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WEB BASED TOURISM INFORMATION SYSTEM USING GEOGRAPHICAL INFORMATION SYSTEM (GIS) - A CASE STUDY

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ABSTRACT

World-wide web is fast becoming useful tool for the tourism industry and it presents a platform that brings products and services to the tourists. A web based tourism information system may provide on-line brochures along with both value and services. Tourists generally want to find objects of tourism and amenities with reference to their geographic position and surroundings. In many cases, it is not satisfying to find a good hotel without a reference to restaurants, sights or event locations located nearby. This case study on web-based tourism information system using GIS for Chandigarh city takes into account the user needs to present the tourism objects in geographic context on interactive tourist maps. This city is rapidly becoming a hot spot for tourists from around the world because of its exotic locations and hospitality facilities. In recent years, it is developing into a world class IT destination as well. Therefore, city's tourism sector may be promoted by global marketing of its tourist attractions, facilities and services.

Thus, this study considers web-based GIS application towards promoting tourism and providing an innovative way to the users to access spatial orientation of the city. GIS content forms the core component of this application as it provides the world wide users with spatial information about the place that is very close to reality. This should further be useful for supporting and planning for tourism through analysis, decision making and management using GIS technique, and making it available online on the internet.

Keywords: *Tourism, Geographical Information System (GIS), Web-based information, Hospitality, Global Marketing*

1.0 INTRODUCTION

Tourism involves travel for predominantly recreational or leisure purposes, and also refers to the provision of services in support of this act. 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). Irrespective of its incident duration, tourism has become an extremely popular global activity. Berno (1999) and Mckercher (1996) describe the word tourism as any business like transport, entertainment or places to stay, involved in the service of people who are on a holiday. A tourist is an individual, who visits a place for interest or pleasure, usually during a holiday (Mckercher, 1996).

Tourism industry involves many businesses that are directly or indirectly involved in providing services to the tourists. Tourism is regarded as one of the largest economic resources to a country's revenue generation. It is a source of foreign currency for developing countries as it involves mobility of tourists to and from one place to another. Developing countries account for almost 30% of world tourism revenue (Dondo et al, 2002). Tourism has numerous tangible and intangible elements as a service industry. Major tangible elements include transportation, accommodation and other components of a hospitality industry. Major intangible elements relate to the purpose or motivation for becoming a tourist such as rest, relaxation, opportunity to meet new people and experience other cultures, or simply to do something different and adventure. For traveling between close and far off places, maps are required as important tools for providing precise locations.

Over the ages, tourism has been supported by travel-books and tour-guides. Typically, such guides include maps that are marked so as to link description of places with their respective locations. For an average tourist, such guides certainly serve their purpose. On the other hand, for the tourists seeking more than just a description, typical tour guides prove unsatisfactory (O'Looney, 2004). Internet revolution changed the way to access information through world-wide web (www) sites of various services. Tourism sector also uses the web technology extensively to publish web pages full of information about the travel, tour and hospitality services. Products and services are being offered online directly to the customers by both tourism suppliers and tourism agencies.

Geographic Information System (GIS) comes into picture when we talk about the maps and its use. "Geographic information systems are used to collect, analyze and present information describing the physical and logical properties of the geographic world" (Goyal et al., 1997). In other words, it deals with the collection, storage, manipulation, analysis and presentation of spatial or geographic data. Simply put, GIS is an information system that allows the use of spatial information effectively (Dockkey et al, 2004). Spatial information integration, spatial analysis and spatial communication have the potential for generating substantial new insights on new information. Power of GIS lies in organising and manipulating spatial information by using, both a database management system (DBMS) and an automated cartographic system for rationally linking map features to attribute data. It provides information in the form of a map but not just picture of a map (Pulusani, 2001). GIS and its usefulness in various areas and applications are well known now. Tourism is one such area where GIS is being used to further support its services (Holm-Pedersen, 1994).

Before GIS, companies hosted a website for their business or with the information about their products or services. Customers could get relevant information easily over the Internet by means of accessing useful and updated information, inquire questions, look for the tourist product catalogues, order bookings and make payments to airlines, hotels and other services. Despite such conveniences, users face problems with extensive information as they have to dig down in the hyperlinks before reaching their answers. Shneiderman (1997) refers this situation as a tragedy of the flood of information. Therefore, web-based GIS mapping solution comes in handy providing an interface from where the user can directly select or query the information they need from or to the map. People can specify their areas of interest and then look at the information described in a map. Otherwise they can also click on the interactive informative map and get the attribute information about the points of interest from the map database.

2.0 TOURISM AND HOSPITALITY - SIGNIFICANCE IN INDIAN CONTEXT

Tourism in India has registered significant growth in the recent years. In 1951, International Tourist Arrivals stood at around 17 thousand only while the same has gone up to 3.92 million in 2005 recording earnings of US$5731 million, a growth of 20.2% over 2004. Tourist arrivals increased to 4.43 million in 2006, up 14.2% from 3.92 million in 2005. Foreign

Department of Hotel Management, BIT-Mesra, Ranchi-835215

exchange earnings from tourism also grew in 2006 by 14.6% from 2005. While the growth in tourism has been impressive, India's share in global tourism scenario and earnings is quite insignificant. It is an accepted fact that India has great potential for development of tourism. World Travel and Tourism council (WTTC) has identified India as one of the foremost growth centers in the world in the coming decade. Tourism is the third largest net earner of foreign exchange for the country and is also one of the sectors employing the largest number of manpower.

In recent times, Institutes of Hotel Management continued to be the backbone of manpower training for hospitality industry in the country. Diploma courses offered by these Institutes were upgraded to degree courses. The scheme of 'Capacity Building for Service Providers' also continued to be implemented for providing basic skills to unorganized sector service providers engaged in activities having direct interaction with the tourists.

3.0 SIGNIFICANCE OF GIS IN TOURISM

Bernhardsen (1999) defines GIS as a system that captures, stores, manages, manipulates, retrieves and analyzes geographic or spatial data through computer hardware/software and other cartographic spatial devices to create map products. McAdam (1999) also defines GIS in a very simple way as a relational database that is capable of manipulating both kinds of spatial and non-spatial data together. Spatial data is in the form of digitized maps and non-spatial data is the attribute data in the form of alpha numeric records associated with the spatial data. It would be appropriate to say that using computers and other latest technologies for dealing with collecting, creating, analyzing or manipulating the cartographic data and maps have been combined together in a system known as GIS. This is a better tool in dealing with huge location specific spatial and non spatial data, and therefore, easy to organize and automate the data that can facilitate planners, officials and general public in planning, development and marketing of tourism activity.

First step towards effective promotion and market strategies is to computerize the tourism industry in India. Second step towards promotion and marketing strategy for tourism is to develop user-friendly web based GIS. As the tourism industry is vast and includes many inter-related segments, use of GIS system is therefore classified into two categories (figure 1) according to the user - management user and public user (Duran, et al. 2003).

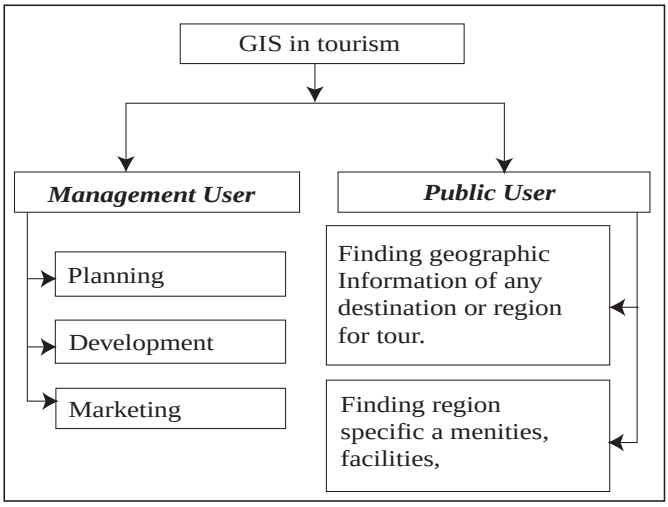

Figure 1. *Classification of GIS use in tourism*

4.0 STUDY AREA

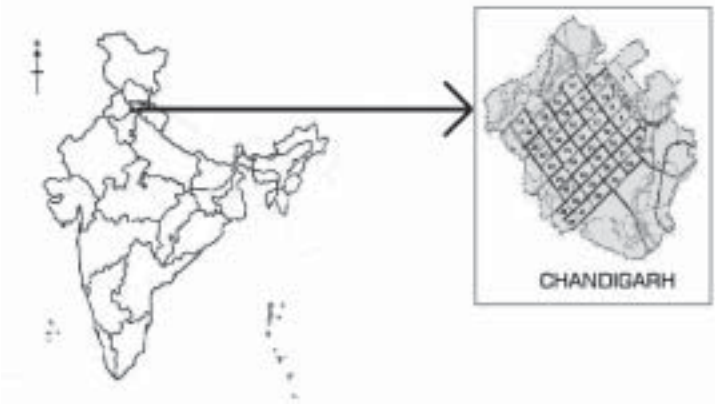

Figure 2*. Location map of Chandigarh city*

Chandigarh, the capital city of states of Punjab and Haryana is the first planned city of India (Figure 2). It is a Union Territory, administered by the Government of India. Le Corbusier, the famous French architect-planner of this city conceived the master plan of Chandigarh as analogous to a human body with a clearly defined head (capital complex), heart (city centre), lungs (leisure valley and gardens), the limbs (cultural and educational

institutions) and the circulatory system. Chandigarh is one of the most significant urban planning experiments of the 20th century. It is only one of the numerous urban planning schemes of Le Corbusier to have actually been executed. It is as famous for its landscaping as for its architectural ambience. Most of the buildings are in pure, geometrically subdivided form with emphasis on proportion, scale and detail.

5.0 OBJECTIVES

Purpose of this study is to explore the role of GIS and Internet together, in the current scenario of new and emerging technologies for the area of tourism/hospitality; and to develop a web based tourism information system. With the world-wide web, people have access to more information than ever before. However, too much information from too many source cause an information overload. Web-based GIS applications are becoming significant in disseminating geographical information on the Internet because of their platform independence, interactivity, and wide accessibility.

Therefore, objectives of this study are:

1. To develop a GIS enabled web-based information system prototype that should provide the tourists with their desired information on tourism/hospitality
2. To develop a prototype application that showcases the tourist and other facilities of the city that should lead to promotion of tourism in the city
3. To develop suitable query tools for the prototype system

6.0 METHODOLOGY

Figure 3 elaborates methodological steps involved in developing Chandigarh tourism information system prototype:

Data used

i. Spatial data: Survey of India Topographical map, other collateral maps and images of the city.

ii. Non-spatial data: Information and history about tourist attractions of the city, services and facilities were acquired from various resources such as tourism related websites and from other relevant agencies/ departments. Field based interviews on the user interests provided the input in regard to the data they may be interested in when searching

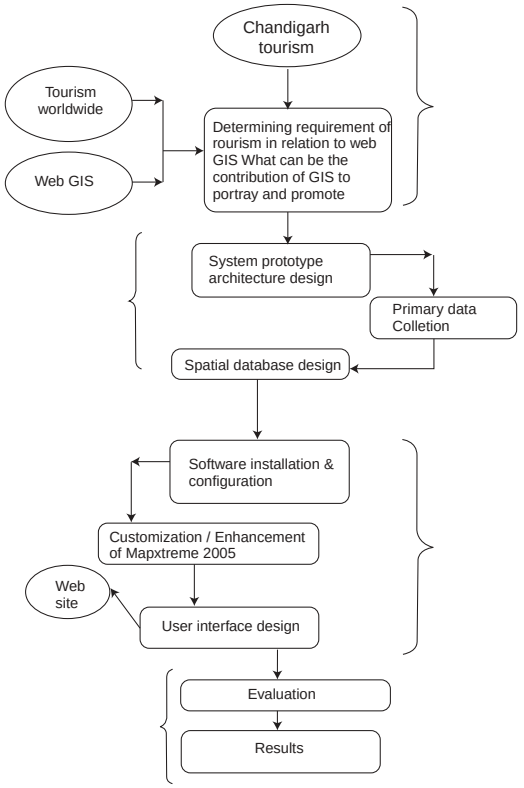

Figure 3. *Methodology flow-diagram*

for the tourist information. Further, the data on hotels/hospitality industries of Chandigarh was collected from the All India Group of Hotels. Other sources used to collect non-spatial data were internet websites, newspapers, travel guides, tourism brochures etc.

Internet GIS - basic components

This is necessary to know the basic components involved in the Internet GIS (Figure 4) while developing a web based GIS application.

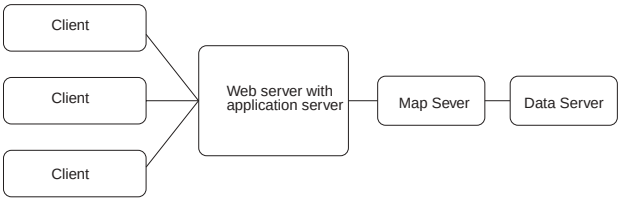

Figure 4. *Basic component of web GIS*

Department of Hotel Management, BIT-Mesra, Ranchi-835215

1. **Client** - This is a typical Web interface with HTML and forms a simple client of Internet GIS. As this type of interface possess very limited user interactivity, as a result it is not possible for the users to interact with the spatial objects and maps. In order to overcome this problem and provide the user with an interface to interact with the spatial data, alternative clients using Web add-ons were developed. These types of alternative interactive clients include dynamic HTML and client-side applications such as plug-ins, Java applets, and ActiveX controls (Peng & Tsou, 2003).
2. **Web server with application server** - Web server and application server constitutes the second component of the Internet GIS. A Web server is also called as the HTTP server. The HTTP server is responsible for replying to the requests from the clients. The Web server can reply in several ways to the client by sending the existing HTML documents or the map images; or by sending Java applets or ActiveX controls; or by passing requests to and invoking other programs that can process the inquiry. Application server receives requests from the Web server. When the Web server receives a request that needs to be processed by some other program, it passes the requests to the Application Server which in turn searches for the respective applicable application program e.g. map server and then passes on the request to process it. The application server acts as a bridge or connector between the Web server and the map server.
3. **Data server** - A data server is responsible for maintaining the spatial as well as non-spatial data in a relational or non-relational database structures. The data server responds to the requests sent through the SQL by a client or the map server for the required data, and thus also called as an SQL server.
4. **Map server** - Map server is a major workhorse component that fulfills spatial queries, conducts spatial analysis, and generates and delivers maps to the client based on the user's request (Peng & Tsou, 2003). Map server performs the GIS functions or services such as query filtering, data extraction, geocoding, spatial analysis, map-making, etc. Output from the map server is either of the two forms - feature data sent to the client for manipulation by the user or a simple map image in a graphic format. There are many web mapping servers and image servers running around the world.

An overview of the software

MapInfo corporation's windows software development toolkit MapXtreme 2005 allows .NET-experienced developers to create powerful

location-enhanced desktop and client/server applications. In support of Microsoft's .NET Framework for Windows, MapXtreme reflects a single object model for developing or extending mapping applications for the desktop, traditional client/server environments or the Web. MapXtreme is an application development tool for data visualization and mapping for better business decisions, management of assets and operations more effectively. In this study, development environment tools, client side map interaction, client side command execution, server side command architecture and web-controls available in MapXtreme software were used.

Flow of data into the GIS database

Figure 5 illustrates different sources and the flow of data into the GIS when developing a working database for the study:

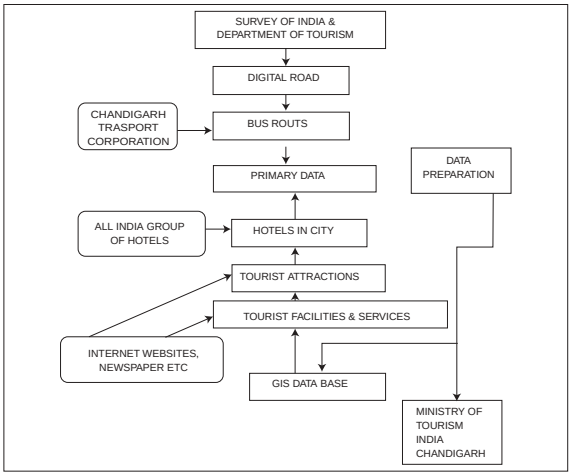

***Figure 5**. Flow of data into GIS database*

Tourism related data collected were attached with geomedia database. This was transferred to mapinfo professional, where data were stored in .tab files for design and interaction by viewing, editing or analyzing the geographical data in a visual context. The other new layers were also compiled and added according to the classification of tourism data. The new layers were created in the form of .tab files and each attraction or facility was represented as a point feature. Features in each layer were also categorized according to different types available and given a category code. On the basis of the categories the symbology was also defined in the layers.

Listed below are the sample data sets available after data processing of GIS database in the tabular form (table 1) for application development:

Table 1. Available data sets after data processing

S.No	Data Set	Type	Categories	Data Format
1.	Hotels	Point	1. Five star 2. Four star 3. Three star	Tab files
2.	Other information	Point	1. Beauty parlour 2. Bookstore	Tab files
3.	Lakes	Polygon		Tab files
4.	Tourist places	Point, polygon	1 Gardens 2. Leisure valley 3. Open hand monument	Tab files
5.	Museum	Point		Tab files
6.	Money exchange center	Point	1. western union 2. Thomas cook	Tab files
7.	Restaurant	Point	1. Indian 2. Chinese 3. Continental 4. South Indian	Tab files
8.	Cinema	Point	1. Multiplex 2. Duplex	Tab files
9.	Information center	Point	1. Tourism information 2. Others	Tab files
10.	Sampark centers	Point	1. Jan sampark 2. Gram sampark	Tab files
11.	Spiritual places	Point	1. Mosque 2. Temple 3. Gurudwara 4. Church	Tab files
12.	Post office	Point		Tab files
13.	Police station	Point		Tab files
14.	Rural tourism	Polygon	Villages	Tab files
15.	Medical tourism	Point	1. Hospitals 2. Ayurvedic 3. Homeopathy.	Tab files

Design and Implementation

GIS based project development consists of components such as data development, data organization and application development that are not similar but different from the standard software development projects. But

still, there are similarities in the development process in assessing user requirements, system requirements and other aspects of development. There are many different methodologies of software development. The prototyping model is one of those and provides feedback from the user during development process rather than at the end. This enables the developer to validate requirements and specifications before implementation of the system which should save the resources of the project in case the result is undesirable. Therefore, prototyping lifecycle process model is followed to develop the web-based GIS application i.e. Explore Chandigarh. Prototyping lifecycle process model is shown in figure 6.

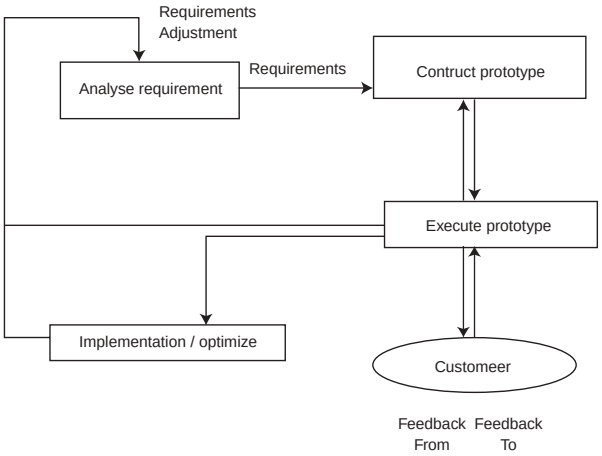

Figure 6. *Prototyping lifecycle process model*

The key to develop a successful tourism application is to correctly define user requirements. It is the most basic and most important part in any study on developing a GIS tool, as each project is unique and holds a different view of the system being developed. In the prototype model, analyzing the requirements is one of the first activities to start developing an application. In order to construct a web-based GIS application, necessary components that participate in the model are client and server. A client can be any browser which is used by a user to interact with the application. A server consists of a web server, interface program, web GIS software and database, which hosts the data and provides data delivery service through request and response process to the client (Peng & Tsou, 2003).

After due customization, only the tools important to help the users in browsing the application were placed in tool bar. This was done to accommodate the toolbar in a single column and increase the map display area. A list of tools with functionality is described in table 2.

Table 2. Description of tools

S.No.	Tool Name	Function
1.	Center Tool	Allows to re-center the map by clicking on map
2.	Distance Tool	Allows to get the distance between two or more points by clicking on the map
3	Navigation Tool	Allow to pan the map by fixed directions: North, South, East, West, Northeast, Northwest, Southeast and Southwest
4.	Pan Tool	Pan Tool allows to reposition the map within its window by dragging in any direction
5.	Point Selection Tool	Allows to select a feature (nearest to the point) when clicked on the map
6.	Polygon Selection Tool	Allows selection of such features whose centroids lie within the polygon. Polygon is drawn on the map using mouse clicks representing nodes of the polygon
7.	Rectangle Selection Tool	Allows selection of all features whose centroids lie within the rectangle. The rectangle is drawn on the map using mouse clicks representing opposite corners
8.	Zoom Bar Tool	Allows zooming of a map to a series of preset levels
9.	Zoom In Tool	Allows drawing of rectangle representing the view to zoom in on the map
10.	Info Tool Sample Web Application	Allows retrieval and display of information for a feature by selecting feature on the screen, by sending requests using JavaScript to a server without having to refresh the entire page

7.0 RESULTS AND DISCUSSION

This study has attempted to develop an accessible Web GIS prototype, through which the spatial information related to the tourism of Chandigarh city tourism information thus can be dissipated to the world-wide users. Figure 7 shows enhanced user interface as developed in this ptototype. Similarly, figures 8(a), (b) and (c) illustrate map navigation functions such as zoom in, zoom out and distance measurements. Example of search function of this prototype is depicted in figure 9.

This integrated online tourist information system can help the tourists from far destinations to explore city tourist activities and decide their tour in an appropriate manner by performing on-line GIS queries, analysis and 'what-if' scenarios.

Figure 7*. Different parts of Chandigarh in an enhanced interface*

Figure 8(a)*. Zoom in function*

Figure 8(b)*. Zoom out function*

Figure 8(c)*. Distance measurement*

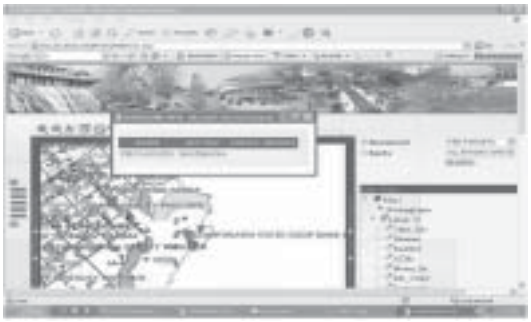

Figure 9*. Search for a restaurant of choice*

8.0 CONCLUSIONS

Web GIS based tourism information system prototype should be useful as online interactive guide for the tourists. This is capable of providing both spatial and non-spatial tourism information. Customization carried out should also allow enhancements with added functionalities of finding a location through queries, hyperlinking the features and proximity search. This Web GIS based application can assist the prospective domestic and foreign tourists to the city in advance planning of their tour in time and with greater spatial details at their disposal. Similarly, tourism related departments, agencies, hospitality industries and other services should also benefit in terms of being able to participate in the global marketing of their tourism products and services. However, this will be appropriate to enumerate the advantages and limitations of this prototype web GIS based tourist information system. Advantages foreseen are as follows:

- This application should enable even naive users who are not familiar with GIS to browse the tourism spatial content through Web over the Internet.
- This application should help the tourists in making adequate arrangements before finalizing and undertaking the tour.
- This application should improve the quality and level of web information.
- This should serve as a utility for the public user as well as a marketing tool for the city tourism management to promote and attract tourists.
- Data can be periodically updated and maintained in real time and space.

There are certain limitations as well with the GIS data involved in the application and the prototype application. These are:

- Technical barrier in the regions with low Internet access speeds. In

major parts of India, an average Internet speed is 56 Kbps, which is a great hindrance for the people in accessing this application.

- Much of the processing is done at the server side and thus, the network has more requests and responses which may result in longer response times.

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