

Development of Decision support System Using Management Information System and Geographic Information System

Teerawong Laosuwan, Poramate Chunpang, Nutchu Laosuwan

Abstract— *The objective of this study is to develop of decision support system using management information system and geographic information system, a case study in the Faculty of Science Mahasarakham University. This system was created by Open Source Software (OSS) and web GIS solution i.e. University of Minnesota Map Server (UMN Map Server), Appserv software, Quantum GIS, PHP, and Edit Plus etc. The UMN Map Server program will process spatial data from vector and raster, and then illustrate the result in webpage by used Common Gateway Interface (CGI) on the client. Although this system serves chemical management methods in Faculty of Science Mahasarakham University, the methodology can be applied elsewhere for similar processes.*

Index Terms— *Decision support system, Open Source Software, MIS and GIS*

I. INTRODUCTION

Hazardous chemical is one that can cause harm or danger to humans and their property. Its danger includes corrosion, burn or ignition, explosion, oxidation, and water reactions. Hazardous chemicals are divided into nine categories: 1) Explosive substances; 2) Gases in form of compressed liquids and solutions; 3) Flammable liquids; 4) Flammable solids and substances that when reacting with water can generate flammable gas; 5) Oxidizers and Organic Peroxides; 6) Toxic substances and inflammatory substances; 7) Radioactive substances; 8) Corrosive substances; 9) Other substances and materials that may be harmful [1].

Management Information System (MIS) is necessary for executives and managers because MIS has functions that can work effectively by integrating internal and external information, both past and present organization information, as well as expected event in the future. Besides, an effective MIS must provide necessary information in appropriate length of time so that management can make correctly decisions on the planning and operation within organization [2]. Geographic Information System (GIS) is a system that integrates hardware, software, and data designed for storing, managing, preparing, analyzing, modeling, and displaying all forms of geographically referenced information in order to solve mapping complexity and management problems [3, 4]. In a case of the Faculty of Science, Mahasarakham University, there are several departments that use dangerous chemicals.

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There is also no system for planning and controlling the use of chemicals. In addition, the exact amount of chemicals stored within Faculty of Science is unknown. As a result, the problems occur including unbalanced and disordered amount of chemicals. The amount of chemicals is too high or too low or none, which can cause other problems such as the delay in distributing or purchasing chemicals, environmental issues, and a risk of hazard caused by chemicals. To facilitate chemical management, the researcher has applied management information system and geographic information system to overcome those problems. Such technology can support the data presentation through management information and geographic information forms and can provide important information leading to chemical management within the Faculty of Science, Mahasarakham University.

II. MATERIAL AND METHOD

A. Spatial data and chemical data

The spatial data and chemical information of this study can be shown in Table 1.

Table 1 Illustrate data usage

Data	Source	Year
boundary, road, building, water (shp file format)	Digitizing from Aerial photo	2012
Chemical information of the Faculty of Science, Mahasarakham University	Department of Chemistry, Faculty of Science, Mahasarakham University	2010

B. Appserv software

In this study, Appserv software is applied to simulate PC into Web Server. Appserv is program suite that integrates individual programs used to manage Web Server. Since this can run on a typical PC, it is similar to simulate PC into Web Server. Appserv software includes the abilities of the programs as follows: 1) Apache Web Server; 2) PHP 3) MySQL and 4) phpMyAdmin, a program that acts as a Database Server [5-7].

C. Quantum GIS

Quantum GIS (QGIS) is an Open Source Geographic Information System. The project was born in May of 2002 and was then established as a project on Source Forge. QGIS aims to be an easy-to-use GIS, providing common functions and features. The initial goal was to provide a GIS data viewer. QGIS now supports a number of raster and vector data formats, with new format support easily added using the plugin architecture. QGIS is open source and fast evolving. QGIS is available for Windows, Linux, BSD, Mac OS, and Android. [8-11].

D. Webpage development and map files programming

Web pages and map files of GIS are related. To avoid confusion, the researcher divided process into two steps including web page writing and map files writing [12, 13]. The relevance between web pages and map files can be viewed as Figure 1.

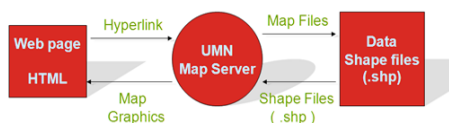


Fig.1. The relevance between web pages and map files

- Webpage writing

Writing the first page of the system includes links to MIS and GIS. On the first page, index.html is saved as file name i.e. Appserv, cgi-bin, msuchem, webmap etc. and then it is stored in a folder titled www.

- Map files writing

Map Files is Configuration file that store the results or determine map form showed on web browser from the operation of Minnesota Map Server. It has .map as its extension that can be created by using Notepad or Editor such as Edit Plus. With indication of map files, Minnesota Map Server can know which files work together and where to work as well as details for displaying map such map color, map size, map address [14-16]. With this, Minnesota Map Server can show map defined by map files. The structure of map files is available in Figure 2.

The structure consists of map object, web object, layer object and layer objects. A layer contains class Object. Map object can have many layers and one layer can have many classes in writing map files. For writing the map object is the writing of map files components, the first step of the writing map files as shown in Figure 3. In this study, the Map files are written in part of Map object as shown in Figure 4.

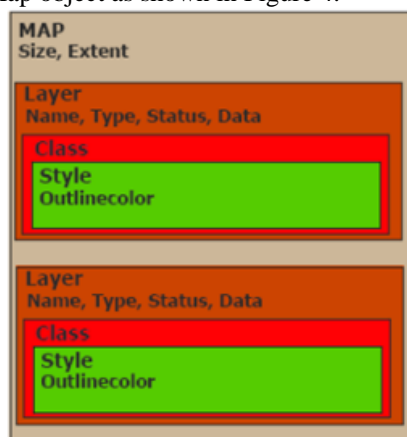


Fig.2. The structure of map files

```

1 NAME
2 IMAGETYPE [gif, png, jpeg, bmp, gif, User Defined]
3 EXTENT [X-min] [Y-min] [X-max] [Y-max]
4 SIZE [x] [y] in pixels
5 UNITS [feet, inches, kilometers, meters, miles]
6 SHAPEPATH ["where are data (.shp)?"]
7 IMAGECOLOR [RED, GREEN, BLUE]
8 PROJECTION "proj=latlong"
    
```

Fig.3. The first step Map files

```

1 NAME mquery
2 IMAGETYPE PNG24
3 EXTENT 103.245 16.2406 103.255 16.2505
4 SIZE 450 350
5 UNITS kilometers
6 SHAPEPATH "data"
7 IMAGECOLOR 255 255 255
8 PROJECTION # projection of mapfile
9 "init=epsg:24047" # "proj=latlong"
    
```

Fig.4. Map files writing in part of Map object

III. RESULT

A. Display page of Management Information System (MIS)

The information system is designed to develop a database of chemical substances and provide information about a wide range of chemicals when wanting to search them. To access the information system, it is necessary to login. Login can be done by typing username and password. The information system has identified types of users including user and administrator. The access to information by user or administrator is different as follows.

1. User

Username and password are required to login to the system. User can see how to login in the Figure 5.

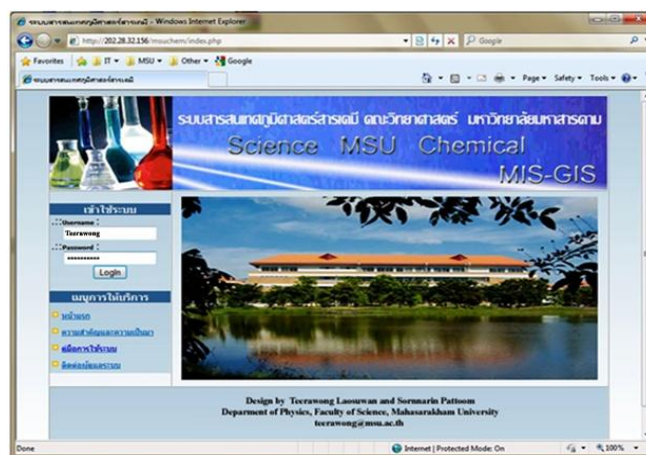


Fig.5. Illustrate of webpage

This system is designed to facilitate seeking for information including a wide range of chemicals, and chemical storage locations. Moreover, user can download Chemical Request Form through this system. User can search chemical information through chemical search system. User can easily search desired chemical information by just typing some keywords or related words, in both Thai and English languages. After user presses search button, the database system will show all related information of keyword. The example of searching for "iron" can be seen in Figure 6 and Figure 7.



Fig.6. Illustrate function of information search

NO	Chemicals	Product/Name	status	molecularformula	molecularmass	size	stock	position	class
1	39-100 G	Ammonium iron(II) sulfate	s	(NH ₄) ₂ Fe(SO ₄) ₂ ·6H ₂ O	392.13	500g	1	A	sci-407
11	39-100g	Ammonium iron(II) sulfate (Univar)	s	(NH ₄) ₂ Fe(SO ₄) ₂ ·6H ₂ O	392.13	500g	4	A	sci-407

Fig.7. Display information output

This information system can be used to search for chemicals located on shelves and in storage rooms. With this capability of the system, it is developed to be able to search and display chemical storage rooms on one to one basis (as shown in Figure 8). This makes it easier to find some kind of chemical and know where to store certain chemical. The obvious benefits of the retrieval system are ease of use and storage. Moreover, this system is easy to use as user who wants to know chemical storage location can select certain shelf or storage room.

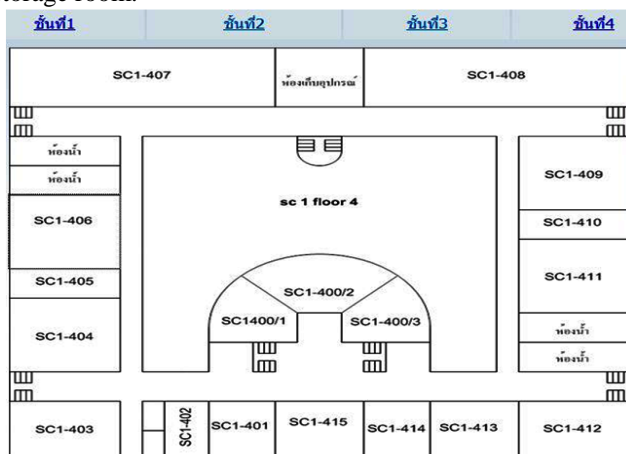


Fig.7. Chemical searching from storage rooms

Data was easily and clearly shown through this search system. The search system will not show any item of chemical in a room that does not keep chemical. Data about chemical storage rooms or relevant data are displayed as shown in Figure 9. If the database system cannot find certain data, it will show user that room has no chemical or indicate that the system could not find the data.

2. Administrator

Administrator is the one who can access, manage and modify information in the system. Admin can add data to the database or delete unwanted data. Unlike user, Admin accesses information in different way. Admin has to log in by using username and password. In this study, the researcher has designed the system with multiple Admin. When Admin logged in to the system, he can add, delete, and change information as needed. The examples of adding and changing information can be seen in Figure 10 and Figure 11.

id=sc1-406

SID	Chemical	Product Name	status	molecular formula	molecular mass	size	stock	position	class
494	30209	1-phenyl-2-(3,4-dichlorophenyl)ethane	1	C16H11Cl2	261.19	25g	1	sc1-406	
495	30210	1-phenyl-2-(3,4-dichlorophenyl)ethane	1	C16H11Cl2	261.19	25g	2	sc1-406	
496	Q-008	Quinone (2-methyl-1,4-benzoquinone)	1	C6H4O2	108.1	25g	1	sc1-406	
497	1403923	1,1'-Diphenyl-2,2'-bis(4-methylphenyl)ethane	1	C24H20	304.34	25g	4	sc1-406	
498	GA13914	2,2'-bis(4-methylphenyl)ethane	1	C18H16	224.32	25g	4	sc1-406	
499	40-10-2	1-phenyl-2-(3,4-dichlorophenyl)ethane	1	C16H11Cl2	261.19	25g	4	sc1-406	
500	9-1075	Chlorobenzene	1	C6H5Cl	112.56	25g	1	sc1-406	
501	4240252	1,1'-Diphenyl-2,2'-bis(4-methylphenyl)ethane	1	C24H20	304.34	25g	1	sc1-406	
502	14021	1,1'-Diphenyl-2,2'-bis(4-methylphenyl)ethane	1	C24H20	304.34	25g	1	sc1-406	
503	14021	1,1'-Diphenyl-2,2'-bis(4-methylphenyl)ethane	1	C24H20	304.34	25g	1	sc1-406	

Fig.9. Display information

Add Data

Code:

Product Name:

Status:

Molecular formula:

Molecular mass:

Size:

Stock:

Position:

class:

Fig.10. Illustrate add data page

Edit

No:

Code:

Product Name:

Status:

Molecular formula:

Molecular mass:

Size:

Stock:

Position:

Class:

Fig.11. Illustrate edit data page

B. Geographic Information System (GIS)

By using the GIS system, user can select to display various pages through map information (as shown in Figure 12). Importantly, the GIS system can show risk range of chemical spills and environmental impacts of chemical spills on nearby area. The system can check the impact of chemical spills for a range of 100 to 1000 meters on water source and faculty buildings.

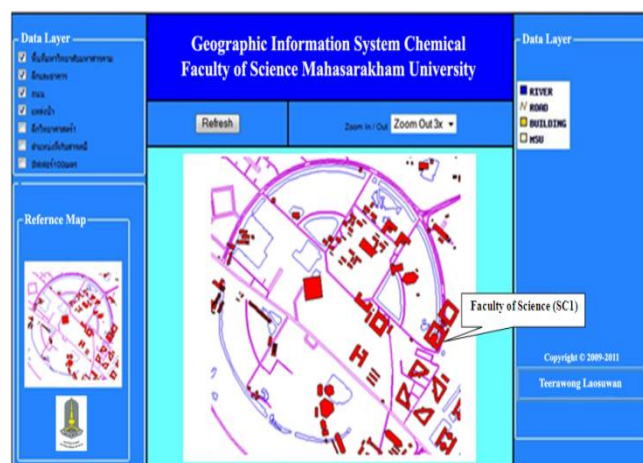


Fig.12. Illustrate various pages through map information

IV. CONCLUSION

The develop of decision support system using management information system and geographic information system, a case study for chemical management in the Faculty of Science, Mahasarakham University, it can be concluded as follows. The author has developed and proposed chemical management with management information system and Geographic Information System. The proposed system can show the amount of chemicals. User can add, delete and change chemical data. The system can indicate chemical storage locations in the Faculty of Science, Mahasarakham University. For Admin part, the author suggests that the system should be improved so that it can be more attractive, various and modern. Moreover, the information system should be checked before publishing in order to avoid data analysis error.

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