A 3D Geo-Spatial Virtual Reality System for Virtual Tourism.

V.F. Balogun, M.Sc.[1]; A.F. Thompson, M.Tech.[2]; and O.A. Sarumi, B.Tech.[3]

[1]Department of Computer Science, University of Manitoba, Canada.
[2,3]Department of Computer Science, Federal University of Technology, Akure, Nigeria.

E-mail: victobal@yahoo.co.uk[1]
ronkeniran@yahoo.com[2]
sphemmy@gmail.com[3]

ABSTRACT

The effective management and promotion of tourism can increase the Gross Domestic Product (GDP) of any country significantly. This paper presents the design of a simplified and generic architecture of a 3-Dimension (3D) model virtual walk-through for tourist centers and historical heritages. We believe that this model could be adapted for its implementation in any state or country. The countries of the world are replete with numerous attractive and historical tourist sites. Many of such places are barely visited and explored because they have not been given enough publicity to draw people to those sites. This model provides platform to overcome these drawbacks by providing easy access and virtual exploration of these tourist sites. We envisage that the system will both promote these sites and also help to preserve the historical heritages of the people in such communities. The architecture is an integration of Virtual Reality System (VRS), Geographical Information System (GIS), and dynamic web technologies. The proposed architecture was implemented using tourist sites in Osun State, Nigeria as a case study. This paper further highlights vital issues relating to its implementation and challenges.

(Keywords: virtual tourism, virtual reality system, geographic information system, dynamic web technologies)

INTRODUCTION

Tourism is viewed by many as travel for recreation, pleasure, or instruction, often in organized groups. It could be visits to attractions, city breaks, trips for business meetings, sports events, concerts, or visits to friends and relatives. Tourism is becoming an integral part of our lives and culture (Chris, 2008). Its economic prospects are indispensable in the socio-cultural development of any nation. It provides employment opportunities and also helps to earn valuable foreign exchange. Kenya and Israel generate a lot of revenue from tourism, so much so that it is regarded as a vital means of sustenance to their economy. According to Tanah (2006), Kenya generates up to 12% of the East Africa economy through tourism. Tourism has even been credited with enhancing intercultural harmony (Chris, 2008). Its development also helps achieve balanced and sustainable regional growth by providing employment opportunities for unskilled workers specifically from the rural areas and also developing interior and remote areas.

TOURISM TAXONOMIES AND PROBLEMS

Classification

Ayeni (2006) categorized tourism as follows:

1. **Cultural Tourism:** Museum, art, galleries, cultural, religious and national festivals, historical monuments, natural features such as sites and buildings, arts and crafts.

2. **Ecological Tourism:** Geological, geophysical, and geomorphologic features (mountains, waters, falls, springs, beaches, national parks, games/forest reserves, botanical / zoological gardens, etc.)

3. **Modern Tourism:** Hydroelectric power, dams, oil rigs, sporting facilities and other notable engineering structures, travel and accommodation facilities.

Problems of Tourism

The countries of the world are replete with numerous attractive and culturally significant tourist sites. Many of such places are barely visited and explored. Fajuyigbe and Balogun (2007) itemized some of these problems. They are:

- Difficulties in updating existing graphical tourist guides and maps (expensive, tedious and time consuming)
- Lack of digital information for tourism facilities and destinations.
- Lack of comprehensive information based on the internet
- Inadequate motivation for effective marketing
- Lack of a technology-driven approach for tourism sustainability.

METHOD OF SOLUTION: VR TOURISM USING WEB-ENABLED GIS

Our proposed method of solution integrates Virtual Reality System and Web-enabled GIS technologies. We therefore describe each of these components as follows:

Virtual Reality

The term Virtual Reality was designated by Jaron Lanier, an important driving force behind this emerging technology (Vince, 1998). Balogun et al. (2005) defined Virtual Reality (VR) as a computer generated experience that submerges the common user to the point in which he believes that he is in another world, place or space. It is a special kind of simulation designed to convince users to a great extent that they are not actually within a computer simulated environment; a 3D computer-generated representation of a scene or object that gives the user a sense of reality and obeys laws of physics.

Owing to the upsurge of the Internet in the 90s, Virtual Reality Modeling Language (VRML) was developed as a programming language for modeling and visualizing objects, situations and virtual world on the Internet (Burdea and Coiffet, 2003; Carey et al., 1997). This constitutes a new means of communication that allows the construction and experimentation with new computer-modeled realities (Odeyale and Balogun, 2006). The latest advances in VRML are becoming popular. 3D scanning technology has been adopted in a number of recent projects in the framework of cultural heritage. For instance, 3D (plus color) scanners, allow the measurement of 3D artifacts such as art works (Cignoni et al., 2001).

GIS and Web Technologies

According to ESRI (1996), Geographic Information System (GIS) is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information. The major concern is to use GIS as a tool for communication between different interest groups like planners, decision makers, and the public. The rapid growth of the Internet provides highly customized, accessible, and interactive source of public information and is changing the ways that people capture and manipulate spatial information.

The implementation of a Web-based GIS could provide interactive mapping and spatial analysis capabilities for enhancing public participation and collaboration in decision-making processes (Nyerges, 1992). A public participation approach situates GIS analytical tools within an expanded framework of communication and discourse, opening opportunities for public participation. Public Participation GIS (PPGIS) is conceived broadly as an integrative and inclusive process-based set of methods and technologies amenable to public participation, multiple viewpoints, and diverse forms of information (Krygier, 1997).

Web-GIS Architectures

There are basically two types of architectures for developing Internet-based GIS applications: client-side, and server-side.

a.) Client-side: architectures allow the users to perform some data manipulation and analysis locally on their own machines. Some client-side applications even require users to install a complete client application (Plewe, 1997). The advantages of this model are its low workload on server and high interactivity at

client-side. The web server does not need to perform any computation, because all computing tasks are performed at the client side. With direct access to the database, the capability of client computer can be maximized to match the traditional client/server application and reserves the platform-dependent characteristic at client side concurrently (Ben and Chang, 1999).

b.) **Server-side:** architecture allows users (clients) to submit requests for data and analysis to a Web server. The server processes the requests and returns data or a solution to the remote client. In server-side Internet GIS applications, all the complex and proprietary software, in addition to the spatial and tabular data remain on the server (Plewe, 1997). The advantages of this design include simplified development, deployment, and maintenance. The major benefit for server-side computing is its true cross-platform capability at the client side. Since the input and output are both generic HTML documents, no special software or plug-in are required. Although this model provides an interactive two-way communication between users and information providers, it is slow because each time a request is made, a new HTML document has to be generated and transferred to the client (Ben and Chang, 1999).

RELATED WORKS AND THEIR LIMITATIONS

In the early 1990's, the United States Department of Justice, recognized the value of geospatial data and techniques in managing crime. They illustrated the value of GIS applications in identifying, visualizing, and analyzing crime trends both locally and regionally. Hence, the Regional Crime Analysis GIS (RCAGIS) was developed to provide police officers, crime analysts, investigators, commissioners, and sheriffs a powerful, yet easy to use crime mapping analysis and reporting application.

RCAGIS was designed to assist police departments in their tactical and strategic responses to crime and to help create an environment where police department personnel assume responsibility for increases and decreases in the amount of crime. RCAGIS operates in a PC environment and uses ESRI's Map Objects (Douglas, 2004).

In 2004, Information Technology Planning Management and Development of Goa, India was developed by Dr. P.k Pandley and Ruma Chakraborty to advice the government in developing and managing the tourism in Goa (Pandely and Ruma, 2004). Now that tourism has emerged as a major activity in Goa, the project also seeks to generate the maximum revenue and employment for the government.

Longametry et al. (2002) developed Ghana geographical information system (GGIS) which was used as a common platform to provide a spatial data bank with integrated multimedia features. It presents GIS in tourism management and promotion in Ghana on the desktop which provides critical data and information required to serve the tourism market.

Fajuyigbe et al. (2007) designed a web-enabled GIS for the management of tourism in Oyo State, Nigeria. The aim of this project was to design a technology for the development, management and promotion of tourism in Oyo state via Geographical Information System and the internet. The authors proposed an architecture that combines server-side and client-side design that enables the user to access the tourist sites using web-enabled GIS. This architecture does not incorporate Virtual Reality system which could give the potential tourist a real life experience of the tourist centers.

Fajuyigbe and Balogun (2007) presented a work on Web-Enabled GIS as a potential tool for sustaining tourism in Western Nigeria. It discusses how a Web-based Geographical Information System (GIS) was used as a potential tool for the rendering and analysis of tourism information for the efficient management, promotion and sustainability of tourism in Nigeria. The architecture used was similar to that of Fajuyigbe et al. (2007) with the exception that it was extended to cover several states in its implementation.

Having reviewed the above cited works, we observed that some of these projects do not make use of GIS. Those that use GIS are not web-based and those that are web-based do not bring in the advantage of allowing potential tourists to have next to real-life experience of touring the sites on-line. We therefore seek for a

solution methodology that allows potential tourists to have a fore-taste of the tourist attractions through immersive virtual tour.

PROPOSED SYSTEM ARCHITECTURE

Our proposed architecture uses a combination of both the server-side and client-side architectures in what we call a "hybrid" design. In this architecture, the user makes requests to the web server through the Web browser and the Web server generates the http response in form of an html page. The proposed architecture is shown below.

IMPLEMENTATION OF THE PROPOSED ARCHITECTURE: THE CASE STUDY

An Overview of the Study Area (Osun State)

There are more than 200 towns, villages, and other settlements in the State. The State covers an area of approximately 14,875 km^2. It lies between longitude 0400E and 0505S and latitude 05558N and 0807W. The State runs an agrarian economy with a vast majority of the populace employed in farming. The State also lies within the tropical rainforest with thick, deciduous vegetation in the southern part which becomes grassland towards the North.

Osogbo, the state capital, houses the National Grid of the National Electric Power Authority. In addition, a rail line cuts through the State Capital. Investment opportunities abound in the densely populated cities of the State. Yam, maize, cassava, millet, plantain, and rice are the major cash crops in the State. Lumbering and the growing and marketing of cocoa and kolanut are carried out on a large scale. The mining sector is yet to be exploited in commercial quantities. Osun State is also blessed with vast mineral resources. These include gold, clay, limestone, kaolin, and granite. It also has many agricultural resources.

Some Tourist Attractions in Osun State

Osun State is amply endowed with tourist attractions of both ancient (Ecology and Cultural) and modern origin. Tourist attractions of recent history reflect the efforts and contributions of the people and government to move Osun state forward into the new millennium.

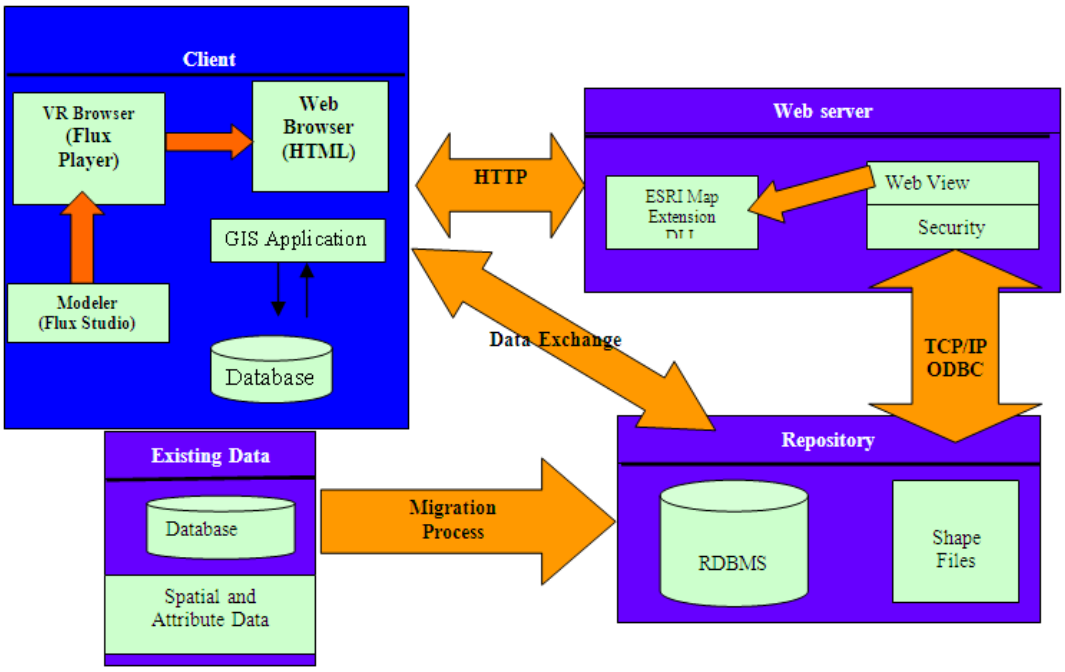

Figure 1: Architecture of the Web Enabled GIS for Virtual Tourism.

- Traditional/Cultural Tourism in Osun State: The War Gong

Figure 2: Front View.

Figure 3: Side View.

- Ecological Tourism in Osun State: Erin Ijesa Waterfalls

Figure 4: Waterbasin.

Figure 5: Firstfall.

- Tourism Attractions of Modern Origin

Figure 6: Ife National Museum.

Figure 7: OAU Museum Building.

METHODS OF DATA ACQUISITION

Data collection on the existing system for the project was done using both the primary and the secondary acquisition methods.

Primary Data: These are data collected through interviews and observation. The interviews conducted include members of the state tourism board, managers of state tourist centers, and employees of the Ministry of Information, Osun State. Also, data was collected through observation at each tourist centers (e.g., parks, lakes, hill sites, zoos etc.).

Secondary Data: Include data collected through tourism journals, books, existing and relevant literatures on tourism, GIS and computer graphics. Others include source information via the internet.

The GIS Data Design

The GIS data includes both spatial data and attribute data; the spatial data being a database that is in some way referenced to locations on the earth and attribute data which consist of additional information to the spatial data (e.g., images, texts, etc.). The core of the database, the spatial component, was developed using ESRI's Arc VIEW® software; it was also used as a front end development platform for enhanced cartographic presentation and visualization. (A hotlink to a feature on the map would display an image, a hotlink could be an image, a text file, an existing project or program).

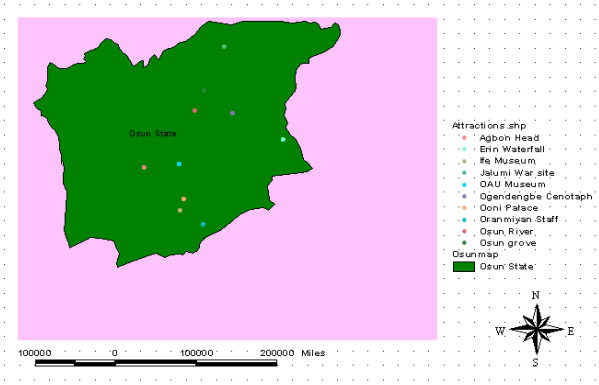

Figure 8: Attribute data (Hotlink)

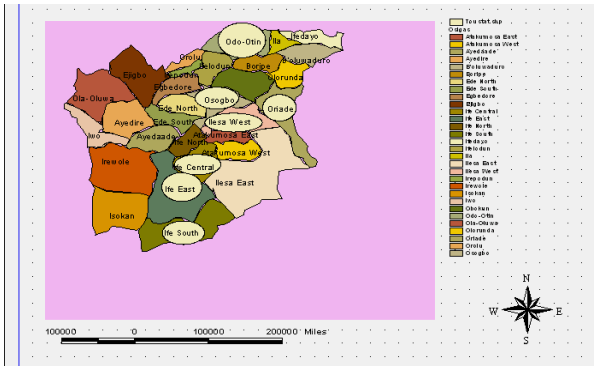

Figure 9: Major Tourist Site in the State.

DATABASE SPECIFICATIONS

The map shape files database was designed using Arc View's back-end (database) facilities, the database specification for the GIS shape files are shown explicitly below.

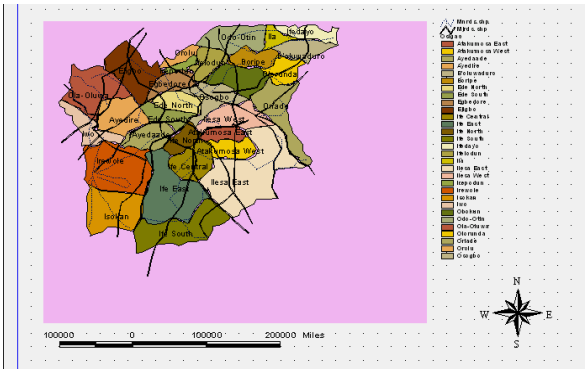

Figure 10: Road Network within Osun State.

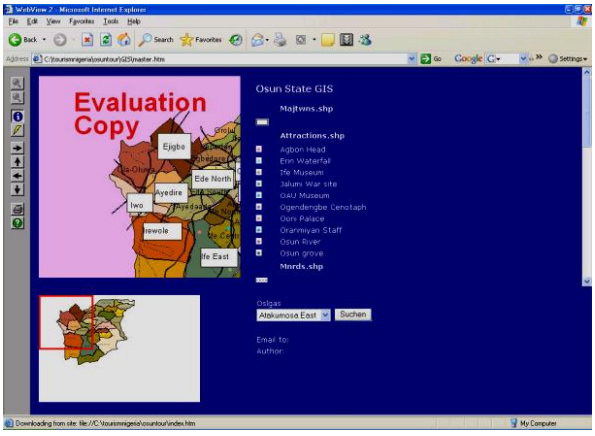

Figure 11: Tourist Centers GIS Page.

INTERNET GIS OUTPUT

The output generated by the queries on the internet was generated using Web View from the geo-coding engine Arc View.

The user enters the address of the site and the site gets running, the homepage is the first page to be seen by the user. It contains a heading and other links to the other pages on the website. The home page is shown below:

Figure 12: Homepage of the Proposed OsunStatetourism.com.

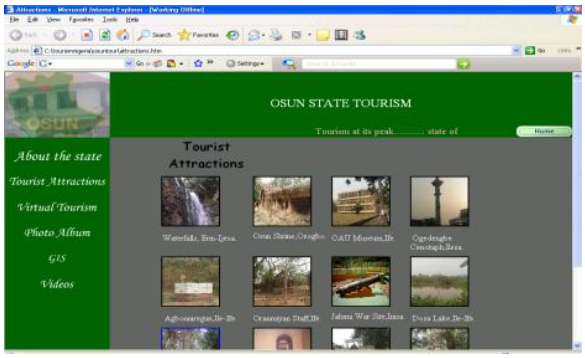

Figure 13: Tourist Attractions Page.

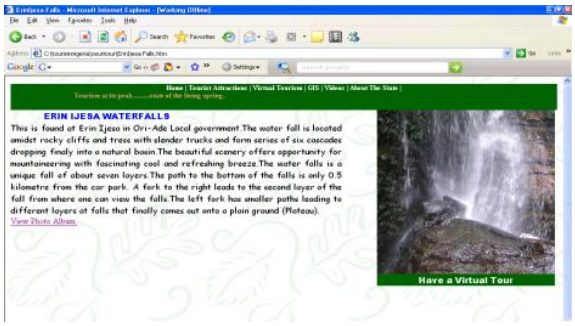

Figure 14: Erin-Ijesa Water Falls Tourist Center.

Figure 15: Oranmiyan Staff at Ile-Ife, Osun State.

Clicking on the "Have a Virtual Tour" link under the tourist attraction picture on a particular tourist attraction page will take us to the virtual environment of such tourism center. As an example, clicking on the "Have a Virtual Tour" link as shown in Figure 13 will take us to its virtual tour environment as shown in Figures 16 and 17, respectively.

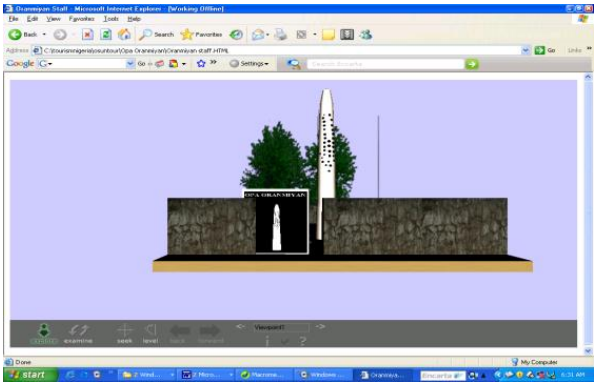

Figure 16: Virtual Tour of Oranmiyan Staff at Ile-Ife, Osun State.

Figure 17: Virtual Tour of Ooni Palace at Ile-Ife, Osun State.

Also, on the tourist attraction page of each tourism center, there is a link name View Photo Album that takes us to the photo gallery of such tourism center.

IMPLEMENTATION SOFTWARE

We here discussed some of the software we used in implementing the proposed architecture.

Client Side Component: At the client side of the architecture, Flux Player® was used to generate the Virtual Reality components of the model, while Flux Studio® was used to model each object in the tourist sites. Dreamweaver® was used as a platform for integrating the VR models with the output of the GIS application. ArcView® 3.2 was used to develop the GIS application, it also make use of an internal database that store the spatial information.

At the server side, Web View® was used to display the geo-spatial information captured by the GIS application and is connected to an ESRI Data Definition Language (DDL) Component.

The repository component of the architecture was implemented using a relational database management system (RDBMS) which enhances easy storage and retrieval of tourism information. It also allows migration of existing data from other applications.

The Architecture can be implemented both on Windows and Linux operating system.

CONCLUSION AND RESEARCH DIRECTION

We have shown in this paper that presenting tourism information with GIS and Virtual Reality via the internet could offer an unparallel platform for the management and promotion of the tourism industry. Tourism agencies, tourists, and the people at large would have access to comprehensive information and thus serve as a great source of motivation to boost the performance of the tourism sector. Adequate incentive can thus be assured for efficient marketing and promotion. In our future work, we hope to incorporate enhanced Map server, GIS, and Virtual Reality technologies that could enable seamless, efficient deployment of tourist sites on the internet.

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ABOUT THE AUTHORS

Victor Balogun (victobal@cs.umanitoba.ca) is presently a Ph.D. student of Computer Science and a Seasonal Instructor at the University of Manitoba, Canada. His current research interests include adaptive routing protocols for wireless mesh networks and evaluation of transport layer protocols for cognitive radio networks. He has also done extensive research in areas like Decision Support Systems, Virtual Reality Systems, Geographical Information Systems, and Mobile Computing. He received his B.Tech. degree in Computer Science from the University of Technology, Akure, Nigeria and his M.Sc. from the University of Lagos, Nigeria. He has worked as a System Engineer at Power Holding Company of Nigeria for several years after which he left to lecture at the Federal University of Technology, Akure in 2004.

Aderonke F. Thompson (ronkeniran@yahoo.com) obtained a B.Tech. degree in Computer Engineering from Ladoke Akintola University of Technology, Ogbomoso, Nigeria where she worked as a System Programmer/Analyst; and a M.Tech. degree in Computer Science from the Federal University of Technology, Akure, Nigeria. She started lecturing in 2006 and currently is a Ph.D. student in the Department of Computer Science, Federal University of Technology,

Akure, Nigeria. Her research interests are in wireless and telecommunication networks security, software engineering, artificial intelligence, and pattern recognition.

Oluwafemi A. Sarumi (sphemmy@gmail.com) is currently a M.Tech. Student and Teaching Assistant staff at the Department of Computer Science Federal University of Technology Akure, Nigeria. His research interests include Data mining and analysis, Biometric authentication systems and Software Engineering. He has also done research work in Virtual Reality Systems and Geographic Information Systems. He received his Diploma in Computer Science at the Federal Polytechnic Ede, Osun State Nigeria and B.Tech. in Computer Science at Federal University of Technology Akure, Nigeria.

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