Development of Web-Based Geographic Information System (GIS) for Promoting Tourism in Sivasagar District

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ABSTRACT: Geographic information system is a computer based system used for capturing, storing, checking, manipulation, analysing and displaying data which are spatially referenced to the earth, in order to solve a complex management problem. Web based GIS or internet GIS became more useful tools for tourism industry, which presents a platform that brings products and services to the tourists. Instead of various tourist guides for the location the tourist might face some problem related to find a hotel, travel cost, mode of transportation, road connectivity etc. The study proposed to develop a web mapping application for Sivasagar Tourism a district of Assam, India using Geospatial technology. The data that published in Geoserver are import from Postgres Sql database to Apache tomcat server. This district is a famous destination for tourists as well as others visitors because of its historical footprints and its exotic locations. This study considers web-based GIS application towards promoting tourism and providing a smarter way to the visitors to access spatial orientation of the town. The web map application will be published for future use with a website on the internet .Web page is design using JavaScript, HTML, Cascade style sheet with the open layers as base map for overlaying the layers.

KEYWORDS: Internet–based geographic information system (GIS), Geospatial technology, Tourism, Web portal, Web page.

1 INTRODUCTION

Now a day's tourism industry is seen as one of the emerging industry in the world. Tourism is regarded as one of the largest economic resources to a country's revenue generation. According to the World Tourism Organization, tourists are people who travel to and stay in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited (WTO, 2001) [14].Tourism department of almost all city or state always have tried to promote the tourism facilities for their own region using several methods. Some of them have their own websites, advertisement, travel guides etc. Geographic Information Systems (GIS) became very popular among the new generation which is used as an efficient tools that provide a smart solution for tourism development. GIS is generally defined as a computer-based tool for mapping and analysing information. GIS is the technology that have improved the information system, understanding capability and data display over the last 20 years as stated by Godchild . Various intensive information that required for the tourism business, tourism information and specially the decision making , monitoring and evaluation etc. can be managed by GIS .GIS can provide a unified tourism information network e.g., it includes maps which provides information about geographic coordinates, infrastructure, tourist attractions, roads networks other facilities related to hotels, hospitals, bank, police station etc. In this study a tourism database have been prepared by using web based GIS for the Sivasagar district. Web GIS is simply the combination of the internet and GIS. Data visualization, query, collecting and editing of geospatial information, analysis are the functions of web GIS. Web GIS have the advantages of Global accessibility, Better cross-platform capability, Diverse applications etc. A complete tourism database have been prepared for the study area contains the hotels, hospitals, police stations, bank, ATM, transport services, places, tourist location etc. along with the roads and rivers using ArcGIS software. A complex GIs tourism database is prepared as there is no any GIs database found for the area. The database is load to the Postgis and connect with

the Geoserver. Geoserver data layers are visualized using Apache tomcat server. The web page is designed by using the html, css, java script and the open layers library is used for the styling the layers. Thus a simple GIs web portal is developed for the study area to promote the tourism facility that   can help the tourists more effectively as per their convenience. They can easily find out the tourist location along with the other facilities from the web portal.
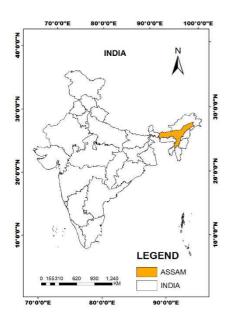
2   OBJECTIVE OF THE STUDY

The present study is aimed to be carried out with the following objectives:

1.   To prepare a   tourism database for Sivasagar district.
2.   Publish all the created spatial and non-spatial data in web platform.
3.   To develop a dynamic web portal that is enabled to solve people's (tourist and concern department) complex quires for the study area.
4.   Promote tourism.

3   STUDY AREA

Sivasagar is a town of Assam state, situated 369 km. away from the Guwahati city. It lies between 94.25 E to 95.25 E and 26.45 N to 27.15 N covering an area of about   2668 square km. It holds a historical significance because of the presence of a large number of historical ruins, most of   which belong to the medieval kingdom of Ahom. The city, because of its high altitude, enjoys a Pleasant climate through the year. The maximum temperature here is around 30° Celsius, while the minimum can dip below 10° Celsius during the winter months. The town is well connected to other parts of India via rail as well as road. There are regular buses available from Sibsagar to the nearby places.
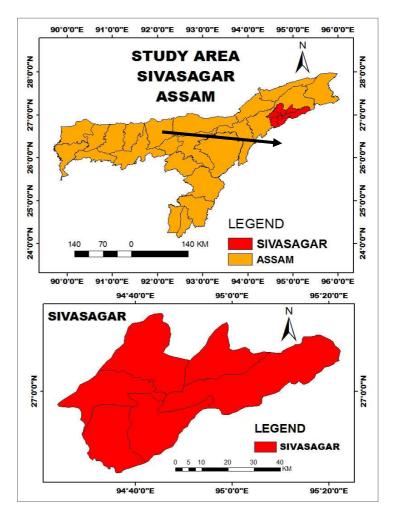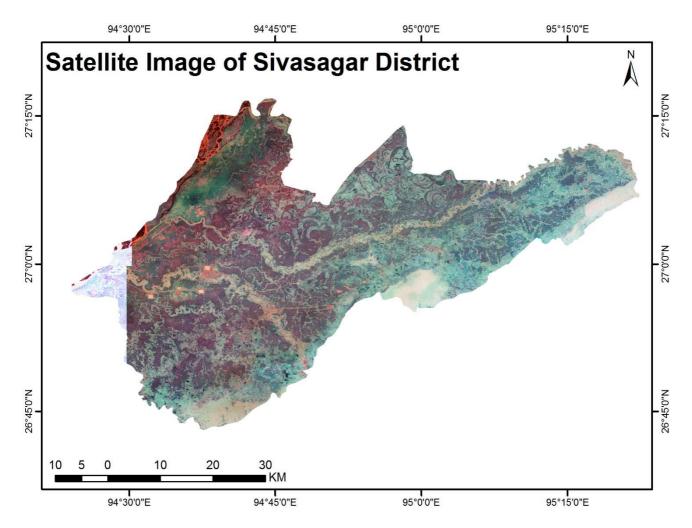

Fig: 1 location map of the study area

Fig: 2 Satellite image   of study area

3.1   TOURIST ATTRACTION OF THE STUDY AREA

The historic town of Sibsagar allures a lot of travellers every year, both for leisure and sightseeing purposes. Rising around the huge 129-acre artificial tank, are the archaeological remains, palaces and temples of the Ahom Dynasty, now preserved as national protected sites.

A number of old Satras of the Vaishnavite culture, Buddhist and Sakta shrines and also Muslim Dargah are found around Sibsagar. Moreover, about 500 tanks, vaults, palaces and forts belonging to the Ahom's, Manipur's, Jaintia Shan and Kachari kings are found in and around the town.

4   DATA BASE & METHODOLOGY

Table: 1 Data used

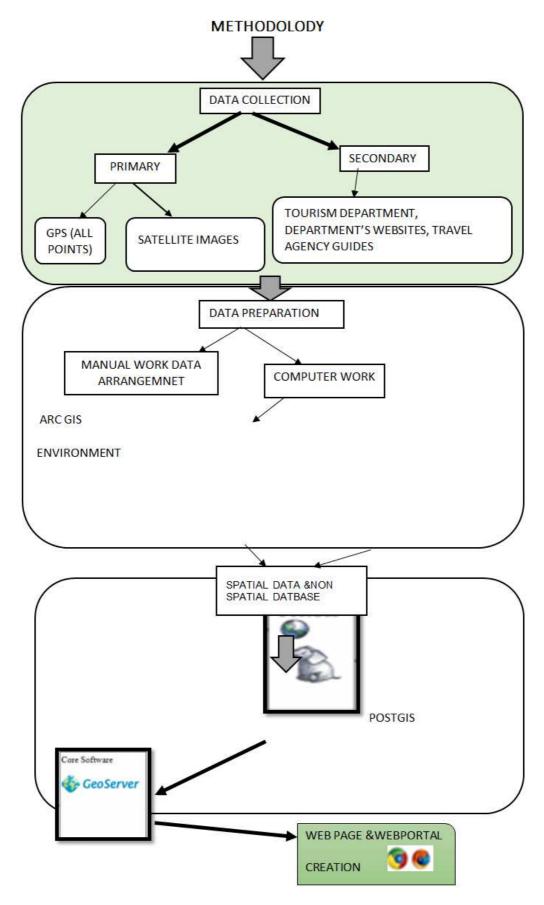| Data used		Description of the data	Source
Spatial data	Shape files	Study area boundary, Rivers	www.diva-gis.org, 2014
		Revenue circle	http.//www.censusindia.gov.in,2011
		Roads, hotels, petrol Pump. Hospitals, police stations, Tourist location, places, atm, bank	GPS, Google earth kml layers
	Satellite data	RESOURCESAT-1 LISS III FCC Used for Georeferencing the Revenue circle	www.bhuvan.com
		Date of Passing 25th March 2012	
Non-spatial data		History and information about the study area, about the tourist location, data about hotels, hospitals etc.	Books, travel guides, newspaper, departmental websites, tourism department of Sivasagar.

METHODOLODY

FIG: 3 flow chart of methods

As shows in the fig: 3 after collecting the primary and secondary data from various sources, data are prepared on ArcGIS environment. The road network is digitized from google earth and other points file like petrol pump, places, hospitals, hotels bank ATM etc. are also collect from existing google earth point location, rivers for the study area were digitized from the satellite image. The location of tourist spots are collected by using GPS. The GPS points are imported into google earth. After saving the all data layers as kml file all kml file are exported to shape file using the global mapper. The shape file are add to the arc map and creating the thematic layers as well as add the attributes for the individual's layers. The all shape file that contains the attributes are load into Postgres database using Postgis shape file and dbf loader from QGIS environment and retrieving the Postgis database to the Geoserver in tomcat server. EPSG-4326 coordinate system is used for the layers as projection. The data layers are styled using sld. Document and published as Geoserver open layer. Geoserver wms layers are connect to the web page as overlaid   with the open street map as base layer.

5   LITERATURE REVIEW

The use of GIS in tourism studies has being minimal though GIS technology has been in tourism Related literature over the years (Gunn and Larsen, 1988) A. Garagon Dogru et.al (2004) designed a dynamic map browser interacting with the earthquake information for Turkey. The web mapping application gives information about earthquakes which provides facilities for perform spatial and attribute query by the users on the Internet. Using Map Objects build the GIS application and MOIMS was used as a gateway program. The drawn maps are displayed on the web browser as an Image.

Seker et al (2002) applied GIS for supporting the planning activities for tourism in Manavgat, located in southern coast of Turkey, and focused on the analysis, management, decision making using GIS techniques, and result was presented on the internet.

A Georeferenced Information System (GeoRIST) has been applied in developing the tourism facility of Agra, India for the travelling community at international and national level by Singh and Sharma et al. (2011) which integrates spatial database, statistical data with textual information for developing a data model that can provide actual and full information for analysis and planning.

An intregrated tourism information system was applied by Zografos et al (2002) on travel and tourism that provide real time information while being on move with a value added service (VAS) for the traveller.

Tyagi (2014) developed a Web based customized Tourism Information System (TIS) for Eastern U.P., built on GIS platform. The application provide an interactive dynamic mapping by showing the location of tourist destinations as well as location of restaurants, travel agents, hospitals, security, passport office, tourist office/information bureau etc. Open source Map Guide (Autodesk) was used for customizing and displaying the database on the web after prepared in Arc map. HTML was used for designing the web page the Eastern U.P. tourism web portal.

Hussain (2006) developed an interactive web based GIS application prototype for Hyderabad city to promote the city's tourist activities and provide the users with an innovative way to access the spatial content of the city. The study was done to develop a GIS enabled online interactive guide for the tourists and also for the residents of Hyderabad through a prototype website, created using Arc IMS User Interface Developer and HTML was used for web page design.

Thecla. I et.al (2014 designed and developed a GIS database for Anambra State of Nigeria to get economic benefits for tourism industry. GIS is provides information about the locations of facilities and resource that represents benefits to the tourism sector of any economy. The use of GIS technology could assist the Anambra State government as well as the Nigerian government with better planning of tourism infrastructure, location, production of better quality maps showing tourists sites.

 Jovanovic & Njegus (2008) has done a study related to the application of GIS and it's components of in tourism and applied the GIS to design and develop the tourism destinations in Zlatibor (Cajetina) and Zlatar areas of Serbia.

Mohan Lalit et. al prepared an interactive tourist maps for Chandigarh city using the web GIS techniques and presenting the results on the web to provide the required information on tourism/hospitality for the tourists. The study developed a prototype application for promoting the tourism for the city adding a suitable query tools for the prototype system.

A presentation was made by Aamir Ali on web and mobile GIS application development, including the web GIS function, mobile GIS function, Architecture, about the server side implementation for spatial database Postgis, oracle, web services – WMS WFC WCS and server side implementation for mapping on GIS server such as Geoserver, ARCIMS, Map server etc.

Marson et al. 2015 focuses on a GIS-based spatial decision support system (SDSS) application integrated with GIS functions and SDSS designs using user friendly graphic user interfaces (GUI) that can help the tourists to choose and plan their activities, according to their convenience for the Langkawi Island of Malaysia. Tourism Database, GIS Server, Web Client

and Desktop GIS application together consist the Tourism Decision Support System (TDSS) which are important for making a GIS based decision support system.

Kommana (2013) used the open source software mainly Geoserver to design a web map application and making it available on the internet that can be used by any institute or NGO.

The data published into Geoserver can be shared worldwide. The user can overlay the Geoserver WMS layers, by choose background e.g. Google Earth, Open Street Map, etc. and adding the zoom in and out, pan, navigation, switch layer, layer overview using different symbols and styles. To create the dynamic web page HTML, CSS and JQuery have been used in this project.

Kumar et al (2015) developing a web GIS based land information system for Bhopal city in open source environment. A web GIS prototype was created for geospatial information of Bhopal city that provides some functionality like pan, zoom, and basic query evaluation that added with the web mapping application. POSTGIS database and Open Layers libraries, Geoserver was used to set up and enhance the website functions. Using three tier architecture the system was designed which contains 3 layers Client layer , Application Layer and Database Layer .Web page design was done with HTML, AJAX and Java Script and Open Layers.

Agrawal et al. (2014) focuses on develop web GIs framework on WAMP and apache tomcat on open source environment. They have been used WAMP server, ALOV, Quantum GIS and MySQL for first frame GIS work, on the other hand for second Web GIS framework, Apache Tomcat server, Geo Server, Quantum GIS, PostgreSQL and Post GIS have been used.

The advantages of web GIS based information and develop a web mapping for tourism as identified above, using open source software's like Geoserver, Map server etc. informed the choice of this research which sought to design and develop a web GIS database for tourism using spatial and attribute data and HTML,CSS, JavaScript for web page design for Sivasagar as this has not been done for the district.

6 TECHNICAL WRITINGS

The study uses web GIS techniques to fulfil its objectives. Web GIS applications have been developed by using open source software's. To develop the web portal for the study area, Apache Tomcat server, Geoserver, Quantum GIS, PostgreSQL and Post GIS have been used. Some basic idea about the web GIs, open source software's and web server is given below:

6.1 WEBGIS

Web GIS is a distributed information system that should have at least a server and the client (a Web browser, a desktop application application). Geoserver, Map server, ARCIMS, Map Autodesk, Apache tomcat are some example of the web server where map data can be stored. In this study the focus is given on Geoserver. Recently the uses open source GIS software's are remarkably increasing with various application.
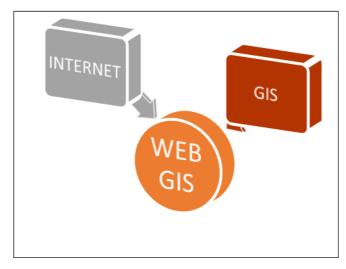

Fig: 4 Web GIs structure

6.2   QUANTUM GIS

QGIS   is a popular choice for desktop GIS. In 2002, a group of volunteers started Quantum GIS as an alternative to GRASS mainly for better graphical user interface and fast spatial data viewing for Linux based systems. Large range of vector and scalar formats like PostGIS, Shapefile, GRASS, WFS, WMS, PNG, JPG etc. are supported by this software. In this study the quantum GIs is used to connect the shape file into Postgis for proper importation of spatial database.
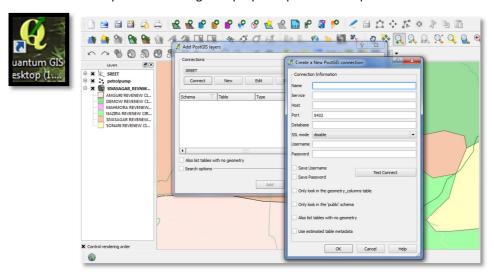

Fig: 5 Connection to Postgis from Qgis

6.3   APACHE TOMCAT

Apache Tomcat is an open source Web server and servlet container. It is widely used for by the applications that are developed using JSP and servlets. It is an open source project of Apache foundation (http://tomcat.apache.org) and it is well-documented, and relatively simple to configure, widely adopted by Geoserver developer community.
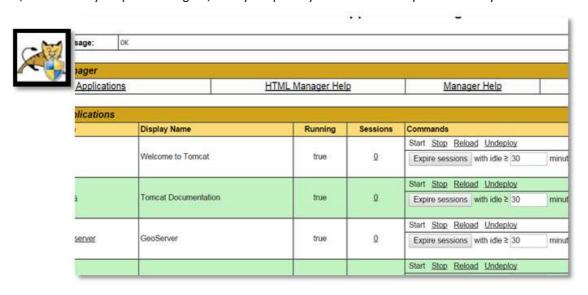

Fig: 6 Tomcat web interface showing Geoserver application manager

6.4   POSTGRESQL

This is the most popular and most capable of all open source relational databases with spatial capabilities, and its features are constantly increasing. It leverages on PostgreSQL, a well-known and powerful RDBMS challenging top commercial products such as Oracle. The current release for Post GIS is 2.0.1 and for PostgreSQL is 9.1.4.Postgis is a famous open source

spatial database that acts as a connector for a simple, small data set that can store in a text file. The below figure shows the complete database of study area that are loaded into Postgis database, i.e. used for this project.
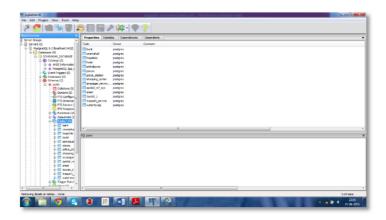

Fig: 7 Postgres Sql database

6.5   GEOSERVER

Geoserver is a Java based open source server which allowed map creating and data sharing.

The data that are stored into Geoserver can be displayed through the web to all over the world.

Geoserver is an open source web server which provides three types of web services:WFS, WCS, and WMS. Web Map Server (**WMS**) is an OGC standard to publish data as maps. The Get Map operation as defined by the Standard, lets a client request maps as images, for example, a png or jpeg file. Web Feature Server (**WFS**) provides raw vector data from Geoserver layers. This allows you to share your Geospatial data in a standard format. Output formats include GML2, GML3, Shape File, JSON, and CSV. As with   WMS, from this point on, you can access the general configuration for the services .Web Coverage Service (**WCS**) publishes raster-based layers. **Geo** Arc Grid are a couple of geospatial examples of coverages. It's almost like having both WMS and WFS in one service. It allows clients to get raster data along With geospatial data to make more analysis locally.
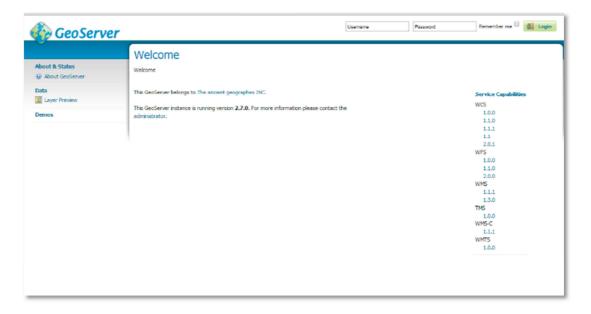

Fig: 8   Geoserver welcome page

6.6 WEB MAPPING

Presenting the Spatial data with its attributes as a map using GIS over the internet is known as Web Mapping. A simple web mapping, presenting the data on the internet by provide simple tools   like zoom bar, layers and panning over the map. Web mapping is divided into two maps, viz. static and interactive maps. Static maps are simply mapped pictures   presented on the web page and they have no user interaction. But interactive maps are advanced maps that allow users to interact with the data on the map. Map object on the web page communicate with the web server to display data on the map which are Stored on a web server. There are mainly three requirement to create a simple web mapping application viz. client side scripting (openLayers),Webservices+ Tiling/Caching Services and Database (PostGIS).

In this study Geoserver, Openlayers and Postgis running on Tomcat as the servlet is used to create a web map application to facilate the tourism database for the district.
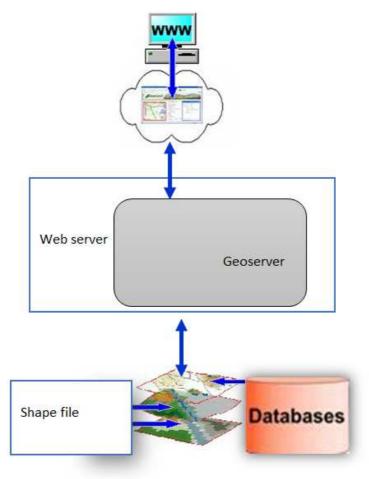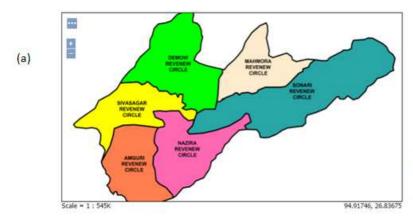

Fig: 9 Web mapping architecture

7 RESULTS

The present study aimed to build a rich tourism database using web GIS and develop a web portal to improve the better tourism facility with effective visualization techniques. A tourism data base with all its necessary information are made for the study area using web GIS techniques.

The below flow diagram shows the thematic layers that have been prepared for the purpose of the study.

(a)

The district with its six revenue circle:

1. Sivasagar revenue circle
2. Nazira revenue circle
3. Demow revenue circle
4. Sonari revenue circle
5. Mahmora revenue circle
6. Amguri revenue circle

(b)

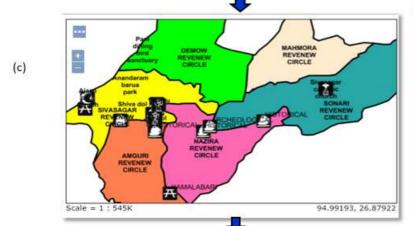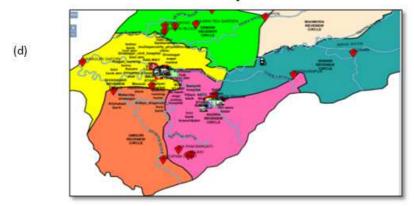| Roads	Length (Sq. m)	Number
National Highway	103969.45164	2 (37, 61)
Major Roads	295837.875697	14
Secondary Roads	76219.793585	10
Local Roads	429122.9939	69
Total	905150.114614	95

Table: 2 the road network of the area

(c)

The study area with popular Tourist location

(d)

The other layers includes places, police Station, hospitals, hotels, ATM

Fig: 10 thematic layers for tourism database

Table: 3 Hospital and hotels number

Layers	Number
Hospitals	7
Hotels	8

All total 7 numbers of hospitals and 8 numbers of best quality hotels are included into the GIS tourism database.

7.1   CLASSIFICATION OF TOURISM DATA

Below Fig:11 shows the classification of tourism of the study area. the tourist location can be classified into five broad categories, historical/archeological, cultural, picnic spots, wild life sanctuary and parks and religious. All names of the tourist location are showed on the basis of their category. All total 19 popular tourist location are found for the study area.
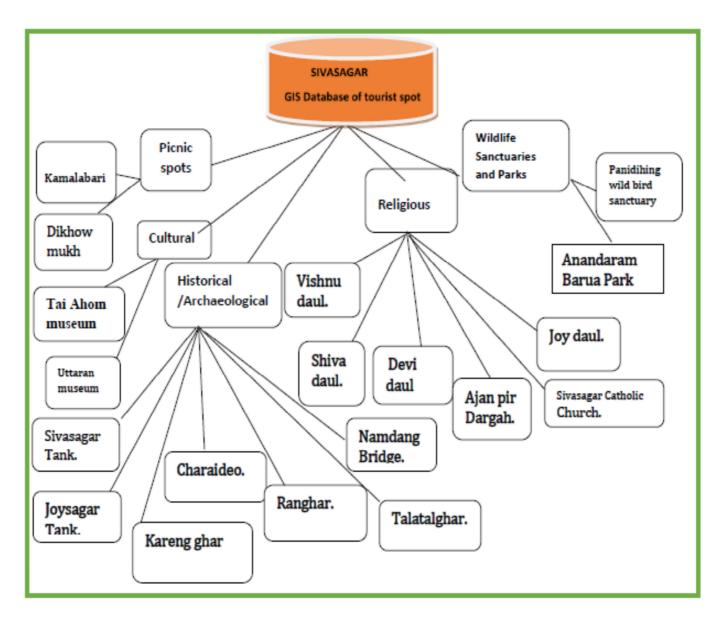

Fig: 11 Classification of tourism data

8   STRUCTURE OF WEB BASED DATA

Tourism database and dynamic interactive maps for the web portal for the present study were created on web GIS platform, using Geoserver as web server. Basic requirements for design a web page are:

1. Page construction (e.g. HTML)
2. Page styling (e.g. CSS)
3. Page interaction (e.g. JQuery)

8.1   HOME PAGE DESIGN

A simple home page is design for Sivasagar which shows the history of the area and with a link to the web GIS tourism portal. The page is design with basic HTML. Fig: 12 shows the home page of the web portal. With a heading *WELCOME TO SIVASAGAR,* the web page contains photos of some popular location of the district. CSS, HTML. JQuery have been used to build the interactive web page.   The Geoserver WMS layers are linked to the web portal with help of localhost i.e. 127.0.01:82/index.html, using apache as the servlet.
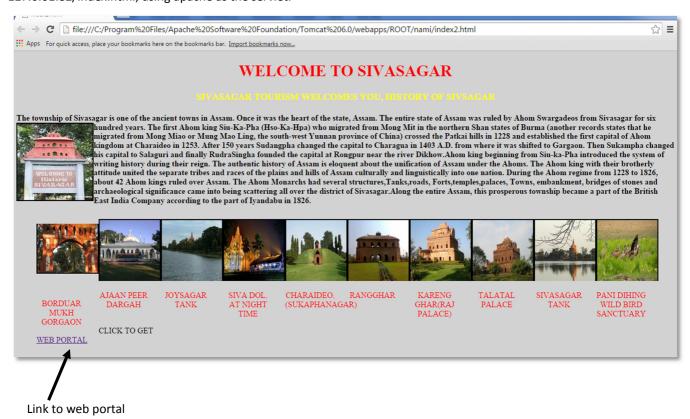

Fig: 12 Home page

The home page of the web portal is includes the history of the district with photos of some important tourists locations. In the left of bottom of the page a link is given to get the web portal. The home page have the on mouse stop and start facility for the photos of the tourist's location as by default they are moving.

9   DISCUSSION

A web portal is developed for Sivasagar which contain dynamic interactive mapping. The web portal contains:

- A base layer with satellite and map view which is linked from open street map.
- Display the map with multiple layers such as the study area, roads, rivers, places, tourist location, police station, petrol pump, bank hotels etc.
- Pan and zoom tool gives facility to handle zoom level and handling map.
- Layer Selection Panel gives facility to select and deselect the layer as per needs of the users.

- The all points layers can be visualize along with the labelling, while selecting a layers.
- The location information in terms of coordinate information serve by the web portal.
- The information tab gives the information about the tourist location and hotel information.
- The date and time facility also given into the web portal.
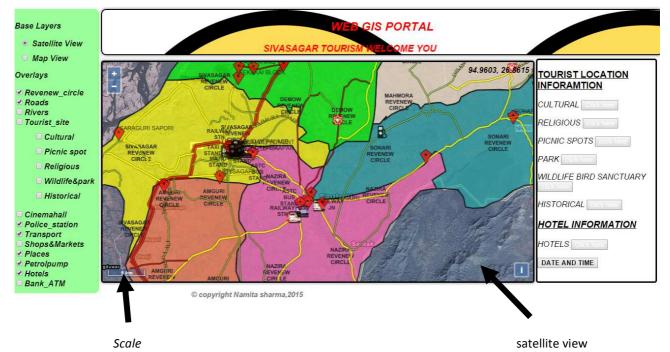- The scale bar presents in the map is in kilometers.

Scale   satellite view

Fig: 13 Web portal Layer

Zoom in &Zoom out   Latitude & Longitude

Layer selection panel   vector layer   Map view
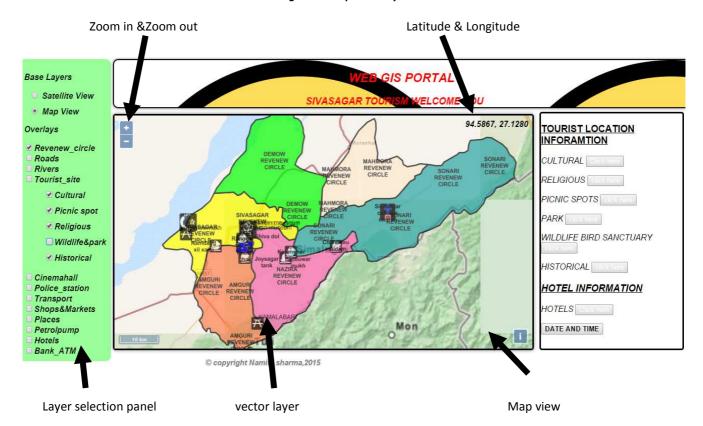
Fig: 14 Tourist layer

The above figure shows the tourist location on the basis of the classification. Tourists can select any of the layer and can get the information about the different tourist spots along with their name and geographic coordinates. This is much easier to get details information about the location by selecting the layers as it showed by the above map. The layers are displays with the name of that particular location. The information tab in the right side gives the information about the tourist location while clicking the click here tab. The information tab also include the information about hotels, date and time and coordinate information of the district. The tourist location are classified under six groups and contain the individual information in each tab. The hotel information tab provide the name of the hotels with its facility, contact number and places, where it is located.

Thus, while tourist wants to know about the tourist location and hotel information they can get both the location and textual information from the web portal.
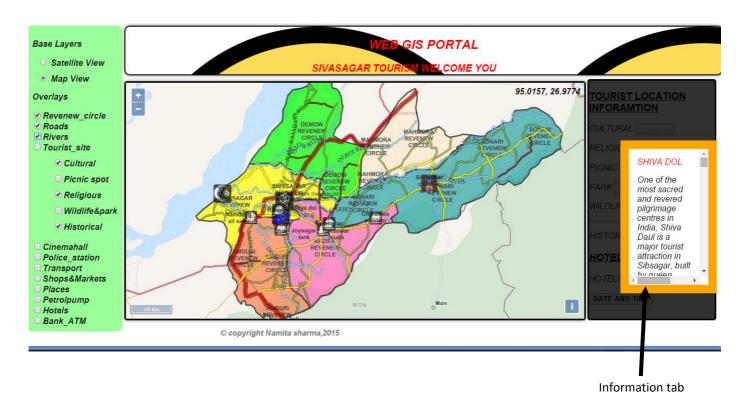

Information tab

Fig. 15 Web portal showing the information

In the above figure 15 shows the information related to historical tourist location. Likewise the tourist can select any of the tourist layers and at the mean time they can get the information about the spots using the information tab.

9.1 TOOLBARS

On left side of the map have the facilities to select and unselect the layer that can be overlaid. The zoom in and out tool present within the map provides the map handling capacity to the users.

10 CONCLUSION

The present study developed a web GIS portal for the Sivasagar district, with simple web mapping applications**.** Web based information system is very important to know the present status of tourism and to improve the tourism facility in future   for the study area. A GIS based tourism data are prepared for this present study using web GIS server. The tourism web portal offer a variety of functionalities like integration of vector files, zooming and panning facility for handling of the map, information tab which contains the information about tourists locations, hotels, date and time and coordinate information, with a layer selection panel having facility to select and deselect the layers, images with history of the study area. This interactive web application is prepared using Postgis, Geoserver, and open layers using tomcat as servlet container.

A classification on tourism data for the study area have been prepared for better understanding about the tourist location. For the vector layers WGS-84 /EPSG 4326   projection is used to publish into open layers. For designing the web pages the study used open layers library, jQuery, open layers Java Script, cascade style sheet, HTML .sld and .xml files are used along with their correspondence svg symbols to style the data layers.

To add the information for different tourist and hotels JAVASCRIPT VOID function is used in the information tab. Using the web GIS techniques a rich GIS tourism database is developed along with a web portal for the study area, which is facilitating an interactive mapping. With an aim to implement more tools to make it more functional and to publish the web portal along with its complete spatial and non- spatial database into a website over the internet for future use of the tourism department of the district the study comes to an end.

11   PROBLEM DURING THE PROJECT

During the study some problem has been faced with Postgis. The problem was related to Load the shape file to the Postgres Sql database. Some of the shape file gave the error message as shape importation failed while importing it from the data directory. Those wrong shape file were corrected using Quantum GIS and directly connected the data to the Postgis from the QGIS. The problem related to get information from the WMS layer is a major drawback of this study. Another problem was found while styling the different layers in Geoserver. To solve this problem the svg symbols are used from QGIS and two file such as .xml and .sld were prepared for each individual symbol to add it into Geoserver style. Finally, the complete work feels like very challenging task as it related to information technologies ,i.e. programming using HTML java, jQuery, css etc. which makes little difficulty to understand the function, coding and tools and working by using them.

12   FUTURE WORK

In this present project it is not possible to see the details of the data that are displayed on the map. Only the basic tools were used in this web portal. A website will be developed for this web portal that it can be access by the whole world and the user can get the all necessary information for their advantages. It will be much better if the user get information for the tourist spots by clicking the location for better idea about the location.

LIST OF ABBREVIATIONS

WTO- WORLD TRADE ORGANIZATION
GIS- GEOGRAPHIC INFORMATION SYSTEM
WMS- WEB MAPPING SERVICE
WFS-WEB FEATURE SERVER
WCS- WEB COVERAGE SERVICE
OSS- OPEN SOURCE SOFTWARE
EPSG- EUROPEAN PETROLEUM SURVEY GROUP
CSS- CASCADING STYLE SHEET
HTML- HYPER TEXT MARK UP LANGUAGE
OGC- OPEN GEOSPATIAL CONSORTIUM
JSON-JAVASCRIPT OBJECT NOTATION

CSV- COMMA SEPARETED VALUE
SLD – STYLED LAYERD DESCRIPTOR
XML- EXTENSIBLE MARK UP LANGUAGE
SVG–SCALABLE VECTOR GRAPHICS
WGS- WORLD GEODATIC SYSTEM

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