

Web-Based solution for Mapping Application using Open-Source Software Server

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ABSTRACT

Web GIS is an advance technology to manage and display all geographical locations on the earth surface. This paper deals with road analysis, to find the shortest path of route etc. so that these types of information can be displayed using Geographical Information System (GIS) technique. The approach combines both spatial and non-spatial data. This paper highlight, the suitability to handle spatial and non-spatial attributes of road features and to display and publish in web based GIS platform. This also commences the suitable software server. This paper deals with Web mapping application using different free tools and Open Source Software server (FOSS) and provides the free server solutions. Open-source software has the advantages of low cost, high stability and security, so it is preferred by the small and medium-sized Web GIS project. In this paper Web based Web-GIS architecture is described and implemented using open source Web-GIS tools like GeoServer, PostGIS and OpenLayers. An area of Bhopal City, M.P. Nagar has been chosen and road network was created in Q-GIS and published in WebGIS Server solutions. This has been used for centralized visualization of geospatial data present in various spatial databases located in different locations. This may have help to developing countries which cannot afford to use such solution. Hence there was a necessity of an open source Web-GIS application that should be both powerful for visualizing and cost effective.

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1. INTRODUCTION

Open source may be viewed by many as a revolutionary phenomenon that is capable of providing the software industry with an alternative and competitive way of doing business (Daoxun Xia, et.al 2010) [1]. Development of the web and expansion of the Internet facility provide two key capabilities that can greatly help to geoscientists. First, the web allows visual interaction with data by setting up a Web Server through which clients can produce maps, proper way of arranging the map and charts, publishing the non-spatial Attribute (data) on the Internet, so that other clients can view these updates and can help them to speed up the evaluation process. Second, because of the near universal nature of the Internet, the geospatial data can widely be accessible (Helali. H, et.al 2002)[2]. Basically GIS is used to provide user with spatial information. In the paper, road information has been used to show the web application. In the case of the traditional GIS, these types of information are within the system or group of system. Hence this disadvantage of traditional GIS led to develop a solution of integrating GIS and Internet, which is called Web-GIS.

The implementation of Open Source WEBGIS application in developing countries like ours will help the country to utilize the money exclusively towards developing skills and local capacity, instead of paying license fees that tie customers to a single vendor. The application provides access to mapping engine functionality, basic GIS capabilities, data storage solutions such as spatial database and additional tools enhance the GIS capabilities of the mapping engine. Web GIS application frameworks are either complete client-server solutions such as GeoServer and Map bender or Web GIS clients such as Open Layers and Ka-Map. Hence many Commercial vendors have developed their own version of WEBGIS application for example ESRI's ARCIMS etc. are expensive and require vast knowledge to implement them.

2. STUDY AREA

The study area belongs to one of the urban patch situated centrally of Bhopal City of Madhya Pradesh. It lies within Latitude: 23° 07 to 23° 54 N, Longitude: 77° 12 to 77° 40 E covering an area of 3183988.25 square meters and the municipality covers 286 square kilometers. In this paper the sample data of Maharana Pratap Nagar (M.P.Nagar) of Bhopal District, Madhya Pradesh, India has been used in the WebGIS based solution. The Road information has been used to show the web application. In addition, some attribute layers have been added to provide geoservices through the Web, such as Web Map Services (WMS) and Web Feature Services (WFS). As shown in Fig.1.

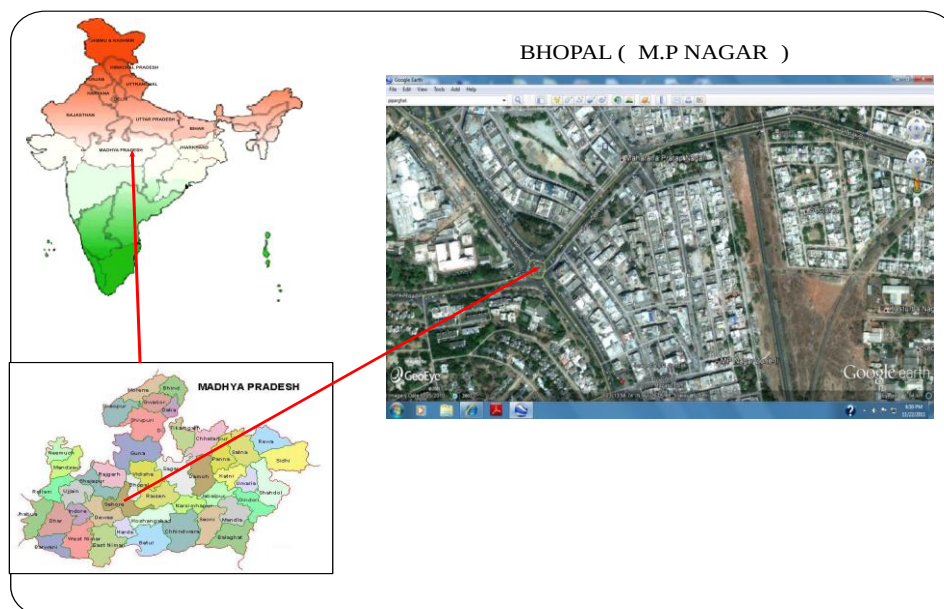


Fig.1 –Study Area of Road Information

3. METHODOLOGY

In this paper Fig.2 shows the overall methodology adopted for creating the system architecture for the WEB-GIS is shown in Fig. 2. The Generated layers of road information in M.P Nagar Bhopal, India with the help of QGIS (Quantum GIS1.7.0) is shown in Fig.3 [3] and loading the Shapefile to PostGIS is shown in Fig.4.

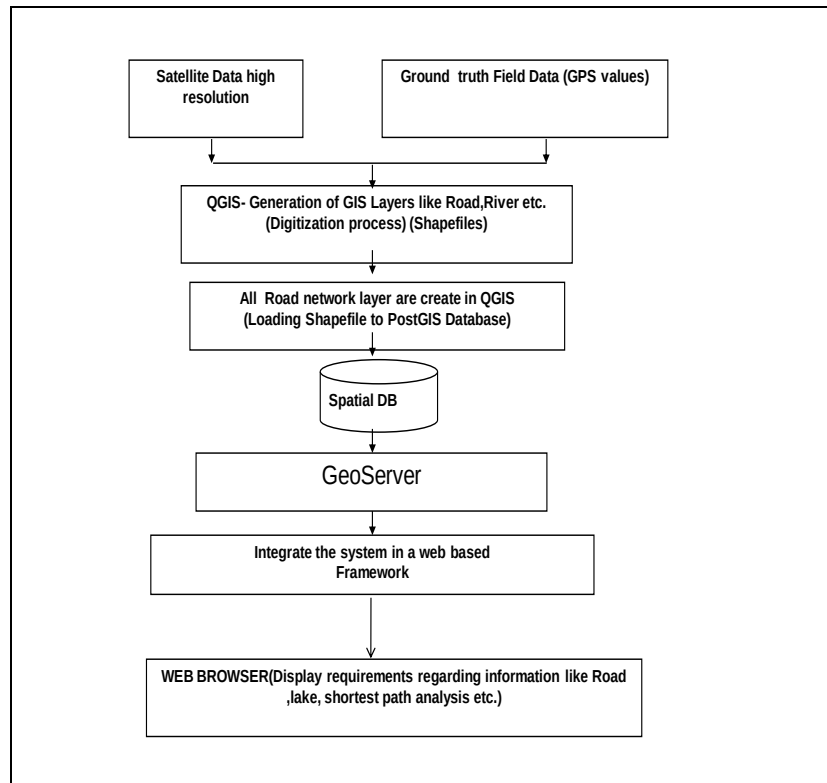


Fig.2- Methodology

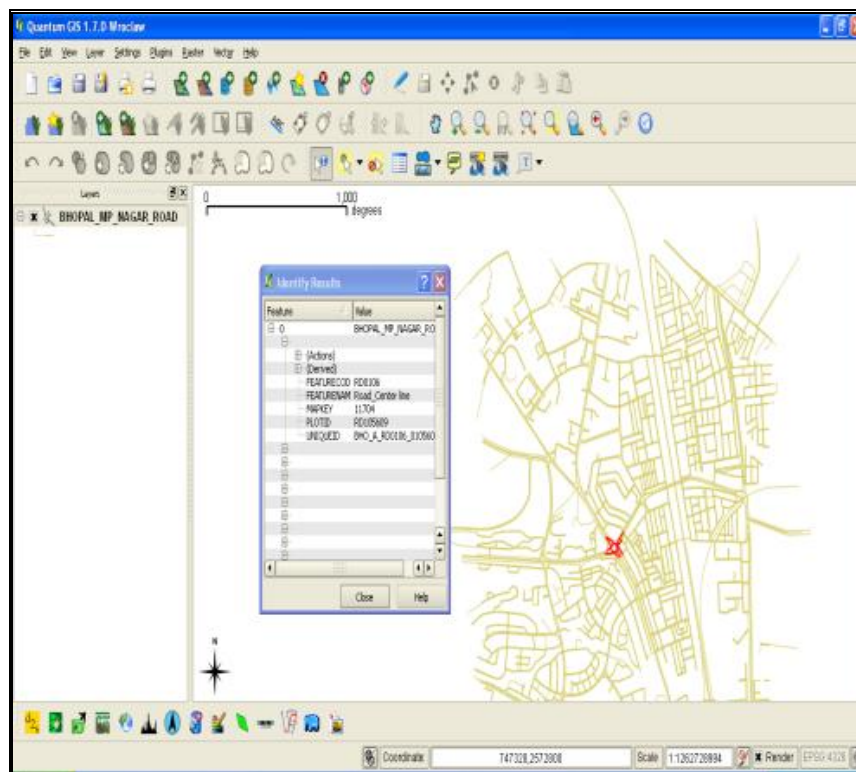


Fig.3 -Create the vector data shape file through QGIS

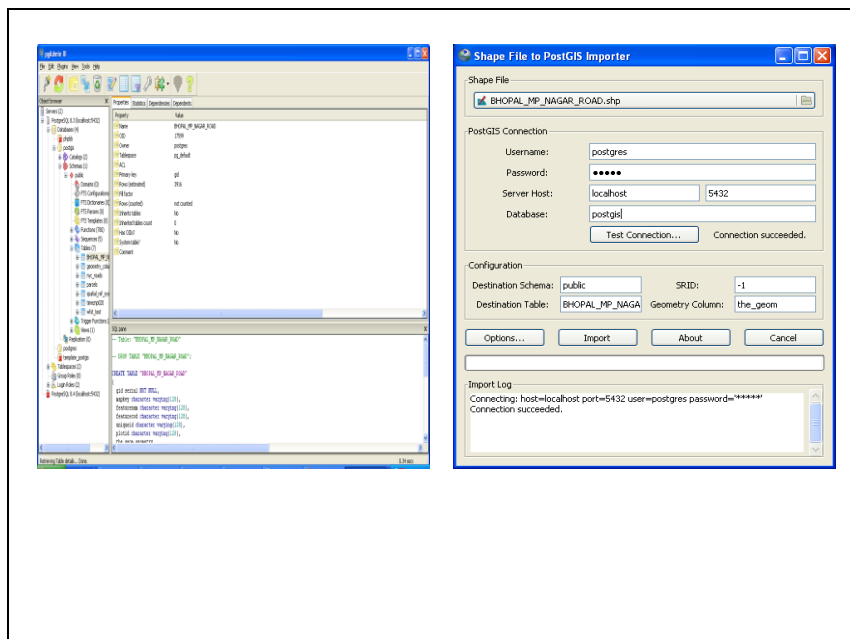


Fig.4- Loading the Shapefile to PostGIS

4. FREE OPEN-SOURCE SOFTWARE AND FREE WEB -GIS SERVER

Open source is a development method for software that harnesses the power of distributed peer review and transparency of process. The open source software has better quality, higher reliability, more flexibility, lower cost, and an end to predatory vendor lock-in. The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well publicized means of obtaining the source code for no more than a reasonable reproduction cost preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Open Source Software (OSS) is developed by an on-going, iterative process where people share the ideas expressed in the source-code. This gives an overview on building web GIS solutions using free open source software geospatial components. A selection of the most advanced and popular open source components and their roles and functionality in an application framework are described. A complete task for building web GIS solutions may include a client-server application framework, a popular client-side server to developed a web –based web GIS mapping application using a GeoServer that are free open source software. GeoServer is the reference implementation of the Open Geospatial Consortium (OGC) Web Feature Service (WFS) and Web Coverage Service (WCS) standards, as well as a high performance certified compliant Web Map Service (WMS). GeoServer forms a core component of the Geospatial Web.

5. RESULT AND DISCUSSION

5.1. NECESSARY COMPONENT USED IN PUBLISHING THE ROAD INFORMATION WEB BASED WEB -GIS SERVER

There are so many Web-GIS Servers available to develop a Web-Based Web GIS application. These are free available in internet to download and to develop own mapping application. These server have low cost, better performance, easy to fetch data base by user, low project cost etc. Among the different FOS server software we have decided to focus on GeoServer and MapServer, since these are the most common geographic servers used and supported by a large developer's community. Important part of Web GIS Server combined with GeoServer, PostGIS, NetBeans and Apache Tomcat have the capabilities to publish map in GeoServer, to create spatial database in PostGIS, programming tool in NetBeans and deployment of web pages in Apache Tomcat. All these components have been used to develop web based GIS server solution and described below.

A. GeoServer

GeoServer is an open source software server written in Java that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards [4]. Being a community-driven project, GeoServer is developed, tested, and supported by a diverse group of individuals and organizations from around the world.

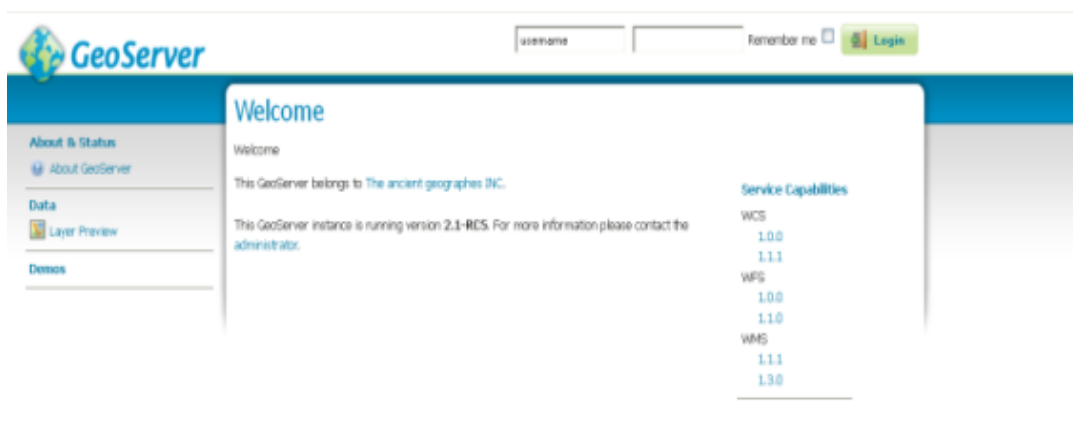


Fig.5-GeoServer

GeoServer allows for great flexibility in map creation and data sharing. GeoServer allows you to display your spatial information to the world. Implementing the Web Map Service (WMS) standard, GeoServer can create maps in a variety of output formats. Open Layers, a free mapping library, is integrated into GeoServer, making map generation quick and easy. GeoServer is built on Geotools, an open source Java GIS toolkit. GeoServer also conforms to the Web Feature Service (WFS) standard, WFS-T which permits the actual sharing and editing of the data that is used to generate the maps. Others can incorporate your data into their websites and applications, freeing your data and permitting greater transparency. As shown in Fig. 5.

B. PostGIS

PostGIS has been developed by Refractions Research as a project in open source spatial database technology. PostGIS is released under the GNU General Public License [5]. To prepare all the layers with the non-spatial attribute and to create spatial data base, the PostgreSQL/PostGIS data base that are open source has been used. The spatial extensions are conformant with the "Simple Features Specification for SQL" published by the Open GIS Consortium. To load shape files in PostGIS database, the Loader utility has been used from PostGIS. Then all process is completed to connect the GeoServer that are worked as a Web-GIS Server to hold the raster and vector format data and display the map.

C. NetBeans

NetBeans is a platform that has been designed from the ground up for building integrated web and application development tooling. NetBeans provides a common user interface (UI) model for working with tools [6]. It is designed to run on multiple operating systems while providing robust integration with each underlying OS. Plug-ins can program to the Eclipse portable APIs and run unchanged on any of the supported operating systems. At the core of NetBeans is architecture for dynamic discovery, loading, and running of plug-ins. The platform handles the logistics of finding and running the right code. The platform UI provides a standard user navigation model. Each plug-in can then focus on doing a small number of tasks well. As shown in Fig. 6.

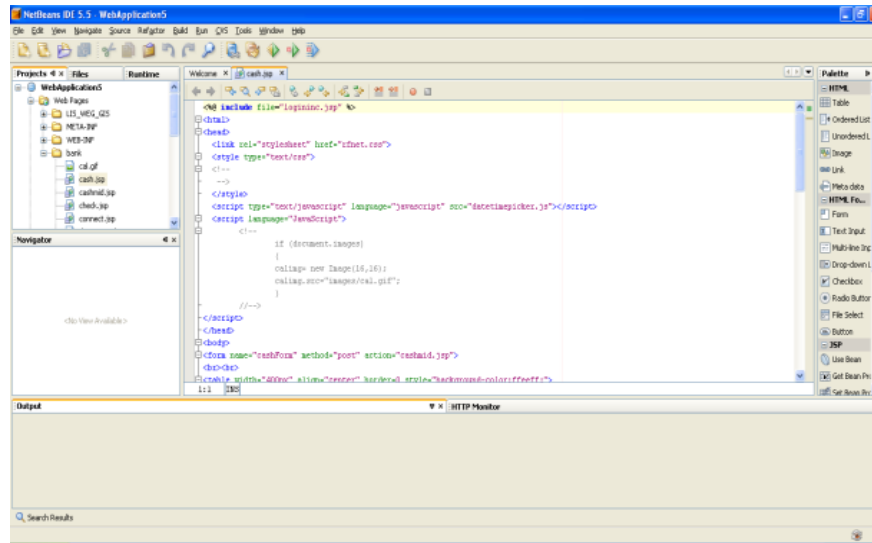


Fig.6-NetBean

5.2. THREE-TIER CONCEPTUAL ARCHITECTURE FOR WEB –BASED WEB-GIS SERVER SOLUTIONS USING OPEN-SOURCE SOFTWARE

The conceptual architecture presents the single mapping server and distributed spatial databases paradigm as shown in Fig.7. The web based Web-GIS architecture consist of three basic components: client side, server side, and data side.

Client Side

It is the terminal that allows the interaction of users with the Web-GIS and provides spatial and non-spatial information display. Internet browsing software's (like IE/Mozilla) and other GIS application software's provides the service requesting and result visualization platform to the users in client side.

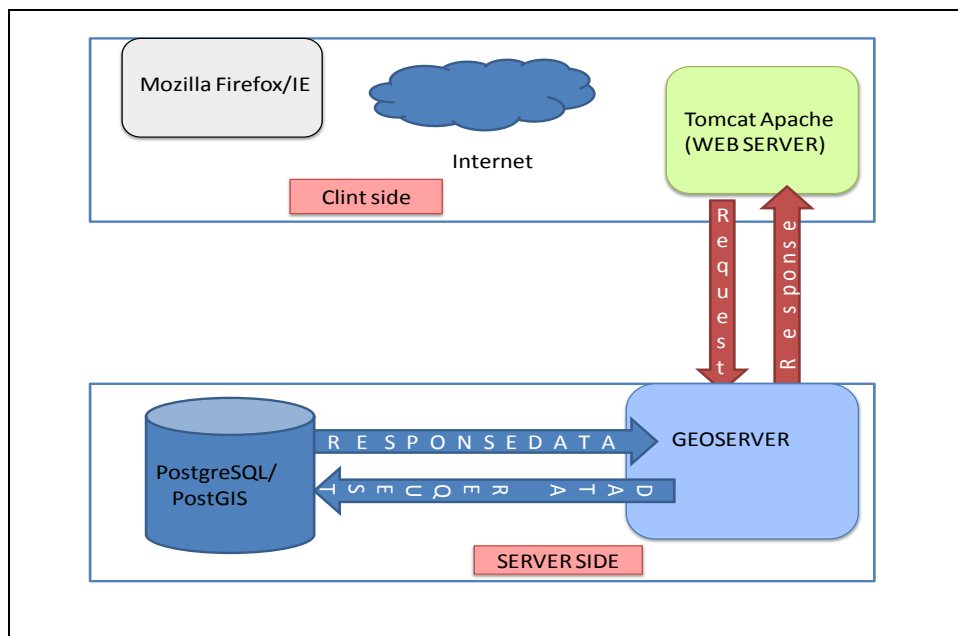


Fig.7-The system architecture of the WEB-GIS

Server Side

It includes Web servers and Mapping servers. 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 the Mapping server [7]. Mapping server completes spatial operations according to client web service requests and returns the relevant results through Web server. A web service is a non-proprietary standard for function calls across the internet. The service accepts requests from clients usually using HTTP and standard messaging streams (raw get, posts, XML etc.) and returns the processed output. And display the mapping application can be used in web-GIS server.

Data Side

Data base is a software package with computer programs that control the creation, maintenance, and use of a database. Dedicated to the organization and management of spatial and attribute data. The data is either present in a centralized or distributed in various geospatial databases. In case of distributed spatial database the geospatial data contained by databases are referenced to the same geographic location. It manages and stores in spatial or non-spatial attribute information of each layer in PostGIS/PostgreSQL Data base. And gives the relationship between the one and more attribute data layer. Some following steps are given client to server side request to return of response result in web based WEB-GIS application.

1. Apache tomcat transfers the parameters request comes from the browser (IE, Mozilla).and Common Gateway Interface (CGI) established the connection between the Internet and Geo Server.
2. GeoServer receives the request parameters. And read the mapfile path by specified parameter (.Xml Configure file), Then it find the database name and table name which consist of spatial and non-spatial database information are stored in PostGIS and PostgreSQL.
3. The PostGIS receives what request are comes from GeoServer. Then PostGIS first verify the Geometric Column from validation and the filters the user's request whether it is correct or not. Then it searches in database table. It sends database and data retrieval requests issued to PostgreSQL.
4. PostgreSQL receives PostGIS data requested information (road information database), according to request data from the database, Then postgresql retrieves and returns information to PostGIS. The PostGIS transmits the information to the Geo Server for post-processing.
5. GeoServer receives relevant information and this information is transferred to Web-Server (Apache tomcat) and displays the results at client side as shown in Fig.7. To display configuration and related information, graphics, production and embedded in the work of spatial information. The dynamically generated graphics embedded in the template gives enough options for the client to use html file. Upon completion the results are returned to Apache as a response to the client.

Web Server manages the client browser, data transmission of Geo Server between, through the TCP / IP protocol. Apache is the world's number one Web server to use. Apache Group is a fully operated through the Internet non-profit organization, which it has to determine the server's standard Apache Web release what should be included. There is no doubt that Apache is a good choice. Geo Server uses several well known open-source software to complete the data format conversion, map projection conversion, spatial database, a large amount of data processing, while it focused on mapping, map graphics formats, interface, the environment, is compatible with Open Geospatial Consortium (OGC) interoperability specifications, etc. As shown in fig 8 the complete Road Information Bhopal (M.P NAGAR) City in web based Web -GIS Server solution.

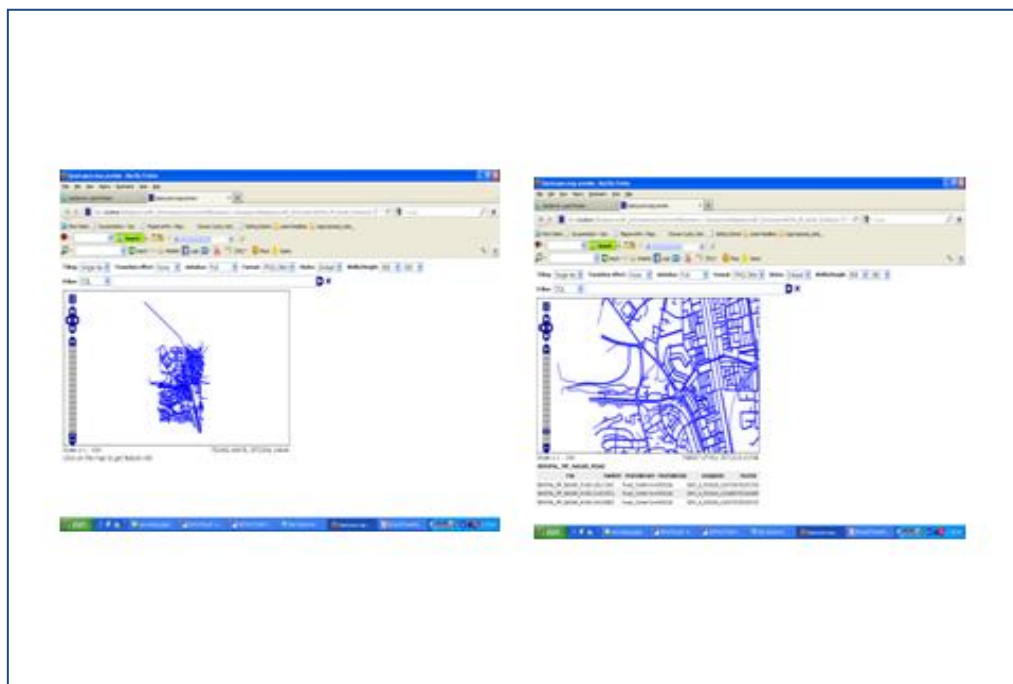


Fig. 8 –Road Information Bhopal (M.P NAGAR) City in web based Web -GIS Server solution

6. CONCLUSION

At present, nowadays open-source Web GIS has a large number of characteristics such as powerful, technologically advanced, and open source code. The open source GeoServer software platform is full featured. Following the OpenGIS specification standards and supporting a variety of map data storage format, it provides a low cost solution for web publishing of geographic information. It can totally replace the commercialized GIS platform software in the small and medium projects with requirements for the relatively simple function. This paper has given the information which WebServer is suitable for development of Web-GIS mapping application that are available Free open source server. This has given the road information data storage integration pattern according to the characteristics of geographic data, and it also studies practically the process and methods of comprehensively using GeoServer, PostgreSQL, PostGIS and OpenLayers and other open source software to publish geographic information, verifying the technical feasibility of the using of open source software to publish spatial geographical information. The visualization Expression of statistical analysis of GIS project is a very important function in geographical information system. The system developed with open source software is very suitable for organizations that have limited financial budget for spatial data sharing, especially in developing countries. Integrating OSS Web service based applications to build spatial information systems is a promising alternative to solutions based on open source server software products.

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