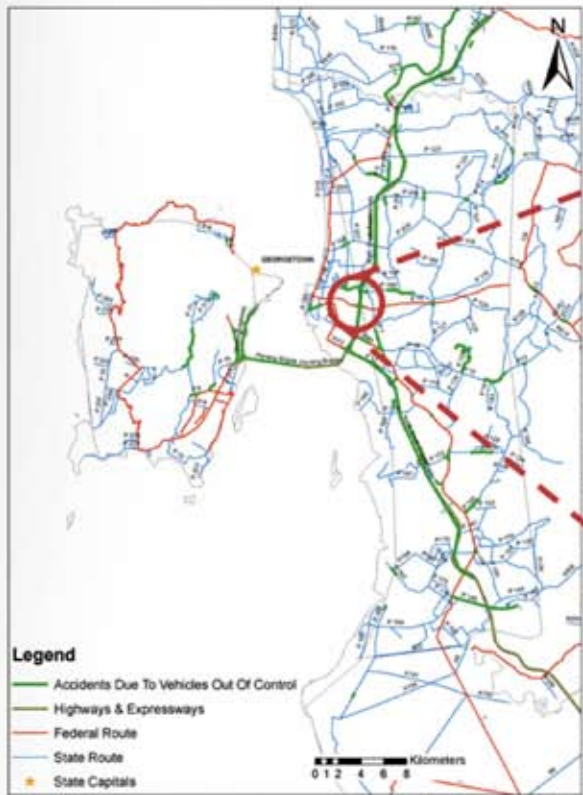


BULETIN **Geospacial** **SEKTOR AWAM**

Edisi 2/2008
ISSN 1823 7762

CENTRALISED SYSTEM FOR ROAD ACCIDENT, SAFETY AND HAZARD STUDIES (CRASH)

**OPTIMAL LOCATION FOR SPEED SENSOR
PULAU PINANG**



MAP ASIA 2008

NOISE EXPOSURE MAPPING IN SHOPPING COMPLEXES USING GEOSPATIAL TECHNOLOGY

GIS APPLICATION FOR CRIME MAPPING AND MONITORING

STAR RATINGS

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Terbitan :
Pusat Infrastruktur Data Geospacial Negara (MaCGDI)
Kementerian Sumber Asli dan Alam Sekitar (NRE)



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DARI MEJA KETUA EDITOR

Assalamualaikum dan Salam Sejahtera,

Setelah genap 50 tahun kita merdeka, pelbagai kemajuan dan pembangunan yang telah kita capai. Begitu juga dengan perkembangan *Geographic Information System* (GIS) di sektor awam. GIS sekarang menjadi salah satu mekanisma dalam penyelesaian tugas harian. Pemangkin kepada pembangunan dan kemajuan GIS adalah dengan adanya Pusat Infrastruktur Data Geospasial Negara (MaCGDI). Infrastruktur maklumat geospasial negara telah dibangunkan bagi menyediakan perkhidmatan dan kemudahan ke arah penyebaran, perkongsian, penggunaan dan pengurusan maklumat geospasial di kalangan agensi-agensi sektor awam.

Seiring dengan kemajuan tersebut MaCGDI juga menekankan akan kepentingan dalam pendidikan GIS. Jika dilihat dari realiti semasa, bidang GIS masih bukan menjadi satu bidang pilihan utama di kalangan pelajar ketika melanjutkan pelajaran di institusi-institusi pengajian tinggi, tidak seperti bidang-bidang lain yang lebih 'glamor' seperti kedokteran, undang-undang, perakaunan, dan sebagainya. Masih ramai lagi yang tidak menyedari wujudnya bidang GIS dan peranannya di dalam pembangunan tamadun manusia walaupun bidang berkaitan pemetaan bumi adalah di antara profesion tertua di dunia. Selaras dengan itu, adalah menjadi misi kami di MaCGDI untuk 'mempopularkan' penggunaan GIS di dalam setiap aktiviti berkaitan pembangunan dan menerap 'kepercayaan' bahawa GIS merupakan satu elemen penting di dalam pembangunan sesebuah negara. MaCGDI juga menyedari bahawa komuniti GIS di Malaysia masih lagi kecil dan dengan itu adalah menjadi satu cabaran bagi MaCGDI untuk membina satu komuniti GIS yang lebih besar, berdaya saing, berinovasi dan berperanan di dalam kemakmuran negara.

Sejarah GIS bermula kira-kira 15,500 tahun yang lampau dengan hanya lakaran-lakaran dan maklumat yang dilukis di dinding gua. Sejarah dengan perkembangan tamadun manusia, evolusi GIS mula berkembang hingga ke era perkomputeran pada masa kini. Kini,

Akhir sekali diharap artikel yang dipaparkan pada kali ini akan memberi ilmu yang berguna kepada para pembaca mengenai perkembangan GIS sektor awam di Malaysia. Selamat membaca!

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Penafian : Kesahihan dan ketepatan tulisan atau pendapat adalah tertakluk pada cetusan idea pengirim artikel.

GIS Application for Crime Mapping and Monitoring

¹Zahriah Othman, ¹Safiza Suhana Kamal Baharin

Abstract

GIS is an effective crime-analysis tool for crime mapping because GIS is proven as a powerful tool in many disciplines related to geographical area. This project deals with the development of GIS and computer based system for police department to manage the community in better manner. This system will contribute in giving beneficial for the police department to planning, analyzing and use it for crime monitoring. Besides, it helps in managing spatial data and attribute data to be more effective and systemic by providing spatial analysis, data query and search capabilities. The interfaces are more user-friendly to guide the user to understand, visualize, build query and statistical report using spatial and non-spatial data easily.

INTRODUCTION

In crime analysis, law enforcement officials have to take a look at a large amount of criminal data then figure out their relationships themselves. The advent of desktop computers and easy-to-use GIS applications have allowed crime mapping and analysis [3] to flourish within law enforcement agencies.

In order to encourage a police department to efficiently safeguard a community, it is essential that officer is provided with accurate, organized information in a timely manner. A GIS can provide a number of specialized tools to help dispatchers collect and relay this information to the officers on the scene. This application is specially designed for IPK (Ibu Pejabat Polis Kontijen) staffs in crime investigation department to manage their task effectively thus switch from traditional method to fully decisions support application.

OBJECTIVES

The main objective of this project is to develop the GIS application for police department. It is involves integration of spatial information and attribute data with graphical user interface in one system. This is important to make sure the user can grasp spatial information visually by attribute data.

The second objective is to assist the police department officers to analyze crime pattern and to manage spatial and attribute data systematically and easily compared to the traditional method that is very much relying on statistical information and paper

filing system.

PROBLEM STATEMENT

As known, advance in computer and information technology play major roles in many disciplines of modern business environment. However, integrating GIS into crime analysis still need special attention. Graphical User Interface (GUI) is a main factor to consider while developing the GIS application. This is because the use of GIS application in assisting the crime mapping and crime monitoring could be optimized through the system interface which could visualize the result of crime analysis. Besides, a good user interface design can spell the difference between acceptance of a software product and its failure in the market. If the end-users find the software to be too cumbersome or difficult to understand, then an otherwise excellent product could be doomed to failure. The goal is to make the software as professional looking and easy to use as possible.

Many technological innovations rely upon User Interface Design to evaluate their technical complexity to a usable product. Technology alone may not win user acceptance and subsequent marketability. The user experience, or how the user experiences the end product, is the key to acceptance. Besides that, existing system has no standard of information that stored into a database because of no relationship created in database system. As a result, the searching process could not be done effectively. Thus, the development of

this project considers effective GUI with GIS visualization and data manipulation capabilities.

METHODOLOGY

The structured system analysis approach chosen as a methodology for developing this GIS application. In this exertion, the proposed system will play a role as a tool to assist in crime analysis and crime mapping for PDRM. This system is based on a method used by US Department of Justice [1] and WEBCAT framework [4]. WEBCAT [2] was developed to give a hand in facilitating crime incident information sharing via online system. The method are as follows:

1. Prepare the geographic and tabular files for geo-coding.
2. Specify the geo-coding parameters.
3. Machine-learning and text analysis.
4. Geo-code.
5. Review results.
6. If necessary, re-specify parameters and geo-code again.

The purpose of using geo-coding is to assign tabular data to a location on the earth's surface to visualize the spatial characteristics of the data. It is analogous to placing a pin on a map in appropriate location. Unlike paper map, when geo-coding in a geographic information system, data associated with the pin, or data point, are available. In order to geo-code either electronically or manually, there must be a common geographic unit of analysis. In law enforcement, address is primarily used as the geographic unit of analysis to which tabular data are geo-coded. However, other types of geographic units are also used such as parcels and postcodes. In the case of geo-coding, geographic data used for geo-coding are called "reference data" since the geographic data are used to reference the tabular data.

SYSTEM MODELING

The engine of the system is designed considering all possible inputs, outputs, table structure and database structure. Input Forms, Output Reports, Menu Screen and dialogues are parts of GUI design. Figure 1 shows the conceptual system architecture for this system.

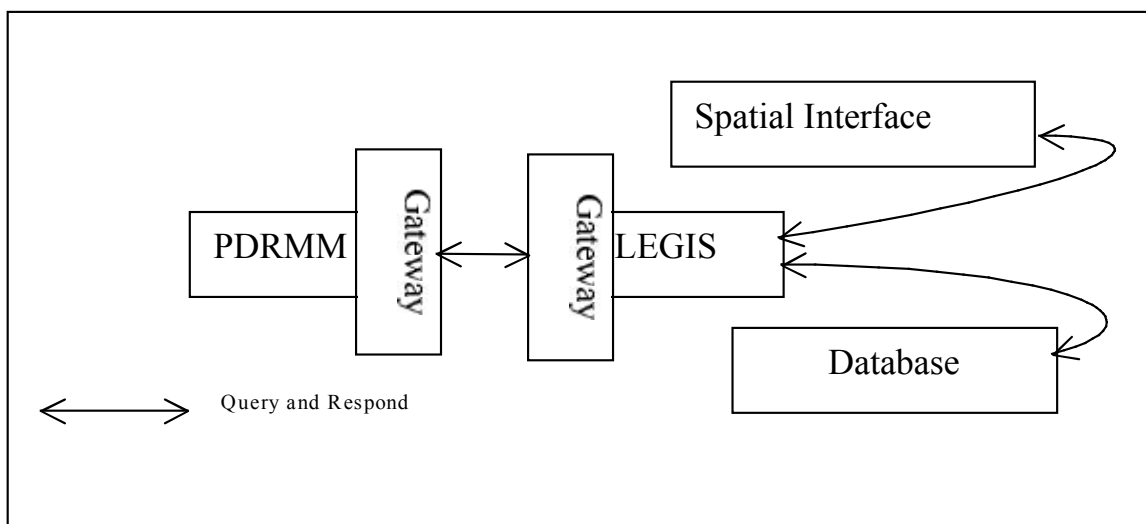


Figure 1: Conceptual System Architecture.

The front-end of the system was designed for GUI in ColdFusion MX and Macromedia Flash MX, and for the back-end, Microsoft Access stored all the information that are related to the system. This web based system used Apache as web server. The physical implementation of logical design is the

user interface. User interface is one of the main parts of the software. To build the user interface, this project used ColdFusion MX as a platform. Figure 2 shows the navigation flow for the system. This flow shows all the interfaces through this system. User interface consists of user forms, reports and maps.

User have to login through the gateway as member to use this system and is authenticated via registered username and password. After police officer enters the correct username and password, page 'Aduan' will be displayed. On this page, user has an option to add new police report by clicking the 'Masukkan Aduan Baru' option. After this option is selected, user has an option either to search the existing report or create a new report.

After the previous stage, investigator will take an action. An investigator can update or insert relevant information at particular report ID. For example, after the report no R005 has been created by police officer, the investigator will be assigned to handle that R005 case. So, the investigator will search this file by using the 'Cari' (search) function. After that, details of information about case R005 will be displayed. The investigator needs to create the case file by entering the investigation case ID or 'No KES'.

Location of the crime also could be mapped into this application. Thus, police department can use this information to view the statistic data (Figure 3) more clearly either attribute or spatial (Figure 4). In this research the copy of police report information can be printed as personal copy. By printing the report, the complainant can easily get the detail information of the report.

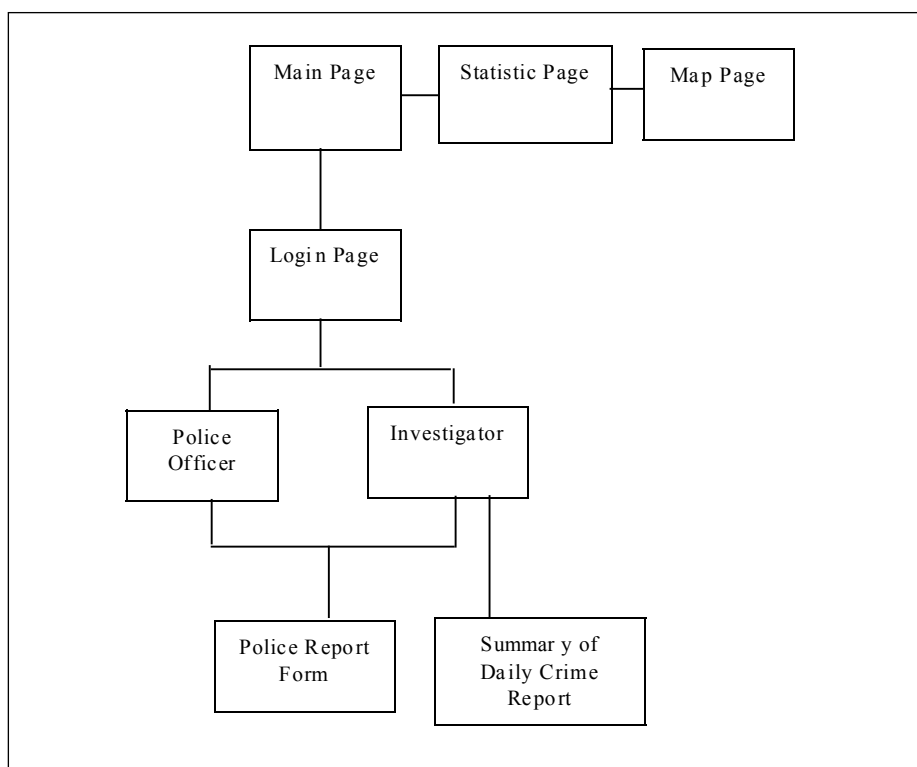


Figure 2: System Navigation Flow.

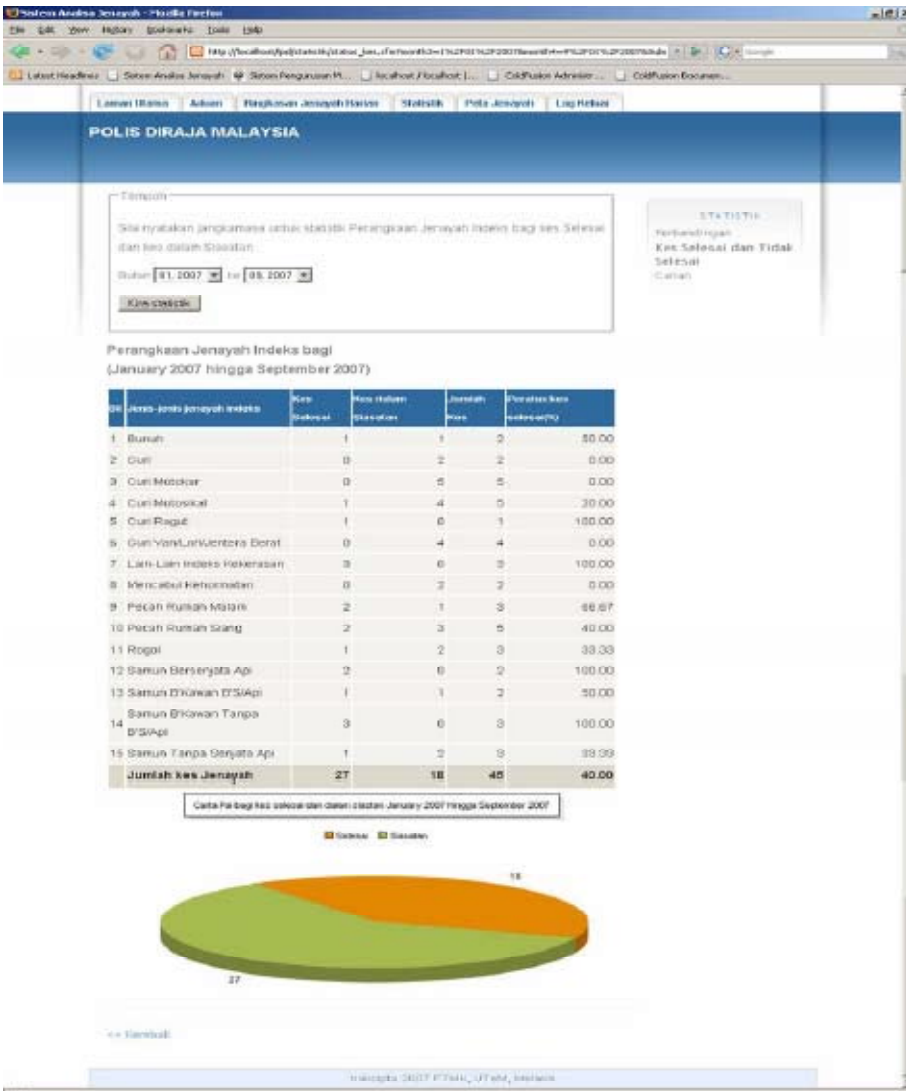


Figure 3: Output of Statistic Data.

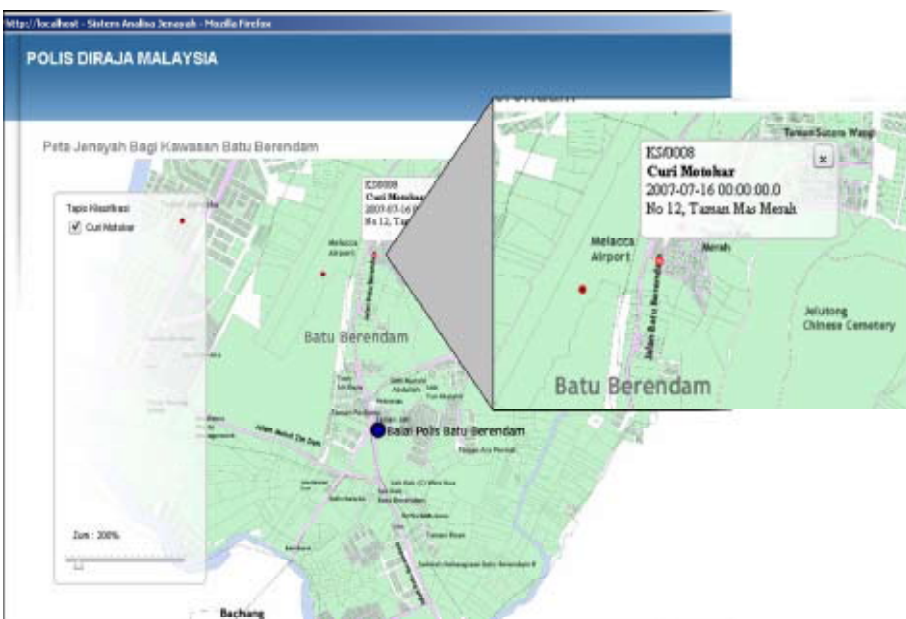


Figure 4: Output of Crime Mapping.

CONCLUSION AND FUTURE WORKS

This work involves the development of the system, which integrates GIS element into crime analysis and crime mapping. This kind of research is a new approach in Malaysia, especially for law enforcement. Ongoing works still need to be done to enable PDRM to locate and retrieve data from distributed police stations and departments. Besides that, the system should have capability to allow multiple analytical tasks such as define the shortest path, buffering analysis, etc. Along with this development, PDRM will gain benefit from the fast and efficient crime analysis in terms of planning, analyzing and using it for event modeling, tactical and strategic planning.

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Noise Exposure Mapping in Shopping Complexes Using Geospatial Technology

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KEY WORDS: noise, noise exposure, GIS, GPS, geospatial

Abstract

Environmental noise is a worldwide problem. Noise results from unwanted sound. Most of the people do not realize the noise exposure level in shopping complexes. Policies on noise control have been developed in Malaysia. Noise exposure studies are carried out to support these policies. Since important decisions are based on the results of noise exposure studies, it is not only important to quantify noise effects, but also to have information on the these exposure level. However the need for this information is often discarded. Noise is a common occupational hazard that leads to one of the most common complaints in the adult population seen by the otolaryngologist – noise induced hearing loss (NIHL). Sound intensity above 80 dBA of a sufficient duration may cause temporary or permanent threshold shifts. NIHL is a problem caused by sounds of significant intensity and duration (Rosen, 2001). The main objective of the study is to Mapping of Noise Exposure Level in Shopping Complex. In order to achieve this, the following activities were carried out:

- *Measurement and data collection of noise exposure level using Digital Sound Level Meter (model 407736): Exttech Instruments.*
- *Measurement and data collection of shopping complex locations using RUSSA Pocket PC + GPS receiver.*
- *Analysis and Mapping of the Noise Exposure Level.*
- *Development of Noise Exposure Database and Noise Exposure Mapping Information System (NEMIS) Application.*

This study was conducted in 10 selected shopping complexes in Wilayah Persekutuan Kuala Lumpur, Wilayah Persekutuan Putrajaya and Selangor. Continuous weekly data were obtained in 10 measurement points using Sound Level Meter and Global Positioning System (GPS) devices. By using these data in geospatial environment, presentation of the noise information can be done dynamically to the respective user.

1. INTRODUCTION

Noise pollution is more illusive than other pollution problems. It is often mobile and it is variable through time and space. Further, noise pollution is a matter of human perception related to personal tolerance and taste.

During the last 20 years there has been increasing concern with the quality of the environment. Along with air and water contaminants, noise has been recognized as a

serious pollutant. As noise levels have risen, the effects of noise have become pervasive and more apparent. (NPC Library Protective Noise Levels.htm, [referred on 5 October 2006]).

Noise pollution has become an important factor in the development of society, in terms of living comfort and also from an economic point of view. The exposure of individuals to noise can cause health problems; under certain conditions can also affect the work efficiency and general quality of urban life.

Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. The main indoor sources of noise are ventilation systems, office machines, home appliances and neighbours. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs. Many countries have regulated community noise from road and rail traffic, construction machines and industrial plants by applying emission standards, and by regulating the acoustical properties of buildings.

In contrast, few countries have regulations on community noise from the neighbourhood, probably due to the lack of methods to define and measure it, and to the difficulty of controlling it. In large cities throughout the world, the general population is increasingly exposed to community due to the sources mentioned above and the health effects of these exposures are considered to be a more and more important public health problem. Specific effects to be considered when setting community noise guidelines include: interference with communication; noise-induced hearing loss; sleep disturbance effects; cardiovascular and psychophysiological effects; performance reduction effects; annoyance responses; and effects on social behaviour. Since 1980, the World Health Organization (WHO) has addressed the problem of community noise. Health-based guidelines on community noise can serve as the basis for deriving noise standards within a framework of noise management.

In general, noise can be define as unwanted sound, is a universal problem and most of us have been affected by it at some time in our lives. Research into the perception of environmental noise, such as that carried out in the National Noise Attitude Study, funded by Defra and carried out by BRE in 1999-2000 showed that approximately 20% of UK respondents reported that noise spoil their home life to some extent, and 8% reported that their home life was spoiled either “quite a lot” or “totally”. As already mentioned,

the London Household Survey 2002 has indicated that 13% of the people surveyed rated road traffic noise a “serious problem”. Although we are still trying to fully understand the links between environmental noise and health, it is clear that noise can cause adverse effects on people, including irritation, annoyance and sleep disturbance. (Department for Environment, Food and Rural Affairs (Defra), 2004. Noise Mapping England. The London Road Traffic Noise Map)

Sound and noise are defined as a vibratory disturbance created by a moving or vibrating source that is capable of being detected by the hearing organs. Noise is specifically defined as sound that is loud, unpleasant, unexpected, or undesired and may therefore be classified as a more specific group of sounds. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance and, in the extreme, hearing impairment. (Caltrans, 1998).

Noise is a common occupational hazard that leads to one of the most common complaints in the adult population seen by the otolaryngologist – noise induced hearing loss (NIHL). Sound intensity above 80 dBA of a sufficient duration may cause temporary or permanent threshold shifts. NIHL is a problem caused by sounds of significant intensity and duration. (Rosen, 2001).

With the advances of information technologies, the study was done to evaluate the capability of geospatial technology in analysing and mapping noise exposure level in shopping complexes. The field work data collected in shopping complexes within Wilayah Persekutuan Kuala Lumpur, Wilayah Persekutuan Putrajaya and Selangor were used to support the study. The fieldwork data were collected using Digital Sound Level Meter and RUSSA Pocket PC + GPS receiver.

2. OBJECTIVE OF STUDY

The main objective of the study is to Mapping of Noise Exposure Level in Shopping Complexes. For the pilot study, the focus of the study was done on 10 selected shopping complexes within Wilayah Persekutuan Kuala Lumpur, Wilayah Persekutuan Putrajaya and Selangor. In order to achieve this, the following activities were carried out:

- Measurement and data collection of noise exposure level using Digital Sound Level Meter (model 407736): Exttech Instruments.
- Measurement and data collection of shopping complex locations using RUSSA Pocket PC + GPS receiver.
- Analysis and Mapping of the Noise Exposure Level.
- Development of Noise Exposure Database and Noise Exposure Mapping Information System (NEMIS) Application.

3. LITERATURE REVIEW

3.1 Definition of Noise

Noise is defined as “unwanted sound.” In the context of protecting the public health and welfare, noise implies adverse effects on people and the environment. Noises cause hearing loss, interferes with human activities at home and work, and is in various ways injurious to people’s health and well-being. Although hearing loss is the most clearly measurable health hazard, noise is also linked to other physiological and psychological problems. (Noise Control Manual, David A. Harris)

Noise is a common occupational hazard that leads to one of the most common complaints in the adult population seen by the otolaryngologist – noise induced hearing loss (NIHL). Sound intensity above 80 dBA of a sufficient duration may cause temporary or permanent threshold shifts. NIHL is a problem caused by sounds of significant intensity and duration. (Rosen, 2001).

Noise is considered to be any unwanted sound that may adversely affect the health and well being of individuals or populations. Physically, sound is a mechanical disturbance propagated as longitudinal wave motion in air and other elastic or mechanical media, such as water or steel. Its main features are sound intensity, measured as sound pressure and frequency spectrum indicating the distribution of the total sound over high and low frequencies. The spectrum is important with respect to the effects of noise on people and with respect to the engineering costs to reduce the noise. (WHO, 1980).

3.2 Definition of Sound

Sound is generated by creating a disturbance in the air, which sets up a series of pressure waves fluctuating above and below the air’s

normal at atmospheric pressure. The pressure wave propagates in all directions from the source of sound. Sound travel in the air at a speed about 330 metres per second. Our ears sense these pressure fluctuations, convert them to electrical impulse and send them to our brain, where they are interpreted as sound. (Quirrouette and Warnock, 1985).

Sound can travel as vibration waves in solids or liquids. The term airborne and structure borne sound are used depending on the medium the sound is travelling in time. When the medium in which the noise starts to spread from the source is air, the noise called airborne; when it starts vibration between structures, it is called structure borne. The structure borne noise occurs when wall, floor or other building elements are set into vibration by direct mechanical contact with the source, such as mechanical equipment or footstep. (Burberry, 1977).

Sound and noise are defined as a vibratory disturbance created by a moving or vibrating source that is capable of being detected by the hearing organs. Noise is specifically defined as sound that is loud, unpleasant, unexpected, or undesired and may therefore be classified as a more specific group of sounds. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance and, in the extreme, hearing impairment. (Caltrans, 1998).

Freestanding source of sound moves outwards in all directions forming a spherical wave front. Sound waves can be reflected. Sound waves are propagated in straight lines, but if obstruction occurs, waves will diffracted around the object. Sound intensity diminishes in proportion to the square of the distance from source. (Limpscomb and Taylor, 1978).

3.3 Global Positioning System (GPS)

Concept

GPS (Global Positioning System) technology is a worldwide radio navigation system based on satellites. There are 24 satellites that revolve the earth round the clock. These satellites have the capability to determine the position of an object on earth that comes under their line of sight. However, in order to determine the position of an object on earth, GPS requires each of these objects to have a GPS receiver. These GPS receivers tune to a particular frequency and listen to the signals

coming from the GPS satellites. The more the number of satellites the GPS receivers signals from, the better the accuracy. It has been proved that if a GPS receiver can process data from a minimum of three satellites, it can present a better accuracy. Upon aligning and synchronizing with the satellites, the GPS receiver receives the location information of the object (namely, itself). GPS provides the following information about an object that has a GPS receiver. These are the latitude, the longitude, the altitude, the speed at which the object is moving, the direction of movement, the date and time of reading.

3.4 Geographic Information System (GIS)

Concept

A Geographic Information System or GIS may be defined as "...a computer-based Information system which attempts to capture, store, manipulate, analyze and display spatially referenced and associated tabular attribute data, for solving complex research, planning and management problems"(Fischer and Nijkamp, 1992).

GIS is a special case of information systems where the database consists of observations on spatially distributed features, activities or events, which are definable in space as points, lines, or areas. Basically this definition entails the visual display of data on a map. (Clarke 2001).

GIS is a system whereby spatial data is stored, retrieved, manipulated and viewed. De Mers (1997) and the ESRI website (2004) summarize the processes involved as follows:

- A data input system in which spatial data from various origins are stored and processed.
- A data storage and retrieval subsystem that arranges spatial data in such a way that it may be retrieved, updated and edited.
- A data manipulation and analysis subsystem that interacts with the data and performs modeling functions.
- A reporting subsystem that displays the information in the database in tabular graphic, or map form.

3.5 Integration of GPS and GIS in Noise Exposure Mapping

Monitoring the effects of noise is only possible with an extensive spatial database and spatial analysing tools. Furthermore computation force is necessary. GIS forms a powerful set of tools for storing and retrieving, transforming and displaying spatial data from the real world for a particular set of purposes. (Burrough, 1986).

GIS contains a database management system designed for spatial data and is therefore a very good system for managing geographic data. GIS offers the same possibilities as other database management systems (DBMS) like:

- The possibility to manage the data (setting authorisation, integrating data, version managing, verifying data, controlling and supervising accuracy and quality).
- Ensuring the integrity and consistency between data.
- Rapid access to the data

- The availability of the data stored in the DBMS to many users and different kinds of applications.

Furthermore GIS offers tools and data structures to deal with the spatial component of the data. (Bernhardsen, 1999).

4. METHODOLOGY

4.1 Location of Study Area

Below is the location sites for the 10 selected shopping complexes within Wilayah Persekutuan Kuala Lumpur, Wilayah Persekutuan Putrajaya and Selangor.

- 1) JUSCO Taman Equine, Seri Kembangan, Selangor.
- 2) GIANT Bandar Puteri, Puchong, Selangor.
- 3) TESCO Puchong, Puchong, Selangor.
- 4) Bangsar Village Shopping Complex, Bangsar, Kuala Lumpur.
- 5) Maju Junction Mall, Jalan TAR, Kuala Lumpur.
- 6) Pertama Complex, Jalan TAR, Kuala Lumpur.
- 7) SOGO Shopping Centre, Jalan TAR, Kuala Lumpur.
- 8) TESCO Mutiara Damansara, Petaling Jaya, Selangor.
- 9) Alamanda Putrajaya, Putrajaya.
- 10) Carrefour Seri Petaling, Bandar Baru Seri Petaling, Kuala Lumpur.

4.2 Equipment Used

For this research study purposes on Noise Exposure Level Mapping, the equipments used as below:

- Digital Sound Level Meter.
- RUSSA Pocket PC and GPS Receiver.

4.3 Methodology Workflow

Implementation of the Noise Exposure Mapping Information System (NEMIS) application will be divided into 4 major phases. Phase I will involve data collection, editing, processing and data integration. Phase II will include the database creation. Phase III involved in application developments and Phase IV for generates the outputs in form of graphs and dynamic maps. Each phases were represent in different colours as figure below.

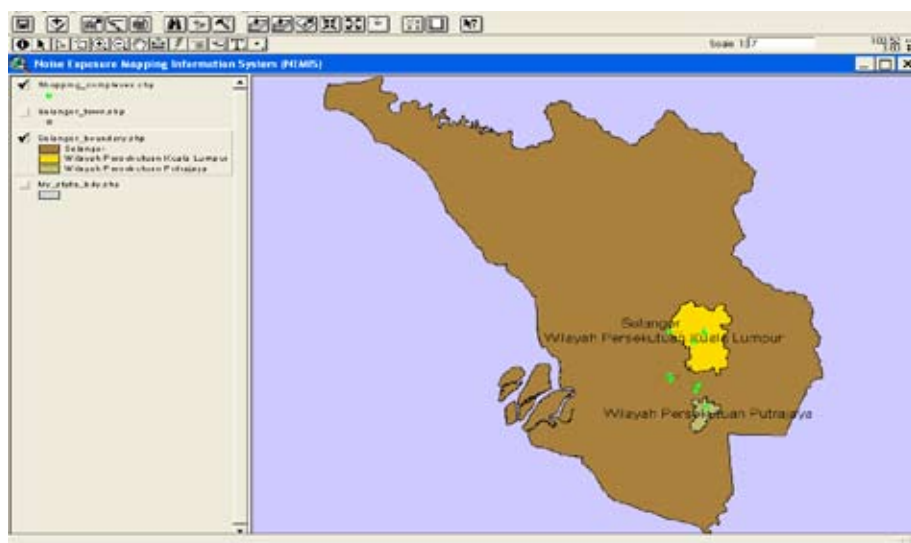


Figure 1: Study Area



Display	3-1/2 digit (2000 count) LCD
Display update rate	0.5 seconds
Microphone	0.5" Electret condensor
Measurement Bandwidth	31.5Hz to 8KHz
Dynamic range	99dB
Measurement Range	35 to 130dB (Low: 35 to 90; High: 75 to 130dB)
Frequency weighting	'A' and 'C' (selectable)
Applicable standards	IEC-651 & ANSI S1.4 Type 2
Accuracy / Resolution	± 1.5dB / 0.1dB
Maximum Hold decay time	<1dB / 3min
Response time	Fast: 125 milliseconds / Slow: 1 second
Built-in calibration check	1KHz internal sine wave @ 94dB
AC Analog output	0.65VAC rms (full scale); 600Ω output impedance
DC Analog output	10mVDC / dB; 100Ω output impedance (approx).
Power	0V Battery
Battery life	50 hours (typical); Low battery indicator alerts user
Operating temperature	32 to 104°F (0 to 40°C)
Operating humidity	10 to 90% RH
Dimensions/weight	9.45 x 2.68 x 1" (240 x 68 x 25mm) / 6.75oz (210g)

Figure 2: Digital Sound Level Meter and Specifications

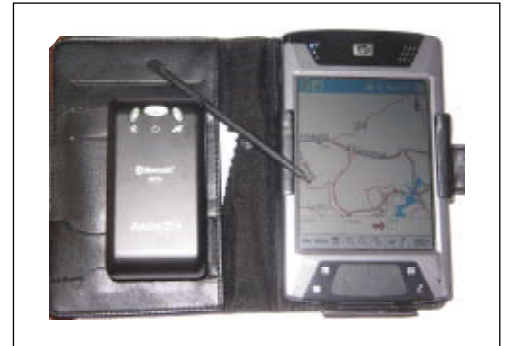


Figure 3: RUSSA Pocket PC and GPS Receiver

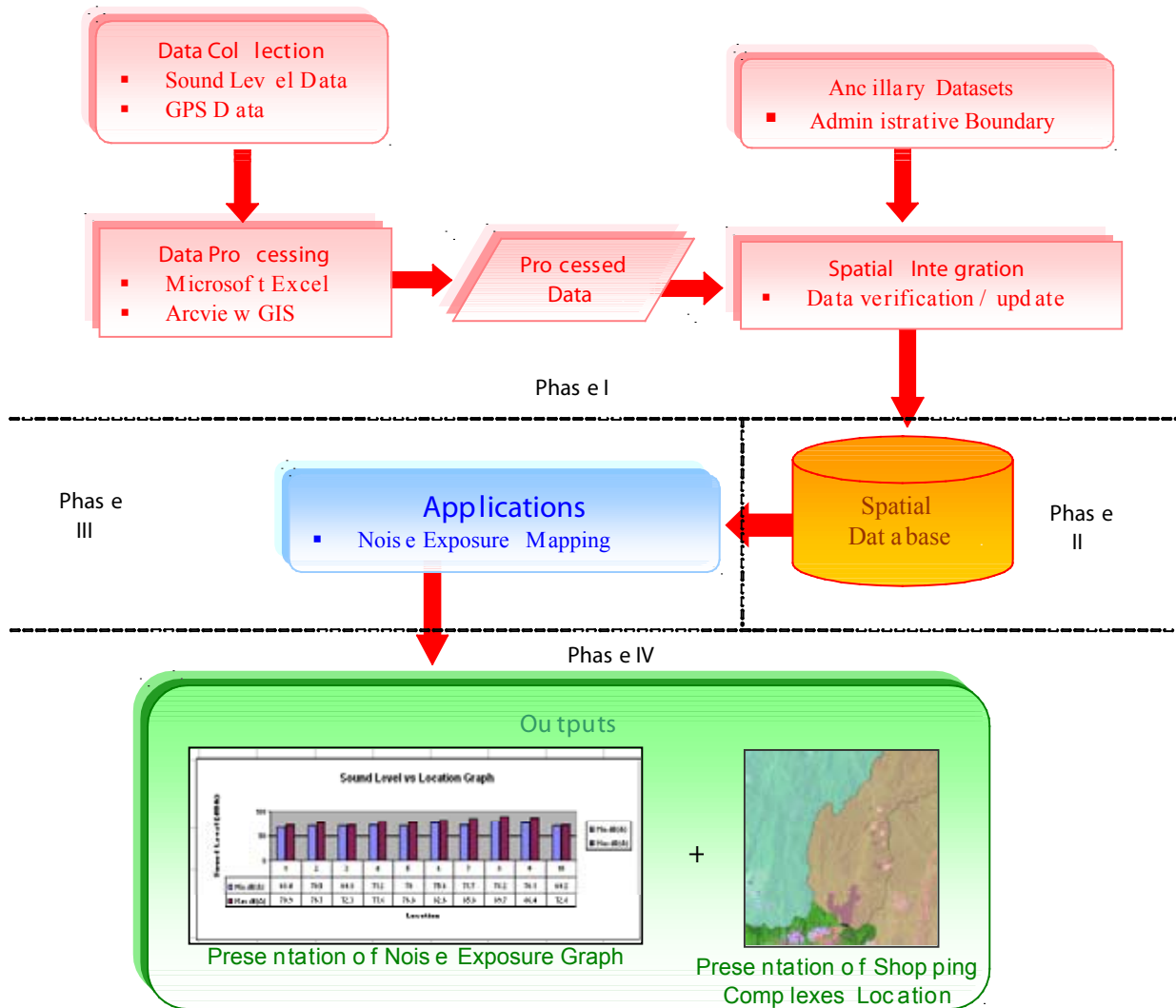


Figure 4: Methodology Workflow

One of the most important elements of developing Noise Exposure Level Mapping application is finding and utilizing the appropriate data. The form of the data is critical to the overall database design, and the success of the analyses performed with the application system.

For this study, fieldwork data collection has been done for sound level data and shopping complexes location data. Besides that, ancillary GIS datasets has been obtained from JUPEM in shapefile format (administration boundary, town). Later, sound level meter data has been processed using Microsoft Excel and the result then exported into GIS environment.

After that, the integration data has been done. The integration has been done between attributes data and spatial data which will be used for analysis purposes.

Spatial database development is the process of building the digital database from the source data - maps and tabular files (fieldwork data). A database construction process is divided into two major activities:

- Creation of digital files from maps, tables and other source documents;
- Organization of the digital files into a GIS database using Arcview GIS.

After completed of spatial database development, Noise Exposure Mapping application has been develop using Webpage Maker V2 (an open source software). Using this open source software, the output for noise exposure level can be disseminate through the internet.

5. RESULT AND DISCUSSION

5.1 Analysis of Data

Analysis of data were done for 10 selected shopping centres and 10 observations were have been done for each selected shopping centres. The comparison data will be shown in graph format as below;

- 1) Graph of Noise Exposure Level of JUSCO Taman Equine, Seri Kembangan, Selangor.
- 2) Graph of Noise Exposure Level of GIANT Bandar Puteri, Puchong, Selangor.
- 3) Graph of Noise Exposure Level of TESCO Puchong, Puchong, Selangor.
- 4) Graph of Noise Exposure Level of Bangsar Village Shopping Complex, Bangsar, Kuala Lumpur.

- 5) Graph of Noise Exposure Level of Maju Junction Mall, Jalan TAR, Kuala Lumpur.
- 6) Graph of Noise Exposure Level of Pertama Complex, Jalan TAR, Kuala Lumpur.
- 7) Graph of Noise Exposure Level of SOGO Shopping Centre, Jalan TAR, Kuala Lumpur.
- 8) Graph of Noise Exposure Level of TESCO Mutiara Damansara, Petaling Jaya, Selangor.
- 9) Graph of Noise Exposure Level of Alamanda Putrajaya, Putrajaya.
- 10) Graph of Noise Exposure Level of Carrefour Seri Petaling, Bandar Baru Seri Petaling, Kuala Lumpur.

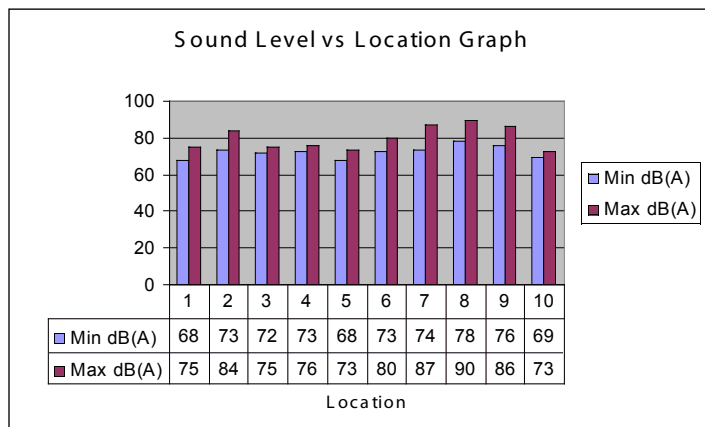


Figure 5: Graph of Noise Exposure Level of JUSCO Taman Equine

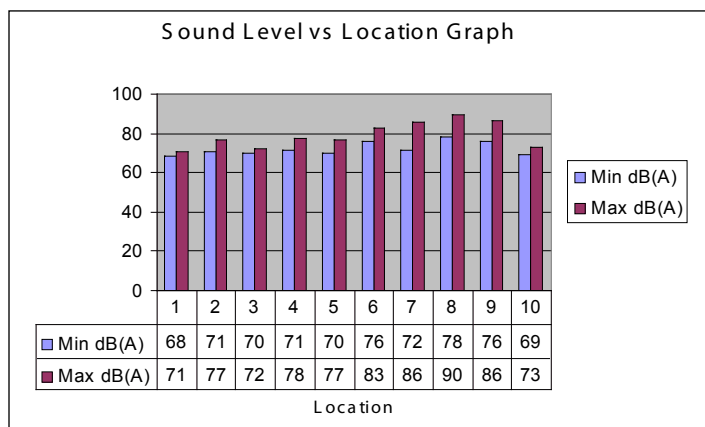


Figure 6: Graph of Noise Exposure Level of GIANT Bandar Puteri

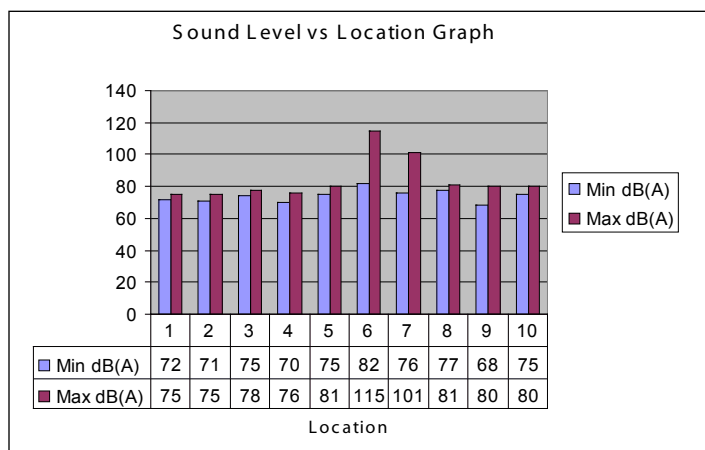


Figure 7: Graph of Noise Exposure Level of TESCO Puchong

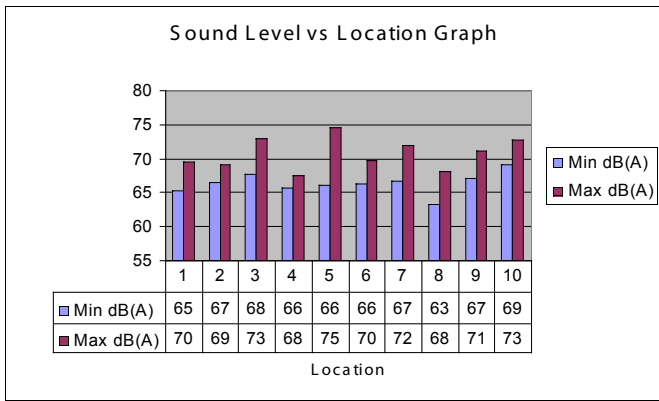


Figure 8: Graph of Noise Exposure Level of Bangsar Village Shopping Complex

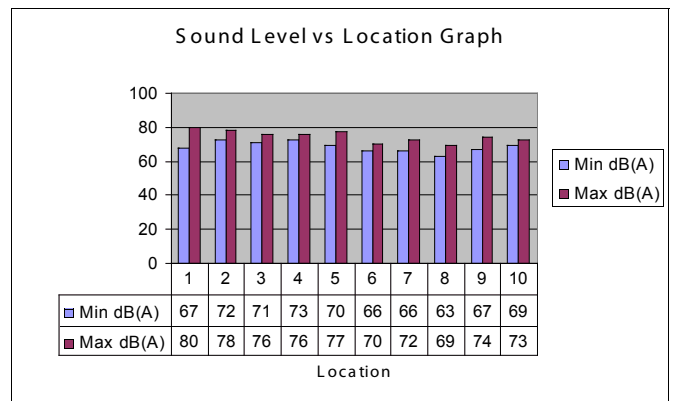


Figure 11: Graph of Noise Exposure Level of SOGO Shopping Centre

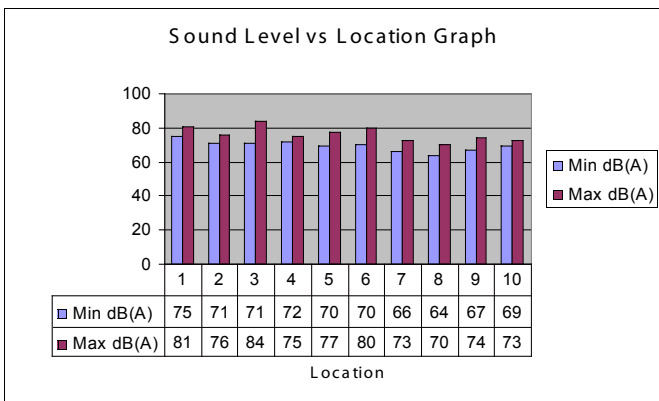


Figure 9: Graph of Noise Exposure Level of Maju Junction Mall

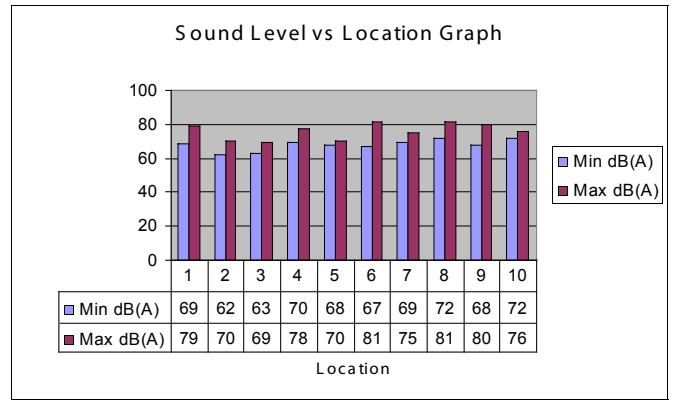


Figure 12: Graph of Noise Exposure Level of TESCO Mutiara Damansara

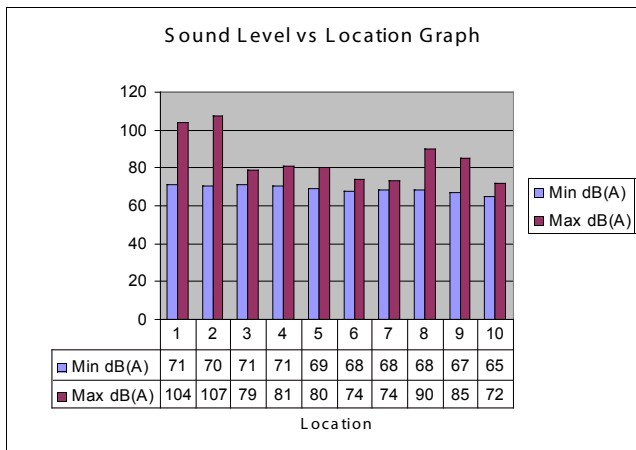


Figure 10: Graph of Noise Exposure Level of Pertama Complex

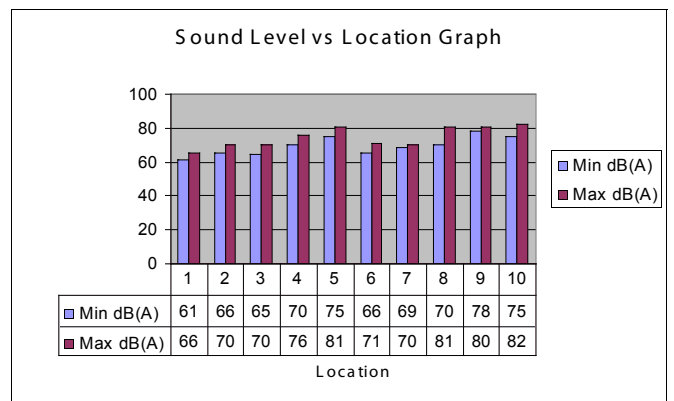


Figure 13: Graph of Noise Exposure Level of Alamanda Putrajaya

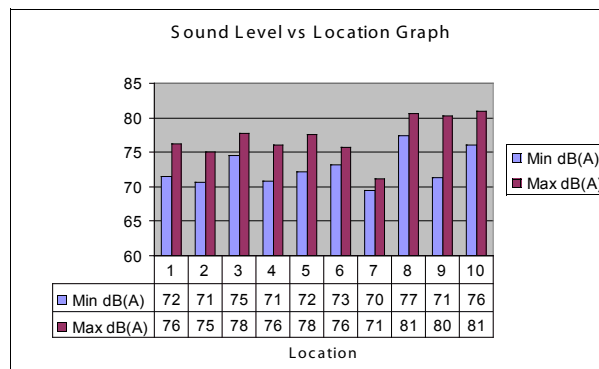


Figure 14: Graph of Noise Exposure Level of Carrefour Seri Petaling

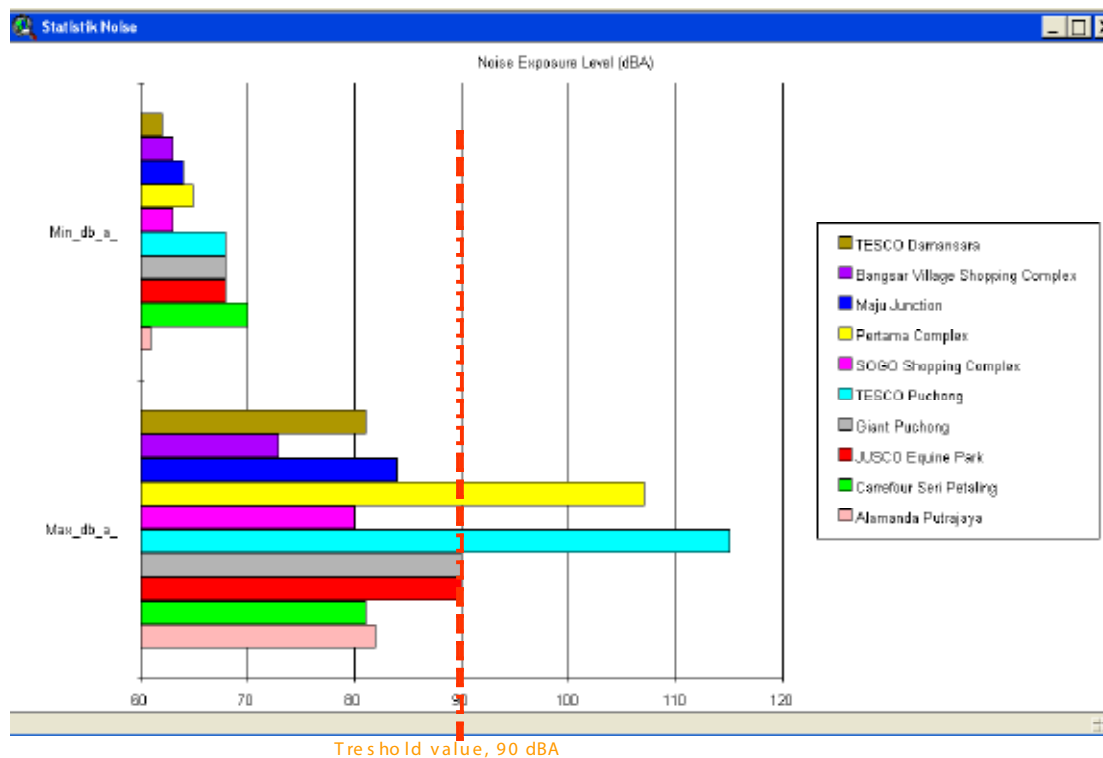


Figure 15: Histogram of Noise Exposure Level of All Study Area

5.2 Discussions

Measurement and data collection of noise exposure level using Digital Sound Level Meter were taken at 10 selected shopping complexes. Based on the observation, the lowest noise exposure level was recorded 61 (dBA) at Alamanda Shopping Centre, Putrajaya and the highest was recorded 115 (dBA) at TESCO Puchong, Selangor. However the average noise exposure level data varies between 61 (dBA) to 115 (dBA) depends on the condition in the shopping complexes itself during the date and time the observation were done.

The source of noise exposure level also varies. Source of noise from the music, voice of peoples, nearby noise from vehicles, children screaming were recorded. During the noise exposure level data observation, the surrounding conditions also take into consideration. Based on the histogram, it shows that there are 4 shopping complexes exceed the treshold limits.

- Pertama Complex
- TESCO Puchong
- GIANT Puchong
- JUSCO Equine

Based on the Allowable Factory and Machinery Act 1967, the Action Level is 90 (dBA).

5.3 Precaution and Assumption Made

Due to the time limitation of the study and other factors, several precautions and assumption has been made through the study especially for measurement considerations.

5.3.1 Sound Level Meter Measurement Considerations

For data observation using sound level meter, several measurement considerations has been made as follow;

- 1) Wind blowing across the microphone adds extraneous noise to the measurement.
- 2) Use the supplied windscreen to cover the microphone when applicable.
- 3) Calibrate the instrument before each use if possible. Especially if the meter has not been used for a long period of time.
- 4) Do not store or operate the instrument in areas of high temperature or humidity.
- 5) Keep meter and microphone dry.
- 6) Avoid severe vibration when using the meter.
- 7) Remove the battery when the meter is to be stored for long periods of time.

5.3.2 GPS Data Measurement Considerations

For GPS data observation, several measurement considerations has

been made as follow;

- 1) Before started any measurement, make sure at least 4 satellite available on the sky to give the x,y, z coordinate.
- 2) Make sure at least 15 degree sky view to get the better result of measurement.
- 3) Make sure the data need to be taken about 1-2 minutes observations to get the most accurate data.

5.4 Limitation and Problems

While conducting the study, some limitations and problems were encountered. Some of them are as follow;

- 1) Due to the time limitation, the scope of the study was narrowed.
- 2) The pilot study were selected for 10 selected shopping complexes only. The travel distance of each location of shopping complex quite far from each others. So that, its quite time consuming for fieldwork data collection purposes.
- 3) The availability of location data/ data floor plan/floor plan for shopping complexes. Some of the shopping complex does not have the appropriate floor plan. Some of them only have evacuation plan only whereas there have also the

shopping complexes does not have both of the informations.

- 4) Editing task for GIS data such as administrative boundary is very tidy and time consuming.
- 5) Data observation for sound level meter need to be taken at least 3 times and then average of maximum and minimum of the data observed were recorded.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

- 1) The crucial part of the study is fieldwork data collection phase. With the good management and planning for fieldwork data collection tasks, it can reduce cost and time saving.
- 2) Generally, the noise exposure level within the 10 selected shopping complexes were between 61 (dBA) at Alamanda Shopping Centre, Putrajaya and the highest was recorded 115 (dBA) at TESCO Puchong, Selangor. The noise exposure level recorded were depends on the condition in the shopping complexes itself during the date and time of the observation period.
- 3) The source of noise exposure level also varies. For example noise from the music, voice of peoples, from escalator, nearby noise from vehicles, children screaming, etc. (Refer Appendix 1 for more details).
- 4) Public awareness and support in matters of noise environment protection has increased. The public also need to be educated to reduce of noise exposure level and avoided to bring along their child and baby during the peak hours at the shopping complex.
- 5) In totality, we can conclude that the noise exposure level in most 10 selected shopping complexes above the safe limits except one or two places exceed the limits during the peak hours. Based on the Allowable OSHA Noise Exposure Levels (OSHA Regulations), the Action Level is 85 (dBA).
- 6) OSHA's Permissible Exposure Limits for noise exposure is 90 dB averaged over an 8-hour work shift. For every 5 dB increase above 90,

the number of permissible hours of exposure is cut in half.

- 7) The Noise Exposure Mapping Information System can be further enhance from the aspect security and module arrangement.

In conclusion, the study has successfully achieved the objective of the study. The main objective of the study is to mapping of noise exposure level in shopping complexes using geospatial technology. The application successfully demonstrate the capability of integrating noise exposure level data with GPS data within the geospatial environment.

Monitoring the effects of noise is only possible with an extensive spatial database and spatial analysing tools. Furthermore computation force is necessary. GIS forms a powerful set of tools for storing and retrieving, transforming and displaying spatial data from the real world for a particular set of purposes. (Burrough, 1986).

Integration of GIS and noise exposure level data has a number of advantages:

- GIS can form a link between geographical and geometrical information of the surroundings and the noise exposure level data. The integration makes it possible to generate dynamic noise exposure level information using latest ICT technology for data dissemination.
- GIS contains additional tools for storing, managing, analysing and presenting the needed geographical data and noise exposure level data.

6.2 Recommendations

- 1) Public awareness programme should be carried out for all employees/customers who are working or visiting at shopping complexes. These employees/customers need to be educated to reduce of noise exposure level and avoided to bring along their child and baby during the peak hours at the shopping complex.
- 2) Duty scheme in the shopping complexes should be revised whereby employees should not working more than 8 hours if exposed to the high level of noise.
- 3) Employees who are working in shopping complexes should be educated with the OSHA Act, Factory and Machinery Act and

the usage of Personal Protection Equipment (PPE).

- 4) Every shopping complexes should have or formed the safety and health committee based on the requirement of OSHA (Act 514).
- 5) Recommended that use of hearing protective devices (earplugs, earmuffs) is permitted only if engineering and administrative controls fail to reduce sound levels within the prescribed levels.
- 6) Noise levels need to be monitored when noise levels are known or suspected to be at or above 85 dB or hearing protective devices are not sufficient to lower exposure to 90 dB. Workers have the right to observe monitoring procedures and to be notified of monitoring results.
- 7) Records of noise exposure must be retained for two years. Audiometric test records must be retained for the duration of the worker's employment. Records must be made available to the employee upon request.
- 8) Employees exposed at or above 85 dB averaged over eight hours must be trained on noise hazards. Training must cover the hazards of exposure to excessive noise levels, reasons for, and proper selection, fitting, and maintenance of hearing protective devices, and an explanation of audiometric testing.
- 9) Further study should be included on study of detail noise induced hearing loss (NIHL) correlations with the noise exposure level in term of cost to compensate for the noise induced hearing loss (NIHL).
- 10) A questionnaire method should be included to get the real data from the employees/workers in the shopping complexes.
- 11) Dynamic/remote sound level meter which capable to transmits the noise exposure level data should be develop to help the authority (DOSM) to monitor the noise exposure level in the shopping complexes for enforcement action purposes.
- 12) Additional data to support more accurate noise exposure level monitoring system should be obtained for further enhancement of noise exposure mapping information system application.



- 13) Further requirements and study should be initiated by respective authority to help the public/ employees aware the long term effect of the higher noise exposure level.
- 14) Development of real time early warning system for noise exposure level which exceed the threshold limit as per OSHA requirements.
- 15) Need further study to include not only sources in the shopping complexes itself, but correlates also with the outside factors like traffic flow, heavy raining, etc. As we know most probably all the shopping complexes location is nearby the main road. So all the noise parameters need to take considerations.
- 16) The Authority should adopt new technical guidelines on the risk assessment on noise exposure at the workplace.

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