# **Publication of Geographic Information Systems in Internet**

E. COLL, J.C. MARTINEZ, J. IRIGOYEN, J.G. SANZ Department of Cartographic Engineering, Geodesy and Photogrammetry Polytechnic University of Valencia Camino de Vera, 46022, Valencia SPAIN

SPAIN

*Abstract:* – This paper explains the publishing of Geographic Information Systems (GIS) in the Internet, using Free Software. The main objectives of this work are: firstly to know about map servers and secondly to make an application to solve a specific problem related with GIS. The result is a web-based application that allows to access a corporative GIS from any computer connected to the Internet, with the necessary security measures.

Keywords: - Geographic Information System, Internet, Map Server, PHP.

# **1** Introduction

GIS technologies are the most efficient way to work with geographic data. A GIS is essentially a database with capacity to store geographic and alphanumeric information, in addition to the software and the staff that manages this database.

Publishing of geographical information through the Internet is crucial for many firms and institutions. Nowadays, it is possible to show in the Internet the information stored in a GIS, thanks to map servers. Besides, several projects of Free Software are appearing that allow to publish GIS [3].

# **2** Objectives

The aim of this application is to offer information about files of a company to any client that has a "userpassword" pair. Therefore, it will be necessary to:

- Install a web server.
- Install a map server.
- Design a web site that allows to search into the cartography.
- Generate reports automatically with the information stored in the GIS.

# **3** Tools and programming languages

The application was installed and set up in a computer running Microsoft Windows operating system. Anyway, these tools are not dependent of the operating system, which enables developers to install them in others like GNU/Linux or MacOS.

# 3.1 Web Server

The web server used in this application is a proof of how free software has succeeded: Apache HTTP Server (commonly named "Apache"). It's a crossplatform web server configured in an easy way with text files [1].

## 3.2 UMN MapServer

One of the most spread GIS Free Software projects is the map server of the University of Minnesota (UMN MapServer) [10]. It consists of some executable files and some libraries that allow to handle vector and raster data.

There are two ways to work with MapServer: using an executable that works with the Common Gateway Interface (CGI) or working through a library with programming languages such as Java, Python, PHP, etc. This last one is very interesting, as it provides flexibility to the system and adds the advantage of adapting the application to our necessities.

The wide UMN MapServer users' community is highly active; consequently, mailing lists, forums and chats are basic information resources. MapServer is present on multitude of projects anywhere in the world, like the one displayed in figure 1 [9].

Furthermore, there are some initiatives of Free Software based on UMN MapServer that create a web application without programming, working from templates and forms [7, 5, 6].

## 3.3 HTML and CSS

The presentation of web contents is possible through the HyperText Markup Language (HTML). This markup language allows to display tables, images, hyperlinks, ... It's the language that the application uses to communicate with the clients.



Fig. 1. Web mapping application from the Indian Ocean Tsunami

The separation between the information and its format enables the normalization of application contents and makes easier the management of that format. This is possible using Cascaded Style Sheets (CSS). With them, format parameters like colors, font shapes, font sizes and so on are established.

#### **3.4 PHP**

PHP or Hypertext Preprocessor, is an open source, server-side, HTML embedded scripting language used to create dynamic Web pages. This way, instead of keeping static documents, these are generated on every request, according to the information extracted from the databases or as a response to the client actions [4].

PHP is also a Free Software project that appears in an huge number of web applications within many different purposes. This language is especially interesting due to its adaptation to the connection with alphanumeric databases, and thanks to projects like MapServer, also with geographic databases.

# 4 The information

#### 4.1 Geographic Information

The geographic information displayed is, on one hand, the basic cartography and on the other a coverage of polygons that determine the extension of a work file. In table 1 project layers and its visualization scale are shown.

Geographic information is stored in *shapefiles*, since they are used in other applications installed in the system. If more security and performance are needed, it will be necessary to store it in relational databases such as *PostGis* or *Oracle*. Anyway, the access to the information is similar in both situations.

Table 1. Layers of the project

Layer	Туре	Min Scale	Max Scale
Files	Polygon	-	-
Roads	Lines	-	500,000
Rivers	Lines	-	500,000
Pop. centers	Polygon	-	150,000
Contour	Lines	-	100,000
Municipal limits	Polygon	-	300,000
Regional limits	Polygon	300,000	-
Coast limit	Polygon	-	-

#### 4.2 Alphanumeric information

Alphanumeric information of files is stored in a Microsoft Access database. Connection between geographic and alphanumeric databases is provided by an unique file identifier. It is possible for one file to exist in the alphanumeric database and not to be present at the geographic database. This case has to be dealt by the application.

To access the database, an ODBC (Open DataBase Connectivity) link has been created and the Structured Query Language (SQL) is used to make requests [2].

# 5 Development

#### 5.1 System installation and configuration

The installation and set up of the web server (Apache and PHP) and map server (UMN MapServer) are not especially complex when proposing a simple system for designing and programming. When preparing a server to really work in Internet, is necessary to consider other aspects like the security and performance, not discussed here.



Fig. 2. Installation of Apache in Windows

Web server installation is completely guided (fig. 2) and it is only necessary to configure where to place the documents. In a PHP configuration, it is necessary to highlight that MapServer requires Apache to use PHP as a CGI executable. The installation of MapServer consists on the appropriate locating of a series of executable files and libraries.

The library that allows the access to MapServer from PHP is called MapScript (fig. 3). After loading this library in a PHP application (see table 2), GIS data becomes accesible and can be managed and displayed.

MapScript				
MapServer Version	MapServer version 4.0.2 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=WBMP OUTPUT=PDF OUTPUT=SWF SUPPORTS=PROJ SUPPORTS=RREETYPE SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE			
PHP MapScript Version	(\$Revision: 1.177.2.1 \$ \$Date: 2003/12/12 13:31:41 \$)			

Fig. 3. MapScript and MapServer information

## 5.2 Design of symbology

The design of layers and symbology is configured in a plain text file (.map), as well as all the subjects related with cartography and the way these ones are displayed (extents, image format, spatial reference system, etc.). This file is read by MapServer on every request.

Table 1 shows maximum and minimum scales of visualization for some layers. These are established to improve the reading of the cartography. Visualization scales are also specified for the labels with the same purpose.

## 5.3 Design of web pages

Four different web pages have been designed. The first one to access to the application, the second one to search on the cartography, another one to list all the files and the last one to see a detailed report of a file.

## 5.3.1 Access page

The most important features of the application are shown in this page (fig. 4). A pair "user-password" is requested to check it in the database. If this pair exists, hyperlinks to the cartographic viewer and to the listing of files appear.

## 5.3.2 Cartographic viewer

It's the most important page of the application as it allows to navigate through cartography with the *zoom* controls and with predefined scales (fig 5). Besides, it's possible to activate and to deactivate the base cartography and the layer of the work files.



Fig. 4. Access page

Selecting one or more files is possible, showing a table with the result of the query (coordinates of the point searched, extent of the search window, etc.). A small form appears in this table. This way, the user can accede to the report of one of the found files.



Fig. 5. Cartographic viewer page

## 5.3.3 Listing of files

From the access page, the user can see the complete alphanumeric listing of the files stored in the database. This is necessary because not all the files appear in the cartography.

This listing, of course, is dynamically generated on every request. Therefore, the information shown is always the most recent and validated.

## 5.3.4 Report

Requesting the report of a file is possible from the cartographic viewer as well as from the alphanumeric listing (fig. 6). Through a SQL statement, this report takes information of the file from many tables of the database. If some tables do not have information about the file, these titles are not shown in the report. In addition, if the file appears in the geographic database, a small detail window is displayed.

Informe del expediente 012/94 "Mejora sistemas riego-desaglies para ahorro de agua" Teo LUAR Francesón Ministerio Zene GAPA 2 CAPA 1 Deposicón Disposicion Linez Lineal	A Let us side class class a	
Decreto de aprobació Publicación: DOGV Número:	n : Fecha:	
martes, 22 de junio de 2004 a las 18:28:56 Sitio web enmarcado en el Trabajo Final de Carrera de Jo	rge Gaspar Sanz Salinas	Volver Cerrar sesión

Fig. 6. Report with map detail

#### 5.4 PHP programming process

#### 5.4.1 MapScript

PHP access to the MapServer services needs to load the proper library (php\_mapscript.dll). In this way, the programmer can work with the objects model of MapServer [10, 7].

Within this object model, and with the values of the variables collected from the HTML form, several actions are possible. This includes, among other things, changing the initial settings of the .map file, modifying the map area and the active layer or performing a search from image coordinates.

Table 2. Example of PHP/MapScript code

```
dl('php_mapscript.dll');
$map_path="D:/WWW/Aljub/";
$map_file="aljub.map";
//Load the map
$map2 =
   ms_newMapObj($map_path.$map_file);
```

#### 5.5 Control of the aspect

Although the application is relatively small, it has been very possitive to separate the "logic" from the "presentation". This is possible using two different operations: first, using style sheets to separate the presentation from its format, and second, using templates for common elements between the pages.

PHP templates have been useful to define on one unique place the header and the footer of web pages. In medium to big projects, the use of some template engine like Smarty (http://smarty.php.net) is essential to separate the work of programmers and the work of designers.

#### 5.6 Security issues

In this application, a limited security system is developed, requiring to the client a valid couple "userpassword". This pair is stored directly into the database.

When an application is focused on the web, the security system has to be improved to avoid attacks and not allowed accesses. This is achieved by developing a users' system and encrypting the information. These encryption mechanisms are available from the programming languages as well as from database software.

# 6 Conclusion

This paper describes a web application resolving a specific need in a defined environment. This is possible thanks to the use of tools that let developers work directly with data through standard programming languages. Instead of providing a template-based application and modifying it to be adapted to the problem, this one is directly attacked without roundups.

The couple PHP–UMN MapServer has been proved to be highly effective to provide out any kind of geographic information adding strength and versatility to the development of any GIS web application.

The use of standard programming languages, as simple as possible, ensures proper usability of the application with any client, not only with traditional computers (i.e. mobile phones).

## 7 Acknowledgments

This work has been partially supported by the research project "Information and Management in Local Administration" BIA2003-07914 from the Spanish Government (CICYT) and the European Union (ERDF funds).

References:

- [1] Apache HTTP Server Project, http://httpd.apache.org/
- [2] Celma M., Casamayor J.C., Mota L., *Bases de Datos Relacionales*, Pearson Prentice Hall, 2003.
- [3] Coll E., Martínez J.C., Sanz J.G., Irigoyen J., *Introducción a la publicación de cartografía en Internet*, Polithecnic University of Valencia, 2004.

- [4] Gilmore, W. J., A Programmer's Introduction to PHP 4.0, apress, 2001
- [5] Mapbender Project, http://www.mapbender.org
- [6] MapLink Project, http://maplink.sourceforge.net/
- [7] MapTools Project, http://www.maptools.org
- [8] McKenna, J., MapServer PHP/MapScript Class Reference, *DM Solutions Group Inc.*, 2004.
- [9] Tsunami Disaster Mapping for Indian Ocean Coastal Regions, http://www2.mapsherpa.com/ tsunami/
- [10] University of Minesotta MapServer, http://mapserver.gis.umn.edu/