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Web Based GIS Application using Open Source Software for Sharing Geospatial Data

Debasish Chakraborty[1], Debanjan Sarkar[2], Shubham Agarwal[2], Dibyendu Dutta[1] and Jaswant R. Sharma[3]

[1]RRSC-East (NRSC, ISRO), New Town, Kolkata, West Bengal, India
[2]Department of Computer Science and Engineering, SMIT, Rangpo, East Sikkim, India
[3]Regional Centres (NRSC, ISRO), Balanagar, Hyderabad, India

Abstract Web based GIS disseminate and shares geospatial data through internet for visualizing and decision making on area of interest (AOI) sitting across the globe. In order to make a cost effective implementation, operation and maintenance of geospatial data over the web, a cheaper yet feature rich alternative to commercial software is required which can be fulfilled by existing free and open source software (FOSS) for geographic information systems (FOSSGIS) and FOSS for web development. This paper provided an efficient approach to customize and integrate an application using FOSSGIS, FOSS web development software and database. It is observed that the presented application developed using FOSS technology enables user to plot the name and locations of interest, display and navigate the map and satellite image of AOI, perform spatial query, search the geographic location in the map, identify features, measure the distance between points and area of the object in the map in web environment.

Keywords *FOSSGIS; FOSS; GeoServer; MapServer; PostgreSQL; Internet*

1. Introduction

A GIS (Geographic Information System) is an organized collection of computer hardware, software, geographic data, methods, and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information [13]. Web based GIS is a type of GIS that combines a geographical information system and web technology. The reach of the GIS system multiples manifold when it is implemented through the internet. Not only does it get a greater user set, it also means that the user need not invest in a resource intensive machine to access the Web based GIS system. This makes Web based GIS both cheap and more readily accessible. Also, in today's world, using Web based GIS means that one can access the geographic data not only from a desktop but also through laptops, mobile phone, tablets, etc. [7]. There are number of proprietary software namely ArcGIS Server [2], Bentley Geo Web Publisher [5], etc. available for the purpose of implementing a Web based GIS application. These softwares provide a complete platform using which a Web based GIS application can be implemented.

However, the use of above proprietary (commercial) software raises the cost of GIS significantly and making it unaffordable for the general user. The number of Free Open Source and OGC (Open Geospatial Consortium) complain GIS softwares are presently being used to minimize the costs encountered in developing Web based GIS application. Free and open-source software (FOSS) is computer software that can be classified as both free software and open-source software. That is, anyone is freely licensed to use, copy, study, and change the software in any way, and the source code is openly shared so that people are encouraged to voluntarily improve the design of the software [9, 1, 4, 17, 6, 8, and 12]. This is in contrast to proprietary software, where the software is under restrictive copyright and the source code is usually hidden from the users. The benefits of using FOSS can include decreasing software costs, increasing security and stability (especially in regard to malware), protecting privacy, and giving users more control over their own hardware.

Open Geospatial Consortium [15] is an international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services. Web Feature Service (WFS), Web Map Service (WMS) and Web Coverage Service (WCS) are the three important OGC standards. OGC-WMS is concerned with serving raster and vector data as maps (images) in PNG, GIF or JPEG format, whereas OGC-WFS allows direct access to the vector data including reading, writing, and updating. OGC-WCS is used to serve or share raster or image layers on the web [7, 11].

We presented an approach for developing web based GIS application using suitable FOSS for sharing the map, satellite image and non-spatial data efficiently in web environment. The main aim of this application is to share the geospatial data of the Institutions and provide a customized interface to display, overlay, navigate, identify, query and search the location of the Institutions in the web environment. This paper is organized as follows. In Section 2 application architecture is discussed. Application interface is presented in Section 3. The final conclusions are drawn in Section 4.

2. Application Architecture

The application architecture is shown in Figure 1. It consisting of three basic components: client, server, and database. Client is the terminal that allows the interaction of users with the application and provides spatial and non-spatial information display. Internet browsing software (like IE/Mozilla/Chrome/Opera/Firefox) and application software provides the service requesting and result visualization platform to the users in client side. Server includes Web servers, application server, geospatial data server and database server. Web server is the intermediary for responding to client service requests and transmitting the information to meet the client's request. The web server parses the HTTP requests to determine the web services and forward it to app server. The App server analysis the request and sends the query either/both to geospatial data server or/and database server. Thereafter the geospatial data server or/and database server completes the query operations according to app server requests and returns the relevant results to app server. Subsequently app server presents the results in customized form to client through Web server.
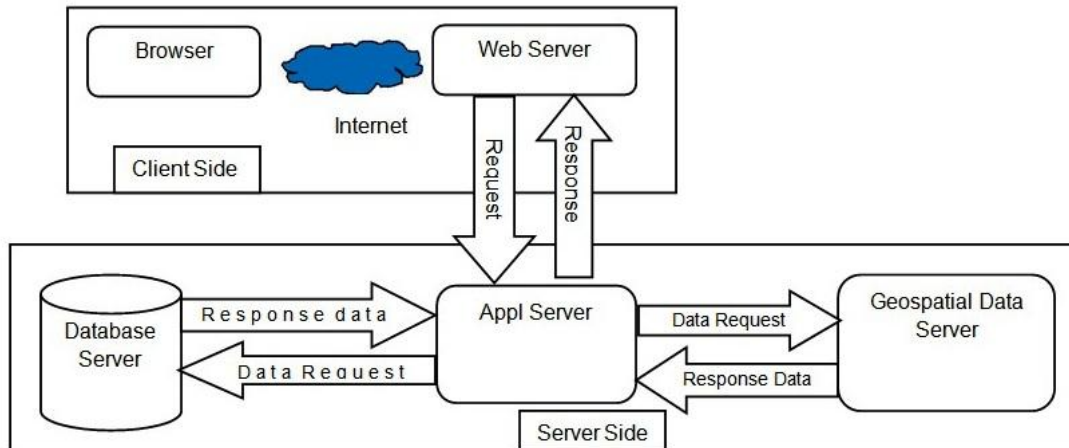
Figure 1: System Architecture of Application

In our application apache is used as the web server because it is the most popular PHP developer package and independent to operating system. It is also easy to install and configure and completely free of charge [3]. GeoServer software is used for sharing the map since the integrated mapping library "OpenLayers" in GeoServer makes map generation very quick and provides a facility of spatial analysis and does not require a plugin [10]. MapServer is used for publishing satellite images since it supports the raster data very well via the inbuilt libraries [14]. PostgreSQL is used as the database server because its concurrency control is better than SQLite and MySQL since it employs MVCC (Multi-version Concurrency Control) and it is designed for high volume environments. It runs on all major operating systems, including Linux, UNIX and Windows. Moreover it can contain both spatial and non-spatial data. It never crashes even under high activity operations and it adds support for geographic objects allowing location queries to be run in SQL [16]. The PHP is used for developing the interface of the application to view, customized retrieval, and query on geospatial data for specific needs. Since PHP is especially suited for web development and support a wide range of databases via ODBC.

3. Application Interface

The "Viewer" is the main interface of the application to view layers, satellite images and non-spatial data. "Viewer" consisting of three frames namely top frame, side frame (i.e. left side frame) and Middle frame. The Middle frame of the viewer is used for viewing layers and satellite image as shown in Figure 2. The left side frame is used for displaying the text information. The viewer comprises of various efficient components which are included in the top frame as well as in side and middle frame of the viewer.

The major components of the viewer include navigation tools, selection tool, map viewer tools, query tool, legend tool, search tools and identification tool. In right side of the top frame of the viewer (Figure 2) shows the various navigation tools: (i) zoom in: helps to zoom the layer displayed in viewer window, (ii) zoom out: helps to zoom out the layer displayed in viewer window and (iii) pan: helps to pan the image/map displayed in the viewer window. The Selection Tool available in left side frame of the viewer is used to select an Organization from multiple choices. Once an Organization is selected, viewer lists the name of the Institutions in its left side frame and plots the locations of those Institutions in the middle frame. There are two query tools: (i) "State wise query" tool is to plot the name and location of the Institutions of an Organization in a State and (ii) "City wise query" tool is to plot the name and location of the Institutions of an Organization in a City. These Query tools are available in left side of the Top frame.

The distance measuring and print map tools are included in right side of the top frame. The distance measuring tool is used to measure the areal distance between two points. Results of map query can be printed out along with detail legend using Print tool. The map can be produced in PDF file formats. The legend tool is made available in left side frame of the Viewer to view the legend of the map. The Institution campus and its surrounding can be viewed along with legend as shown in Figure 2 by just clicking an Institution listed in the left side frame. The display tools: Map, Satellite & Hybrid are available in right side of the top frame of the Viewer enables to display the map, satellite image and hybrid image of the campus of the Institution by simply clicking Map, Image and Hybrid tool respectively.

The address of the Institution can be fetched by clicking the pointer showing in Figure 2. A popup box is used for displaying the address. In addition to that the same popup box contains tools namely (i) upload photo tool: to upload the photo of the Institution in the server, (ii) more info tool: to show brief information about the Institution and provides the link to the official website of the Institution, and (iii) bust stop and railway station search tools: to display nearby bus stops and railway stations of the Institution respectively. To upload the photo user needs to provide the photo in JPG/GIF format together with description.
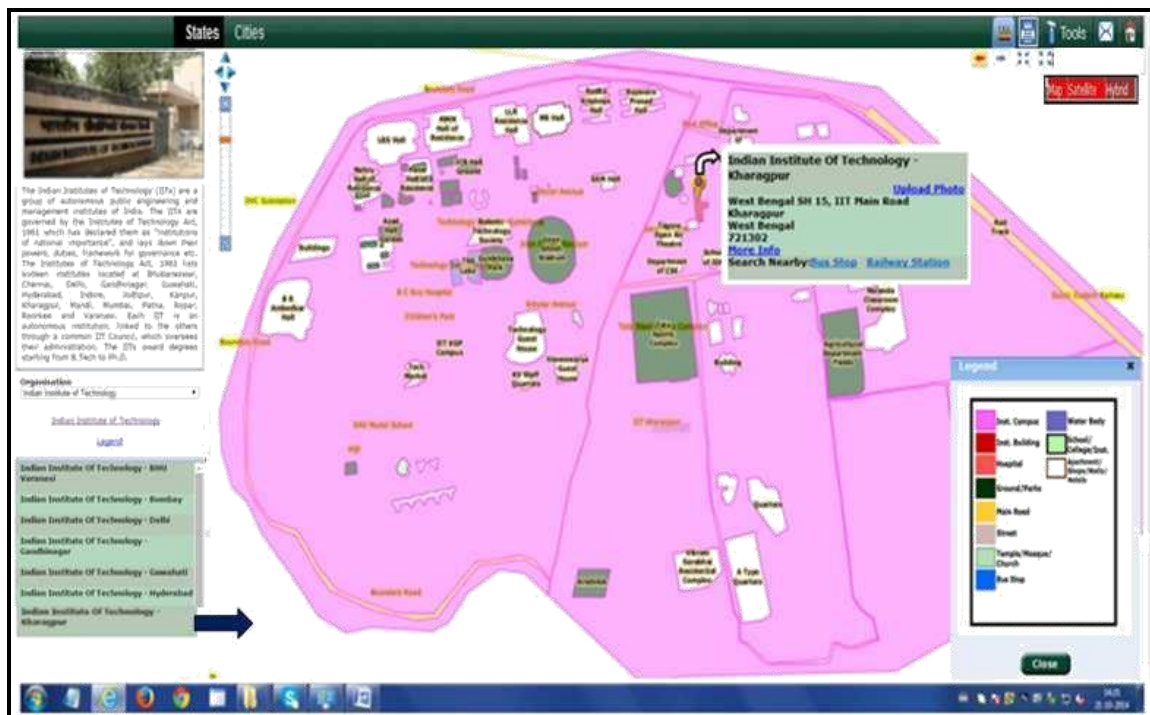

Figure 2: Viewer Showing Area Extent of the Institution along with the Legend

4. Conclusion

The adopted approach and its implementation using FOSSGIS: Geoserver and MapServer, FOSS Web server: Apache, FOSS Web development software: PHP and Database: PostgreSQL provides data sharing and mapping services. It shares the information and geospatial datasets allowing users with limited GIS knowledge to access the information customized for specific applications that reduces operation costs management. The GIS and various web technologies can be efficiently combined as a mechanism to share spatial information freely, openly and easily.

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