and language, HTML, CGI, and the theories about Public Participation GIS (Chang, 1997). The implementation concept base on global data sharing permits users to acquire and implement activities of interest the same way as implementation of application through the local area network.

Currently, there are five platforms used for developing Web-GIS applications namely graphic snapshots (maps), spatial database catalogs and libraries, map generators, real time map browsers, and real time maps and images (Rima County CAD/GIS, 1997; Chang, 1997). Thus, the platform has to be predetermined before the development of web-based GIS to ensure its suitability and meet the aim and objectives of development itself.

3.1 Underlying Concept of Web-Based GIS Using ArcIMS

ArcIMS is an Internet Map Server software which includes the components required for web development such as authoring, designing, publishing and administering Internet mapping application. It allows web clients, map server, data server and Web Server to communicate between one another. Through ArcIMS developers are able to build the web-based GIS faster and manage MapService over the internet. The software has assist web developers in:

i. preparing geographic data and service to internet
ii. customisation of the web page built together with the mapping application
iii. integration of local data with server data through ArcIMS site via the internet
iv. managing more than one project files and web page provided as service to the internet users
v. measuring the system's capability base on user requirement

The Web-GIS applications developed for the case of Klang Valley adopts the ArcIMS conceptual architecture comprising three main parts:

- Clients
- Middleware/Application Server
- Data Storage

Basically, the Web-Based GIS architecture is as illustrated in Figure 2.

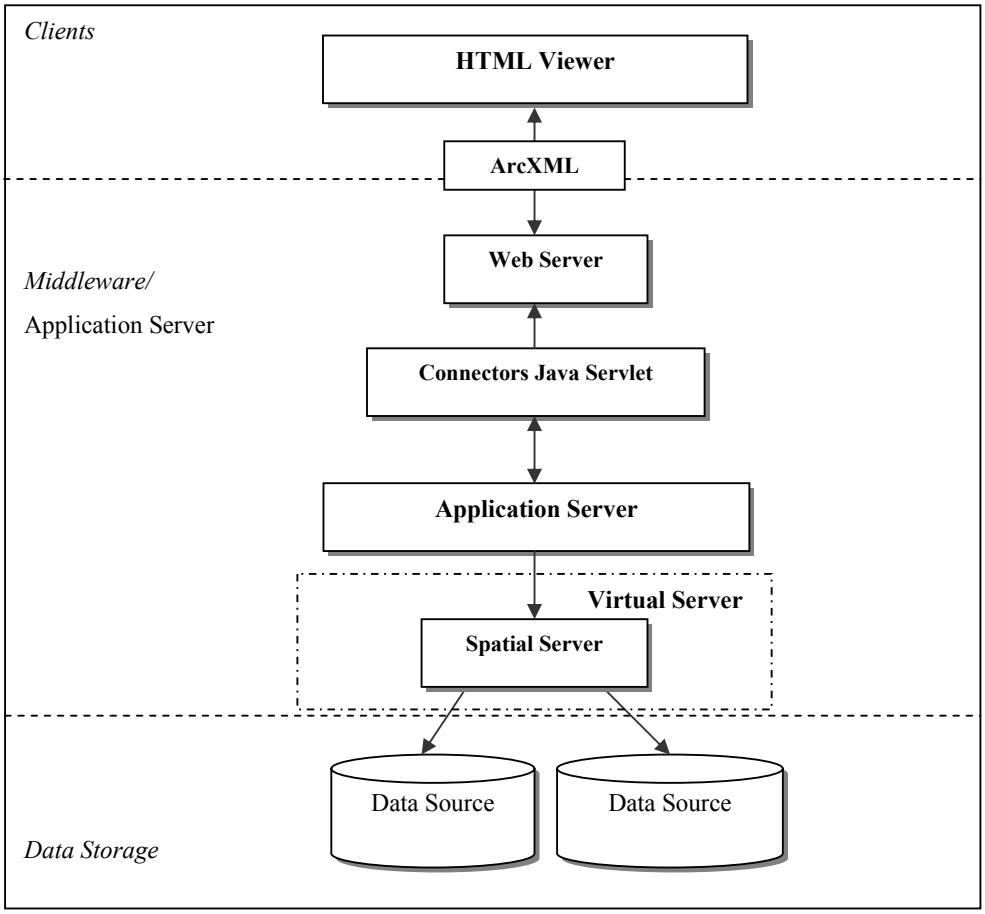

Figure 2: Architecture of Web-Based GIS Using ArcIMS

The architecture stresses on communication between the three main parts through the use of ArcXML whereby in the client/server stage, ArcXML is used to implement the MapService configuration and it acts as an interface to any query implemented by the client to the Web Server to be submitted to the application connector. In the context of web-based GIS development, the client submits request through application of HTML viewers and the application connector used is the Java Servlet. Java Servlet operates together with the Web Server to enable the HTTP submitted together with the client query to the application server.

The application server will retrieve the requested data which is stored distributedly and identify the MapService provided in running condition on the Spatial Server. In this stage, Spatial Server acts as the main part in the data request and submission processes as the Spatial Server is the controller to the flow of data from and to the data storage.

The Spatial Server provides five main functions in ArcIMS implementation. It involves image rendering, feature streaming, geocoding, querying and feature extraction. However, the Spatial Server could not be accessed directly from the application server but rather through the Virtual Server. The Virtual Server comprises one or more Spatial Server provided depending on the goal and use of the system. Thus, access can be made through MapService preparation on the Virtual server. There are two type of MapService provided namely image and feature.

In the web system developed, the application of Image Server (Virtual Server) for the MapService used enables the process of 'image rendering' onto the Spatial Server to be done. Subsequently, maps will be generated on the server and returned to client in the JPG, BMP or PNG format.

As for the requirement of clientside components, ArcIMS supports HTML and Java clients. The HTML/DHTML Viewer is chosen for the system development. It's written using HTML, DHTML and JavaScript. HTML Viewer is lighter weight and only one Image MapService can be displayed at a time. When a user clicks on a map or tool, a request is generated by the viewer and sent to a Spatial Server using the Servlet Connector. When a response is returned, the client passes the response for display instructions. The HTML/DHTML Viewer requires that browsers must be version 4.0 and higher and Netscape Communicator 4.5 or 4.6.1 to handle the communications for requests and responses.

4.0 THE WEB-BASED GIS FOR KLANG VALLEY

Web-based GIS for Klang Valley is initiated as an extension to the prior developed Application of Geographic Information System for Klang Valley Region (AGISwlk). While AGISwlk was meant as a planning support system for decision makers in planning and monitoring of the region, the Web-Based GIS is more towards inviting public participation apart from providing information in the form of maps and data for public access, and paving the path for data sharing with agencies having the same interest.

Various stages of users will be allowed to access the web page via web browsers such as Microsoft Internet Explorer 4.0 or the latest version. The web page allows user to view and use the information displayed for further processing. The GIS web page was developed with the aim to facilitate users, especially BKWPPLK's client to acquire information in digital form. Nevertheless, the web page acts as a source of reference in making decision and evaluation for planning and development purposes where Klang Valley is concerned.

4.1 Development of Web Based GIS for Klang Valley

Initially, the programming of Klang Valley Web-Based GIS applications was implemented by integrating four software components including Map Objects, Map Objects Internet Map Server, HTML, and Visual Basic. However, various problems were encountered throughout the application development. For example, a programmer requires advanced knowledge in HTML and Visual Basic application apart from MapObjects and Internet Map Server to develop such application.

Furthermore, HTML application implies difficulty for programmers to identify programming error when it occurs as it is not equipped with a compiler. In addition, there are still weaknesses in preparing icons and toolbars on the web interface produced in the context of customisation processes and interactive system. The ArcIMS is easier to apply with the help of wizard application and thus facilitate the user in web page development, without the need for concrete background in programming. Thus, the customisation activities can be carried out easily using HTML and JavaScript.

In addition, Map Objects only allows the access to external database through Data Access Objects (DAO) and ODBC, whereas ArcIMS uses the ArcSDE layer for accessing tabular data and shapefiles on the database. ArcSDE provides interface that enable user to choose the Relational Database Systems (RDBMS) to store and manage spatial data rather than DAO AND ODBC. It allows the use of various databases such as Oracles, Informix, SQL server DB2 and any database able to store large quantity of data. Furthermore, the Map Objects IMS Server can only be implemented in the Windows environment while the ArcIMS Server (version 3) application is able to be run on Windows NT as well as Sun Solaris platform.

In view of these cost benefit, the ArcIMS software package was chosen for the Web-based GIS

development. Generally, the web page is built in the form of HTML viewer using the ArcIMS software. Maps and geographical data were stored in AXL files for user access from the server. Maps will be displayed to internet users through images processed on the server each time a request received from the client. Each AXL file is built base on the database designed for AGISwlk.

Three of the applications in ArcIMS used for the web development are:

- Author MapService File
- Designer for Web Pages
- Manager for publishing MapService and administer Spatial Server

Nevertheless, the system could be developed completely through the use of ArcIMS Manager which compile all the three applications in sequence following the framework of a web development.

Authoring MapService File
Simple map generation through a user-friendly interface will ease the users in acquiring the required maps and information. The map generation process involves retrieval of shapefiles and images from the database. Other than that, this application enables connection to the database and use of symbols that could be defined on the maps generated.

Designer for Web Pages
The web design can be developed through the ArcIMS Designer which combines the web interface produced with the maps prepared earlier. First, user is directed to justify the MapService selected and subsequently choose the viewer to be used on the web as well as template and elements to be displayed on the web. User will then choose the toolbar function base on maps produced interactively. The output will be the real HTML that can be customised and enhanced for more specific uses.

Manager for Publishing MapService and Administer Spatial Server
The ArcIMS Manager has tools for administering the ArcIMS site for MapServices, Spatial Servers, and Virtual Servers. ArcIMS is designed so that MapServices, Spatial Servers, and Virtual Servers can be added and removed while the ArcIMS site continues to operate. A site configuration can be saved so that when there is downtown, the site will automatically restart with the same configuration.

4.2 Klang Valley Web-Based GIS: Some Applications

The applications involved are important components in assisting urban planning and management processes. Due to that, internet users are allowed to choose the application provided in the web page for further analyses and query base on the chosen displayed maps. There are a total of 10 applications listed for user selection including Transport and Traffic; Facilities and Utilities; Tourism; Industry and Commerce; Land use, Physical and Built up; Environment; Green Areas; Recreational Areas; Socio-economic and Population; Geohazard as well as Low Cost Housing and Squatters. Each of these applications serves a specific function in urban planning and management. For example, user need only select the Socio-economic and Population application from the menu provided to retrieve information and perform analyses on population density for the year 2000. Subsequently, the web application will process the request and display the output to user in forms of maps and tabular data.

In this web page, user will be provided with a toolbox that functions in the implementation of the *Zoom In, Zoom Out, Pan, Hyper Link, Full Extension, Identify* and *Query* operations on the selected displayed maps. This enables user to carry out the intended operations more interactively and easier without the need for any specific skills. Therefore, it is more time effective.

5.0 CONCLUSION

Web-based GIS is a new approach that provides large opportunities to GIS users in improving their involvement in planning and management for a more efficient and well-organised urbanisation projects. This approach is able to support global GIS application in carrying out survey and making more rational decisions.

The ArcIMS software is a product that facilitates the development of web-based GIS by integrating a combination of application such as authoring, designing and administering internet mapping which simplify the overall process of development and web publishing. The selection of HTML viewer for clienside is meant to provide a more specific interface and application output to meet the internet user requirement, especially the clients of BKWPPLK. The made easy web development and customisation processes apart from not consuming large spaces, have been the main factors why the ArcIMS is chosen for developing an efficient Web-Based GIS for Klang Valley.

The Klang Valley Web-Based GIS is currently undergoing the testing stage. Thus far it is able to aid user in preparing map visualisation and tabular information for each specified application. The Web-based GIS for Klang Valley serves as a web development model for a more interactive GIS application in Malaysia that offers opportunities for public participation with the aid of ArcIMS 3.0.

Using Web-Based GIS as a new tool for exchanging and gathering information brings numerous benefits. It also assists in the public participation, which is useful in making decision for urban planning and management. The Klang Valley region provides a good case study for the use of high technology to improve the urban planning

and management in Malaysia. At the moment, web-based GIS can be seen as an effective means that allows transparency in planning processes. It will be a simple way for the public or local governments to provide or exchange spatial information on the Net.

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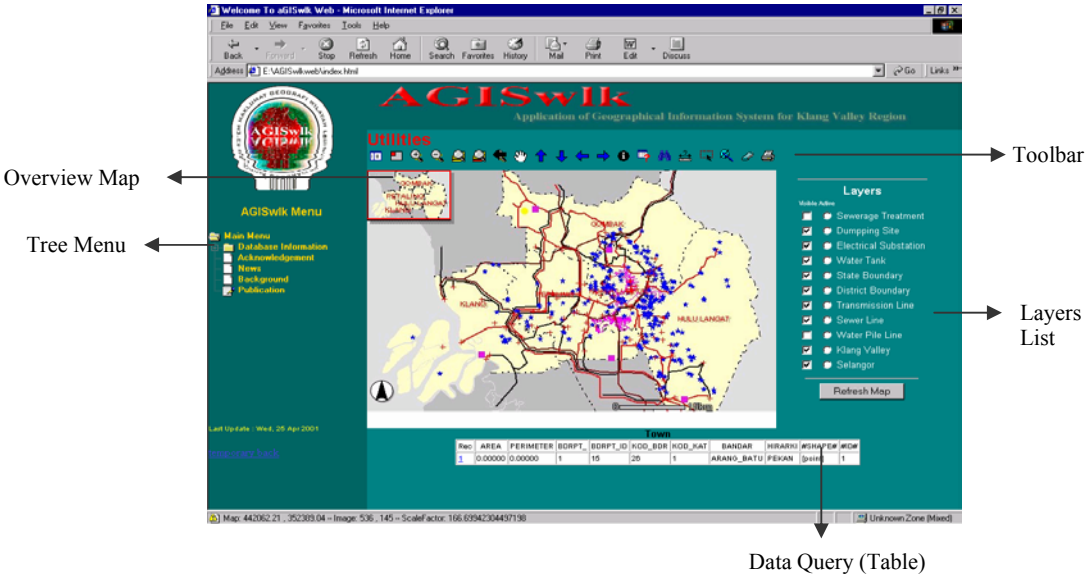
Appendix

AGISwlk Main Menu

AGISwlk Applications:

1. Transport and Traffic
2. Facilities and Utilities
3. Land Use, Physical and Built Up Area
4. Recreational and Green Area
5. Socio-Economic and Population
6. Low Cost Housing and Squatters
7. Industrial and Commercial
8. Environment
9. Tourism
10. Geohazard

application selected



Utilities Application in Web-Based GIS for Klang Valley