

**THE APPLICATION OF MI PRO IN THE MANAGEMENT OF AIR  
QUALITY AND NOISE POLLUTION AT CONSTRUCTION SITES**

**KUNG TECK LI**

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**Dedicated to my Heavenly Father,  
and  
to my beloved parents and family.**

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## **ABSTRACT**

Good air quality and low noise pollution are two of the many factors that can be considered as contributors to healthy and comfortable living conditions. In the context of their management, the amount of environmental data required for conducting analysis, planning and decision making are abundant and too complex. Hence, a more systematic data handling and analysis deemed necessary. Therefore, this study looks at the application of Geographical Information System (GIS) in solving the problem. This system is designed to provide a cost-effective, efficient and faster way of handling the air quality and noise pollution data for construction sites and also to enhance the data organisation structure. In order to make GIS a useful system and capable of producing good results within a short period, it must first be able to receive and interpret information in an effective manner. Organisations that utilise environmental information for decision making purposes at construction sites must have a thorough understanding of air quality and noise pollution data. The output produced by this system are presented in the form of digital graphics such as thematic maps, graphs, charts and histogram while most textual outputs are displayed as tables and forms. By manipulating the data in GIS database, a user is able to conduct an analysis and implement future plans to manage air quality and noise pollution level on construction sites at a much faster pace. In this study, it is proved that GIS can be used to develop an air and noise pollution database system and it can also be considered as a good decision making tool for air and noise pollution control at construction sites.

## ABSTRAK

Kualiti udara yang baik dan pencemaran udara yang minima merupakan dua faktor yang penting kepada kehidupan yang sihat dan selesa. Dalam konteks pengurusan pencemaran udara dan bunyi, jumlah data yang diperlukan untuk menjalankan analisis, perancangan dan membuat keputusan adalah terlalu banyak dan kompleks. Satu cara pengurusan dan analisis yang lebih sistematik perlu diterokai. Oleh itu, kajian ini mendalami aplikasi Sistem Informasi Geografikal (GIS) untuk menyelesaikan masalah tersebut. Sistem ini direka untuk menyampaikan cara pengurusan data kualiti udara dan pencemaran bunyi di tapak pembinaan yang lebih kos-efektif, efisien dan lebih cepat serta menekankan struktur susunan data yang elok. GIS yang dibina haruslah berupaya menerima dan menyampaikan pelbagai interpretasi maklumat sebelum digunakan. Pemahaman kepada data kualiti udara dan pencemaran bunyi menjadi penting untuk pihak-pihak yang perlu membuat keputusan berdasarkan maklumat kualiti alam di tapak pembinaan. Sistem ini dapat menyampaikan pelbagai persembahan maklumat dalam bentuk peta tematik, graf, carta dan histogram. Kebanyakan tulisan teks disampaikan dalam bentuk jadual dan juga borang. Membuat manipulasi terhadap data yang tersimpan dalam *database* GIS juga membolehkan seseorang pengguna menjalankan analisis serta mengurus kualiti udara dan pencemaran bunyi di tapak pembinaan dengan lebih cepat. Dalam kajian ini, telah dibuktikan bahawa GIS boleh digunakan untuk membina system *database* pencemaran udara dan bunyi serta dianggap sebagai alat yang baik untuk membantu pengguna semasa membuat keputusan berdasarkan kawalan pencemaran udara dan bunyi.

## TABLE OF CONTENTS

| <b>CHAPTER</b>       | <b>SUBJECT</b>            | <b>PAGE</b> |
|----------------------|---------------------------|-------------|
|                      | <b>TITLE PAGE</b>         | i           |
|                      | <b>DECLARATION PAGE</b>   | ii          |
|                      | <b>DEDICATION PAGE</b>    | iii         |
|                      | <b>ACKNOWLEDGEMENT</b>    | iv          |
|                      | <b>ABSTRACT</b>           | v           |
|                      | <b>ABSTRAK</b>            | vi          |
|                      | <b>TABLE OF CONTENTS</b>  | vii         |
|                      | <b>LIST OF TABLES</b>     | xii         |
|                      | <b>LIST OF FIGURES</b>    | xiii        |
|                      | <b>LIST OF SYMBOLS</b>    | xvi         |
|                      | <b>LIST OF APPENDICES</b> | xviii       |
| <br><b>CHAPTER I</b> | <br><b>INTRODUCTION</b>   |             |
|                      | 1.1 Introduction          | 1           |
|                      | 1.2 Problem Statement     | 3           |
|                      | 1.3 Objectives            | 3           |
|                      | 1.4 Scopes of Study       | 4           |
|                      | 1.5 Expectations          | 4           |
|                      | 1.6 Hypothesis            | 5           |
|                      | 1.7 Limitations of Study  | 5           |

## CHAPTER II LITERATURE REVIEW

|   |    |
|---|----|
| 2.1. Air Pollution  | 6  |
| 2.1.1. Introduction   | 6  |
| 2.1.2. Air Pollutants from Construction Site                  | 7  |
| 2.1.2.1. Carbon Monoxide (CO)                                 | 7  |
| 2.1.2.2. Particulate Matter (PM) or<br>Windblown Dust         | 7  |
| 2.1.2.3. Ozone (O <sub>3</sub> )                              | 9  |
| 2.1.2.4. Nitrogen Dioxide (NO <sub>2</sub> )                  | 10 |
| 2.1.2.5. Sulphur Oxide (SO <sub>x</sub> )                     | 11 |
| 2.1.2.6. Hydrocarbons (HC)                                    | 12 |
| 2.1.2.7. Lead or Plumbum (Pb)                                 | 13 |
| 2.1.3. Sources of Air Pollution                               | 14 |
| 2.1.4. Effects of Air Pollution                               | 15 |
| 2.1.4.1 Effects on Health                                     | 15 |
| 2.1.4.2 Effects on Plants                                     | 16 |
| 2.1.5 Factors Affecting Air Pollution Level                   | 17 |
| 2.1.5.1 Air Stability   | 17 |
| 2.1.5.2 Wind Direction and Velocity                           | 17 |
| 2.1.5.3 Rainfall  | 18 |
| 2.1.6 Air Pollutant Index (API) in Malaysia                   | 18 |
| 2.2 Noise Pollution   | 21 |
| 2.2.1 Introduction to Noise Pollution                         | 21 |
| 2.2.2 Definition of Sound                                     | 21 |
| 2.2.3 The Concept of Sound                                    | 23 |
| 2.2.4 Characteristics of Sound                                | 24 |
| 2.2.4.1 Amplitude, Wavelength,<br>Period, Frequency and Pitch | 24 |
| 2.2.4.2 Sound Intensity                                       | 26 |
| 2.2.4.3 Sound Pressure  | 26 |
| 2.2.4.4 Sound Power Level                                     | 28 |
| 2.2.5 Measurement of Sound                                    | 29 |

|         |  |    |
|---------|--|----|
| 2.2.6   | Noise Pollution in Malaysia                    | 30 |
| 2.2.7   | Source of Noise Pollution                      | 31 |
| 2.2.7.1 | Transportation                                 | 31 |
| 2.2.7.2 | Human Activities                               | 31 |
| 2.2.7.3 | Industrial and<br>Construction Area            | 32 |
| 2.2.8   | Effects of Noise Pollution                     | 33 |
| 2.2.8.1 | Health   | 33 |
| 2.2.8.2 | Sleep Interference                             | 34 |
| 2.2.8.3 | Communication                                  | 34 |
| 2.2.8.4 | Work   | 34 |
| 2.2.9   | Noise Pollution Control                        | 35 |
| 2.2.9.1 | Monitoring Program (OSHA<br>Technical Manual)  | 35 |
| 2.2.9.2 | Protection on Human (OSHA<br>Technical Manual) | 36 |
| 2.2.9.3 | Employee Training and<br>Education             | 36 |

### **CHAPTER III    GEOGRAPHICAL INFORMATION SYSTEM (GIS)**

|       |                        |    |
|-------|------------------------|----|
| 3.1   | Introduction to GIS    | 38 |
| 3.2   | History of GIS         | 39 |
| 3.3   | Concept of GIS         | 41 |
| 3.4   | Characteristics of GIS | 42 |
| 3.4.1 | Data Capture           | 42 |
| 3.4.2 | Data Integration       | 44 |
| 3.4.3 | Data Conversion        | 45 |
| 3.5   | Component of GIS       | 45 |
| 3.5.1 | Data                   | 45 |
| 3.5.2 | Hardware               | 46 |
| 3.5.3 | Software               | 47 |
| 3.5.4 | People                 | 49 |



|       |   |    |
|-------|---|----|
| 3.6   | Subsystem of GIS                            | 49 |
| 3.6.1 | Data Collection                             | 49 |
| 3.6.2 | Data Input                                  | 50 |
| 3.6.3 | Data Storage and Retrieval                  | 50 |
| 3.6.4 | Data Manipulation and Analysis              | 51 |
| 3.6.5 | Data Output and Display                     | 51 |
| 3.7   | Application of GIS                          | 51 |
| 3.7.1 | Hydrography                                 | 52 |
| 3.7.2 | GIS in Emergency Respond Planning           | 52 |
| 3.7.3 | GIS in Urban Planning                       | 52 |
| 3.7.4 | GIS for Fire Department                     | 53 |
| 3.7.5 | GIS in Marketing                            | 53 |
| 3.7.6 | GIS in Agricultural Watershed<br>Management | 53 |
| 3.8   | Advantages of Implementing GIS              | 54 |
| 3.9   | Problems of Implementing GIS                | 54 |

## **CHAPTER IV    METHODOLOGY**

|       |                           |    |
|-------|---------------------------|----|
| 4.1   | Introduction              | 55 |
| 4.2   | Preliminary Survey        | 56 |
| 4.3   | Data Collection           | 56 |
| 4.4   | Map Digitization          | 58 |
| 4.5   | Coordinate Transformation | 59 |
| 4.6   | Database Development      | 59 |
| 4.6.1 | Creating Table            | 60 |
| 4.6.2 | Geocoding                 | 61 |
| 4.6.3 | Creating Thematic Maps    | 61 |
| 4.6.4 | Mapping in Layers         | 62 |
| 4.7   | Data Analysis and Results | 62 |

## **CHAPTER V     RESULTS AND ANALYSIS**

|       |                                     |    |
|-------|-------------------------------------|----|
| 5.1   | Introduction                        | 63 |
| 5.2   | Data Input                          | 63 |
| 5.2.1 | Mapping                             | 63 |
| 5.2.2 | Registering Raster Images           | 67 |
| 5.2.3 | Creating Tables                     | 67 |
| 5.2.4 | Creating Graphs for Pollution Data  | 69 |
| 5.2.5 | Geocoding                           | 72 |
| 5.2.6 | Thematic Mapping                    | 73 |
| 5.2.7 | Mapping in Layers                   | 79 |
| 5.3   | Data Manipulation and Data Analysis | 79 |
| 5.3.1 | Data Integration                    | 79 |
| 5.3.2 | Creating Voronoi Polygon            | 81 |
| 5.3.3 | Selection Using Queries             | 82 |

## **CHAPTER VI     DISCUSSIONS AND CONCLUSIONS**

|     |                                 |    |
|-----|---------------------------------|----|
| 6.1 | Discussions                     | 86 |
| 6.2 | Conclusions                     | 87 |
| 6.3 | Suggestions and Recommendations | 88 |

|                   |    |
|-------------------|----|
| <b>REFERENCES</b> | 89 |
|-------------------|----|

|                         |    |
|-------------------------|----|
| <b>APPENDICES A – I</b> | 91 |
|-------------------------|----|

**LIST OF TABLES**

| <b>TABLE NO.</b> | <b>TITLE</b>  |    |
|------------------|---|----|
| <b>PAGE</b>      |   |    |
| 2.1              | Important health effects associated with exposure to different air pollutants | 15 |
| 2.2              | Categories of air quality under API system in Malaysia                        | 20 |
| 5.1              | Tabular information on air and noise pollution data                           | 80 |

## LIST OF FIGURES

| FIGURE NO. | TITLE  | PAGE |
|------------|--|------|
| 2.1        | Simplified relationship of nitrogen oxides emissions with formation of NO <sub>2</sub> and other harmful reaction products including O <sub>3</sub> and PM | 10   |
| 2.2        | Hydrocarbons Chain   | 13   |
| 2.3        | Hydrocarbons Ring  | 13   |
| 2.4        | Amplitude of sound   | 24   |
| 2.5        | Wavelength of sound  | 25   |
| 2.6        | Period of a wave   | 25   |
| 2.7        | Hearing Protectors   | 36   |
| 3.1        | Data layering concept  | 41   |
| 3.2        | Scanning paper maps to produce digital data files for input into a GIS   | 43   |
| 3.3        | Collecting latitude and longitude coordinates with a Global Positioning System (GPS) receiver  | 43   |
| 3.4        | Data integration in different forms through a GIS  | 44   |
| 3.5        | Data conversion in GIS   | 45   |
| 3.6        | Subsystem of GIS   | 49   |
| 4.1        | Operational procedures of study  | 55   |
| 4.2        | Anemometer for wind speed  | 57   |
| 4.3        | Sling Psycrometer for humidity and temperature   | 57   |

|         |   |    |
|---------|---|----|
| 4.4     | High Volume Sampler for Total Suspended Particulate (TSP)   | 57 |
| 4.5     | Toxic Gas Probe for toxic gases                             | 57 |
| 5.1     | Topographic Map of Mutiara Rini                             | 64 |
| 5.2     | Vector Image of Mutiara Rini Routes                         | 65 |
| 5.3     | Vector Image of Construction Sites                          | 65 |
| 5.4     | Vector Image of Sampling Stations                           | 66 |
| 5.5     | Combination of Raster Image and Vector Image                | 66 |
| 5.6     | Raster Image Registration Dialog                            | 67 |
| 5.7     | Dialog box for creating table                               | 68 |
| 5.8     | Base table of air and noise pollution data                  | 68 |
| 5.9     | 3D Graph of Air Pollution Data at Mutiara Rini              | 69 |
| 5.10    | Graph of CO Levels at Mutiara Rini                          | 70 |
| 5.11    | Graph of Noise Pollution Level (dB) at Mutiara Rini         | 70 |
| 5.12    | Joining two different tables into single graph              | 71 |
| 5.13    | Comparison between Wind Speed and CO Levels at Mutiara Rini | 71 |
| 5.14    | Geocode Dialog  | 72 |
| 5.15    | Thematic Map Dialog (Step1 of 3)                            | 74 |
| 5.16    | Thematic Map Dialog (Step2 of 3)                            | 74 |
| 5.17(a) | Original Landuse Map  | 75 |
| 5.17(b) | Thematic Map of Noise Pollution                             | 75 |
| 5.18    | Thematic Map of Total Suspended Particulate (TSP)           | 76 |
| 5.19    | Thematic Map of Carbon Monoxide (CO)                        | 76 |
| 5.20    | Thematic Map of Ozone (O <sub>3</sub> )                     | 77 |
| 5.21    | Thematic Map of Sulphur Dioxide (SO <sub>2</sub> )          | 77 |
| 5.22    | Thematic Map of Nitrogen Dioxide (NO <sub>2</sub> )         | 78 |
| 5.23    | Thematic Map of Temperature (°C)                            | 78 |
| 5.24    | Mapping in Layers   | 79 |
| 5.25    | Data integration in MI Pro                                  | 81 |
| 5.26    | Voronoi Polygon for sampling stations                       | 82 |

|      |   |    |
|------|---|----|
| 5.27 | Query dialog for API greater than 100       | 83 |
| 5.28 | Unhealthy air pollution level               | 84 |
| 5.29 | Query dialog sound level greater than 60 Db | 84 |
| 5.30 | Unhealthy noise pollution level             | 85 |

## LIST OF SYMBOLS

|                 |   |  |
|-----------------|---|--|
| API             | - | Air Pollution Index                                |
| CAD             | - | Computer-Aided Design                              |
| CO              | - | Carbon Monoxide                                    |
| CO <sub>2</sub> | - | Carbon Dioxide                                     |
| CPU             | - | Central Processing Unit                            |
| dB              | - | Decibel  |
| DBMS            | - | Database Management System                         |
| DRT             | - | Cathode Ray Tube                                   |
| EDSS            | - | Environmental Decision Support System              |
| ESRI            | - | Environmental Systems Research Institute           |
| etc.            | - | and so forth                                       |
| <i>F</i>        | - | Force  |
| ft              | - | Feet   |
| GBF/DIME        | - | Geographic Base File/Dual-Independent-Map-Encoding |
| GIS             | - | Geographic Information System                      |
| GPS             | - | Global Positioning System                          |
| HC              | - | Hydrocarbons                                       |
| HPDs            | - | Hearing Protection Devices                         |
| Hz              | - | Hertz  |
| LAN             | - | Local Area Network                                 |
| MI Pro          | - | MapInfo Professional                               |
| MPJBT           | - | Majlis Perbandaran Johor Bahru Tengah              |
| MRT             | - | Malaysian Revised Triangulation                    |
| NO <sub>2</sub> | - | Nitrogen Dioxide                                   |
| O <sub>3</sub>  | - | Ozone  |

|                  |   |   |
|------------------|---|---|
| OSHA             | - | Occupational Safety and Health Act              |
| $p$              | - | Pressure  |
| $P$              | - | Power   |
| Pa               | - | Pascal  |
| PANs             | - | Peroxyacyl Nitrates                             |
| Pb               | - | Plumbum   |
| PM               | - | Particulate Matter                              |
| PM <sub>10</sub> | - | Particulate Matter less than 10 microns in size |
| RAM              | - | Random Access Memory                            |
| RGB              | - | Red Green Blue                                  |
| RMG              | - | Recommended Malaysian Air Quality Guidelines    |
| RMS              | - | Root Mean Square                                |
| RSO              | - | Rectified Skew Orthomorphic                     |
| PSI              | - | Pollution Standard Index                        |
| SIL              | - | Speech Interference Level                       |
| SO <sub>2</sub>  | - | Sulfur Dioxide                                  |
| SPL              | - | Sound Pressure Level                            |
| SQL              | - | Structured Query Language                       |
| SWL              | - | Sound Power Level                               |
| TSP              | - | Total Suspended Particulate                     |
| WAN              | - | Wide Area Network                               |
| WGS              | - | World Geodetic System                           |
| WHO              | - | World Health Organisation                       |
| 3D               | - | Three Dimensional                               |
| %                | - | Percent   |



**LIST OF APPENDIXES**

| <b>APPENDIX</b> | <b>TITLE</b>  | <b>PAGE</b> |
|-----------------|---|-------------|
| A               | API Status Indicator                                  | 91          |
| B               | API Values from 5 to 500                              | 92          |
| C               | Air Pollutant Index Process Flowchart                 | 94          |
| D               | Schedule of Permissible Sound Levels                  | 95          |
| E               | Malaysian Ambient Air Quality Guidelines              | 96          |
| F               | Specific Air Pollutants and Associated Health Effects | 97          |
| G               | Data Collection Form                                  | 98          |
| H               | Air and Noise Pollution Data                          | 99          |
| I               | Topographic Map of Mutiara Rini                       | 100         |

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

The rapid growth occurring in Malaysia means more development and construction will take place. But recent studies has encounter that there are less successful examples of air quality and noise pollution data management practices observed at a wide variety of construction sites, including residential, commercial, and transportation sites. According to the survey done on few main cities in Malaysia by Department of Environment Malaysia, high percentage of the urban public was exposed to noise levels exceeding 75dB (Jabatan Alam Sekitar, 1999). Besides, construction projects often stir up dust from unpaved roads, driveways, and bare yards. Dirt tracked or deposited onto paved roads from construction sites can cause airborne or windblown dust, which can be unhealthy for people living nearby. Breathing the small particles in dust can cause lung damage, and worsen conditions such as asthma, bronchitis, and sinusitis (Bela *et. al.*, 1997).

Poorly monitored construction sites can harm not only aquatic environments, but adjacent properties, public roadways and drainage systems as well. These problems stem not only from soil erosion, but also from materials and practices commonly used in construction activities. Construction site air quality and noise pollution control efforts are now emphasizing the most appropriate set of practices for data collecting, data analysis, interpreting, modeling and also publicizing the data to ensure their effectiveness in monitoring processes.

This study will illustrate construction site air quality and noise pollution monitoring practices through the use of Geographical Information System (GIS). GIS is an industry that is popular in the western countries and is now thriving in Malaysia. It has been implemented in many agencies and departments in Malaysia for various applications such as Penang Geographic Information System (PEGIS) in 1992 which is now under the control of Penang Development Corporation, Computerized Planning Information System by Malacca City Council in 1994 to convert all land related information with the Council Administrative area into a more efficient and integrated digital format, Darul Ehsan GIS (DEGIS) to promote the sharing of data among the various state agencies and to create the metadata for Selangor, establishment of National Infrastructure for Land Information System (NaLIS) since 1992 to provide timely access to land information, eliminate or reduce duplication of data capture and promote effective data sharing among related agencies.

Among early users of GIS are Department of Survey and Mapping (JUPEM), Malaysia Centre for Remote Sensing (MACRES), Department of Agriculture, the forestry department, Geological Survey Department, Valuation and Property Services Department, Public Work Department and Economic Planning Unit.

GIS is always associated with both computer hardware and software as the means for data input, data analysis, data manipulation, data output and data storage. The implementation of GIS in air quality and noise pollution monitoring can be very useful as it create visual charts showing the attributes of different air quality and noise pollution measurement. Therefore, GIS can be described as a best tool to address spatial data of environmental problems in construction site.

## 1.2 Problem Statement

Air quality and noise monitoring is a large scale project which, among the others, includes many processes, such as data collecting, data analysis, interpreting, modeling and also publicizing the data. Decision-making is a complex process, influenced by many factors, both human and non-human. A GIS application cannot make decision for people. However, GIS is able to provide many simulated results, which can help the decision-makers to achieve the decision and answer to problems (Idrus, 1997). The problems which hinder and complicate the air and noise pollution monitoring practices are listed as follow:

- a. Difficulties when too much air and noise pollution monitoring data to be manipulated, comprehended, analysed, interpreted, publicized and defended.
- b. The data are not efficiently handled by manual or conventional methods because the conventional method is too costly, time-consuming and high-demanding of manpower.
- c. Difficulty in data processing and data updating.
- d. It is difficult to use 2D tools to store and to analyse 3D data.
- e. Limitation when working with dissimilar data types.
- f. Difficulty in communicating and presenting the data to non-technical people.

It is therefore, obvious that there is a need to build up a database system for air quality and noise pollution data with the help of Geographical Information System (GIS) software, MAPINFO (MI Pro).

## 1.3 Objectives

The objectives of this study are as follow:

- i. To apply MAPINFO (GIS software) in developing a database system for air and noise pollution produced by construction activities.

- ii. To investigate its capability as a management decision making tool related to the control of air and noise pollution at construction sites.

#### **1.4 Scopes of Study**

The scopes of study can be outlined as follow:

- i. To collect data and create a user-friendly spatial database system that reflects the air quality and noise pollution level at construction site.
- ii. To develop an air quality and noise pollution management system using tools within MAPINFO.
- iii. To utilise the management system developed as a tool in predicting and mitigating air and noise pollution at construction site.

#### **1.5 Expectations**

The following are the expectations from this study:

- i. Implementation of Geographical Information System (GIS) in the monitoring of air quality and noise pollution at construction site will be more efficient and simpler comparing to the conventional methods.
- ii. The practice of building up a database with GIS will be able to help in air quality and noise pollution data management.

## **1.6 Hypothesis**

Geographical Information System (GIS) can provide a cost-effective, efficient and faster way of handling the air quality and noise pollution data at construction site.

## **1.7 Limitations of Study**

Limitations in this study are:

- i. The software used in this research is MapInfo as it is the only easily accessible GIS software available in the faculty.
- ii. The study can only be conducted on selected construction sites in Johor Bahru due to the limitation of resources. It is therefore, the data from the study might not be enough to reflect the overall status of air quality and noise pollution in Johor Bahru.
- iii. Due to unavailability of equipments, the data from all the sampling points can only be taken at separated times. Therefore, no Air Pollution Index (API) can be calculated. Air quality can only be previewed separately by the intensity of each pollutant. The only parameter used to determine the level of noise pollution is Decibel level (dB).

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