

A Web GIS Tool for Rural Development: A Case-Study

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Abstract— Rapid growth in population is increasing the pressure on people's representatives and local administrators in taking right decisions on providing various services to the population even at village level. The use of emerging technologies like GIS can increase the understanding capacity of authorities about the location characteristics of various resources and infrastructure facilities. As such, an attempt has been made in this paper, to demonstrate how the display & analytical capabilities of GIS in combination with free and open source software for geospatial (FOSS4G) tools can effectively be used for the development of a web based geographical information system that helps in retrieval of information about various facilities available at village level. The paper discusses the methodology in developing the web GIS and procedure for retrieval of information taking Rajanagaram Assembly Constituency in East Godavari district of Andhra Pradesh state in India as an example.

Index Terms— Apache Tomcat, Geoserver, GIS, Postgre SQL

I. INTRODUCTION

Rapid pace of development and rapid growth in population has impinged on practically every aspect of livelihood including the resources and services that are available to the common man. Thus the government administrators are in search for effective governance systems with major emphasis on efficiency, accessibility and transparency. The knowledge and understanding of the geography and location of various facilities available to the public plays an important role in making the right decisions by the respective government departments and/or people's representatives in providing various services to the public. In these situations Geographical Information System (GIS) can become a very valuable tool to provide such a Spatial Data Infrastructure (SDI). GIS technology provides a common platform for managing and visualizing diverse information (both spatial and non-spatial) and to carry spatial analysis and modeling. The new paradigm of software development, Open Source Software (commonly known as FOSS) brought to fore that it is possible to develop web based GIS tools to achieve these tasks. Web based GIS technology has an advantage of providing wider access, offering quicker decision-making capability for planners. Usage and capabilities of web GIS for administration has already been demonstrated earlier by Yaakup et. al. (2001), SN Prasad et. al. (2008) [3] and Subhasmita sahani et al. (2014) [2]. The present paper

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focuses on an another attempt of development of Web GIS in combination with FOSS4G tools for village administrators and people's representatives.

II. MATERIALS AND METHODOLOGY

2.1. Study Area

For the present study, Rajanagaram Assembly Constituency in Andhra Pradesh state of India is considered. Rajanagaram Assembly Constituency consists three administrative divisions namely Rajanagaram mandal, Sithanagaram mandal and Korukonda mandal of East Godavari district of Andhra Pradesh. The location of the Rajanagaram Constituency is shown in Fig 1.

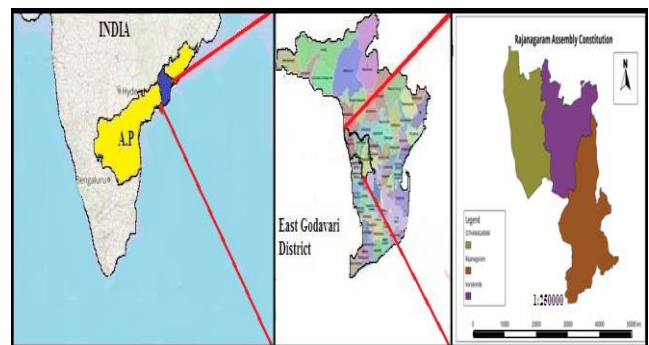


Fig. 1: Rajahmundry Assembly Constituency in East Godavari District of Andhra Pradesh.

2.2 Data, tools and methodology

The objective of the present work is to prepare a web based GIS for people's representative and government officials that enables to retrieve geospatial data efficiently. Three fundamental geospatial web services viz., Web Feature Services (WFS), Web Map Services (WMS) and Web Coverage Services (WCS) are used in the present work. Open Geospatial Consortium defined guidelines for these web services (Amirian, 2008) [1]. A developmental flow diagram as shown in the Fig. 2 explains the methodology used in the present work. Entire Web GIS application is developed with the help of HTML and JavaScript programming languages. Apache Tomcat, a web container, is used to maintain the application that is managed by Geoserver which is an Open source server written in Java. The Web GIS application is published by Apache2 (web server), and used open source Java script mapping library viz., Open layers. The data, tools and methodology used in the present work is explained in detail below.

(i)Data:

Geographic locations and attribute information of various point, line and polygon features viz., primary Schools, MPUP Schools, high Schools, hospitals, post offices, villages, fair price shops, roads, and water bodies existing in the study area are collected and with the help of GPS and used.

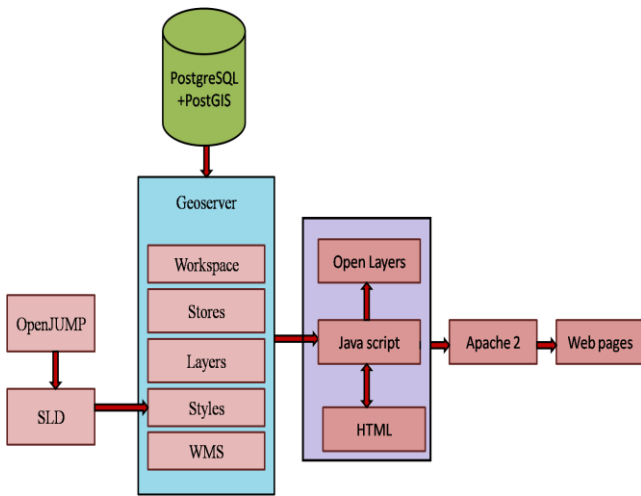


Fig. 2: Developmental flow diagram of the Web GIS interface

(ii) Tools and methodology:

(a)GIS Software: OpenJUMP and Quantum GIS software are used to prepare various shape files.

(b)Geoserver: GeoServer is an open source software server written in Java that allows users to share and edit geospatial data and designed for interoperability. It publishes data from any major spatial data source using open standards. GeoServer is the reference implementation of the OGC Web Feature Services (WFS), Web Coverage Services (WCS) standards, and Web Map Services (WMS). The OGC WFS is a protocol for serving geographic features across the Web. Feature information that is encoded and transported using WFS includes both feature geometry and feature attribute values. WMS is also a protocol for creating and displaying map images created from spatial data. Spatial layers/Shape files can be uploaded and published into the workspace and store provided by Geoserver, which can later be used in spatial data processing and analysis.

Creation of a workspace for spatial layers will always be the first step in the Geoserver. The workspace can be used as container to group similar layers together and the workspace name is an identifier describing the project. Each layer is referred by its workspace name i.e., in constituency: s_primary_schls, the constituency is the workspace name and the s_primary_schls is the name of the layer/shape file.

(c)PostGIS: PostGIS is spatial database, which is build on top of a standard database PostgreSQL. PostgreSQL provides transaction management, disk

storage routines, SQL processing and planning and other tasks of standard database. PostGIS provides spatial types, functions and indexes. It supports both geometry and geography types. It also adds spatial functions like area, distance, union, difference, buffer, touches, intersects, within, contains, overlaps etc. PostGIS is a free and open spatial database, which enabled GeoServer to connect a free database. To add the s_primary_schls shape file, a new store is to be created. The PostGIS store is a part of Geoserver that connects PostGIS database with the layers. A data store contains vector format spatial data. It can be a file (such as a shape file) or a database (such as PostGIS), or a table in database.

(d)Apache Tomcat: Apache Tomcat is an open source Web server and servlet container. It is widely used for the applications that are developed using Java Server Pages (JSP) and servlets. Before running the servlet, one need to start the Tomcat servlet engine. To start Tomcat, the JAVA_HOME environment variables are to be first set to the Java Development Kit (JDK) home directory. By default, Tomcat server runs on HTTP connector port 8080. The port 8080 can be changed to any other port number for our convenience. The Apache HTTP server 7.0.42 is used to run the Java Server Pages and servlets. In the present case Apache Tomcat is used to run the JSP and Servelets.

(e)Open Layers: Open Layers is an open source JavaScript library for displaying map data in web browsers. It provides an Application Programming Interface (API) for building rich web-based geographic applications similar to Google Maps and Bing Maps. Open Layers libraries are used for better visualization of web page. Open layer is used for client side 2D visualization by displaying spatial layers in the web page with Open Street Map and Bing Map for Spatial Web services. It is completely free, open source Java Script. It can also be used to display a dynamic map in any web page.

(f)Hyper Text Markup Language (HTML) and Java programming languages are used to write scripting for the development of Web GIS.

III. RESULTS AND DISCUSSIONS

3.1 Web GIS and its utility

The present web application is developed keeping in mind the requirements of various clients viz., people’s representatives and government officials. The basic focus is on visualization of the study area, query and creation of intermediate processing results with several basic functionalities like zoom in, zoom out, pan etc. The application potential of the web GIS is demonstrated in this section by taking one mandal viz., Sithanagaram mandal of the study area. The objective of the work viz., retrieval of geospatial data, query etc. can be achieved by the utilization different tags viz., anchor tags, link tags, selection of radio buttons etc. available on different web pages at different stages of application. The stepwise procedure for retrieval of information and query is explained

by a flow chart given in Fig.3. The home page of the current web application consists of three anchor tags viz., Rajanagaram Mandal, Korukonda Mandal and Sithanagaram Mandal as shown in Fig.4. Each one of these anchor tags will help the client to enter into the respective mandal's home page (Fig.5). The mandal home page again contains several anchor tags one for each village in the mandal and a link tag viz., Mandal Information to view comprehensively overall information about that mandal i.e., population, education (number of primary schools, MPUP schools and high schools), number of govt. hospitals etc. (Fig.6).

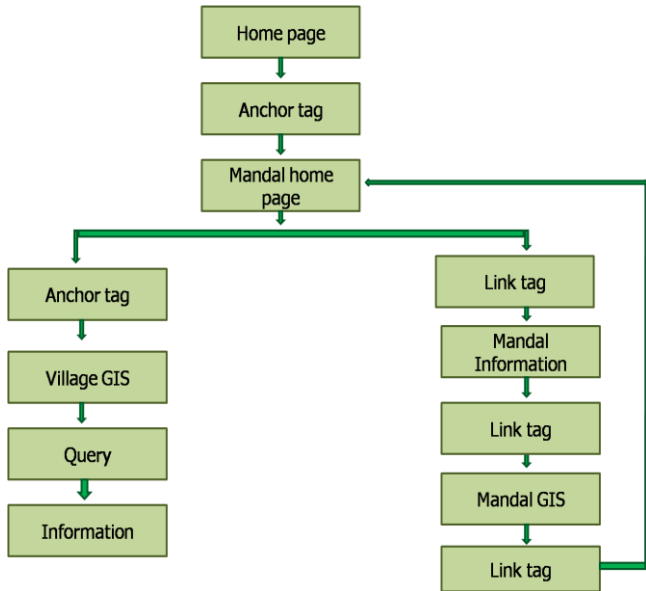


Fig .3: Procedural steps for retrieval of information using web application.

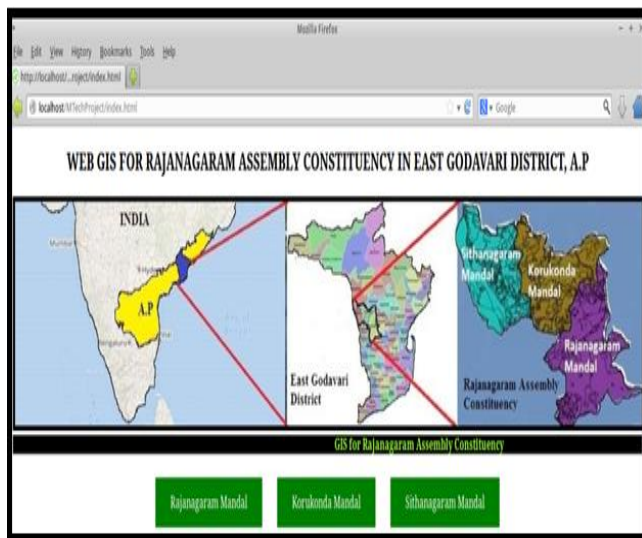


Fig. 4: Home page of the web application with three anchor tags.

The link tag “Mandal web GIS” on the mandal information page (Fig.6) leads to the respective mandal Web GIS interface (Fig.7), which enables the user to view comprehensively all the amenities present in the mandal. The web page displays the study area i.e., Mandal boundary either on an Open Street Map (OSM) or on a Bing Map based. The display of this base layer can be accomplished by the selection of the respective radio button provided under the layer system.



Fig. 5: Mandal home page with Anchor tags and link tag.

A provision is also given on the web page to display various amenities present in the mandal in the form of an overlay on the base layer with the help of check boxes given separately for each theme. Fig. 7 shows the display of various amenity layers like water bodies, village locations, roads, primary schools, high schools, hospitals etc. on OSM base layer as well as Bing satellite image. The link tag “Back to the Mandal Home page” on the mandal web GIS interface brings back the control to the previous page i.e., Mandal home page (Fig.5).

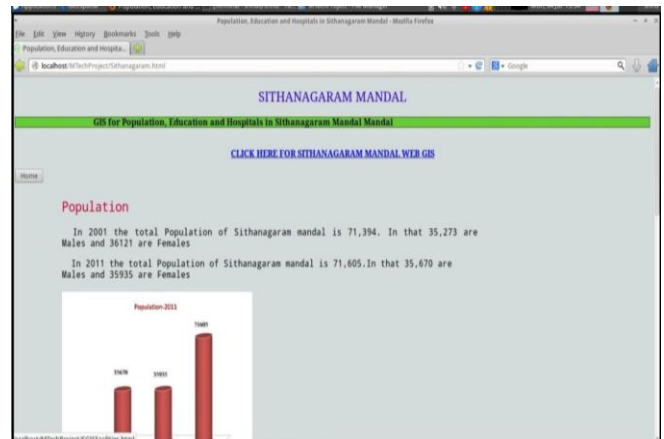


Fig. 6: Description about population, education and government hospitals of Sithanagaram mandal

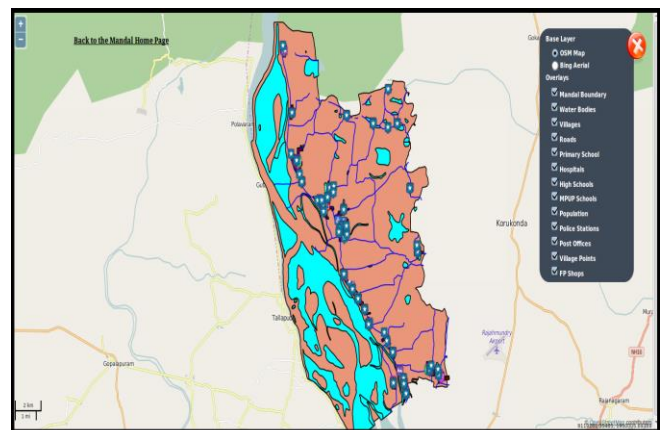


Fig. 7: Web GIS page for Sithanagaram mandal

The information (spatial and non-spatial) about various amenities at village level can be retrieved by running spatial queries on the village query page (Fig.8). Anchor tags provided on the mandal home page enables the user to enter onto the village query page wherein spatial queries for retrieval of information regarding various themes viz., education, post offices, health etc. can be run. This web page displays the amenities from villages within the selected radius (in meters) depends upon the value of interest. For example, the query “primary schools from Sithanagaram village within 1000 radius (in meters)” will result in the display of all primary schools existing within a distance of 1000 meters from Sithanagaram village as shown in the Fig.9. Similar, queries can be run on the village query page to retrieve and display the information regarding other facilities like high schools, MPUP schools, hospitals, post offices etc. available in the particular village.

IV. CONCLUSION

Use of emerging technologies like GIS in combination with FOSS4G tools enables development of user-friendly web based tools. An attempt is made in this paper to develop a user friendly web based GIS that facilitates geospatial information retrieval through queries. As the one developed in this paper is only a preliminary version. The application would be refined and integrated with more information for efficient developmental of rural areas.

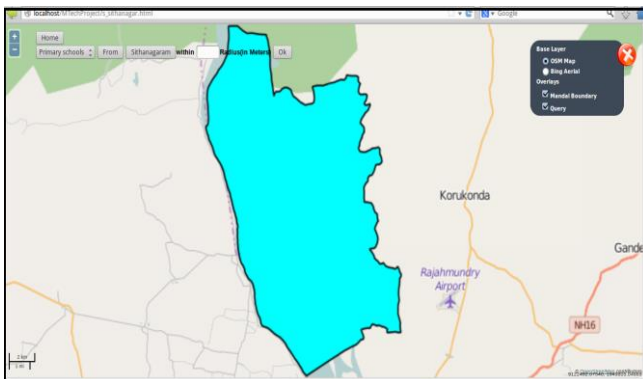


Fig. 8: The village query page.

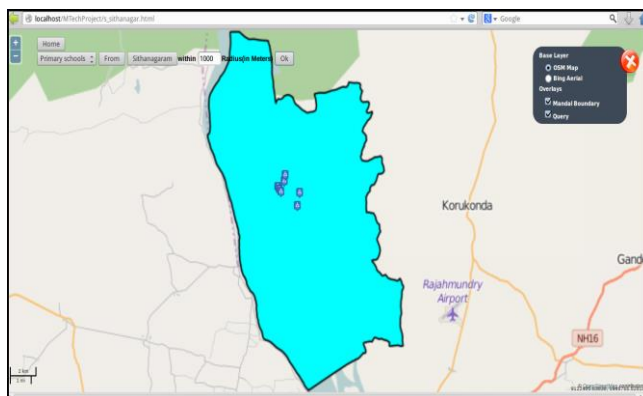


Fig. 9: The primary Schools from Sithanagaram Village within a distance of 1000 meters.

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