THE ROLE OF “WEB GIS” IN THE DEVELOPMENT OF TOURISM – IN THE CASE OF BAHIR DAR TOWN AND ITS SURROUNDINGS, AMHARA REGION, ETHIOPIA.

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ABSTRACT

An efficient promotion of tourism, not only allows significant gain of foreign currency but also it has an effect in building the image of a country. The tourism industry in Ethiopia is not gaining the expected foreign currency and also it is not promoting the real image of the country as expected. One of the major problems for the development of tourism in the country is promotion for attracting people. The main objective of this study is to develop a web based GIS utility that allows the tourists to have spatial and non spatial tourism information about Bahir Dar town anywhere in the internet. This study intends to develop a prototype based on a three tier architecture using client/server paradigm. Apache, Mapserver, PHP, and chameleon are the open source software that are used for developing the portal. Google API also used to enhance the query capability of the tourists directly from the Google satellite image. The developed web based GIS portal enables the tourists to get digital tourist map that contains information about the major tourist spots, hotels, health centers, and transport destinations of the town depending on their needs in easy and user interface way anywhere on the internet.

Key words: Tourism, Web GIS, Open source, Google API.

BACKGROUND OF THE STUDY

As to visitors flow and revenue generated from tourism UN-World Tourism Organization (UNWTO) published in 2013 shows that international tourism had grown to 1087 million in arrivals. Accordingly, when we compare the international performance of the industry in 2012with that of 2013, it shows that tourism grew at an regional levels is like that Asia Pacific is having 6% growth comparative previous years and Europe is 5%, south east Asia 10%Europe 11%, North Africa 6% respectively. In this North Africa was showing 6% it covers maximum Ethiopia, Kenya and Egypt etc.
In Ethiopia there are potential tourist attraction sites in different parts of the regional states. Bahir dar, the capital of Amhara regional state is rich in a variety of aspects to attract tourists. To promote tourism in Bahir dar, the city administration is taking several measures through different ways. However, there is still a need to organize high performance web system for tourist attraction sites and facilities to promote and fulfill interests of tourist.

Now a day’s web GIS is the first choice in promoting tourism in most of the countries. The ability of GIS to analyze and visualize spatial and non spatial data in the form of maps made it an essential tool for tourism. GIS is currently converging with several other technologies to provide new levels of accessibility and functionality (Drummond et al., 2008). As web technologies and the GIS advanced considerably and practiced widely (Tan, 2003) the web based GIS has become a popular means of information sharing and visualization.

Web GIS is a geographic information system distributed across a networked computer environment to integrate, disseminate, and communicate geographic information visually on the World Wide Web (Gillavry, 2000). Advancements in technology have changed the way tourists travel and plan their trips. Tourists need to find out the relevant distance from the airport to the hotel, the distance between different attractions and the accommodations, the exact position of tourist sites and other facilities easily. Geographic Information System (GIS) and satellite images have provided a new way of accessing location-based information. Web-based Geographic Information Systems facilitate the widespread use and dissemination of spatial information services and promote the technology to a much greater audience than it has ever been introduced before. The utility of the Internet allows information to be exchanged in a rapid and efficient manner, thereby helping tourists make important decisions quicker. The applications running on the Internet, known as the World Wide Web (WWW) give tourists countless powers for obtaining and disseminating the appropriate tourist information.

The release of Google maps in February 2005 caused a sensation in the web mapping industry. Google Maps presented a novel web-based mapping application which garnered the world’s attention with its high speed and high degree of interactive mapping capability, as well as features including high-resolution satellite images and an attractive map design. A search of existing literature shows very little research focusing on the usability of web GIS applications for tourism in Ethiopia. This thesis will examine the usability of web GIS application for tourism by using open source software. As a result, this thesis intends to contribute to the further technical development of the usability of web GIS application for tourism.

LOCATION OF THE STUDY AREA

Bahir dar is located in the North Western part of Ethiopia at a distance of 565 kilometers from the capital city of Addis Ababa, Ethiopia country. Astronomically, the study area is located at 11°29’ – 1 1°41’ N latitude and 37°16’ – 37°27’E longitude. The landscape is flat with some small hills to the east and west. The average elevation of the town is about 1795 msl. It covers an area of 16000 hectares. The foundation of Bahir dar dates back to the 14th century associated with the establishment of Kidane Mehret church near Lake Tana. The maximum and minimum temperature of the study areas is 29.50C and 7.10C, and the rainfall is 1437mm.
METHODOLOGY

Web GIS development cycle:
Developing a web GIS is more than simply using the appropriate hardware and software (Alesheikh & Helali, 2001). GIS based project development consists of components such as data development, data organization, and application development that are not similar and different from the standard software development processes (Mir, 2006). The web GIS development cycle is a step by step method from requirement analysis to the ongoing use and implementation of the expected portal. Figure 11 shows the web GIS development cycle which is described in terms of 6 major activities starting with requirement analysis and ending with implementation of the web GIS system.

RESEARCH OBJECTIVES

General objectives
* Develop a web based GIS utility that allows the tourists to have spatial and non spatial tourism information about Bahir dar town and its Surroundings.

Specific objectives
> To develop graphical user interface
> Designing and developing a portal that provides both spatial and non spatial tourism information
> Development of a dynamic digital tourist site map of Bahir dar town and its surrounding.
> To use Google API sources code to enhance the user query capabilities on Bahir dar town and its surrounding tourism.

GIS applications in tourism
There are two categories for the use of a GIS system in tourism, public use and management use. The public wants to find geographic information about a place before they go there. They want to know where things are located, what amenities are available, what the climate is like, and be able to do site specific searches to find information. This can be achieved through Web-based GIS. The other user of the GIS is the Management side; management may be done by individual operators, a tourism group, or by the local municipality. Management users want to query the system for where customers are coming from, their socio-economic backgrounds, and good potential locations for new tourist sites etc.

Tourism destinations are usually characterized by three different landscape features Points, lines, and polygons. Point features are individual tourist attractions, for example a historic site along the highway. Coastal beaches are represented by a linear pattern, while big theme parks or natural parks are characteristics of a polygon feature. These location attributes are essential to a geographic information system (Wayne, 2003). Geographic Information Systems (GIS) is a rapidly expanding field enabling the development of applications that manage and use geographic information in combination with other media. In the tourism industry, GIS is used to provide:

> A digital map base for printed maps
> Digital files for Internet mapping
GIS technology offers great opportunities for the development of modern tourism applications using maps. This technology integrates common database operations such as query with the unique visualization and geographic analysis benefits offered by maps. (Verka, 2007)

WEB GIS

Web GIS is the process of designing, implementing, generating and delivering maps on the World Wide Web by combining both the advantage of GIS and the internet (Wikipedia, 2010). GIS integrates and relates data with spatial component and supports users to view in proper format which supports in making complex spatial decisions through visualization, interactive modeling and analysis environments. GIS is thus far utilized to help with perception and understanding of spatially distributed phenomena in many areas of decision making and evaluating problems (Sakamoto et al., 2004). Generally GIS systems were considered as monolithic and platform-dependent applications (Wong et al., 2002). The development and rapid growth of web and web based application created a new platform for traditional GIS to grow and spread. Unfortunately, not everyone has access to GIS, nor would be able to spend time necessary to use it effectively. Web GIS became a cheap and easy way of disseminating geospatial data and processing tools (Alesheikh et al., 2002).

Web GIS have the highest number of users, although typically internet users focus on simple display and query tasks (Goodchild et al., 2005). The capability of Web GIS for interacting dynamically in distributed environment from cross platform to client/ server computing system made it more interesting to develop and use for accessing spatial information. The major development of cartography is using web as a distribution medium. By the means of web, now it has opened the possibility of the availability of real-time maps, cheaper maps sharing, more frequently updated database sources and cheaper software and hardware requirement. There are some problem and difficulties for fully development of web mapping. Some technical difficulties such as bandwidth, lower resolution of image are common. Reliability issues and security issues are limited the expansion of web mapping.

The development of web cartography and GIS is steady as compare to web technologies. Web 2.0, a new generation of Internet services and technology (Deshpande et al., 2006), support user interaction significantly. This evolution leads GIS away from data browsing, analyzing and managing for individual decisions, and more towards group participating and communicating on social decision issues (Carver, 1999). As (Craig et al., 1999) describe the Public Participation GIS principles as accessibility, understandability, and accountability, Web GIS continues to draw attention as a public participation tool (Sakamoto et al., 2004). Nowadays, Google Maps, Google Earth, OpenStreet Map, Yahoo Maps, Microsoft’s live search maps and other many commercial as well as non-commercial applications provide many kinds of geographical related information such as detailed maps, satellite images and terrain maps covering all over the world and allow users to use their APIs (Zhelu, 2009).

Web GIS Architecture

The basic approach for deploying Web GIS application depends on the user requirements that have to concern with which web GIS packages are suitable to accomplish their objectives (Phisan, 2001). Developments of web GIS are changing as fast as internet and Web technologies. Because one depends on the other. According to
(Dang, 2000) there are basically two types of architectures for developing web based GIS applications client-side, and server-side.

Server-Side Strategy
In a server-side web GIS application, a Web browser is used to generate server requests and display the results on client-side browser. A web GIS server usually combines a standard Web (HTTP) server, GIS application server, and the GIS databases and functionalities that reside completely on the server. As it is shown in figure 1 users interact with the client machine and type the address they are looking for (the request), which is transferred to the Web server. The Web server passes the request to the GIS application server, which runs an address matching routine, generates a map graphic, convert the graphic to Web format, wraps the image in HTML and sends it back to the Web server, which then returns the response to the client as a standard Web page. Map data transmitted to a Web client are in standard HTML formats that can be accessible through any Web browser, creating significant positive implications for performance, reliability and size of user base. Because of the entire complex and proprietary software, as well as the GIS databases resides on a server, it is easier for simplified application development in Server-side applications for deployment and maintenance of data. But server-side solutions are primarily associated with poor performance and limited user interface and interaction.

Client-Side Strategy
Client-side Web GIS applications can provide full GIS analysis and management support to specific users within business, government or public sectors. In a client-side Web GIS application, users are required to install a complete client application. In such systems, either a substantial amount of GIS functionality is moved to the client, or only the user interface is enhanced slightly to enable specific user interaction. In either case client-side application require software of some kind (other than browser) to be transferred to the user. In client-side Web GIS, the client system should be enhanced to support GIS operations. That is, to implement client-side solutions, software must be transferred to the client (Dang, 2000).

As it is shown in figure 2 in client-side Web GIS, the main tasks will be processed in the server, which is basically delivering files. The server receives request from the client and starts to communicate to the database and retrieves attributes of the map stored in the database. The GIS application server has also direct access to the map file. The map file could be SHP, DXF, etc and used to create map files like lines, point, area and labels. The server provides the client with raw data map and HTML image. The primary advantages of client-side solutions is improved performance.

Available Technologies For Web GIS:
Web GIS being one of the newest fields in Geographic Information systems. Different software and technologies are being developed in both commercial as well as open source. For Commercial purposes commercial companies develop well documented software that contain advance features but the price for that technology is high while open source system is developed by communities and can be used free of charge by having poor documentation. Open source system is developing rapidly with the involvement of large number of people. The major technologies involved in the realm of Web GIS today are (Detwiler et al., 2009)

Commercial: ArcGIS Server by Environmental Research Institute (ESRI), GeoMedia WebMap by Intergraph, MapXtreme by MapInfo and MapGuide by Autodesk.

Public APIs: Google Maps, Yahoo Maps, Microsoft Virtual Earth (2D).

WEB TECHNOLOGY FOR WEB BASED GIS

Web Server
Web server is the server that accepts HTTP requests from clients, and serves them HTTP responses along with optional data contents, which usually are web pages such as HTML documents and linked objects such as images. The most popular web server software is Apache based on Net craft survey in January 2009. Apache HTTP Server is the open source software and available for a wide variety of operating systems, including Microsoft Windows, UNIX, and LINUX. It supports many programming languages like PHP and Python.

Scripting Language And Javascript
A scripting language allows controlling one or more software application. Scripts are different from core programming language often interpreted from source code and embedded in other applications. In web based application scripts are embedded in HTML code. Client side scripting are executed in client-side by web browsers whereas server side scripting the scripts runs on server side or application servers. The popular server side scripts are PHP, ASP and JSP. JavaScript is a client side object oriented scripting language which is popular for developing client side application. It is developed by Netscape in 1995 and closely related with Java programming language and influenced with other programming languages but easier to program.

API
Application Programming Interface (API) which constitutes a language and message format is set of data structures, routines or protocols used by an application to communicate with other control program, communication protocol or operating system. Almost every application depends on the APIs of the underlying operating system to perform such basic functions as accessing the file system (Orenstein, 2000) APIs are implemented by writing function calls in the program, which provide the linkage to the required subroutine for execution. An API entails program module in computer to perform the operation or links to the existing program to perform the tasks. Based on function and interaction the API also differs in the implementation in that environment. Generic APIs are full set of APIs included in library of programming languages. These API interacts with operating system, DBMS and other applications and facilitate interaction between users and the computers. Specific API only addresses defined specific problems like yahoo API, Google API. Language specific API operate in a specific language using syntax and components of that language where as language independent APIs can operate in different application and programming language. This feature of language independent APIs is required feature of service oriented API which doesn’t limit on specific system, process or platform and useful for web services. The API itself is largely abstract in that it specifies an interface and the behavior of the objects specified in that interface. The API acronym may sometimes be used as a reference not only to the full interface but also to a single function or even a set of multiple APIs provided by an organization. Thus the scope is usually determined by the person or document that communicates the information. Based on the API documents, the user could learn and combine exist functions in the application more easily and efficiently.

Open Source Software For Web-Based GIS
Open source software are programs whose licenses give users the freedom to run the program for any purpose, to modify the program, and to freely redistribute either the original or modified program without further
limitations or royalty payments. There are many open source software available to develop the web based GIS. The descriptions on software below are some of them selected to be used in this paper.

**Map Server:**
Map Server is an open source development environment for building spatially enabled internet applications. It can run as a CGI program or via Map Script which supports several programming languages. Map Server was developed by the University of Minnesota so, it is often and more specifically referred as "UMN Map Server", to distinguish it from commercial "map server" (David Fawcett et al., 2010).

**Anatomy of a Map Server Application**

A simple MapServer application consists of:

- **Mapfile** – it is a structured text configuration file for Map Server application. It defines the area of the map, tells the MapServer program where the data is and where to output images. It also defines the map layers, including their data source, projections, and symbology. It must have a .map extension or MapServer will not recognize it.

- **Geographic Data** - MapServer can utilize many geographic data source types. The default format is the ESRI shape file.

- **HTML Pages** - the interface between the user and MapServer. They normally sit in Web root. In it’s simplest form, MapServer can be called to place a static map image on a html page. To make the map interactive, the image is placed in an html form on a page.

CGI programs are ‘stateless’, every request they get is new and they don’t remember anything about the last time that they were hit by the application. For this reason, every time your application sends a request to mapserver, it needs to pass context information (what layers are on, where you are on the map, application mode, etc.) in hidden form variables or URL variables. A simple mapserver CGI application may include two html pages:

- **Initialization File** Uses a form with hidden variables to send an initial query to the http server and mapserver. This form could be placed on another page or be replaced by passing the initialization information as variables in a URL. **Template File** controls how the maps and legends output by map server will appear in the browser. By referencing map server CGI variables in the template html, you allow map server to populate them with values related to the current state of your application (e.g. map image name, reference image name, map extent, etc.) as it creates the html page for the browser to read. The template also determines how the user can interact with the mapserver application (browse, zoom, pan, query). Figure 3 shows basic architecture of map server Applications.
**Figure**. Basic Architecture of Mapserver Applications

> **MapServer CGI** - The binary or executable file that receives requests and returns images, data, etc. It sits in the cgi-bin or scripts directory of the http server. The Web server user must have execute rights for the directory that it sits in, and for security reasons, it should not be in the web root. By default, this program is called map serv.

> **HTTP Server** - serves up the html pages when hit by the user’s browser. You need a working HTTP (Web) server, such as Apache or Microsoft Internet Information Server, on the machine on which you are installing MapServer.

**CHAMELEON**

Chameleon is an open source, distributed, highly configurable, environment for developing Web Mapping applications [http://www.mapcruzin.com](http://www.mapcruzin.com). It is built on Map Server as the core mapping engine and works with all Map Server supported data formats. It also works well with Open GIS Consortium standards for Web Map Services WMS and Web Map Context Documents (WMC) through Map Server’s support for these standards. Chameleon has a plug-in architecture. A large number of plug-ins, or widgets as they are called by the Chameleon developers, are available. A Chameleon widget can implement a mapping task such as zooming, panning, showing legends, or displaying map coordinates. Over a hundred widgets are distributed with the application and developers can easily create their own widget for any specific task. Figure 4 shows a typical Configuration of a Chameleon using Mapserver.
Post GIS:
Post GIS ([http://postgis.refractions.net](http://postgis.refractions.net)) is a spatial extension to Postgre SQL, enabling Postgre SQL to be used as a backend spatial database for GIS. It allows geographic objects to be stored in the database and included support for GiST-based T-tree spatial indexes and functions for basic analysis of GIS objects. Post GIS follows the Open GIS simple features specification for SQL. Post GIS is open source software and takes advantage of the extensibility of postgre SQL.

Post GIS is a very complete system, probably the most used actually in computer environment to use with GIS applications. There is the possibility to add pg Routing extension to provide geo spatial routing functionality with routing algorithms.

As Post GIS is still under development (though rapidly evolving), some limitations still apply

> Topological relationship can at the moment only be tested between the two objects. An exception is the = operator which compares the actual geometries.
> Named spatial relationship predicates for testing spatial relations between geometric objects are still missing, such as: Relate(), Touches(), contains(),crosses() and disjoint. Post GIS at the moment also lacks most spatial operators that support spatial analysis, like: Buffer(), Intersection(),Union(),Difference() and sym difference().

MASHUP STYLES

Server-side mashup
The first type of mashups style is server-side mashups. Server-side mashups integrate services and content on the server. The server acts as a proxy between web applications on the client, typically a browser, and the other web site that takes part in the mashup. In a server-side mashup, all the requests from the client go to the server, which acts as a proxy to make calls to the other web site. So, in a server-side mashup, the work is pushed from the web application client to the server. Figure 5 shows how a server side mashes up works
Client-side mashup

In a client-side mashup, the service or content integration takes place in the client, which is typically a web browser. This is in contrast to a server-side mashup, where the service or content integration takes place in the server. Figure 6 shows how a client side mashup works.

![Figure 6. How a Client Side Mashes Up Works](image)

Assessment Of Related Work:

According to (chDodo et al., 2004) one of the problems encountered in the tourism industry is the need for quick update and maintenance of the voluminous tourism data. In Zimbabwe, tourism authorities are continuously collecting data on tourist facilities. At the Zimbabwe Tourism Authority, most of this information is stored in hardcopy format. Some of the information gets lost after some time. The researcher uses ARC view version 3.2 and visual basic programming language to overcome the problem.

The problem of tourism development in Addis Ababa city, Ethiopia was identified. According to (Mesele, 2009) the main problem for the development of Addis Ababa tourism is lack of appropriate promotion. He uses web based GIS application using open source software for promoting the tourism facilities of the city on the internet. The problem of ecotourism in Sundarbans Bangladesh was identified by (Azizur, 2010). He uses GIS Organize structured information about Ecotourism to planners and developers, to utilize and find location suitability under conflicting demands and facilitate monitoring and controlling of ecotourism activities.

Web based GIS approach for disseminating the spatial and non-spatial tourism information of East Java Indonesia on the internet was done by (Tran, 2006). In order to achieve his objective the researcher develops a spatial and non-spatial data base. He uses mysql DBMS for storing the non-spatial data and the spatial data were stored as ESRI shape files. Finally he develops an interactive user interface by using different web site developing programming languages and he connects the developed spatial and non spatial data base with the website.
Web GIS development cycle
Developing a web GIS is more than simply using the appropriate hardware and software (Alesheikh & Helali, 2001). GIS based project development consists of components such as data development, data organization, and application development that are not similar and different from the standard software development processes (Mir, 2006). The web GIS development cycle is a step by step method from requirement analysis to the ongoing use and implementation of the expected portal. Figure 11 shows the web GIS development cycle which is described in terms of 6 major activities starting with requirement analysis and ending with implementation of the web GIS system.

Requirement Analysis
The objective of this research is to disseminate tourism information of Bahir dar town and its surroundings through the internet so that tourists can access the data easily. The requirement analysis step has been performed by making informal interview with some people that don’t have knowledge and access of GIS software and by reviewing a related literature. These steps produce two critical pieces of information.

> A list of function that is needed. The required functions are the basic visualization functions such as Pan, Zoom and more advanced functions such as object identification, spatial query and distance measurement. Tourists can use these functions to view information about the required place.
> A master list of available /needed geographic data. Several layers for tourism information were captured by using GPS. The basic once that used in these research are major tourist spots, hotels, bus station and airport. The information gained in the requirement analysis activity went directly into the conceptual system architecture design activity.

CONCEPTUAL SYSTEM ARCHITECTURE DESIGN

The main architecture principles that are the basis for creation of the ArcGIS portal are: Interoperability - the architecture should ensure efficient system integration with relevant external system.

Openness - the architecture should be open for integration.
Flexibility - the architecture should ensure the degree of flexibility.
Scalability - the architecture should also ensures that the system implementation can be scaled efficiently in relation to possible scenarios on growth in transactions, volume of data and number of concurrent users, etc.

Portability - the hardware and the software should be open to several platforms considering hardware architecture and operating systems.

The conceptual system architecture is designed as three tiered software architecture to full fill the main architecture principles (figure 12). It is server side architecture. It comprise of Web application, Web Service and Spatial database. In web application, there are the website using JavaScript codes to show the information with some basic GIS functions and several web interfaces for the management. In web service, there is the web server using Apache, which supports PHP script to generate the webpage dynamically. In the data base PostGIS is used to store the spatial data. Google Map Server is used to provide the external map services.
A request from the client is sent through the HTTP to the Apache web server. The PHP scripts are parsed and interpreted by the PHP CGI program or Apache module, and the result are included in to the web document. Parameters for the attribute queries are passed to PHP, which is used as an interface to the PostgreSQL database. As the result of such a query, attribute data are passed back the same way and are embedded in to the HTML code of a web document. If a map request reaches the web server (simultaneously or independently), it is passed to mapserver’s PHP/mapscript module, which processes the spatial data (read either from a file or from the PostGIS database) and creates a vector PNG file. The vector file is also embedded to the client, where it is displayed by the local web browsers. Figure 13 shows the query work flow.

**Acquisition of GIS software**
Selecting suitable software is an important step in a successful implementation. The software components presented in this section form a multi-component prototype with open interfaces that could also be used for distributed applications with the components running on different platforms. Software was evaluated on functionality, performance, and independent of the hardware and operating system. Web GIS requires specific hardware and software configuration. Apache, Mapserver, PHP, postGIS, and chameleon are selected for this research. It is notable that all the selected software are under open source licenses. Figure 14 shows the prototype of selected software.

**Geo Spatial Database Design Method**
The geo spatial database design involves creating and arranging various geo spatial data such as point, poly line and polygon objects with their attribute table. The color, weight, size and symbols of these objects have to be analyzed and implemented. Geo database organizes spatial data into a hierarchy of data objects. These data objects are stored in feature classes, object classes, feature datasets and raster datasets. An object class is a table in geo database that stores non-spatial data. All the geographical data features must contain spatial reference. The spatial reference describes the coordinate system, the spatial domain and data precision of the feature. Figure 15 shows the sources and the steps in creating the geospatial database for this research.

**Data Preparation**
After collecting the necessary data and setting the appropriate method, the data were prepared using ArcCatalog and ArcMap. Before exporting the GPS reading points in the field to ArcGIS, it is necessary to prepare the data to be fed to the ArcMap program in a usable and simple form. The collected data was stored into several columns of fields. These fields are the key feature of the data. They should be able to provide the most important information about the collected data. Table 3 shows collected data about Hotel.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>Name of the Hotel</td>
<td>Text</td>
</tr>
<tr>
<td>X_value</td>
<td>Longitude Value</td>
<td>Double</td>
</tr>
<tr>
<td>Y_value</td>
<td>Latitude Value</td>
<td>Double</td>
</tr>
<tr>
<td>No_of_beds</td>
<td>Number of beds in the Hotel</td>
<td>Short Integer</td>
</tr>
<tr>
<td>Hot_shower</td>
<td>Hot shower availability in the hotel</td>
<td>Text</td>
</tr>
<tr>
<td>Internet</td>
<td>Internet availability in the hotel</td>
<td>Text</td>
</tr>
<tr>
<td>Credit card</td>
<td>Credit card acceptance in the hotel</td>
<td>Text</td>
</tr>
<tr>
<td>Restaurant</td>
<td>Availability of a restaurant in the hotel</td>
<td>Text</td>
</tr>
<tr>
<td>Transport</td>
<td>Transport availability of the Hotel</td>
<td>Text</td>
</tr>
</tbody>
</table>

**COLLECTED DATA ABOUT HOTELS**

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In the same way information about other collected data was putted in a table and made ready to be export to ArcMap. In order to export the collected data to ArcMap the next step is creating a data base file using Microsoft excel. Data base file format of the individual collected data were created.

In the processes of exporting data to ArcGIS, it is also important to use the appropriate coordinate system. There are two main classes of coordinate systems as discussed in the literature review. According to EPSG’s geodetic parameter registry, Bahir dar under the projected coordinate system lies in the Adindan UTM zone 37N. After identifying the projected coordinate system of Bahir dar the next step is projecting the collected data. In ArcMap all the collected data in excel format was converted to shape file by projecting to Adindan UTM zone 37N. Figure 16 shows the created and available data for developed web based GIS Portal.

APPLICATION DEVELOPMENT

Interface design
The usability of Web GIS portal mostly depends on the interface design. If the interface is not designed well according to the user’s expectations and does not fulfill their requirements then errors occur. Web maps are different from general web pages or other computer applications, but at the same time these maps can be accessed through web browsers in graphical user interface.

Maps can also be considered as user interfaces. (Peterson, 1995) mentioned that the word interface has the relation to maps in two ways, firstly, interfaces to the world and secondly they consist of user interface elements. The layout of the map, its legend (a small table that explains symbols used on the map), scale bars, and North arrow are all features of the map’s user interface that allow the users to interact with these maps. To design user interfaces for web based GIS applications important usability issues like satisfaction, learn ability, efficiency, effectiveness and error prevention should be considered, which are highly relevant to web-based GIS applications. After software setting up and running properly, a user friendly graphical user interface was designed.

Template File:
The template file controls the display of map server output in a web page. More precisely, the design of the graphical user interface (GUI) and the way how users can interact with the applications are defined here. In the most trivial case when the mapserver CGI program is used, the template file is a normal HTML page that can be design like any other web page. In the more advanced case if the PHP/MapScript module is used, the template file also contains PHP codes. Home.html is the template file that is used in this application. PHP functions are stored in a plain PHP files, which is included in to the template file. Every time the application load it includes other PHP files on demand. A number of JavaScript codes and Cascading Style Sheets (CSS) used to make the web page dynamic and interactive. For increasing the functionality of the web page different pages have been designed and linked to the template file.

Preparation of Map file:
The map file can be regarded the configuration file and controls all other aspects a mapserver application has to deal with. The layers to display, the display parameters (how shall the layer be displayed) and the query parameters (which layers can be queried). A mapfile is hierarchical. Each mapfile defines a number of other
objects. These objects include scale bars, legends, map colors, map names, map layers, etc. Mapfile definitions consist of keyword-value pairs. Some values are lists of items separated by white space, and these lists must be enclosed in quotes. Single quotes and double quotes are both acceptable. Keyword values with embedded blanks must be quoted, but it’s good practice to quote all strings.

Map files can be acquired by two manners from a manually created text file or by using free software allowing to export the data and structure of the geographic map in the a map file (Amein, 2007). For this study Map file were created manually. The projection, extent, location of map file, class and labels were coded on notepad and saved as a bahirdar.txt with map file format. The next map file syntax explains the basic elements that should be consider in developing a map file. The map file developed for this research work is found at the ANNEXURE-I.

<table>
<thead>
<tr>
<th>MAP NAME</th>
<th>prefix attached to map, scale bar and legend GIF filenames are created using this mapfile. It should be kept short.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMAGETYPE</td>
<td>the format of the displayed image, gif</td>
</tr>
<tr>
<td>SIZE</td>
<td>size in pixel of the output image (i.e. the map)</td>
</tr>
<tr>
<td>SHAPEPATH</td>
<td>the path to your data folder on your computer</td>
</tr>
<tr>
<td>UNITS</td>
<td>what units are used, feet</td>
</tr>
<tr>
<td>WEB TEMPLATE</td>
<td>the path to HTML template</td>
</tr>
<tr>
<td>IMAGEPATH</td>
<td>the path to a temp-folder where you keep images created</td>
</tr>
<tr>
<td>IMAGEURL</td>
<td>the url of the temp folder</td>
</tr>
<tr>
<td>END LAYER NAME</td>
<td>name of the layer</td>
</tr>
<tr>
<td>DATA</td>
<td>the name of the Shape file in the data archive</td>
</tr>
<tr>
<td>STATUS</td>
<td>[on] off, Default turns the layer on</td>
</tr>
<tr>
<td>TYPE</td>
<td>the data represented be point, line, polygon</td>
</tr>
<tr>
<td>CLASS</td>
<td>signals the start of a CLASS object</td>
</tr>
<tr>
<td>COLOR</td>
<td>color of the element</td>
</tr>
<tr>
<td>END END</td>
<td></td>
</tr>
</tbody>
</table>

**Working with Chameleon**

As explained in detail in the literature review, chameleon is built on mapserver as the core mapping engine and works with all map server supported data formats. But integrating chameleon with map server is not enough to display the maps on the web. Chameleon has to be integrated with the created map file and the designed user interface. The first step to integrate the created map file and other data with chameleon is to put them in a different folder within the ms4w. A directory myApp was created having four sub folders and putted in the app sub folder of ms4w. Figure 17 shows the application directory structure used in chameleon.

**RESULT AND DISCUSSION**

The purpose of the study was to develop a web based GIS for tourism development of Bahir dar town and its surrounding using open source technologies. The developed portal shows that it is possible to set up a working interoperable multi component application consisting of open source software products. Based on the literature review, it has been established that similar systems have been developed to guide tourism such as web based GIS for tourism development as sighted by (Fajuyigba, 2007), web GIS for tourism (Tran, 2006). The outcome of the review lead to the conclusion that a web based GIS can be described as a website that contains pages stored on a
web server with spatial and non-spatial information in a dynamic way (Tran, 2006). These web based systems are in line with the definition provided by (Ch. Dodo et al., 2004) that a web based GIS was an application that not only disseminates information, but also proactively interacts with the users to aid them in their task.

The findings from the study show that the developed prototype has been able to meet the requirements of a web GIS information system. The developed system is accessible from anywhere in the world. It is designed and developed to be a platform for global and free sharing of information as advocated by (Dang, 2000).

The main advantage of the developed portal over the traditional GIS is that traditional GIS was restricted to specific people but the developed web-based GIS is accessible to a large number of people with easy to learn and easy to use method. It don’t only provide free access to maps and other tools like zooming and panning but also provide other map related services.

Although there are many on-line information systems, very few were identified that relate to web based GIS for tourism. The existing websites on Bahir dar provided plain information in form of web pages, some of them are static and the others are dynamic. But all of them lack digital maps with the necessary tools for navigation through the map. No web GIS information system on tourism in Bahir dar was sighted during the study period, which justifies the relevance of this study. The developed prototype provides information on tourism, which is accessible globally but with content limited to Bahir dar situation. It provides information on location of tourist spots, hotels, banks, transport destinations, health centers, and some additional information deemed important for tourists. Armed with this information, the tourists can then make informed decisions on which hotels to stay and which tourist sites to visit at a given estimated cost. This type of information is deemed as very important in the promotion of tourism in the town and its surroundings.

CONCLUSION

For Tourist database, GIS is an efficient tool for the cost effective collection, storage and analysis tasks. In the age of Information Technology and present focus of administration through e-governance, it is desirable to have any GIS database on the internet. The Map Server software provides an efficient environment for the tourism industry. This can be very helpful in the promotion of tourism in Bahir Dar. As a tourist planning to visit a specific place can get all the details from the web based portal. Some other tools are also helpful in the customization of GIS functionalities, if required for a specific task like – Google Image API. It Offers a wide variety of modification and query handling modules that can be incorporated into a Web GIS portal to increase its effect. For the developing countries like Ethiopia, cost is the primary consideration for the adaptability of GIS technology. Under these circumstances, open sources software Provides all the data storage and analysis for free.

RECOMMENDATIONS

In view of the different capabilities demonstrated by the developed web based GIS, which incorporates web-based applications with GIS to handle both data on spatial and non-spatial, it is recommended

- To enhance the capability of the system, additional features should be integrated.
- Tourist service providers and other institutions to be engaged in promotion and use of the web based GIS tour guide method for selection of tourist sites.
This study focused on tourism in Bahir dar town and its surroundings, as one of the tourist attractions steadily picking up momentum in the last few years, there are several important tourist attractions sites which can use and benefit from the

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