

Application of Geographic Information System in Management Air Pollution Index Record Using MapInfo

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Abstract

In recent years, haze has become an annual event that worsens from time to time. This is a serious problem for those having asthma or other respiratory diseases. They might face death threat if they are exposed to serious haze condition for a certain period. Hence, the seriousness of haze or air pollution should be informed to the Department of Environment (DoE) immediately. DoE has published a web page for the public to acknowledge the air pollution index reading. However, the current webpage of the DOE for Air Pollutant Index (API) records have different interfaces respectively which required users to shift from the interface to other interface repeatedly in order for the user to get the full detail and a clearer picture of the situation. A research was conducted to find out the enhancement in delivering the information of API by adopting Geographic Information System (GIS) software, MapInfo. The results indicated lots of enhancements are achieved by adopting GIS in database management for API records. Amongst the benefits are convenience and user friendly map interface where users can retrieve all the desired information from a single interface. Besides that, users obtaining the information at a faster pace compared to the existing system. GIS also provides a better and less space occupying methods to store all data.

Keywords: Geographic Information System (GIS), Air Pollutant Index (API).

Introduction

The recent August 2005 haze episode was not a new experience for Malaysia as this phenomenon has been occurring almost every year. Haze is said to be a partially opaque condition of the atmosphere caused by very tiny suspended solid or liquid particles in the air. This particulate matter is hazardous to health, especially associated with lung and eye deceases. The impact of haze is not serious for a healthy person but will be a serious problem for those have asthma or other respiratory diseases. They might face death threat if they are exposed to serious haze condition for a certain period. Hence, the seriousness of haze or air pollution should be informed to this group immediately.

A Geographic Information System (GIS), or more commonly referred to as a geospatial information system is a system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the earth. It is a computer system capable of integrating, storing, editing, analyzing, sharing, and displaying geographically-referenced information that allows users to create interactive queries (user created searches), analyze the spatial information, edit data, and present the results of all these operations. This study examines the effectiveness of GIS to improve the information management of Air Pollutant Index reading. The results enable users to obtain their desired information directly from a simple and user friendly interface thus they could be aware of the current API reading and subsequently take necessary precaution measures.

Methodology

This section is focused on the handling and management of the raw data using the GIS software, MapInfo. Figure 1 summarizes the entire process of handling and management of the raw data.

The attribute data need to be insert are the following items. All fifty one station containing the general attributes including items (a) to (e). Item (f) to (p) are at the case study station only, which are the five stations in Perak State.

- a) Stations Name
- b) Stations location
- c) Stations type
- d) Latitude of the stations
- e) Longitude of the stations
- f) API records from 01 January 2005 to 31 December 2006
- g) General information of API
- h) Flow chart to calculate API reading
- i) Photo of CAQM station
- j) Graphs showing each of the API Sub Index function
- k) Instrumentation to record each of the sub indexes
- l) Data Validation Process Flowchart
- m) Status indicated by the API reading
- n) Level of pollution
- o) Health measure to be taken during that API reading
- p) A spreadsheet that can compute the API reading based on the input of sub index readings

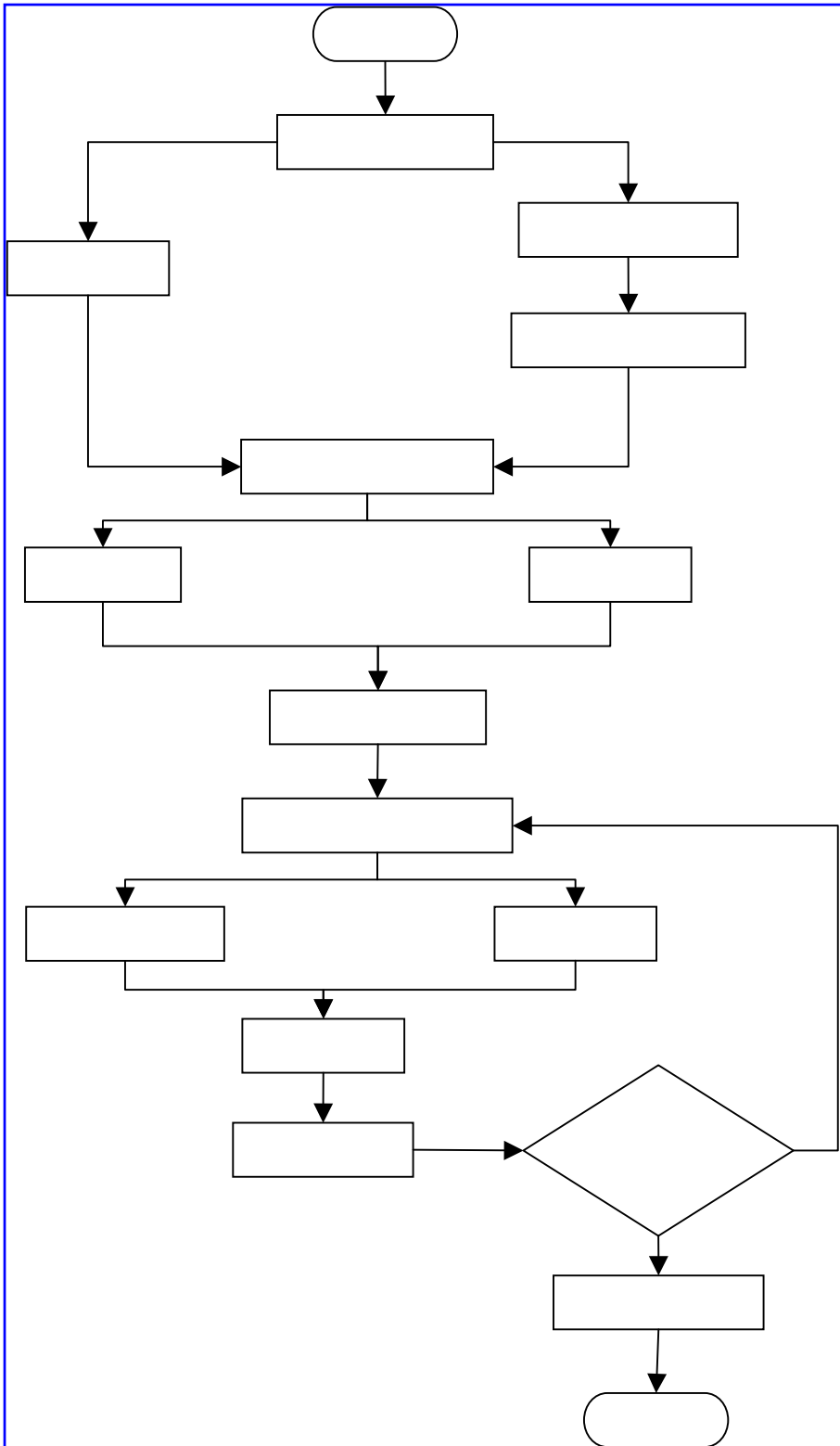


Figure 1: Flow Chart of Information System Development

After the data are being inserted into the GIS software, the data need to be manoeuvred therefore data could be stored and retrieved according to the system design. This stage is including to edit, to remove errors, to further process, re-arrange the information data and to link the data with the map interface. For example, Line Graphs showing API readings from January 2005

to December 2006 for five stations in Perak are produced from raw data and are included in the interface.

Results

After an information management system for API record is designed and accomplished, it is tested and reviewed in ensuring the original objectives has been achieved. It is found that this system has the enhancements which will be discussed in the following section.

Simple and User Friendly Interface

Figures 2 and 3 show the map interface created using MapInfo. The relevant information of API could be retrieved within a single map interface. However, the information is actually stored in various database files. MapInfo organizes all its textual or graphical information in the form of tables. The Info Tool List Window at the lower left corner of Figure 2 list out the general attributes data of the respective station.

The tables would display as separate layers in the map interface. Digitised maps are organized into layers. Layers are like transparent papers that are stacked on top of one another. Each layer contains different aspects of the whole map and map objects such as points, lines and texts.

For example, one layer may contain state boundaries, a second layer may have symbols that represent the API stations, and a third layer might consist of text. By stacking these layers one on top of the other, a complete map is built. We can display one, two or many tables at a time according to our needs. This enables the users to retrieve all the information through a single map interface which contains various layers. Users no longer need to retrieve different information by entering different interfaces which stored respective individual information.



Figure 2: Partial map interface in MapInfo showing Peninsular of Malaysia

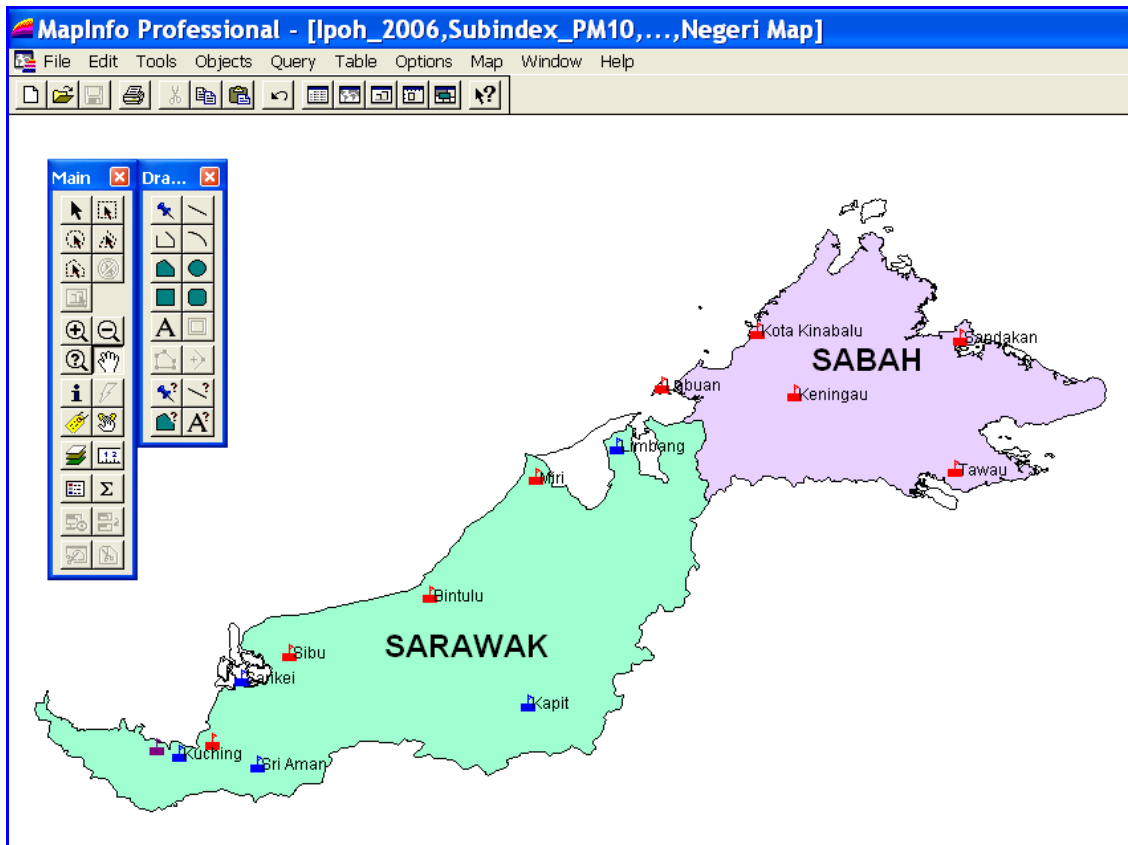


Figure 3: Partial map interface in MapInfo showing East Malaysia

Fast Retrieval of Data

Differ from the spreadsheet programme like Microsoft Excel, MapInfo provide the user to choose their desired information from the database system which contains millions of data. The users can narrow down the data to be retrieved and sorting according to their needs with a single command.

For instance, a foreign tourist wants to know the entire API records in year 2006 at Ipoh by sorting the results in ascending order of the API readings thus user can aware when is the critical period that Ipoh are affected by haze. If user is finding that data from a spreadsheet programme, user might need to locate the API readings from thousands of data in the spreadsheet. If user is well-versed in that software, user might use the “find” command to locate the relevant API readings. However, user still needs to copy and paste the readings to another spreadsheet where user could subsequently sort out the readings in ascending order.

If all the API readings are stored in MapInfo, user needs to retrieved the API readings by using the “Select” command in the Query Menu of MapInfo. By keying in what kind of information user would like to find and retrieve, MapInfo will locate the data for them and sorting according to user requirement. Figure 4 shows the correct expression in the “Select” command (Figure 5) which will give the desired results as shown in Figure 6.

Another example is a DOE officer would like to know the minimum, maximum and the average API readings at Taiping in years 2005 to 2006. Once again, user need to select all the relative data in a spreadsheet

programme before user could obtain the results through the “MIN”, “MAX” and “AVERAGE” functions respectively. This might take user quite a long time to do so depend on how the data are saved in the spreadsheet file.

However, to get the same results from the MapInfo is much easier and faster. User only needs to perform the “Calculate Statistics” command in the Query Menu and user will get the results immediately. Figure 7 shows the results of the command. Besides that, a large volume of API readings store in a spreadsheet programme will consume relatively more memory than it does in MapInfo. This will subsequently prolong the respond time of the spreadsheet programme.

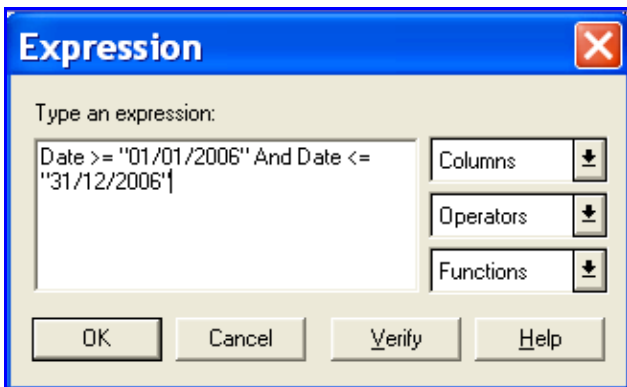


Figure 4: Retrieve the Ipoh API records in year 2006

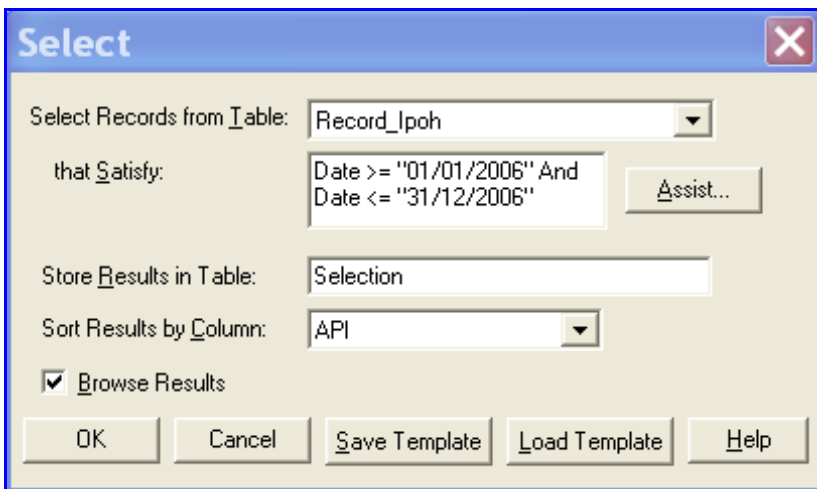


Figure 5: Retrieve API records in year 2006 by ascending order according to API readings

Ipoh_2006 Browser			
Station	Date	API	
Ipoh	22/06/2006	32	
Ipoh	24/06/2006	34	
Ipoh	29/10/2006	34	
Ipoh	06/05/2006	34	
Ipoh	01/10/2006	35	
Ipoh	27/10/2006	35	
Ipoh	17/06/2006	35	
Ipoh	23/06/2006	36	
Ipoh	21/06/2006	36	
Ipoh	25/10/2006	37	
Ipoh	19/06/2006	37	
Ipoh	18/06/2006	38	
Ipoh	11/02/2006	38	
Ipoh	20/06/2006	40	
Ipoh	28/08/2006	40	
Ipoh	10/09/2006	40	
Ipoh	03/10/2006	40	
Ipoh	26/10/2006	40	
Ipoh	17/05/2006	40	
Ipoh	27/05/2006	41	
Ipoh	16/06/2006	41	
Ipoh	11/07/2006	41	
Ipoh	02/10/2006	41	
Ipoh	05/11/2006	41	
Ipoh	08/11/2006	41	
Ipoh	16/11/2006	41	
Ipoh	27/11/2006	41	
Ipoh	12/02/2006	41	
Ipoh	14/05/2006	42	
Ipoh	10/06/2006	42	

Figure 6: Partial view of the table containing Ipoh API records in year 2006 by ascending order according to API readings.

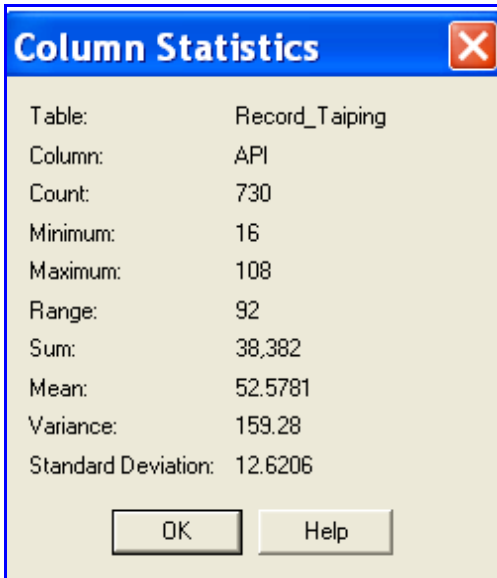


Figure 7: Results from “Calculate Statistics” command in years 2005 to 2006

Graphing

MapInfo provides a variety of graphs to be plotted based on the database stores in a table. These graphs are Bar Graph, Histogram Graph, Line Graph, Pie Graph, Scatter Graph, Bubble Graph, Column Graph, Area Graph, Surface Graph and 3-Dimensional Graph. A line graph is best fit for showing the API readings as shown in Figure 8. MapInfo graphs are linked directly to the source data. Any modification on the source data will be reflected simultaneously on the graphs. This could be a useful advantage for updating a graph that shows the daily API records.

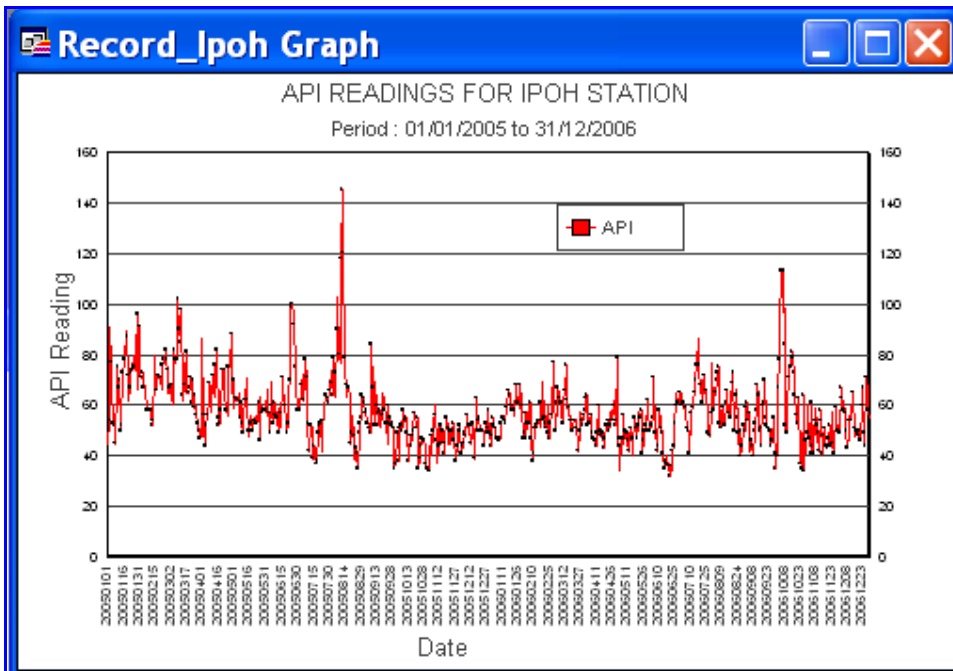


Figure 8: Line Graph showing the API readings at Ipoh in years 2005 to 2006

Real-Time Computation of API Reading

A real-time computation of API reading is produced using the Microsoft Excel. This spreadsheet is subsequently linked to the MapInfo. The users could activate the spreadsheet from the map interface in MapInfo and key in the readings for each sub index into the spreadsheet. The spreadsheet will process the raw data and produce the result of API reading instantly. The results are including the predominant air pollutant parameter, status, level of pollution and health measures to be taken for the respective API reading (Figure 9).

Computation of Air Pollution Index (API)						
Item	Description	CO	O3	SO2	NO2	PM10
1	Reading for Subindex	4.00 ppm	0.05 ppm	0.80 ppm	1.60 ppm	600.00 µg/cu.m
2	API Subindex	44	50	400	400	500
3	API Reading	500			PM10 (Predominant Air Pollutant Parameter)	
4	Status	Hazardous				
5	Level of Pollution	Severe aggravation of symptoms and endangers health.				
6	Health Measures	»»	Elderly and persons with existing heart or lung disease should stay indoors and reduce physical activity.			
		»»	General population should avoid vigorous outdoor activity.			
		»»				
EMERGENCY						

Figure 9: Spreadsheet file that will generate the API reading based on the raw data of sub index readings

However, a further research should be held to link the raw data of sub index readings to the spreadsheet file directly. With this setup, the possibility of human error can be reduced furthermore.

Similar to the linking of incoming raw data, the API reading output could be delivered directly to the database file in the MapInfo. This could reduce the time to produce the API readings from the sub index readings and concurrently accomplish a system that can provide real-time API readings.

Conclusions

Many of enhancements are achieved by adopting GIS in database management for API records. As discussed in previous sections, amongst the benefits are a convenience and user friendly map interface where users can retrieve all the desired information from that single interface. Besides that, the users are obtaining the information at a faster pace compared to the existing interface and system. GIS also provides a better and less space occupying methods to store all the data.

These advantages might not excite a healthy person. However, it would be a priceless present to whose having asthma or other respiratory diseases. By obtaining the real-time condition of the air pollution, they can take adequate preventive measures before the haze affected their health condition. Besides

that, the authorities can make crucial decision and take necessary action faster based on the real-time API readings.

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