

A Review: Geo-Information Technology for Web-Mapping Application

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Abstract: A GIS is typically consists of Software, hardware, data and users. Today, a vast majority of Internet users uses Web GIS technology, Some example are finding residency and address in an unknown city or even if you lost you can detect your location using your phone GPS and easily find your path. For Creating a Web-GIS application the first and important step is to create GIS data. Second one is to store the created data. In order to store GIS data for web there are many Data Management System (DBMS) that support spatial data. There are many GIS software application to generate, store, manipulate and update GIS data. After storing GIS data on the database publishing map and the data from database is third step. To do this thing, we have much application which allows us to share, edit and process geospatial data. Web GIS is capable to become efficient tool to be used in supporting the process of such as data sharing, decision making, manipulation of data information and map. Therefore by interaction and interoperability of user interface application, database application and server application enable us to create our own Web-GIS application.

Keyword: Web-GIS, Data Server, Web Server, Web Map Server.

1. INTRODUCTION

GIS is a system capable of capturing, editing, storing, analyzing, integrating and displaying geographically referenced information. Since 1960's GIS has expanded and become a part of main stream Information Technology (IT). Development of the web and Internet facility provide two key capabilities that can greatly help to geoscientists. First one is the internet allows visual interaction with data by setting up a Web Server through which clients can produce maps, publishing the non-spatial data on the Internet, proper way of arranging the map so that other clients can view these updates and can help them to speed up the evaluation process. Second, since the universal nature of the Internet, the geospatial data can widely be accessible anywhere and anytime which make the application flexible [4].

Fundamentally, GIS is used to provide user with spatial information. In the case of Traditional GIS spatial and non-spatial information was within the organization or group of organization. Hence the information provided by GIS is restricted within the boundary. To overcome the disadvantage of traditional GIS, WEBGIS come in to picture. As Internet is widely accepted, Geographic Information System (GIS) is moving from stand-alone, isolated to internet application i.e. Web-GIS. Its applications have been used in a wide-range of domains such as environmental management, agriculture, urban planning, and transportation and so on [3]. Spatial database is important part of the WEB-GIS architecture and it allows the storage and querying of data that is related to objects in space, represented in vector format as points, lines and polygons.

Internet GIS can be defined as cyber-infrastructure framework for online geographic information services (GI services) utilizing both wired and wireless Internet to

access spatial data and spatial analytical tools. Internet GIS compared to traditional desktop GIS open, distributed, task-centered information services [8]. The basic architecture of Web-GIS is shown in figure 1

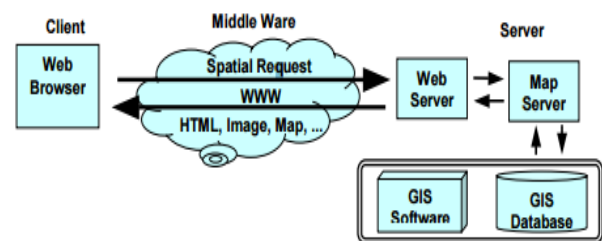


Fig.1 Web-GIS Architecture [1]

The Internet GIS is not the synonyms with Web-GIS. Internet GIS refers as internet is used to exchange the data, analyze the data, and present result, but Web-GIS refers WWW is used as clients [10].

The remainder of this paper is structured as follows. Section 2 presents Web-GIS and Anatomy of web-mapping application. Section 3 presents important component of Web GIS. Section 4 presents Web GIS solution using open-source software. Finally, section 6 presents Conclusion.

2. WEB-GIS AND ANATOMY OF A WEB-MAPPING APPLICATION

Though term Web-GIS and web mapping are used synonymously, even if they do not mean the same. Fact is, the boundary between web maps and web-GIS is fuzzy. Web mapping is enabling the designing, visualization of geographically referenced data through a web interface available online. While Web GIS enables the

communication of all components to happen through the web, enabling diverse data, algorithm analysis, users and visualization techniques that may be hosted at any location on the web. The difference between web GIS and web mapping is shown in figure 2.

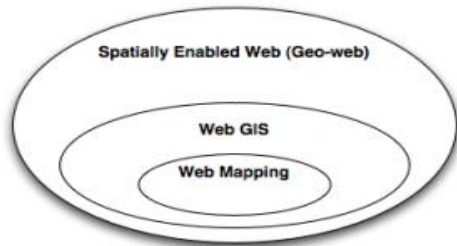


Fig.2 web GIS and web mapping

Web Geographical Information System (Web-GIS) or Internet GIS are related to web mapping but with special importance on analysis, processing of project-specific geodata, as well as exploratory aspects. Web mapping usually involves client-server interaction. If any application contains a map and it does something, then we can say that it is web map application. Web-GIS emphasize spatial data processing aspects more involved with design aspect such as data acquisition and server software architecture such as data storage and algorithm. Figure 3 shows the important components of the web-GIS application system and how they are related to each other [7].

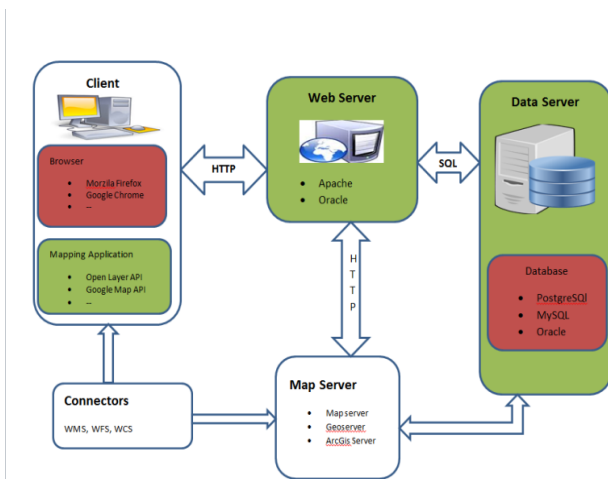


Fig.3 Structure of Web Mapping (Web GIS) [7]

Since last few years, the importance of interactive web maps has exploded. Few years back, creating interactive maps was reserved for big companies or experts with lots of money. But now days, with the emergence of free services like Google maps online mapping is easily accessible to everyone. Web maps are expected to be fast, easy to use and accurate. Since web maps are online, they are supposed to be accessed anywhere. Some tools are there that fulfill all this expectation.

The tools are Open Layer API, Google Map API and so on. Open Layer is an open source, client side JavaScript library for displaying map data in web browser. Since it is

purely client-side library, it doesn't require server side software or setting. Open Layers makes it easy to create fast, modern and interactive map application.

3. IMPORTANT COMPONENT OF WEB GIS

a. Desktop Application

In order to display any feature of map it needs to import GIS data. Features which are using a GIS data can be any vector layers (.shp file) or raster layers. Spatial information on computer deal with the GIS application. There are many GIS application available and are normally program with a graphical user interface that can be manipulated using the mouse and keyboard. The application is ArcGIS, QGIS, uDig, and so on.

Table 1: Comparison between QGIS and ArcGIS

	QGIS	ArcGIS
1	It is open source software.	It is commercial software.
2	It is freely available.	It is not freely available.
3	It can be installed on different operating system.	It can only be install on windows operating system.
4	It is not licensed software.	It is single user licensed software.
5	It is developed by all over the world programmers.	It is developed in secured environment of ESRI.

Quantum GIS (QGIS) is open source geographical information system (GIS) application and popular choice for desktop application for viewing, editing and analyzing geospatial data from variety of raster, vector and database formats. QGIS provides integration with other open source GIS packages, including PostGIS, and Geoserver to give extensive functionality. Plug-ins, written in python or C++, extend the capability of QGIS. QGIS supports a large range of vector and scalar like shape file, WMS, WFS, PostGIS GeoTiff, JPG, PNG, etc. ArcGIS is used for its analytical functionality; QGIS is fine for simple data viewing, simple editing, and symbolization [9].

b. Database Management System (Data Server)

Technically, Database Management System is software system that uses a standard method of cataloging, retrieving and running queries on data. The DBMS manages incoming data, storage and organize data and provide way to users or other program to update and retrieve data from database.

There are many DBMS's but some very popular examples include MySQL, Oracle, RDBMS, PostgreSQL, and IBM DB2 and so on. Database management systems are often classified based on database model and they support. Since there are so many database management systems available now days, it is important for them to communicate with each other. Open Database Connectivity (ODBC) driver comes with many database software which allow integrating with other database.

Table 2: Comparison between MySQL and PostgreSQL

	MySQL	PostgreSQL
1	Open-Source RDBMS written in C, C++.	Open-Source ORDBMS written in C.
2	To integrate with other RDBMS it faces issue.	It can easily integrate with other RDBMS.
3	Best for simple storage	Best for Geo-Mapping Storage
4	MySQL traditionally focused on read mostly web apps.	PostgreSQL traditionally focused on reliability and data integrity.

For manage and store the **GIS data PostgreSQL/PostGIS** is commonly used. **PostGIS** has been developed by Refrations Research as a project in open source spatial database technology. Postgres seems to be most popular for open-source web mapping. It is used by MapServer, Geoserver, OpenStreetMaps and CartoDB. PostGIS adds spatial data types like points, line, polygon, multipoint, multilinestrings, multipolygons and geometry collections. It supports both geography and geometry types. It also adds spatial function like distance, area, union, difference, intersects, etc[3,9, 13].

c. Map Services

A map services provides the map itself. There are a plenty of different map services backend, which includes WMS, ESRI ArcGIS, WFS, OpenStreetMaps and Google maps. The basic principle behind all those service is that they allow us to specify the area of the map we want to look at and then the map servers send back response containing the map image.

There are numerous web map servers are available which include MapServer, Geoserver, Arc Server. Some are free and on some commercial restriction may apply with various services in some situation.

Table 3: Comparison between Geoserver and MapServer

	Geoserver	MapServer
1	Open-source Java based	Open-source C or C++ based
2	Good for vector data	Good for raster data
3	Geoserver requires servlet like Apache tomcat	MapServer requires Apache httpd
4	Geoserver support WFS-T	MapServer don't

After storing geo-data on the database (PostGIS), **Geoserver** is used to publish map and the data from database. Geoserver allow for great flexibility in map creation and data sharing. Open Layers, a free mapping library, is integrated into Geoserver, making map generation quick and easy [3].It has fully-featured Web administration interface. Role based security can be configured in it. Geoserver allow you to display your spatial information to world.

Geoserver allow data sources like vector data, database (PostGIS, Oracle), Servers (WFS, ArcSDE) and raster data. Geoserver also provides services like Web Features Services (WFS), Web Map Services (WMS), Web Coverage Services (WCS), Key Hole Markup Language (KML)[9] [13].

4. WEB GIS SOLUTION USING OPEN-SOURCE SOFTWARE

The basic principle of Web GIS is that the client sends a request to server and then servers receives the request and parse it and according to request result is returned to clients. The promise of open source is better quality, higher reliability, more flexibility, lower cost. Commercial WEB-GIS software raises the following issues. (i) It is expensive, (ii) it has a steep learning curve, (iii) it is difficult to integrate with existing IT infrastructure, (iv) it does not offer out of the box geo-processing functionality. Hence the use of Open Source software offers the potential to overcome this issue and assist the deployment of spatial data and geo-processing functionality on the World Wide Web (WWW).

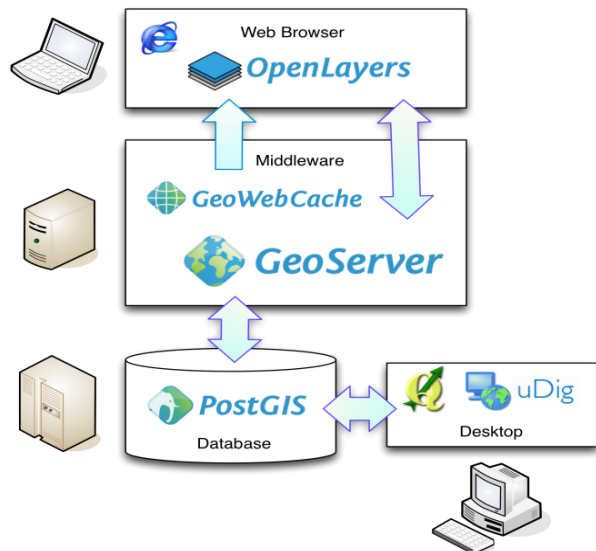


Fig.4 Arrangement of open source component to create web GIS map application [7]

Geoserver is usually referred as map engine, which is core of Web GIS. Without Geoserver, Web GIS is like water without source. Most of the web operation is done through Geoserver. Geoserver uses several well-known open source software.

5. CONCLUSION

This study reveals open source tools are effectively used in the field of GIS which provide similar functionality as like commercial tools. Also it is possible to implement web mapping system based solely on open-source software that are more cost effective than many commercial system. The system developed with open source software is very suitable for organization that have limited financial budget for spatial data sharing.

As figure 4 describes how the open-source tools are work together to create web map GIS application. These tools provide graphical quality, interactivity, flexibility. In first stage we create vector layer using QGIS which is useful tool to create vector layer, raster layer. PostGIS database is used to store, manipulate and update the attribute data of layer created in QGIS. Geoserver is used for publishing the data from vector data, PostGIS data, raster data, and WMS features. Open Layer is library used for displaying data on web browser. Open layer is better support for point, line, and polygon (i.e. vector data)

The vector layer of campus can be display on the web by using QGIS, PostGIS, and Geoserver very efficiently and effectively with no cost.

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