3. METHODOLOGY

3.1 INTRODUCTION

This chapter discusses the approach of the research methodology in order to achieve the goal and objectives described in Chapter 1. The chapter start by briefly describing the ability and capability of ArcView, Avenue scripting language and Dialog Designer. This is follow on with the ISCST3 model emphasizing on the input data parameter and interpolation of the output using ArcView. Finally, a brief description on the approach of customisation using Avenue and Dialog Designer, and also the minimum hardware and software required in this research work conclude this chapter.

3.2 OVERVIEW OF METHODOLOGY

The approach of this research work is to manipulate and utilize the capability of the GIS system used i.e. ArcView 3.1. The Avenue programming language and Dialog Designer in the ArcView system will be used to create graphical user interface (GUI) and customisation to integrate the three components. Avenue is the programming language and development environment that's part of ArcView (ESRI, 1994) while Dialog Designer is a user interface tool for application development in ArcView (ESRI, 1997).

The research work will integrate the air pollution modelling and the environmental monitoring components within a GIS environment. The outline of the methodology of this research project is best illustrated in **Figure 3.2.1**.

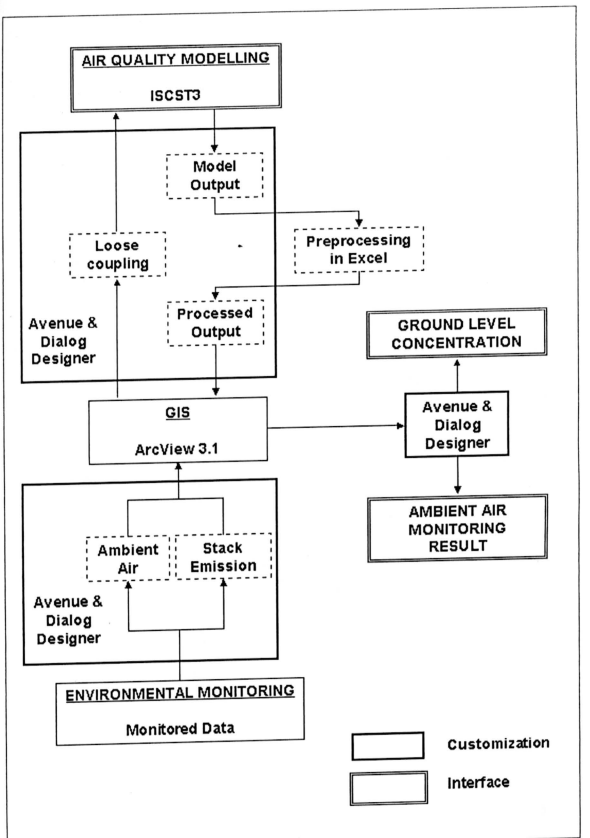

FIGURE 3.2.1: METHODOLOGY OF THE GIS INTERFACE AND CUSTOMIZATION

As shown in **Figure 3.2.1**, three main GUI interface will be customized at the end of the research. They are air quality modelling interface, predicted ground level concentration interface and lastly the interface for ambient air monitoring result. This three main interfaces form the important foundation in the ambient air quality monitoring system.

3.3 ArcView 3.1

ArcView 3.1 is a software program, developed by Environmental Systems Research Institute (ESRI), which is used to do GIS analysis. It differs from Arc/Info in that Arc/Info is designed to develop GIS data while ArcView 3.1 is designed to interact with GIS data which has already been created.

All activities within ArcView 3.1 are organized with a Project. A project contains all the views, tables, charts, layouts and scripts for a particular ArcView application (ESRI, 1996). The functions of ArcView 3.1 include: displaying coverage in a view, viewing the related attribute tables of this view, relating attribute tables with a key item, plotting charts to display spatial information, and creating layouts of the view and related tables and charts.

ArcView 3.1 will be used to integrate the predicted ground level concentration which will be presented in an iso-contour surrounding the source of pollutant. Monitored ambient air at certain residential receptors identified in the EIA report of the iron and steel plant will be input into the GIS system.

Synthesis and analysis of the data for the predicted and monitored air quality concentration using GIS will enable a better environmental monitoring tool.

3.3.1 Avenue

Avenue is a scripting language and development environment that is part of ArcView. Avenue is fully integrated with ArcView and will only run from within ArcView. There are many uses for Avenue for customisation, automate function or develop a complete application that runs from within ArcView.

ArcView provides the necessary customisation and language environment tools in an easy-to-use framework with Avenue. With Avenue, graphical user interface can be created, interacting graphical controls could be established, fine tuning the behaviour and appearance of those controls, and writing scripting code for the created interface. In addition, event such as starting up and shutting down a project can be link by Avenue script.

3.3.2 Dialog Designer

A dialog designer is a user interface development tool for applications development in ArcView (ESRI, 1997). A dialog organizes a single task or set of related tasks onto a separate window under a particular menu item or on the button bar.

The Dialog Designer supplements the ArcView's interface with dialogs that perform a specialized task. The Dialog Designer does not modify any of ArcView's existing dialogs or replace ArcView's main window and run the application completely from a dialog.

Before the Dialog Designer, designing and building of custom dialogs is impossible in ArcView. Thus, other applications that run outside of ArcView, such as Microsoft Visual Basic, provides the necessary function. While this works to a degree, getting the external dialog to communicate with ArcView is clumsy and inefficient. The Dialog Designer extension provides

- A cross-platform development that works on the PC, UNIX workstation, and Macintosh.
- Integrated dialogs that communicate directly with ArcView.
- Direct access to and manipulation of ArcView components such as tables, views and themes.
- An easier way to distribute an application; everything can be included in an ArcView project or incorporated into an extension.

3.4 Prediction of Air Pollution Concentration

The prediction of the ground level concentration of this project will be generated by the ISCST3 model as described in Chapter 2 of this dissertation. The input data will be based on monitored stacks emission of the plant. Meteorological data obtained from the nearest Malaysian Meteorological Station i.e. Batu Berendam Aerodrome, Melaka. An hourly surface data from 1998 to 2000 was

obtained from the Malaysian Meteorological Department. The surface data obtained was pre-processed before it could be used in the model. **Appendix 3.1** shows a sample pre-processed meteorological data to be used in this research work. **Table 3.4.1** shows the variable and the format required for the creation of the meteorological input data of the ISCST3 air quality model.

TABLE 3.4.1: METEOROLOGICAL DATA STRUCTURE AS REQUIRED BY ISCST3

Variable	Unit	Fortran Format	Columns
Year (last 2 digits)	-	I2	1-2
Month	-	I2	3-4
Day	-	I2	5-6
Hour	-	I2	7-8
Flow Vector	degree	F9.4	9-17
Wind Speed	m/s	F9.4	18-26
Ambient Temperature	(K)	F6.1	27-32
Stability Class (A=1, B=2, C=3, D=4, E=5, F=6)	-	I2	33-34
Rural Mixing Height	(m)	F7.1	35-41
Urban Mixing Height	(m)	F7.1	42-48

Note: I = Integer number, F = Floating number with decimal

Source: USEPA (1999)

The consideration of Y2K compliance of the ISCST3 was considered in the development of the software by the USEPA and this is overcome by making use of the 4-digit year input on the ME SURFDATA card to identify the starting century and the starting 2-digit year for date windowing.

3.4.1 Interpolation of Ground Level Concentration using ArcView

The ISCST3 model output which has been pre-processed in Excel spreadsheet is then added into ArcView as new table. The data is then interpolated using ArcView built-in interpolator. ArcView will generate grid data (raster) for the user specified grid size which is shown as a surface shape in the View. The contour of the surface is then generated according to the user specified interval using *create contour function* in ArcView.

The earlier generated surface is then further reclassify according to the required interval by the user. The feature table of the reclassify shape is then joined with the user specified concentration interval table. The new joined reclassify shape is then saved into a new shape file. The contour generated earlier is also saved as new contour shape file.

The newly created ground level concentration and contour for a particular scenario is then added to a new view which will have the basic geographical data such as landuse and the ambient air monitoring station. The ground level concentration in the end of the research work will consists of

predicted iso-contour during the EIA and also the post-EIA i.e. from 1998 to 2000 for TSP, SO_2, NO_2 and VOCs.

Figure 3.4.1 summarizes the interpolation process to be employed in the research work.

3.5 Input of Air Quality Monitoring Results into ArcView

The third interface of this research work is the ability of data entry and updating to the existing database i.e. monitored ambient result for each sampling point. The ability of updating of the existing database will enable an up-to-date ambient air monitoring result.

Each sampling point will have four environmental criterias i.e. PM_{10}, SO_2, NO_2 and VOCs. Graph for each environmental criteria for the monitored period compared to the Malaysian Recommended Air Quality Limits is shown for each sampling point. Visualization of the trend for each environmental criteria will enable the better representation of the temporal feature.

3.6 Analysis and Synthesis of Results

Ultimately, this research work would like to analyse and synthesis the predicted and monitored result in a spatial and temporal form in ArcView system to enable better visualization of the result obtained. The analysis will provide information for decision making purposes.

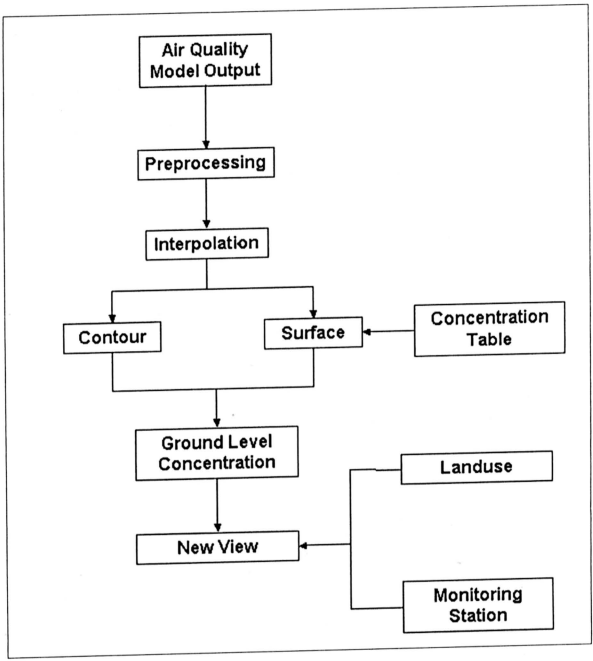

FIGURE 3.4.1: FLOWCHART FOR INTERPOLATION PROCESS IN ARCVIEW

3.7 Customisation of GIS as Monitoring Tool

In designing and customizing the window-based applications, the following question was asked initially to facilitate the customisation process:

- Which objects are needed by the application?
- How does the application respond to events?

After careful consideration, window-based application created had to go through the following stages or steps in order to create a good and user friendly interface:

- **Stage 1**. Create required documents such as the view or the chart.
- **Stage 2**. Customize the interface by adding the menu option and items.
- **Stage 3**. Develop Avenue scripts that respond to the selection of menu items.

Each stage requires an understanding and careful design of the required interface for the application. Due to limited programming background, help has been sourced from:

- discussion group in the world wide web;
- published work; and
- help resource in ArcView.

3.8 Hardware and Software Requirement

From the above discussion on the methodology to be employed in this research, several GIS and auxiliary software will be utilised to achieve the objectives of the research work. **Table 3.8.1** summarizes the minimum hardware and software requirement of the system needed for the application development.

TABLE 3.8.1: SUMMARY OF HARDWARE AND SOFTWARE REQUIREMENT

Hardware	**Description**
Computer	Industry-standard personal computer with at least a Pentium or higher Intel-based microprocessor and a hard disk.
Memory	24 MB RAM or higher (32 MB recommended)
Operating Software	Windows 98/98SE, Windows 2000 or higher
Software	
Air Quality Model	Industrial Source Complex Short Term Version 3 (ISCST3)
GIS	ArcView 3.1 or higher Arcvlew Spatial Analysis 2.0 or higher
Spreadsheet	MS Excel 2000 or higher