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Developing a Web-Based GIS for Tourist Attractions and Cultural Heritage in Oyo Town, Nigeria

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Abstract:

This research focused on developing a web-based GIS for tourist attractions and cultural heritage in Oyo town, Oyo state, Nigeria. The study considered the present situation of tourism in the study area as it seems almost dead due to the lack of awareness programmes to push the state's tourism to the world market. Before tourism can be well-accepted by all and sundry, understanding the locations of the various tourist attractions need to be made known. The town lacks an up-to-date tourist guide map, including the non-availability of digital information for tourism. The study aimed at developing a web-based Geographic Information System (GIS) for tourist attractions and cultural heritage in Oyo town. The methodology involved database design and creation, satellite image georeferencing and onscreen digitizing in ArcGIS 10.8, spatial analysis, and publishing of a web map in ArcGIS online. Products generated included tourist maps, digital road network maps, and other thematic maps showing hotels, restaurants, markets, and police stations. The paper recommended that government should properly document all the tourist sites in Oyo town, develop a functional tourism database using GIS technology to better enhance the tourist experience, and that detailed information about tourism activities should be easily made available and accessible from the tourism database.

Keywords: Tourism, cultural heritage, geographic information system (GIS), web map

1. Introduction

Tourism is one of the world's largest and most rapidly expanding industries, contributing more than ten percent to global GDP and generating employment for 200 million people, according to annual research by the World Travel & Tourism Council (WTTC) (Ake, 2001). Most countries face management and promotional challenges because they use static methods such as brochures, books, posters, and television broadcasts, as well as websites with non-interactive maps to manage and promote tourism resources. The approaches are not only expensive due to information updates and expirations but also do not provide sufficient abstractions to guide tourists while planning for travel (Mango, Colak, and Li, 2020).

Technology plays a vital role in tourism, and it is crucial to the expansion of the industry. Information Technologies (ITs) and tourism are two of the most dynamic motivators of the emerging global economy. Both tourism and IT increasingly provide strategic opportunities and powerful tools for economic growth, redistribution of wealth, and development of equity around the globe. In the 21st century, the global economy is driven by three major industries: technology, telecommunication, and tourism (Adeleke, 2006). Tourism is a human activity that arises from consumers' economic consequences and preferences. It also has economic consequences, both good and bad, for nations and their regions (Holloway & Taylor, 2002). According to Khan et al. (2020), tourism development has some benefits, which include:

- Economic development,
- Capital investment,
- Agriculture development, and
- Energy development

Tourism has great to speed up progress across the economic sectors in a sustainable manner. Communities, therefore, need to understand the relative importance of tourism to their region, including tourism's contribution to economic activities in the area (Daniel, 2013). The potential for expansion of the tourism market, and the associated impact on economic growth, are especially high in Africa due to its abundant natural assets, such as beaches, wildlife, cultural heritage, and adventure opportunities (Nyasha et al., 2020). Food vendors, drivers of commercial vehicles, restaurants and hotels, and other goods and service providers maximize their gains, strengthening the economic capital of these communities. Palaces and the birthplace of great kings, battlegrounds of ancestors, and other significant cultural sites can be developed into tourist sites to generate revenue (Alisa & Ridho, 2020).

The tourism industry in Nigeria is developing, and Oyo state is fast becoming a leading destination for tourists in the country. With this new development, the government is making efforts through the tourism board to develop and maintain this sector as a major source of revenue for the state and country. With the global expansion in urbanization and the increasing stress of urban life, people search for places to relax and ease their stress and leisure, and the natural sites in Oyo state are obvious choices. The state is endowed with a wide variety of rich natural resources and cultural features that can be productively utilized for its tourism development. 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. GIS integrates and relates data with spatial decisions through visualization, interactive modeling, and analysis environments. A Web GIS is a GIS application made available through a common web browser; it could be further developed to allow many more people to have access to GIS functionality and to enhance community participation in planning. Web-based GIS consists of the following system components:

- A client for sending a request through a web browser,
- A web server with an application server, and
- A data server

The components would be integrated to develop a web-based GIS portal for Oyo town. Web-based GIS is one of the newest fields in Geographic Information systems for web-based map creation. Different software and technologies are used to develop web mapping using commercial, open-source, and public software. A web-based GIS application allows users to access GIS with its basic functionalities like searching locations, getting directions, zooming, panning, and printing maps via web browsers. Web-based GIS brings a lot of ease to users (Shen et al., 2008). Web-based GIS applications enhance the capabilities of users in three different directions.

The first one is the access to spatial data and different information; with the web-based environment, a simple GIS gets the ability to become interactive, dynamic, and accessible to large groups of users as a visual communication tool.

The second one is spatial data exploration and geo-visualization, which offer business-minded people support for better decision-making for their business.

The third one is processing, analyzing, and modeling spatial data (Dragicevic, 2004).

Web tourism is one of the trending ways of exploring the world of tourism to the world. However, this study will not only leverage web tourism but integrate web tourism with GIS technology, thereby bringing precision in the location of tourist centers, hotel facilities, eateries, etc., to the web interface. Here, tourists around the world will be able to run spatial interaction among the tourism facilities, which comes easier on the platform of Online ArcGIS software by ESRI. The customized webpage for this study can be found at:

<https://storymaps.arcgis.com/stories/d50afcd02af7462abeacee4ba02ed37a>

2. Study Area

Oyo is an ancient city in Oyo State, Nigeria. It was founded as a capital of the remnant of the historic Oyo empire in the 1830s. Its inhabitants are mostly the Yoruba people, and its ruler is the Alaafin of Oyo. Oyo has a total area of 2,427 km² with an estimated population of about 573, 474 in 2022. Tourist sites in Oyo town include: the Old Oyo national park, Aafin, Erelu dam, Akesan market, Owode market, Ajegunle market, Opa oranmiyan, Ogun shrine, and so on. In Owode market, one of the items that are dominantly purchased is the talking drum, while in Akesan market, one can find some traditional items that are used for sacrifices.

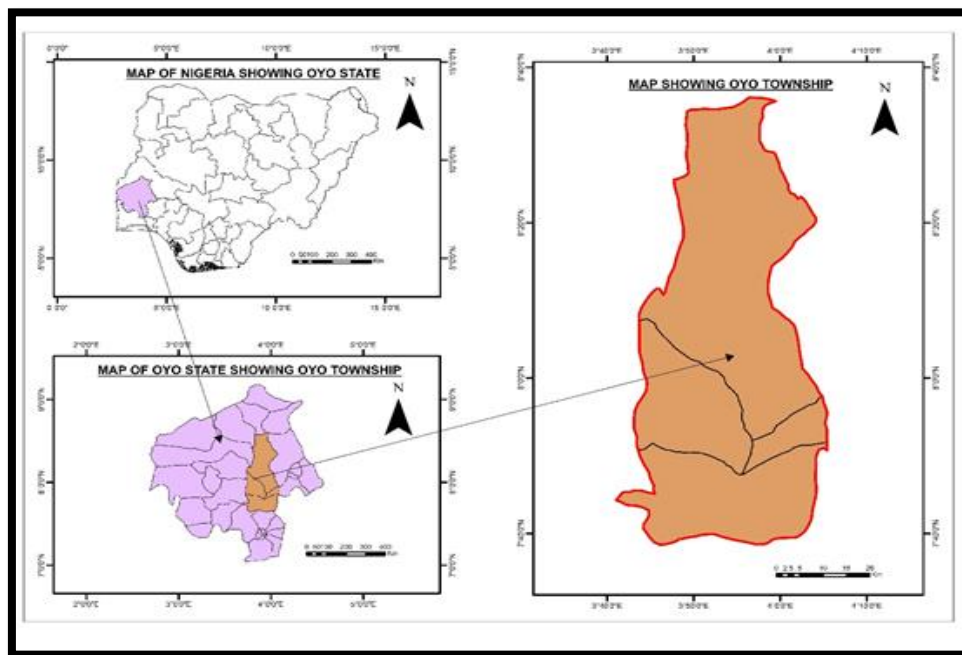


Figure 1: Map of Study Area

3. Brief Historical Review of Tourism in Nigeria

As a result of the decline in the oil revenue generated by the Nigerian government and the fallout from the global financial crisis, the Nigerian government has been looking for other ways to generate revenue to stimulate the country's economy. The Nigerian government selected the Tourism sector as one of the sectors crucial to its economic survival - part of the government's seven-point economic growth agenda and its 2020 program for sustainable economic development (NTDC, 2010). The government anticipates that the tourism sector's repositioning will make it a major source of revenue generation (NTDC, 2010).

Tourism in Nigeria dates back to the 1920s when some foreign geologists and archaeologists discovered some ancient terra-cotta about the Nok culture (Esuola, 2009). However, it was not until 1962 that organized tourism began in the country with the creation of the Nigerian Tourist Association by a group of tourism practitioners in the country (NBS, 2010). The efforts of the Nigerian Tourist Association led to Nigeria's admission into the International Union of Official Travel Organization (IUOTO), now the World Tourism Organization (WTO), in 1964 (Esuola, 2009). Tourism was subsequently placed under the Federal Ministry of Commerce and Tourism. The Department of Tourism was established under the statutory act as amended by the official gazette no. 15 vol. 75 of March 3, 1989 (FMI, 1999), and in 1976 the Nigerian Tourist Board was established by the then head of state, General Olusegun Obasanjo, under decree 54 of August 8, 1976 (FMI, 1999).

The Federal government formulates policies and key implementation strategies for sustainable tourism development in Nigeria. A dedicated Ministry of Culture and Tourism located at the Federal Secretariat Abuja is charged with the policy initiation and maintenance of relationships with States and Local governments on issues relating to tourism, as well as overseeing sustainable tourism development. The Culture and Tourism Ministry carries out this function through the Nigerian Tourism Development Corporation, an agency set up by an act of parliament. The tourism department is divided into two subdivisions. These are Tourism Development and Promotion Division (TDPD) and the International Cooperation Division (ICD) (Esuola, 2009).

The TDPD deals with tourism planning, tourism facilitation, tourism legislation, travel assistance, and incentive policies. Basic data travel-related statistics compilation and computation, tourism information documentation, market surveys for domestic tourism organizations, planning coordination and evaluation, education and training, and budget and incentive funds. While the International Cooperative Division deals with bilateral and multilateral cooperation, exchange of technical information with the international organization, technical cooperation, and relationship with The UN World Tourism Organization (UNWTO), WTO Africa Commission, Economic Commission for Africa, European Economic Community (EEC), Economic Community of West African States (ECOWAS), United Nations Development Program (UNDP).

Tourism is all about the activities of persons away from their familiar environments of the home and workplace for a while and the facilities and services provided to enable them to meet their felt needs both in transit and at the destination area (Dantata, 2005). It can be defined as the temporary movement from home to an unusual place for business, recreation, sightseeing, visit, or points of interest, whether near or far. The place of interest can vary from one person to another. A hotel, nightclub, restaurant, or park can be a place of interest to one person, and for another, it may be historic sites, conservation sites, and other outdoor places within a city or urban center. Tourism management can be enhanced by GIS technology which provides a toolbox of techniques and technologies of wide applicability for achieving sustainable tourism management. Attribute information on the various tourism facilities collected from different sources can be linked to their respective spatial features.

4. Historical Facts about Oyo Town

Earlier efforts to protect the cultural heritage of societies across the globe had focused primarily on material (tangible) expressions, such as monuments, the built environment, architecture, and smaller-scale artworks (Ahmad, 2006). The tangible (material) aspects of the New Oyo empire that constitute cultural heritage resources include: monuments, historic public buildings, homes, farms, castles, cathedrals, museums, and archaeological ruins and associated relics (Dallen & Gyan, 2009). Most of the previous investigations of Oyo history focused on the Old Oyo empire, including studies by Clapperton (1929), Clarke (1938), Walters (1954), Willet (1960), Agiri (1975), Sowunmi (1979), Soper and Darling (1980), Agbaje-Williams (1983), Soper (1993), Aremu (2000), Folorunso et al. (2006), and Olukole (2008). Despite these works, there is still a scarcity of information about the New Oyo. Accordingly, there is a need to document the cultural resources of the New Oyo and their prospects for sustainable cultural tourism and commemoration. The vitality of the Old Oyo empire until the late 18th century was attributed to the effective rule of an Alaafin named Sango. The Alaafin served as the supreme judge within the Oyo empire. His was the final court of appeal, and he often represented a sense of sodality and honor for the people through intertwined roles of administering law, governance, and resolutions of equity (Salami, 2006). Sango was a descendant of Oranmiyan, who was, in turn, a descendant of Oduduwa, a founding figure among the Yoruba people. As such, Sango in Yoruba history and tradition was held in high esteem, and the importance of Sango can be observed in the shrines of both the Old and New Oyo empires. The expansion of the Old Oyo empire met with resistance in the 14th century from the Borgu and Nupe polities, who feared that Oyo might take a strategic position in the trans-Saharan trade to their detriment (Okpoko, 1998). With the conquest and expansion of the Oyo empire between the 15th and early 19th centuries, the Oyo became one of the largest polities in Africa, covering most of the region encompassed by Yorubaland, the Benin Republic, and Togo (Oguntomisin, 2002). Although political power within the Old Oyo empire was broken by the Fulani Jihad war of the 19th century, the New Oyo kingdom remains a salient point of historical reconstruction and preservation of modern cultural heritage. The construction and layout of the New Oyo kingdom are, to much extent, a similitude to the Old Oyo empire. However, with colonization and industrialization, cultural values and practices also shifted to create distinct facets of the New Oyo empire (Olukole, 2009). In the Yoruba tradition, great importance is attached to the first son of a king, popularly referred to as 'Aremo Oba.' The first son is honored as the heir to the seat of his father. He is given much honor and power among the subjects of the king in the traditional Yoruba kingdom. In the New Oyo, however, the Aremo's seat no longer exists. Therefore, his house lies abandoned. This abandonment could explain the still-standing ruins of the mud house, known as the Aremo house in the Old Oyo. The ruins of this packed earthhouse reveal the type of architecture that characterized the settlements of the ancient Oyo. According to Watters (1954), the Aremo's packed earth house of the Old Oyo was probably reinforced with palm oil which served to 'water-proof' the materials against rain. This view is corroborated by the findings of Irvine (1969) about shea butter (*Butyrospermum paradoxum*) and palm oil (*Elaeis guineensis*) being used as water-proofing substances in the construction of packed earth houses, thereby reducing surface erosion of the walls. This use of shea butter or palm oil probably accounts for the durability of mud walls in the humid tropical environment of Nigeria. It is worth noting that most of these packed earth houses that characterized ancient Yoruba architecture have today been replaced by structures made of concrete. Many of today's town halls, meeting places, and compounds (known in Yoruba as 'Agbo-Ile') are now built using modern concrete but remain in a replicated settlement pattern like the Old Oyo. The New Oyo compound, consisting of the palace and the Akesan market, is located in the central part of Oyo town. Opposite the New Oyo palace stands the Old Oyo palace, said to be constructed by Atiba Abiodun, the ruling Alaafin who founded the New Oyo, known as 'Agodi Oyo,' between 1837 and 1838. The palace at the New Oyo, like the Old Oyo, is surrounded by a perimeter wall. However, the Old Oyo palace was approximately six times the size of that of the New Oyo. This New Oyo compound and courtyard system is a basic and traditional Yoruba arrangement involving a group of households (Agbaje-Williams, 1983). The compound system consists of a house or compound of many rooms, each inwardly facing a large open courtyard. As for the palace area and gates, they are all replicated in the New Oyo, while the tradition of locating the Akesan market near the king's palace was also upheld in the New Oyo. The closeness of both the old and new Akesan markets to the king's palace is typical of what obtains in all Yoruba towns (Mabogunje, 1962; Ojo, 1966). Within the New Oyo palace complex, there is an inner gate that encloses the king's court. At this entrance, there are several works of art, such as wood carvings typical of Yoruba royal palaces. Within the palace are rooms known as an ode. The ode provides residential space for the king's attendants and representatives, the king's trumpeters, the king's guests, and the head of the king's slaves or mapenpa. Some other buildings lie southwest of the palace. Other rooms within the Oyo palace include Ile Igba, Adodo Kekere, Ile Imole, Ilesanyin, Inaso, Adodo, Ile Ori, Olorunkumefun, Iyake, Ile omokunrin, Oriloye, and Ita Ile loke. Within the palace area of the modern Oyo is a museum that houses art and craftworks typical of both the New and Old Oyo empires.

5. Tourist Attractions and Cultural Heritage in Oyo Town and Its Environs

The following are the available tourist attractions and cultural heritage in Oyo:

5.1. Old Oyo National Park

Old Oyo National Park is one of the national parks in Nigeria, located across northern Oyo State and southern Kwara State, Nigeria. The park takes its name from Oyo-Ile (Old Oyo), the ancient political capital of the Oyo Empire of the Yoruba people, and contains the ruins of this city. The Old Oyo National Park was previously a habitat for the endangered West African wild dog (*Lycaon pictus manguensis*). However, none now exists in the park due to hunting pressure and the expanding human population in the region. The following are the animals in the park ostrich, tortoise, bird, a herd of western hartebeests, grey heron, grey-headed kingfisher, kobs (Kobus kob) antelope, royal python, forest, and museum.

5.2. National Museum, Aafin Oyo

Within the palace area of the modern Oyo is a national museum that houses art and craft works typical of both the New and Old Oyo empires. The first section of the museum has images of the Nok Terra-cotta, the Igbo Ukwu Bronze artifacts, the Ife Bronze head, the FESTAC 77 logo, and items from Owo, Benin, and some other parts of Nigeria. The next section of the museum hosts some Yoruba traditional religious items that might not look like museum material to some culture bearers. There is an èrè ibejì (carved image of a twin), a staff of Sàngó (god of iron), carving of Èsù (devil), and a big Ifá divination bowl (Ọpón Ifá). The big divination bowl is used for communal divination, and it can only be accessed by three high priests. The most impressive item in the museum is a small ante-room carved out as a Sàngó section. Considering that Sàngó is an essential figure in Ọyọ history, this section has life-size carvings of Sango and his wives. It is also painted red for emphasis. At the entrance of the ante-room is a colonial section with a big coal stove that belonged to the former Anglican missionaries. A picture of the house where Captain W. A. Ross, District Administrator of the Ọyọ Division, lived in Ọyọ is displayed. Images of some colonial tombs and a church building inside the old Saint Andrews College are also displayed.

The museum also has a section for Gẹ̀lẹ̀dẹ masks, Ẹpa masks, and the carvings of a hunter in his full element. The section also has a big Ayò Ọlópón which was carved like an Ifá divination board, complete with the figures. The carving shows an intersection between Yoruba spirituality which Ifa embodies, and the recreational life of the people. It suggests tolerance rather than the profanity of the sacred. One of the few things that are common to all Nigerian museums is the currency section which exists in the Ọyọ Museum too. The section traces the history of legal tender in the country, from cowries to the British Pounds and the modern Nigerian Naira now in use. The last section of the museum is the drum section, with a display of drums and an old doorpost. The doorpost was used to carry messages about the places they secured. The doorpost at the museum had carvings of people farming, hunting, and fishing. Those were the common occupations in the town where the doorpost existed.

5.3. Erelu Dam

Erelu dam is located about 6.4 km northwest of Oyo Town, southwestern Nigeria, on an impoundment area of 1.61 km and a catchment area of 243.36 km². It is a gravity dam built on River Awon. It lies within latitude 7° 53'0" - 7° 55'30" North of the equator and longitude 3°53'30" - 3°56'0" East of the Greenwich meridian. The area is well drained by River Awon jointly with tributary streams such as Iwon, Ilaka, and Oriko, flowing east-westward and following the topography to form a dendritic drainage pattern. The dam is located in a tropical savannah climate with two distinct seasons, wet and dry, from April to October and November to March, respectively (Iloeje, 1981). It serves as a principal source of water supply to an increasing population of Oyo township.

5.4. Ese Oloja Hill

The hill is located along Imini road in Ilora town. The hill is a twin hill, and tradition has it that the bigger hill is named the wife while the smaller hill is named the husband. A church is built on the hill by the Christ Apostolic Church (CAC) Mission. People from far and near, including Europeans, visit the hill any time of the year, and C.A.C. members from all over the world converge on the hill (church) annually for special worship service.

5.5. Ifeniyi Hill

This hill is found at Oke Isanmi in Ilora town. It was the first place of settlement for the forefathers of Ilora people who migrated from Ile-Ife town. It is believed that people lived on the hill before the expansion of Ilora town to its present size. It is also believed that the hill provides security (protection) to the people, especially from wars and external aggression.

5.6. Obanako (A Big Tree)

Obanako is a Deity that was worshipped in Ilora town before this modern age. It first settled within the community, and when people defiled it, Obanako decided to leave the community for a place called Oluwatedo, now known as Obanako Settlement. The Deity surrounds itself with a chain. The people believed that the Obanako was an intermediary between them and God. They also believed that it gave them protection during wars. They have a popular song they sing in praise of Obanako's power of protection thus:- (Ogun nle mi bo wa o, Obanako gba mi o!) meaning I am pursued by war; Obanako, rescue me o!

5.7. Orisa Popo (Mystery Water)

This is a Deity found in Ilora Town. The Deity was worshiped by Ilora people before the advent of Christianity and Islam. Today, the Deity is being worshiped in the month of June every year to coincide with the harvest of the new yam. It is being worshiped for three (3) good days. It is believed that the Deity has the power of protection, healing, and provision. If there is a misunderstanding between two Ilora people or if one person cheats another, the person cheated will invoke the spirit of Popo river to judge between them.

5.8. Sogidi Lake

Sogidi lake is found in Aawe town. It is believed that Sogidi is a female human being turned into a lake and that she lives in the lake till today. Half of its body is fish, while the remaining half is the human body. Sogidi is worshiped by the people of Aawe yearly, and during the annual festival, Sogidi will come out of the lake. It was believed that Sogidi had

the power to heal and give babies to barren women. In every month of October, when Aawe Day is celebrated, Aawe Indigenes and visitors pay homage to the Lake to ask for blessings, protection, and long life.

5.9. Igi Omo

Igi Omo is an ancient tree owned by the Alajoguns (witches and wizards). The tree is found in Ilora town. It was believed that if a leaf was plucked from the tree by anybody, bad things would happen to the person. All efforts put forth to cut the tree by both the indigenes and Europeans have failed. For any part of the tree to be used, the Alajoguns must be consulted.

5.10. Odo Eegbe

Odo Eegbe is a merciful and lenient river found in Fiditi town. The Oba and people of Fiditi appease the god of Eegbe river, especially during the dry season when water is difficult to get, with a bucket full of water poured inside the river. Before getting home after the rituals, they will all be soaked with rainwater. On getting to town, enough water will be found everywhere - wells, streams, and rivers. An annual festival is held for the river.

5.11. Aribonbo Sana – Iyawo

This is a Deity found in Ilora. Every woman married into Aribonbo community is bound to dance around the Deity after the birth of her baby.

Other attractions to potential tourists in Afijio Local Government area are:

- Kuntanti Shrine at Aawe Town
- Oke Ajadi at Fiditi Town
- Yemoja at Akinmorin Town
- Erugun Ati Ilu Aje Town

6. Methodology

The step-by-step procedure adopted in carrying out this research is documented in this section. It covers database design, data source and data acquisition, system selection, data conversion, database creation, security, and maintenance.

6.1. Database Design

Database design constitutes one of the core tasks in developing any GIS application. It involves the process by which real-world entities and their interrelationships are analyzed and modeled to derive the maximum benefits while using the minimum quantity of data (Kufoniya, 1998). The design phase for this study consisted of three stages, namely:

6.1.1. Conceptual Design

The objective is to determine the basic entities, the spatial relationships among the entities, and the attributes of each entity that supports the process and the application for which the database is designed. The vector data structure in which points, lines, and polygons were used to represent spatial entities was adopted for this study.

6.1.2. Logical Design

For this project, the relational data model was used. In relational database structures, data are stored in simple records known as Tuple (row) containing a set of attribute values that are grouped in two-dimension tables known as relations. Each table contains items or data called fields about some objects. The objects are found along rows and fields or attribute values along columns.

6.1.3. Physical Design

This is the representation of the data structure in the format of the implementation software.

6.2. Data Acquisition

6.2.1. Primary Source

This process involved the collection of primary data, that is, location data of the tourist attractions, police stations, hospitals, hotels, and market field observation using KoBoCollect Application which was later uploaded to ArcGIS online platform.

6.2.2. Secondary Source

Satellite image of the town was georeferenced and digitized in ArcGIS 10.8, while some pictures of the cultural objects were taken from the National Museum Aafin Oyo, Old Oyo national park, and Erelu Dam.

6.3. Database Creation

The database was created and populated in Microsoft Access 2019 and then transferred to ArcGIS environment. Polygon, Line, and Point layers were created respectively for study area boundaries, Roads, Tourist Attractions, Police Stations, Hospitals, Hotels, and Markets data.

ID	Name	Type	Management	Location	Year_of_Est.	Peak_Period
1	Erelu Dam	Dam	Government	Oyo	1961	Mar. to Sept
2	National Museum Aafin, Oyo	Museum	Government	Oyo	2003	Anytime
3	Old Oyo National Park	Park	Government	Oyo	1952	All year round
4	Sogidi Lake	Lake	Traditional Ruler	Aawe	1750	All year round
5	Ese Oloja Hill	Hill	Traditional Ruler	Ilora	No information	All year round
6	Ifeniya Hill	Hill	Traditional Ruler	Ilora	No information	All year round
7	Obanako	Deity	Traditional Ruler	Ilora	No information	Anytime
8	Orisa Popo	Lake	Traditional Ruler	Ilora	No information	Anytime
9	Igi Omo	Tree	Traditional Ruler	Ilora	No information	Anytime
10	Odo Eegbe	River	Traditional Ruler	Fiditi	No information	Anytime
11	Aribonbo Sana-Iyawo	Deity	Traditional Ruler	Ilora	No information	Anytime
12	Kuntanti Shrine	Deity	Traditional Ruler	Aawe	No information	Anytime
13	Oke Ajadi	Hill	Traditional Ruler	Fiditi	No information	Anytime
14	Yemoja	Deity	Traditional Ruler	Akinmorin	No information	Anytime
15	Erugun	Deity	Traditional Ruler	Ilora	No information	Anytime
16	Ilu Aje	Deity	Traditional Ruler	Fiditi	No information	Anytime

Table 1: Tourist Attractions and Cultural Heritage as Implemented in ArcGIS Online

7. Spatial Analyses and Information Presentation

GIS is different from every other information system because of its spatial analytical capabilities, which integrate both spatial and non-spatial data to answer questions relating to spatial problems in which location is a critical factor. The spatial analysis uses spatial information to extract new and additional meaning from GIS data. Among its abilities are measurement techniques, spatial search, attribute queries, proximity analysis, overlay operations, and analysis of models of surface and network analysis.

7.1. Buffer Analysis

This is a spatial function in which a zone of interest is created around a given feature or object. It is often used to demarcate areas affected or not affected by a spatial activity or to show the extent of coverage of an activity. The buffer operation in this study determined the level of coverage of the tourist attractions and cultural heritages. A buffered distance of 1km was used to identify the facilities that are available within the buffer zone. The facilities include: hotels, markets, hospitals, and a police station (figure 3).

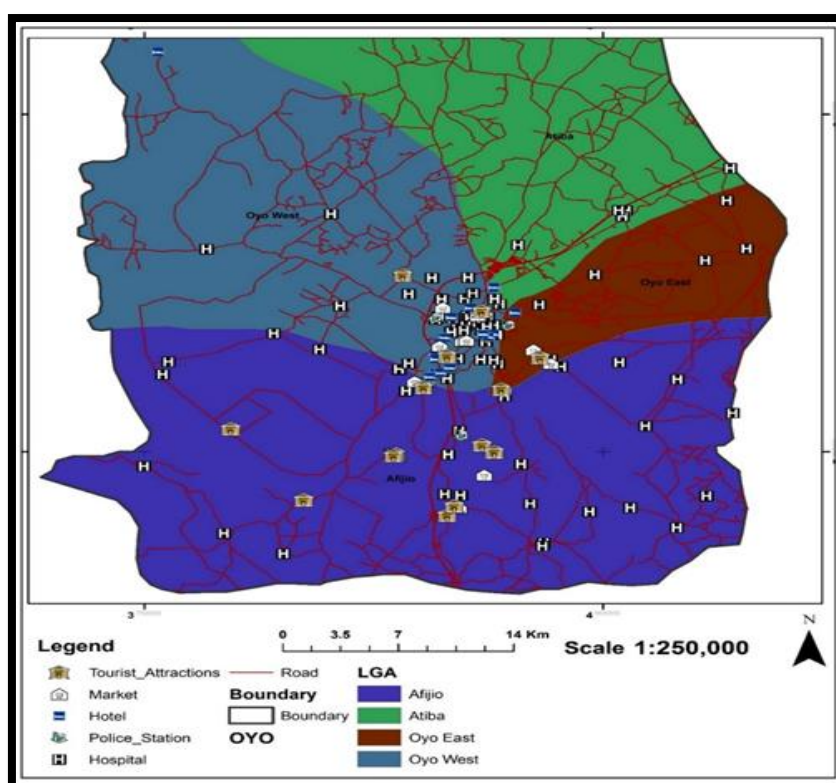


Figure 2: Composite Map of the Study Area

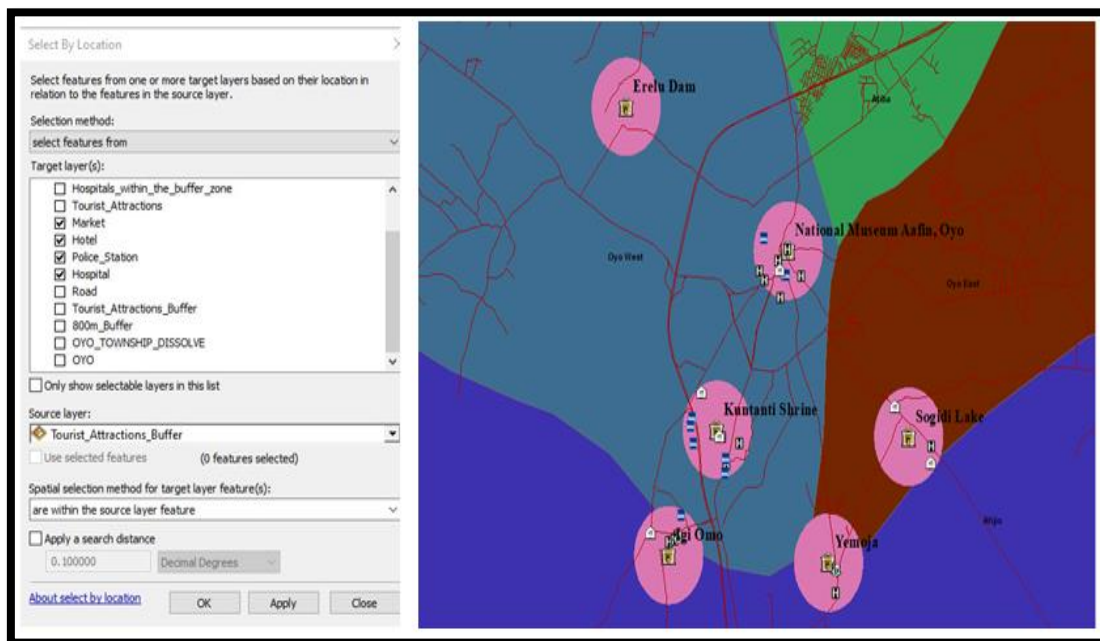


Figure 3: Facilities within 1Km Buffer Distance from Tourist Attractions

Figure 3 shows the tourist attractions buffered by 1km. The analysis revealed that 9 out of 21 hotels, 7 out of 11 markets, 2 out of 6 police stations, and 16 out of 91 hospitals are within the 1km buffer coverage. This implies that intending tourists may have to travel beyond 1km to access some of these facilities depending on the particular tourist attraction or cultural heritage they are visiting. For instance, in Oyo west, there are more facilities and many tourist attractions/cultural heritage compared to Atiba, where there are fewer facilities and tourist attractions/cultural heritages.

7.2. Spatial Search

This common GIS analysis searches for certain attributes in the neighborhood, which must be logically defined. The search operation is used in GIS to search for a particular area of interest. It is used to process and manipulate data to generate needed information used in decision support systems.

7.2.1. Query 1 (Single Criteria)

Select by attribute from Tourist Attractions, Tourist attractions whose location is Ilora. Syntax ('Location' = 'Ilora')

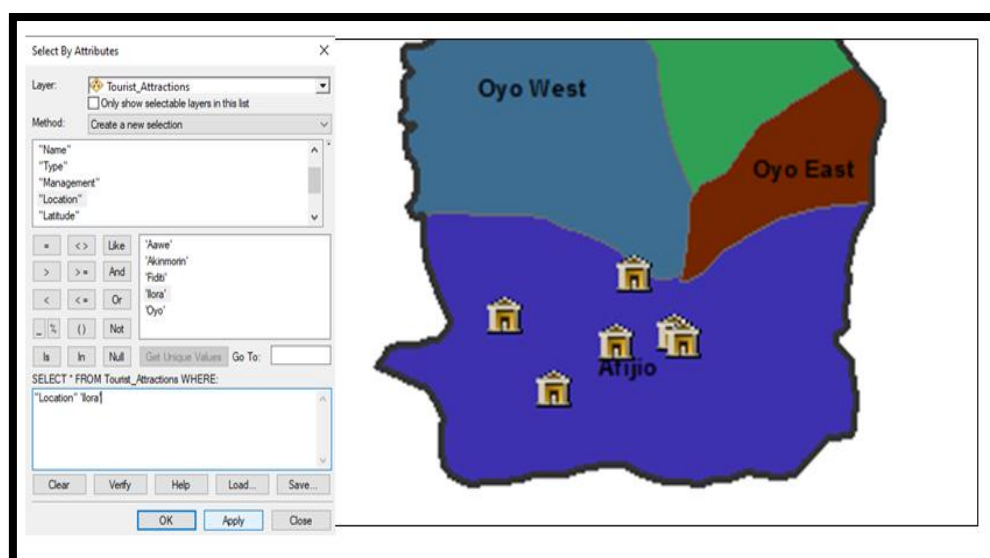


Figure 4: Query Showing Tourist Attractions Whose Location Is Ilora

The result shows that the following tourist attractions are in Ilora: Ese Oloja Hill, Ifeniya Hill, Orisa Popo, Igi Omo, Arimonbo Sana-Iyawo, and Erugun.

7.2.2. Query 2 (Single Criteria)

Select by attribute from hotels, hotels with an average charge between N10,000 to N20,000. Syntax ('Ave_Charge' = 'Between N10,000-N20,000')

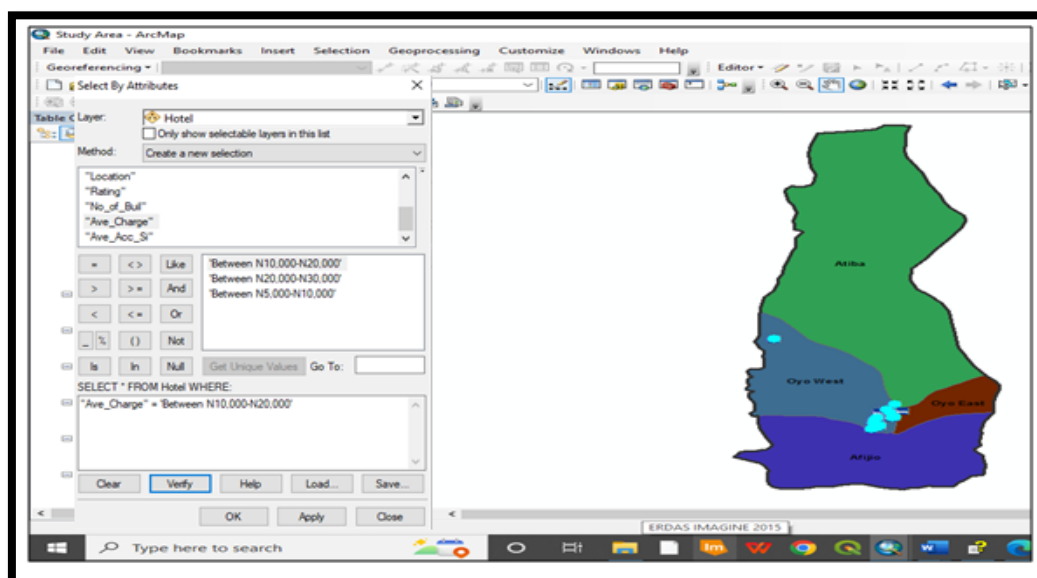


Figure 5: Query Showing Hotel Rates between N10,000 and N20,000

The result shows hotel rates from N10,000 to N20,000. The result shows that thirteen hotels out of twenty-one hotels have an average charge between N10,000 to N20,000 which shows that a large percentage of the hotels is between this average charge hence making it affordable and their facilities are okay. All thirteen hotels have three stars rating.

7.2.3. Query 3 (Multiple Criterion)

Select by attribute from hospitals, hospitals that are owned by the private and its local government area is Oyo west. Syntax ('OWNERSHIP' = 'Private' AND 'LGA' = 'Oyo West').

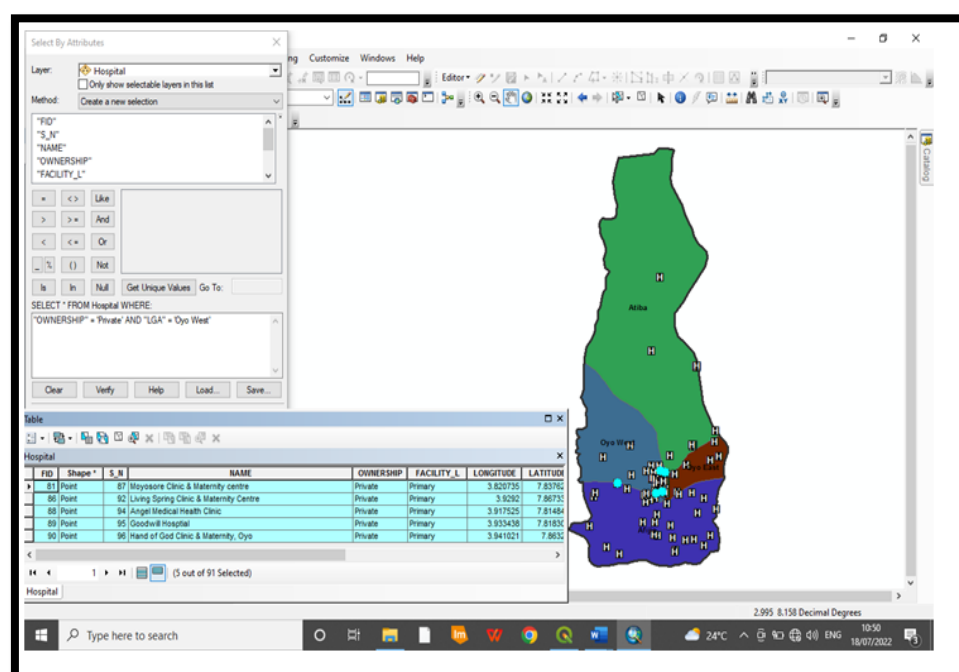


Figure 6: Query for Hospitals Owned by Private and Their Local Government Area in Oyo West

The result shows the hospitals owned by private practitioners with locations in Oyo West Local Government Area. The hospitals include Moyosore Clinic & Maternity centre, Living Spring Clinic & Maternity Centre, Angel Medical Health Clinic, Goodwill Hospital, and Hand of God Clinic & Maternity.

7.3. Network Analysis

Network Analysis deals with a set of interconnected linear features such as roads, railways, power lines, sewage pipes, telephone lines, etc. It is a tool for analyzing the structure of a network. ArcGIS Network Analyst solves common network problems, such as finding the best route across a city, finding the closest emergency vehicle or facility, identifying a service area around a location, or servicing a set of orders with a fleet of vehicles.

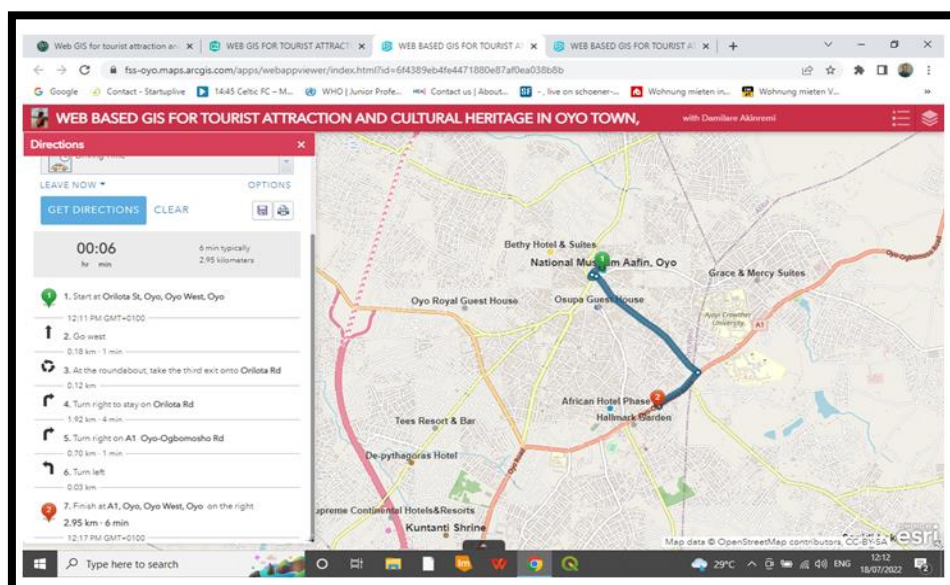


Figure 7: Web Map Showing the Best Route from National Museum Aafin to Babifona Resort

Network analysis (figure 7) showed the best route from National Museum Aafin, Oyo, to Babifona Resort. The best route is shown in the blue line.

7.4. Design and Implementation of Web GIS for Oyo Town

ArcGIS Online was used to design and implement web GIS for tourist attractions and heritage for the study area, and ArcGIS Story Map was used to design the website. The web page consists of several interfaces, including the home page, an Interactive map, and pictures of some tourist attractions. It is an online database management system that reveals the tourist attractions and cultural heritages in the study area with facilities around them. The facilities include: hotels, markets, hospitals, and police stations. The home page for the website can be found at: <https://storymaps.arcgis.com/stories/d50afcd02af7462abeacee4ba02ed37a>

Figure 8 shows the Web GIS home page with a legend containing all the map layers which users can explore to identify tourist attractions and other facilities. Figure 9 (a – e) shows pictures of what tourists are likely to see at the sites.

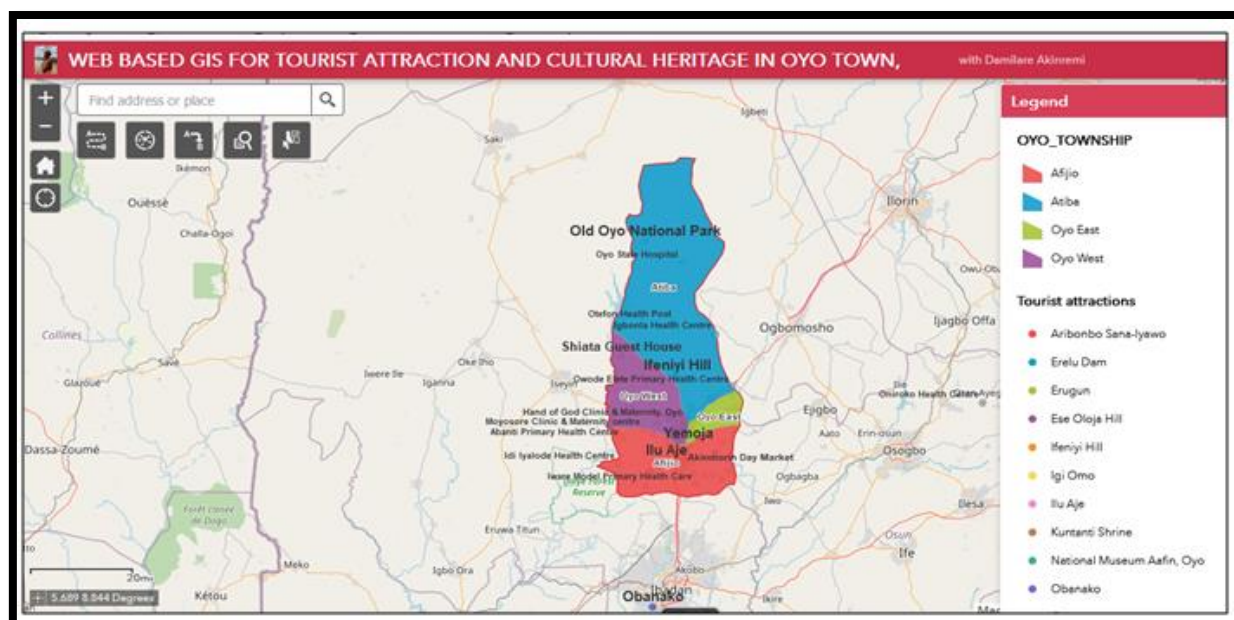


Figure 8: The Home Page of the Web GIS for Tourist Attractions in Oyo Town



Figure 9: Some Artifacts in Oyo Museum



Figure 10: Erelu Water Works



Figure 11: Old Oyo National Park



Figure 12: Old Palace of the New Oyo Empire

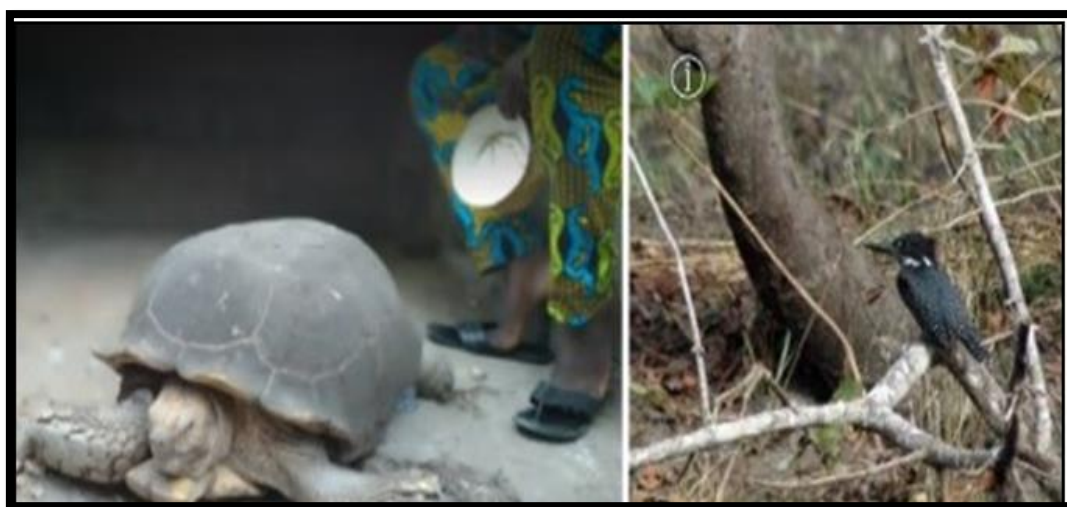


Figure 13: Old Oyo National Park

8. Conclusion and Recommendations

The efficiency of tourism management has been greatly enhanced in this research by GIS. This research has revealed the tourist potential in Oyo town, Oyo State. The tourist sites include: physical attraction sites, cultural heritage, and museums. A spatial database and a digital road network for decision support in tourism management have been created. This spatial database created can be manipulated to answer basic generic questions, which can help tourists, tourism managers, planners, policy-makers, and the tourism industry, in general, to achieve sustainable tourism development and provide better facilities and services to cater to the needs of the tourists and the environment. This project identified that the information needs of the tourist, tourism managers, planners, policy-makers, and the tourism industry are hardly met with a manual system. Hence, a computer-based system was employed, and a web-enabled medium was also developed. Data are easily entered into the database, and it is possible to generate reports for decision-making, statistical reports, and research purposes. The following are recommended in light of the findings of this study:

- Oyo State tourism board should look into the possibility of adopting web-based GIS for tourism development in the State and for improved internally generated revenue in the state.
- All tourist sites, cultural heritages, and other facilities in the state should be properly mapped and documented in a GIS database.
- Detailed information about tourism activities should be easily available and accessible from the tourism database.

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