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DEVELOPING WEB-BASED GEOGRAPHIC INFORMATION SYSTEMS AS A TOOL FOR PLANING AND PROVIDING TOURISM RESOURCE IN ADDIS ABABA CITY, ETHIOPIA

BY

ABIY HAILEMARIAM MAMO

JUNE, 2021

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APPROVAL SHEET

This is to certify that the thesis prepared by Abiy Hailemariam entitled asDeveloping Web-Based Geographic Information Systems for Tourism Planning and Management for Addis Ababa Cityis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Tourism Development and Management compiles with the regulations of the university and meets the accepted standards with respect to originality and quality.

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DECLARATION

I declare that, this thesis prepared for the partial fulfillment of the requirements for the Degree of Master of Arts in Tourism Development and Managemententitled "Developing Web-Based Geographic Information Systems for Tourism Planning and Management for Addis Ababa City" is my original research work prepared independently by my own effort with the close advice and guidance of my adviser. I also declare that this thesis has not been presented in any university and all sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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Signature: _____

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LIST OF ACRONOMYS

CSA	Central Statistical Agency
CSS	Cascade Style Sheet
	CGI
GADM	Database of Global Administrative Areas
	GML
GIS	Geographic Information System
HTML	Hyper Text Markup Language
OGC	Open Geospatial Consortium
MoCT	Minister of Culture and Tourism
NMA	National Meteorological Agency of Ethiopia
	OCG
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNWTO	United Nations World Tourism Organization
	WCS
WFS	Web Feature Service
WMS	Web Map Service
	ASP

JSP

ABSTRACT

In many Sub-Saharan African countries, tourism is one of the most important and fastest-growing economic sectors. However the sector has not developed at the anticipated rate in emerging nations such as Ethiopia. Although Ethiopia has many potential tourist attractions, due to insufficient and inadequate tourism promotion, shortcomings in website content, such as a lack of maps and up-to-date information, have become a barrier to the sector's development. These are not only costly due to the need for information updates and expirations, but they also lack sufficient abstractions to assist visitors in making travel plans.Web-GIS databases are one of the most successful ways to sell tourism. The primary goal of this study was to create a GIS-enabled online interactive tool for tourists. Using data obtained from the Addis Ababa city administration, this study created a Web-based Geographic Information System (GIS) model with dynamic and interactive maps for managing and promoting tourism resources. This was created using open source Web-GIS software, GeoServer, PostgreSQL, and Tomcat Apache, and users have access to it. Web maps were designed and created using the outcomes of spatially based tourism data flow and database models contained in a web-based GIS with more abstractions.The designed model allows for the management and promotion of tourism resources in order to ensure a successful and long-term tourism industry.

Keywords:*Free Open Source Software, interactive maps, prototype, Internet, tourist information, Web-GIS.*

CHAPTER 1

INTRODUCTION

1.1. Background and justification of the study

Tourism is described as the act of visiting areas outside of one's typical surroundings for no more than one year for the purpose of enjoyment, business, or other activities relating to the area visited (Berhanu et al., 2017). Tourism, according to Macintosh and Goeldner (1986), is the totality of phenomena and relationships that arise from the interactions of tourists, business suppliers, host governments, and host communities in the process of recruiting and hosting these tourists and other visitors. Tourists are persons who travel to and stay in areas outside their typical surroundings for less than a year for leisure, business, or other purposes that are not related to the exercise of a remunerated activity from within the location visited (UNWTO, 2006).

A variety of activities engage the tourism business, either directly or indirectly, to facilitate visitor services. In this aspect, it is a means of generating funds that may be used to create jobs and boost a country's economy. Tourism has become one of the most important socioeconomic phenomena of our day, according to the United Nations World Tourism Organization (UNWTO, 2012). Tourist arrivals worldwide have increased steadily from 25 million in 1950 to 681 million in 1980, 438 million in 1990, and 681 million in 2000. In 2009, worldwide visitor arrivals were 880 million, with international tourism receipts totaling $852 million (Mishra, 2011).

In many developing nations, especially Sub-Saharan Africa, tourism is an important source of foreign exchange revenues and jobs (Mango et al., 2019). Revenues earned from the number of tourists, as well as social-economic gains in many areas such as agriculture, hotel services, and hunting, all add to its relevance (Fayissa et al., 2008). The number of visitors visiting Sub-Saharan Africa has increased in recent years (Amalu et al., 2017). In the 2018 report of the United Nations World Tourism Organization (UNWTO, 2018), the growth in tourist arrivals was also seen on a worldwide scale, with Africa leading the other continents by 9%, followed by Europe at 8%.

Ethiopia is a land of origin with welcoming people who are proud of their country's historical, cultural, and natural treasures (Zerihun, 2017). Ethiopia boasts a diverse range of natural, historical, and cultural features, earning it international acclaim. UNESCO has designated thirteen of its heritages (four intangible and nine tangible) as world heritage sites (MoCT, 2019). Since the 1990s, international visits have been steadily increasing, going from 115,000 in 1999 to 849,000 in 2018 at an average annual rate of 11.56 %(MoCT, 2019).

Addis Ababa is home to a diverse range of cultural, historical, architectural, aesthetic, economic, spiritual, political, and symbolic tourist attractions. If these sites are well-marketed, they have bigger tourism potential. The city administration of Addis Ababa is taking a measure to promote tourism in the city. However, a high-performance Web-GIS interactive database system for tourist attraction sites is still needed to promote and meet tourist interests.

According to McAdam (1999), the potential of a GIS to assist in decision-making activities can help tourism planning and management.GIS enables the evaluation and targeting of marketing efforts, customization of visitor packages, development of new opportunities, and the discovery of potential collaborative arrangements among partners by identifying the spatial relationships between tourists' origins and the attractions visited or services used (Chancellor and Cole, 2008). Web GIS, a GIS component, is the process of developing, implementing, creating, and providing maps on the World Wide Web by combining GIS and the internet's benefits (Zerihun, 2017). The user's decision-making is aided by a web-based GIS assistance system that also provides information about their selected tour programs (Raghuvanshi et al., 2006).

These recommended new study attempts to develop a Web-Based GIS portal for Addis Ababa, which may be utilized towardspromoting tourism and providing a new way to the users to access spatial locations and information ontourism interest.

1.2. Statement of the problem

Thousands of travelers visit Ethiopia each year to see the country's roughest and inaccessible regions (Raghuvanshi et al., 2006).). Tourism accounts for the majority of a country's overall economic development and growth. In this context, despite Ethiopia's abundance of natural and

man-made resources, the sector has received little attention in recent years. Tourism has evolved into a substantial source of revenue for the sector's numerous stakeholders (Kidane-Mariam, 2015).

Despite the accelerated growth of tourism in Ethiopia, there are still critical problems in managing and promoting tourism resources (Berhanu et al., 2017). The ability of a country to develop, manage, and market its tourism facilities and activities determines the success of tourism in that country. To manage and promote tourism in Ethiopia, static means such as brochures, books, television and radio broadcasts, and websites with non-interactive maps are used (Abel, 2012). Because they involve comprehensive productions (e.g. printing) and distributions of continuously updated information, these static and traditional approaches are costly (Mango et al., 2020). Furthermore, because of a lack of engagement with tourists, the websites currently employed feature maps and social media or apps such as Facebook and Twitter, which provide minimal information (Eraker et al., 2016). As a result, these systems are unable to answer some important and specialized tourist questions, such as which and where world heritage sites are located inside specific locations.

The introduction of web applications changes the way tourists gather information about their tour destinations. With the integration of web and GIS applications opportunities for inexperienced users arise to look at maps over the internet. According to Raghuvanshi et al. (2006), GIS and spatial data usage through the internet have twofold advantages. Firstly, it facilitates the integration and functionality of a variety of data with other applications, and secondly, it facilitates the easier and wider distribution of data and functionality to the end-users. Besides, a Web-based GIS support system facilitates the user in decision making and provides information on their desired tour programs.

Several pieces of research have been undertaken to promote tourism resources in Africa by employing spatially based tourism data to build maps and websites with interactive elements (pan, zoom, search, etc.). (Raghuvanshi et al., 2006; Abel, 2012; Mango et al., 2020). Earlier research, on the other hand, was unable to do geographical analysis based on visitor inquiries. Furthermore, the majority of research concentrated on the use of technology to offer tourism

information rather than the administration and organization of data needed to keep the business afloat.

The exciting system is not IT based information system that is only based on paper base and human information that is why the resource is not full supply to the beneficiary.

Therefore, this study has used tourism data collected from the field to design a spatially based tourism data flow and database model for managing and organizing tourism resources. To this end, the study designs a Web-based Geographic Information System (Web-GIS) model with dynamic and interactive maps enriched with pop-ups information and spatial query capabilities for tourists to explore more information. This model provides an opportunity to manage and promote tourism resources for a successful and sustainable tourism industry for Addis Ababa and a country level when adopted.

1.3. Objective of the study

1.3.1. General objective

The general objective of this study is to design a web-based GIS model with dynamic maps enriched with pop-ups information and spatial queries capabilities for tourists to have spatial and non-spatial tourism information about Addis Ababa.

1.3.2. Specific objectives

Based on the above-stated general objective, the following specific objectives are formulated.

- ✓ To assess the current information system to plan and promote tourist in Addis Ababa.
- ✓ To design a GIS enabled web-based information system prototype that provide the tourists with their desired information on tourism.
- ✓ To develop a dynamic digital tourist site map of Addis Ababa.
- ✓ To create free web-GIS system to display tourist information system through the portal .
- ✓ To create query tools that are appropriate for the prototype system.

1.4. Research questions

Therefore, in order to achieve the above objectives, the study attempted to answer the following research questions:

- What information systems are currently used to plan and promote tourist in Addis Ababa?
- What are spatial and non-spatial tourism information needed to develop GIS enabled web-based information system for tourist?
- What is the free web-GIS software used to display the created tourist information system through the portal?
- How to produce dynamic digital tourist site map through WebGIS?
- What are the source codes used to develop suitable query tools for the designed system?

1.5. Significance of the study

This study designed a web-based GIS model for the management and promotion of tourism resources for Addis Ababa city administration.Basically, this study providesrelevant information to government organization, NGOs, policy makers and implementers to understand the gaps and to take action to improve the situation on tourism management and promotion. Tourism in Addis Ababa would be made available to several users around the world through web-based GIS. Thus, such web-based GIS would host a wider public around the world and willenhance the tourism potential of the study area. Furthermore, such online Web-GIS tourist systems may serve as a possible marketing platform not just for the tourism industry, but also for allied industries such as hotels, travel agencies/planners, and airline services.

The research is also expected to contribute for the concerned stakeholders, especially for Addis Ababa tourism bureau to understand the major suitable sites and to provide digital maps for the development of tourism industry. Finally, the study is expected to serve as a source or reference material for conducting further research in the field. In addition, the study will help planners and policy makers to be aware of the significance of tourism in terms of the importance it provides for generating revenue- by attracting tourists, conserving the natural environment and providing a playground for promoting learning.

1.6. The scope of the study

The scope of the study is geographically focused onAddis Ababa City Administration, which is home to tremendous tourist attractions that have various cultural, historical, architectural, aesthetic, economic, spiritual, political and symbolic values. Conceptually, this study is delimited on design a web-based GIS model with dynamic maps enriched with pop-ups information and spatial queries capabilities for tourists to have spatial and non-spatial tourism information about Addis Ababa. Methodologically, this study incorporated different open sources software like GeoServer, Tomcat, GeoWebCache, PostgreSQL and PostGis to develop Web-based Geographic Information System (GIS) model with dynamic and interactive maps for managing and promoting tourism resources using data collected in Addis Ababa.

1.7. Limitations of the study

One of the limitations of the study was unable to get the position of some tourist sites like former public buildings and residences of former notables. Understanding and selecting among a variety of existing technologies for Web GIS development has been difficult due to the need for software to identify each of these components in order to construct the system architecture. This aspect of the procedure has taken longer than anticipated. Furthermore, knowing the needs of tourists was critical in making key design decisions. It was required to go out of the perspective of the programming software and into that of a potential tourist.Help and opinions from other team members that are experts in the area of tourism were also critical since in reality, these professionals have greater knowledge about the specific needs of the tourism business. Finally, The suggested model is reliant on the availability of the internet for information access. When internet access is restricted, the desired information may be unavailable. Nonetheless, this study gives vital information and insight that can be quite useful in tourism management and planning.

1.8. Organization of the study

This thesis is organized into five chapters. The first chapter is about introduction to the study.The second chapter deals with review of literature which contains a brief description of theoretical basis and some previous works relevant to the present research. The third chapter is devoted to brief description of the study area and a thorough explanation of the methodologies employed for

data collection and analysis. Chapter four deals with the results and discussion and finally chapter five present conclusion and recommendations of the study.

CHAPTER 2

LITERATURE REVIEW

2.1. Conceptual Literature

2.1.1. Tourism Concept and Definition

There is no single definition given for the tourism industry due to differences of ideas and attitudes of peoples and organizations defining it at different periods of time. Mathieson and Wall (1982) note that as the temporary movement of people to destinations outside their usual places of work and residence, the activities carried out during their stay in those destinations and the facilities produced to meet their needs, a good working concept of tourism was established.Tourism is both an activity and an art. It is partly demand-driven, as a result of the consumer's economic conditions. Primarily, tourism is concerned with people travelingto historical and other tourist attraction places for different purposes. The term tourism was more closely connected with the concept of a trip than with the concept of a person being temporarily away from home for leisure, business, or other reasons, implying that tourism is a relatively new phenomenon(United Nations World Tourism Organization, 2008).

For the purpose of recreation and business, tourism can be defined as tourism is the act of travel for leisure, pleasureor business and the provision of services for this act (Edensor, 2018).Tourism encompasses the activities of people who travel to and stay in a place outside of their usual environment for not more than one year and not less than one day for leisure, business, or other purposes that are not related to the exercise of a remunerated activity from within the visited place (UNWTO,2008). Tourists, on the other hand, are persons who travel and remain in areas outside their customary surroundings for more than twenty-four hours and for a period of not more than one year for leisure, business, or other reasons not related to the execution of an activity paid from within the place visited (UNWTO, 2008).

2.1.2. Categories of tourist attractions

A tourist attraction, according to Negashe et al. (2011), is a location of interest where people visit, usually for its inherent or shown natural or cultural worth, historical significance, natural or architectural beauty, and leisure and enjoyment. Natural and artificial attractions are the two types of tourism resources. Historical, heritage, and cultural attractions are all types of man-made attractions.

2.1.2.1. Natural attractions

Natural tourist attractions are attraction that have been created by nature. Many of these places have been granted to preserve their nature and provide services for the public to enjoy the sights. With its flora and fauna, safaris, jungle trekking, all sorts of natural habitats, mineral waters with healing properties and health spa development, warm and clear water in wild seas are designated as natural wonders (Negashe et al, 2011). Overall, natural tourist attractions categorized into a landscape (mountain areas, meadows, mosaic plain land seas, rivers, lakes, caves,beaches, wetlands, hills escarpments and natural woodlands), Wildlife (biodiversity, land-based mammals, flora, birds and insects), natural resources (water, climate, air).

2.1.2.2. Cultural attractions

Cultural tourist attractions consist of social relations and materials, artifacts, behavioral patterns, knowledge and values that have been acquired and transmitted through generations. (Negashe et al. 2011) note that the main cultural tourism resources are industry and commerce (famous shops and shopping malls, markets, farm attractions, andworkplace visits, sport and leisure activities such as participant, as a spectator, traditional games and sports. arts (theatres, art gallery), traditional crafts (pottery, traditional furniture, traditional clothing and jeweler) and language (dominant language of the country, minority and regional languages).

2.1.2.3. Historical and heritage attractions

Historical and heritage attractions, according to (Negash et al. 2011), are attractions that are old and have been in place for a long time and are now historical. Religious sites (churches, cathedrals, shrines, and mosques), architectural styles (particular building styles), and heritage

attractions (museums, castles, palaces, ancient monuments, historic gardens, historic landscapes, and historic communities) are among them.

2.1.3. Tourism in Ethiopia

Despite the fact that there had been many types of travel in Ethiopia from the Axumite period for many centuries, the concept of tourism and its appraisal in a genuine sense was unknown until recently (Shibabaw, 2008).

Ethiopia's unique and mostly undiscovered cultural, historical, archaeological, and ecological features are widely regarded to have significant tourism potential. These resources are essential for attracting visitors and establishing a robust tourism business. With its 3,000 years of history and more than 80 ethnic communities each with their own distinct languages, cultures and traditions, Ethiopia stands out as a unique country in Africa (United Nations Economic Commission for Africa, 2015). But unfortunately, the country could not get the economic benefits deserves by the sector. However, in recent years, thanks to the construction of infrastructure such as highways and hotels, and the critical role of government marketing, the country's image has changed dramatically around the world. But still, there is a long way ahead to exploit efficiently the benefits of the tourism sector and secure its right position in the economic sector (Ethiopian Tourism Statistics Bulletin, 2006-2008).

Ethiopian tourism organization (ETO) wasestablished in 1961. It didn't work until September 1964, though. ETO was created to respond to the central administration's goal and implement a tourism promotion program, as well as to stimulate the construction and maintenance of necessary facilities (Arthur, 1968).Ethiopian Tourism and Trade Corporation (ETTC) was founded in 1965 with the goal of purchasing small-scale handicrafts from local sources and selling them to tourists, as well as planning land and water transportation and safari tours (shibabaw, 2008).

According to the World Bank (2006), Ethiopia's tourism business suffered from a variety of negative effects from 1974 for two decades, including a prolonged civil war, severe drought, and restrictions on tourist admission and free movement. The Ethiopian Tourism Organization (ETO) was upgraded to the Ethiopian Tourism Commission (ETC) in 1980, with the primary goals of

developing and promoting tourism both domestically and internationally, developing and expanding lodging and recreation facilities, and developing Ethiopian natural and cultural heritages.

However, in the 1980s tourism declined greatly. The recovery began in the 1990s due to the establishment of a number of hotels, tour operators, travel agents etc., and the general number of visitors to the country increase.By 2006 tourism has contributed 4.1% to the GDP. The number of overseas tourists arriving in 2008 was 383,399. However, the sector's contribution to GDP has remained limited (0.77 percent in 2008). By 2014, it had increased its contribution to 4.5 percent (World Bank, 2015). Through the recently established Tourism Transformation Council, the Ethiopian government is currently implementing a number of strategic measures to further develop the country's tourism sector, including infrastructure investment and capacity building on destination management and product development (UNECA, 2015).

During Emperor Menelik's reign, Addis Ababa was founded in 1887. Following the city's founding, a number of social institutions arose. The following points are noteworthy: Emperor II Menelik school and hospital from 1909 to 1910, Empress Taytu guesthouse in 1908. Other institutions, such as postal, telephone, telegram, and hydroelectric power services, as well as the Ethio-Djibouti Railway, were constructed under the reign of this great king. Addis Ababa is the capital city ofthe Federal Democratic Republic of Ethiopia and hub of political, economic and cultural activities ofthe country. It is the headquarters of the African Union (AU), the United Nations EconomicCommission for Africa (UN-ECA) and the host for multi-lateral funding organizations such as the WorldBank, the European Commission, UNDP and others. In addition, the city also gathers over 103embassies and heads of diplomatic missions, different international, regional and sub-regionalorganizations and several international NGOs.As a result of these institutions, as well as the city's geographical location, terrain, and climate conditions, the city has seen a significant increase in the presence of various tourist attractions as well as visitors from all over the world. Tourism is a burgeoning sector in Addis Ababa and throughout Ethiopia. Over the last decade, tourism in the country has increased by 10%, resulting in an influx of visitors to Addis Ababa. In 2015, the European Council on Tourism and Trade named Ethiopia the number one tourist spot in the world.

Regarding the challenges and prospects of tourism industry, lack of promotion, lack of physical infrastructure (road, transportation system, network facility, availability of hotel accommodations especially tourist sites), misperceptions about Ethiopia, and a shortage of human trained power are the main challenges of the tourism industry in Ethiopia, according to Sintayehu (2017) in his study. Furthermore, lack of information and awareness, technical know-how, and inadequate promotion activity, lack of tourist-related infrastructure, lack of consistent tourism strategy and policy, lack of tourism safety, and lack of tourism diversification are some of the industry's major issues (Dabour, 2003). Because the African Union was founded and is based in Ethiopia, Ethiopia is a capital city of Africa.Apart from that, Ethiopian Airlines is one of the most well-known African airlines and a member of the Star Alliance, with several direct flights all over the world. Ethiopia is also one of the most important African countries in terms of UNESCO heritage registration (Sintayehu, 2017). Generally speaking, this is a wonderful opportunity for Ethiopia's tourism business to grow.

2.1.4. Contribution of Tourism

The tourism business contributes significantly to society's social, economic, cultural, and environmental growth. The tourism business is one of the world's fastest expanding economic sectors and the largest manpower employer, generating billions of dollars annually by transporting a billion people from one place to another. Tourism helps to maintain and keep the country's natural and cultural resources, prevents local population movement, and improves the economic and socio-cultural status of the local community. It acts as a strategy for economically protecting natural regions while also increasing their economic importance and raising environmental awareness (Sharma et al., 2012).

Mutual appreciation, tolerance, understanding, awareness, family ties, learning, respect, and relationships are all enhanced by social interaction between the tourist and host communities. On the one hand, inhabitants of the host country got education about the outside world while sitting at home, on the other hand, they used tourism-funded amenities such as universities, libraries, healthcare institutions, and internet cafés (Ibid).

Tourism, according to Reisinger & Steiner (2006), is an economic growth engine that generates foreign exchange revenues, generates jobs and income, and stimulates domestic spending.

Tourism's importance as a stimulus for the growth of other economic sectors like agriculture, entrepreneurship, construction, entertainment, and infrastructure, as well as its contribution to local and regional development (WTO, 1991).

Tourism may play a significant role in economic stimulus plans in times of crisis if it is viewed as a fundamental component of such plans, as both an economic stimulant and a source of job creation that complements other industries, particularly manufacturing (Vellas, 2011). Tourism can be seen of as an economic sector that helps the green economy thrive. It is based on passenger travel, which has minimal environmental impact because travel and tourism account for only 5% of total carbon emissions (WTO, 2008).

According to Altes (2018), tourism's direct export revenues are expanding in Ethiopia, and tourism appears to be the country's third largest source of export revenue after agriculture and industry. For example, in 2017, travel and tourism contributed ETB 49,144.2 million to GDP directly (2.7 percent of GDP). In 2017, travel and tourism contributed ETB 121,435.0 million (USD 5,074.3 million) to GDP, accounting for 6.8% of GDP. In 2017, travel and tourism supported 604,000 jobs directly (2.4 percent of total employment). In 2017, travel & tourism employment accounted for 6.1 percent of total employment (1,538,000 jobs), including jobs supported indirectly by the industry (Altes, 2018).

Tourism impacts are likely to change over time as a destination area develops (Butler, 1991). The sort of tourist activities participated in, the features of the host community in the destination region, and the nature of the interaction between visitors and inhabitants, according to Wall (1997), are major elements contributing to the nature of the impacts. Davison (1996) proposed a number of comparable factors, including the importance of timing and place in terms of tourist effects. Davison (1996) asserted that the relevance of the 'where' and 'when' factors set tourism's impacts apart from those of other industrial sectors. In terms of tourism being concentrated in space, Davison (1996) stated that, unlike many other industrial activities, tourist production and consumption occur in the same site. The tourist consumes the product while visiting the tourist destination. As a result, tourism's effects are mostly focused on the tourism destination.

Davison (1996) claimed that the fact that tourist impacts are concentrated in time is due to the fact that it is a seasonal activity. Tourism is generally seasonal due to two major factors: climate

and holiday seasons (Davison, 1996). Climate is a crucial aspect since it influences important tourism resources such as the number of hours of sunshine or the amount of snowfall at different seasons of the year. The ability of tourists to visit a site at a specific time of year, such as during school vacations or an annual vacation, tends to make it seasonal activity.

2.1.5. Application of GIS for Tourism

Geographic Information System (GIS) is decision support computer-based systems for collecting, storing, presenting and analyzing georeferenced data to solve complex problems regarding planning and management of resources (National Center of Geographic Information and Analysis, NCGIA, 1990). GIS is a rapidly growing field that enables the development of applications that manage and use geographic data in conjunction with other media, such as a digital map base for printed maps, digital files for Internet mapping, digital files for mobile mapping, attractions map, and Website with interactive mapping in the tourism industry (Abel, 2012). GIS technology opens up a world of possibilities for the development of modern map-based tourism applications. This technology combines basic database activities like querying with the unique visualization and geographic analysis capabilities that maps provide (Verka & Angelina (2008).

Recreational facility inventory, tourism-based land management, visitor impact assessment, recreation-wildlife conflicts, mapping wilderness perceptions, tourist information management systems, and decision support systems are all examples of GIS applications in tourism, to (Giles, 2003).

The use of GIS in tourism is not a new occurrence in the developed world, but its applications in the developing world are still being expected (Raghuvanshi et al., 2006). According to Bahaire & Elliot-White (1999), GIS systems have been used for tourism planning in North America, including scenario analysis in Davos Valley and tourism planning in South Carolina. They've also been in handy when it came to documenting and assessing tourism resource inventory data in British Columbia, Canada. The establishment of the Tourism and Recreation Information Package (TRIP) to aid in planning and policy making in Scotland was one of the first GIS implementations in the UK.

According to Abel (2012), the demand for tourism marketing has increased, and GIS can play a significant role in tourism marketing. Before visiting a place, visitors want to learn about its geography. They want to know where things are, what services are available, how the environment is, and how to search for information on specific websites. Management users are interested in learning more about the method by which customers arrive, their socioeconomic backgrounds, and prospective new tourism destinations. As a result, GIS and RS have played a critical role in tourism marketing and management.

2.1.6. Web GIS for Tourism Management and planning

By integrating the advantages of GIS and the internet, Web GIS is the process of developing, implementing, creating, and delivering maps on the World Wide Web (Fu, 2016). The internet's discovery in the 1980s set in motion a chain of events that included the development of GIS online mapping technologies (Coleman, 1999). GIS systems were considered monolithic and platform-dependent applications by Wong et al. (2002). The rapid growth and development of the internet and web-based applications provided a new platform for traditional GIS to grow and spread (Zouagui et al., 2017). Web GIS has evolved into a low-cost and simple method of spreading geographic data and processing tools (Alesheikh et al., 2002).

Web GIS's capacity to interact dynamically in a distributed context, ranging from cross platform to client/server computer systems, made it more appealing to develop and utilize for spatial data access (Abel, 2012). The use of the web as a distribution medium is an important advance in cartography. By using the internet, real-time maps are now available, as well as cheaper map sharing, more regularly updated information sources, and lower software and hardware requirements. For the full development of web mapping, there are some problems and obstacles, such as technological difficulties, dependability issues, and security issues (Ibid). Web GIS, as described by Sakamoto et al. (2004), continues to garner attention as a public involvement tool because of its accessibility, understandability, and accountability.

The Internet is now the most widely utilized medium for promoting tourism destinations (Lo et al., 2011). Web GIS enables for the display of visual descriptions of ideal locations, identifying where the points of interest are, where to obtain the services required, and all other relevant up-

to-date information that will aid in the planning of a trip (Calbet, 2011). As a result, a well-planned and implemented GIS for tourism can help Ethiopian's tourism development.

2.1.7. Architecture of Web GIS

Web GIS applications use a web browser as a client to send and receive requests, and a web server to react. Non-spatial online applications normally simply have a web server, whereas web GIS has an additional server for spatial data called a data or map server (Agrawal & Gupta, 2017). This server manages geospatial data, provides WMS and WFS services for geospatial data, and may perform GIS functions such as editing, routing, and object tracking. Using middleware technologies like as Remote Procedure Calls (RPC) or Open Database Connectivity (ODBC), the client can send a request to a server located anywhere (Tsou and Buttenfield 2002). From a multi-tier approach to plug-and-play to SOA (Yang et al. 2010) to cloud computing, the online GIS architecture evolves (Yang et al. 2011).

A Web GIS has two components. The client-side interface, which runs in a web browser and transmits the user's requests to a server, is the first part. A Web GIS server, also known as an Internet mapping server (IMS), supports mapping and spatial analysis services, as well as Web GIS software and databases (Figure 1). (Pispidikis & Dimopoulou, 2015). Thin client, thick client, and hybrid architectures are the three basic types of architectures for developing Internet-based GIS applications (Agrawal and Gupta, 2017)

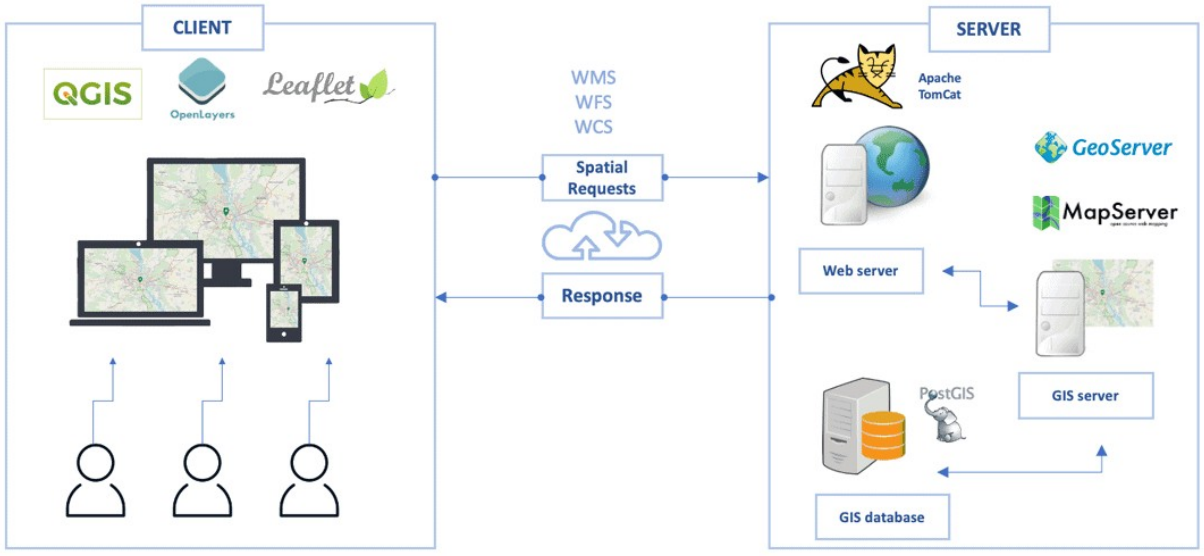


Figure 1:How a typical Web GIS model works

2.1.7.1. Client

Thin Client Architecture (Server-Side Applications)

Figure 2 shows the design, which has a low resource need on the client side and does all of the work on the server side (Alesheikh et al. 2002). Figure 2 depicts the communication between a Web browser, a Web server, and a GIS server in schematic form. Because the client cannot directly call the GIS server, it must use an interpreter such as CGI, Web Server Application Programming Interface (API), Active Server Pages (ASP), Java Server Pages (JSP), or Java-Servlet (Helali, 2001). According to Mi et al. (2004), a Java-servlet is more efficient than a CGI script since it does not need to start, load, or stop for each request and can manage numerous clients' queries.

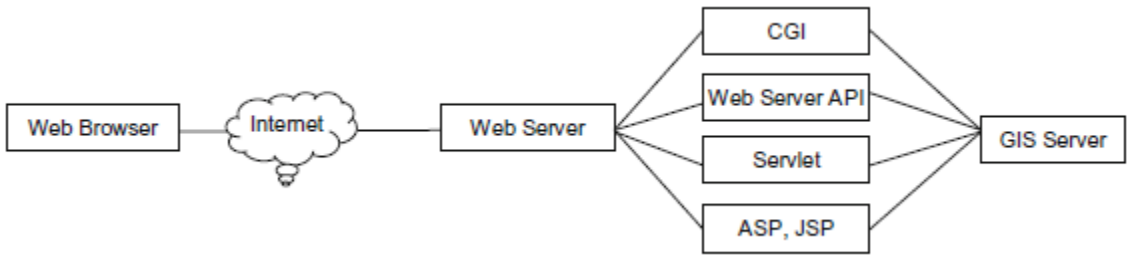


Figure 2: Thin client architecture (adapted from Alesheikh et al. (2002))

The advantages of this architecture, according to Alesheikh et al. (2002), are that there is no client-side accountability. It only requires resources to make the HTTP request to the server and to show the server's processed response. The majority of the results are in image formats such as JPEG, GIF, or PNP. As a result, raster data may be simply shown. Because the server provides centralized control, data updates and maintenance are simplified. It is a low-cost option because the client does not have to invest much money. As a result, the server is overburdened, causing long response times owing to bandwidth and other concerns. On the other hand, this architecture has disadvantages, such as limited client capabilities, which causes the client to make a new request every time, even for basic map activities like zooming and querying (Alesheikh et al., 2002). This raises the amount of interactions with the server while not fully utilizing the client's capabilities (Wu and Huang, 2009).

Thick Client Architecture (Client-Side Applications)

The client is more powerful in this design, as shown in Figure 3, because the browser's capabilities are enhanced by plug-ins, applets, or ActiveX. As a result, processing can be done both on the server and on the client (Alesheikh et al., 2002). From simple document retrieval to more dynamic apps, user interface functionality has advanced. The executable that operates on a specific data type is known as a plug-in. It must be installed on the client system ahead of time. On its native data type, it provides specialized viewing and manipulation functions (Alesheikh et al., 2002).

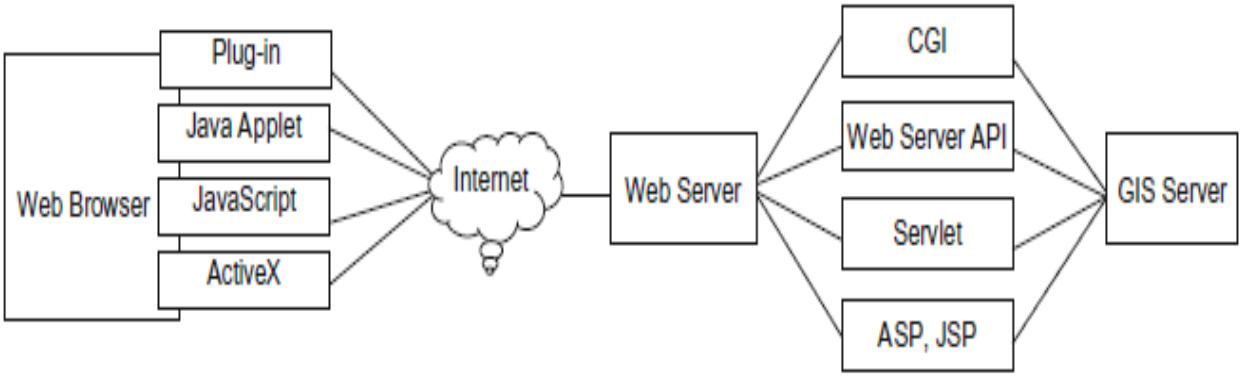


Figure 3: Thick client architecture (adapted from Alesheikh et al. (2002))

Because the server provides raw data that may be used for many purposes, this architecture allows the client-side system to run even when there is low or no communication with the server. This also indicates that the client does not need to request tiny operations from the server. As a result, the strain on the server is reduced because some of the processing is done on the client side (Alesheikh et al., 2002). However, it has limits when it comes to distributing software and data. It's difficult to distribute software. Due to platform incompatibilities, some prospective customers will be lost, and other users will surely have difficulty loading software, and providing technical help is time consuming and costly.

Hybrid architecture

This is a hybrid architecture that combines thin and thick client architectures (Agrawal and Gupta, 2017). In client/server systems with a hybrid design, the server stores data in a relational database management system, and desktop clients access the data using normal browser software. Some tasks involving data processing are handled on the server side, while others involving user interaction are handled on the client side. It makes use of both client-side and server-side technology. This design was originally built on an Applet-CGI combo, in which the applet is used on the client side and CGI is utilized on the server side. As a more efficient approach, the applet-servlet was developed (Agrawal and Gupta, 2017).

2.1.7.2. Web Server and Application Server

The Web server is the piece of software that replies to HTTP requests from clients. It's built to reply quickly to a huge number of client requests and transmit static files. The request is delivered through HTTP to the Web server, which checks the server's hard drive for the file in question. When a file is not spelled correctly or the request is not submitted with the correct path, it will not be found on the server. If the user's Web browser isn't set up to show a specific file type, the user is prompted to save the file to his hard drive (Pispidikis & Dimopoulou, 2015).

The Apache HTTP server and the Internet Information Services are the most widely used Web servers today (IIS). All modern operating systems, including Windows, Linux, Mac OS X, and Unix, support Apache. It is open source software provided under the Apache software license. It

is managed by the Apache Software Foundation and supported by an open source community (Pispidikis & Dimopoulou, 2015).

The application server is protected by the web server's inability to manage and return only static pages. It handles both the dynamic content of web pages and the concurrent requests from users using the supporting script engine. As a result, the Web server expects the application server to return the dynamic content result, and the application server, in turn, expects the Web server to return the final static file to the client. It is possible to interface with the database and other servers, such as the Map server, via the application server (Pispidikis & Dimopoulou, 2015).

2.1.7.3. Web Mapping Servers

A web mapping server is a subset of the web server concept that specializes in mapping. Requests are submitted to the server in the same way as they are sent to a web server, and they are understood and responded to (OpenGeo, 2012). The GeoServer, Map Server, and ArcGIS server are the most often used web-mapping servers. The first two are free online mapping servers, and the third is a paid service (OpenGeo, 2012).

1. **MapServer**

MapServer is a well-known Open Source project that displays dynamic spatial maps over the Internet. MapServer is a CGI program that sits idle on your Web server in its most basic form. When a request is delivered to MapServer, it creates an image of the desired map using information given in the request URL and the Mapfile. In addition to images for legends, scale bars, reference maps, and values supplied as CGI variables, the request may return images for legends, scale bars, reference maps, and values passed as CGI variables (OpenGeo, 2012).

According to OpenGeo (2012) Anatomy of a MapServer application consists of:

Mapfile – it is a MapServer application's structured text configuration file. It defines the map's area, tells the MapServer software where the data is, and tells the MapServer program where to output images. It also specifies the data source, projections, and symbology for the map layers. MapServer will not recognize it unless it has a map extension.

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

HTML Pages - it serves as a user-to-MapServer interaction. They're usually found in Webroot. MapServer can be used to place a static map image on an HTML website in its most basic form. The image is placed in an HTML form on a page to make the map interactive.

CGI programs are ‘stateless,' meaning that each request they receive is unique, and they have no recollection of the last time they were hit by your application. As a result, every time your application sends a request to MapServer, it must provide context information in hidden form variables or URL variables (such as which layers are active, where you are on the map, and so on).

A simple MapServer CGIapplication may include two HTML pages:

- **Initialization File** - It sends an initial query to the web server and MapServer using a form with hidden variables. This form could be moved to a different page or replaced by supplying the initialization data as URL variables.
- **Template File** - This file determines how MapServer's maps and legends appear in the browser. By referencing MapServer CGI variables in the template HTML, you allow MapServer to populate them with values pertinent to the current state of your application (for example, map image name, reference image name, map extent, and so on) as it builds the HTML page for the browser to read. The user's ability to interact with the MapServer application is likewise determined by the template (browse, zoom, pan, query).

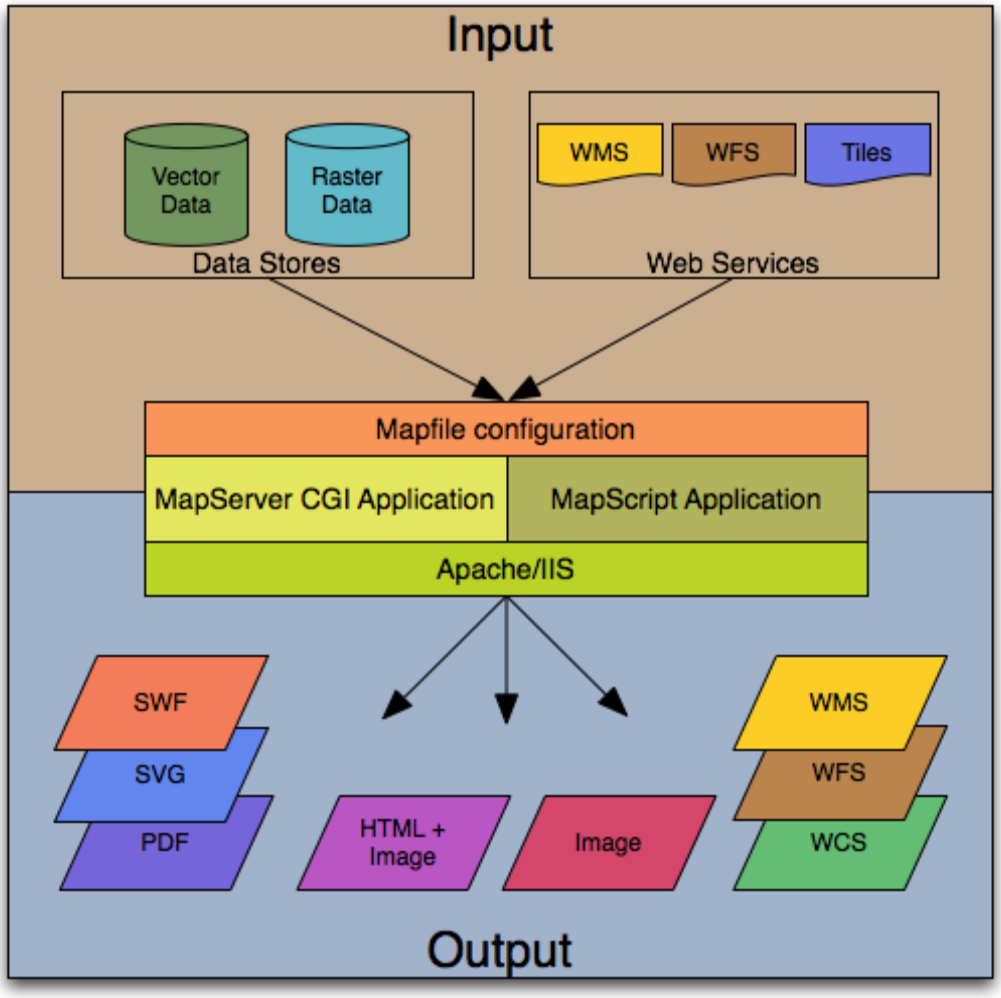


Figure 4: The basic architecture of MapServer applications (The MapServer Team, 2021))

MapServer CGI - A binary or executable file that receives requests and responds with graphics, data, and other information. It's located in the HTTP server's CGI-bin or scripts directory. The Web server user must have executed permissions for the directory it is in, and it should not be in the webroot for security reasons. MapServer is the default name for this software.

HTTP Server - When the user's browser requests HTML pages, the HTTP Server responds. On the workstation where MapServer is being installed, you'll need a working HTTP (Web) server, such as Apache or Microsoft Internet Information Server.

Chameleon – It is an environment for deploying and managing Web mapping applications that is very configurable and adaptive. Chameleon includes the ability to quickly create new applications using a shared pool of widgets that can be inserted into an HTML template file.

Web Map Service (WMS)- Georeferenced images are available online just for viewing, not for further data processing, through the WMS service. The client submits a request to the map server, which generates the final image and responds to the request based on the parameters of the request. The image generated by the WMS is the request's ultimate product, and it is supplied as vector or normalized data, or a combination of both. A WMS standard request must be in one of two formats: Get Capabilities or Get Map. The first is used for spatial data metadata in an XML format document. The second produces a georeferenced image as a result (Pispidikis & Dimopoulou, 2015).

Web Feature Service (WFS)- The WFS service is used to access vector data directly, returning the geometry and properties of the latter. The language GML (Geographic Markup Language), which is an extension of XML, is used to describe spatial data. Get Capabilities, Describe Feature Type, Get Feature, Lock Feature, and Transaction are the primary demands that include a service WFS. The user receives spatial data metadata in XML document format using Get Capabilities (Pispidikis & Dimopoulou, 2015).

2. GeoServer

GeoServer is a Java-based open source software server that lets users share and edit geospatial data. GeoServer publishes data from any major spatial data source using open standards, making it interoperable (OpenGeo, 2012). GeoServer is a web-mapping server that provides access to data in a predefined range of formats and sources (files and databases) via predefined protocols. GeoServer serves as an abstraction layer in several ways. It enables standards-based geographic data access regardless of the original data type. In chapter three (methodology part), the essential concepts and architecture of GeoServer are presented.

2.1.7.4. Data Server

The data is distributed in a database by the data server. When dealing with spatial data, the database usually connects to the map server, which then executes the query. For non-spatial data,

the Application Server and, in particular, the accessible server-side programming language can be used to access data from the database. The SQL (Structured Query Language) language is used for database querying, whether spatial or non-spatial. PostgreSQL, MySQL, and Oracle are the most often used databases in online applications. Oracle is a commercial product, while the first two are open source databases. MySQL is unsuitable for spatial data, however, PostgreSQL with the PostGIS spatial database is seen to be the best option (Pispidikis & Dimopoulou, 2015). PostGIS is a PostgreSQL spatial extension that makes it possible to utilize PostgreSQL as a backend spatial database for GIS. It includes support for GiST-basedT-tree spatial indexes and functions for basic analysis of GIS objects, as well as the ability to store geographic items in the database (OpenGeo, 2012).

2.2. Empirical Literature Review

Tourism is viewed as an engine for economic growth and there are many researches that focus on the area. In the following paragraphs some of the major empirical works are presented.

Fajuyigbe et al. (2007) used ArcView and Web View Standard Edition to create a web-based tourist website for the Oyo State in Nigeria, which has weak tourism management and promotion. The created maps were uploaded to the internet via a web page with an interactive user interface. Furthermore, Berhanu et al. (2017) used a prototype of three-tier client/server architecture to build a web-based tourism for promoting Addis Ababa, while Abel (2012) used a prototype of three-tier client/server architecture to design a web-based tourism for promoting Bahir Dar town and its surrounds. The two studies' GIS web maps had some movable widget tools and search capabilities, but did not demonstrate spatial query analysis to provide additional abstractions to tourists.

One of the issues in the tourism business, according to Dondo et al. (2002), is the requirement for timely updates and upkeep of the massive tourism data. Tourism officials in Zimbabwe are constantly gathering data on tourist amenities. The majority of this data is kept in hardcopy format at the Zimbabwe Tourism Authority. After a while, some of the knowledge is gone. To solve the problem, the researcher employs the arc view version and the visual basic programming language.

By building a spatial and non-spatial data base, Tran (2006) investigated the creation of a Web-based GIS approach for disseminating spatial and non-spatial tourism information of East Java Indonesia over the internet. The researcher used MySQL DBMS to store non-spatial and spatial data, and then used several web site development programming languages to create an interactive user interface that connects the produced spatial and non-spatial data base with the website.

Some countries use cloud computing systems such as GIS clouds and ArcGIS online, which provide easy, on-demand network access to a shared pool of configurable computing resources with low maintenance costs (Jadeja & Modi, 2012). These platforms, on the other hand, focus on the use of technology to transmit information, but the management of data flow to keep the system running is left out. As a result, many Sub-Saharan African countries (including the study region) lack proper mechanisms for managing and developing tourism resources that are dispersed throughout their country (Munanura et al., 2013).

The actors of this study proposal a model of tourism geodatabase as a repository for building dynamic and interactive online maps, which are combined with spatial analytic features to allow tourists discover more information, for proper management and sustainability of tourism. Finally, we employ the suggested geodatabase to create a web-based GIS model and do some spatial analysis using the model's web maps to realize the model's abstractions from practical usability and tourism utility.

Web GIS is commonly designed for simplicity, intuition, and convenience, making it typically much easier to use than desktop GIS. Unified updates: For desktop GIS to be updated to a new version, the update needs to be installed on every computer. For web GIS, one update works for all clients.

The dynamic and interactive Web-based ways and methods of analyzing spatial data are useful for the exploratory analysis of different dimensions of travel patterns. They allow the researchers, tourists, planners, and administrator to interact, explore, and manipulate spatial and attribute of facilities, natural, and cultural features constituting the tourism products of destination. Web-based GIS can help not only to visual nature of tourism products but also facilitate regular changes to any updated information. Web-based GIS Tourism Information System, in addition, is beneficial for tourists, employers, local governments, and other stakeholders in the decision-making process regarding

territorial development and destination management. In this study, an effort has been made to develop an interactive set of data where tourism objects are combined with Web-based GIS technology in order to develop tourism information systems for Addis Ababa city that can be easily uploaded on the web for wide publicity of tourism potentials. The proposed Web-based GIS tourism information system will produce an accurate and valuable answer for travelers. The system described in this paper more.

CHAPTER 3

MATERIALS AND METHODS

3.1. Description of study area

3.1.1. Location and topography

Addis Ababa, Ethiopia's political capital and most important commercial and cultural center, is located in the country's central highlands and covers an extent of 540 km2.The study area is astronomically, the study area is located at 8050' N – 905' N and 38038' E – 38052'E. The city lies at the base of an isolated mountain called Entoto,with elevation ranging from 2015to 3035meters above sea level (Figure 5)(Teferi & Abraha, 2017).

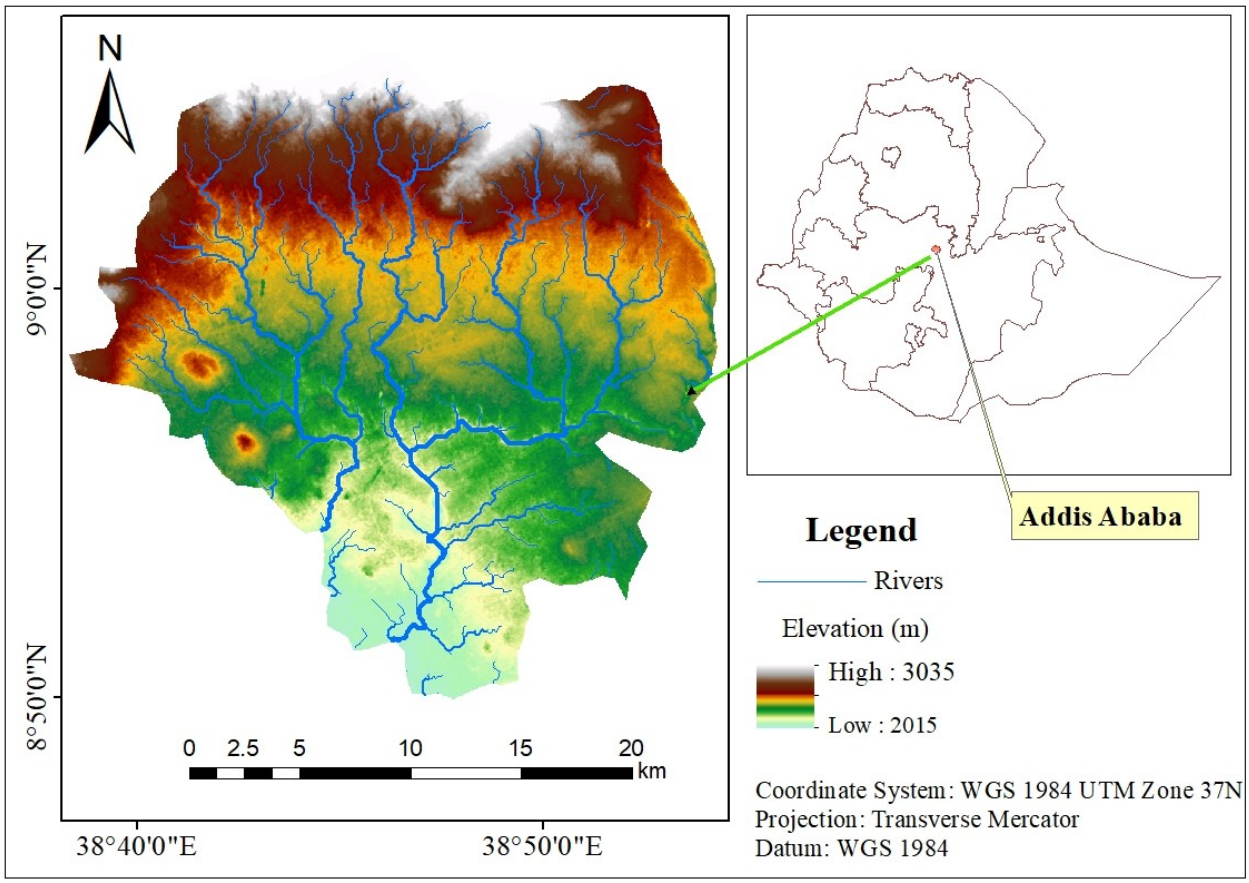


Figure 5: Location and elevation map of the study area

The topography is undulating and form plateau in the northern, western and southwestern areas of the city. However, Bole and south western section of the city are distinguished by gentle morphology and flat land areas. The city has continued to grow to the south, west, and east. Because of the topography, expansion to the north is constrained.

3.1.2. Climate

Addis Ababa has a sub-tropical highland climate with year-round moderate temperatures of around 240°C for the peak and 120°C for the low. There are two rainy seasons: the primary rainy season lasts from June to mid-September, and days and nights are cool by local standards. Short rains fall from March to mid-April, bringing with them generally mild nights and pleasant days, as well as a period of rainfall known as Belg. The months of late April and early May are the hottest and driest, with warm to hot days and chilly nights. The average annual rainfall is around 1,200 mm, with over 80% of that falling during the rainy season (NMA 2017).

3.1.3. Demography and socio-economic activities

Addis Ababa has a total population of 2,739,551, with 1,305,387 men and 1,434,164 women, according to the 2007 census. The city is entirely urban, with no rural residents within its administrative limits. 662,728 households were counted in 628,984 housing units in the capital city, resulting in an average of 4.2 people per household. Addis Ababa is home to 22.9 percent of Ethiopia's urban population and 3.7 percent of the country's total population (CSA, 2007). The national central statistical agency, which conducts national census forecasts, estimates Addis Ababa's population to be 3,603, 000 people (CSA, 2019).

Addis Ababa, Africa's diplomatic capital, is home to a number of international institutions, including the African Union's (AU) headquarters and the United Nations Economic Commission for Africa (UNECA). Several people come to the city in quest of work and services due to its location and prestige. Its yearly growth rate is between two and four percent, with rural-urban mobility accounting for around forty percent (Erena et al., 2017).

With economies rooted in non-agricultural sectors, cities like Addis Ababa provide close to half of Ethiopia's national GDP.Addis Ababa's economy is by far the most powerful of all Ethiopian cities (Erena et al., 2017). According to AABoFED (2015), Addis Ababa accounts for a quarter of Ethiopia's national GDP. The city government's gross domestic product (GDP) increased from ETB 85.1 billion in FY2011 to ETB 164.77 billion in FY2017. In the 2016/2017 fiscal year, the per capita income hit US$2,086. The service industry is the backbone of Addis Ababa's economy. In the fiscal year 2016/2017, agriculture contributed ETB 1.73 billion, industry ETB 33.24 billion, and the service sector ETB 122.04 billion to development. In addition, the city government's GDP increased by 11.19 percent over the previous year. The service sector, with a lion's share of 78.4 percent, industry, with 20.43 percent, and others associated to agriculture, with 1.16 percent, have all contributed to the city's economic development in the last seven years (Ethiopia PEFA Assessment, 2019).

3.1.4. Major Attractions of Addis Ababa

Addis Ababa's location in the highlands causes the scenery to be undulating, giving it an exotic scenic charm. In total, the city has roughly 150 cultural heritages. 35 historical churches, two

mosques, 26 former public buildings, 72 former notables' dwellings, 17 monuments, caverns, and bridges, and six historical sites are among them (Berhanu et al., 2017). If adequately advertised and appropriately utilized, Addis Ababa's cultural, historical, and heritage heritages have more tourism potential. The most important tourist attractions in the city are discussed below.

La Gare/ Ethio-Djibouti Railway Station: It is the Railway Station for the Franco-Ethiopian railway line from Djibouti to Addis Ababa, which was constructed 1897-1917. In addition, it functioned as a rest house for travelers. Paul Barrias, a French architect, designed it. It was constructed between 1928 and 1929. It can be found at La Gare.

Ethnological Museum: The Ethnological Museum is an excellent place to learn more about the Ethiopian people's numerous ethnic groups. It's inside the Addis Ababa University Sidist Kilo campaus.

St. George's Cathedral and Museum: St. George's Cathedral is one of Addis Ababa's most well-known places of worship and iconography. The property is situated on a hilltop with a view of Menelik II Square. A museum on the side of the cathedral is worth a quick visit. It's decorated with antique church artifacts as well as religious manuscripts, Ethiopian crosses, and costumes. Inside the church, visitors may travel in a circuit around the cathedral and see an outstanding collection of paintings depicting biblical and Ethiopian historical episodes.

Holy Trinity Cathedral (Kidist Selassie) and Museum: While St. George's Cathedral is one of the most well-known in Addis Ababa, the Holy Trinity Cathedral is the city's most hallowed Ethiopian Orthodox cathedral and, after the churches of Lalibela, Ethiopia's most sacred venue of prayer. The grounds of the Holy Trinity Cathedral are bordered by weeping pine trees, and the cathedral is ornamented with statues and carvings, giving it a true medieval feel. Another museum, located behind the cathedral, houses more Ethiopian historical artifacts, previous Ethiopian Emperors' crowns, and a collection of remarkably well-preserved Amharic Bibles and religious writings.

Merkato: In 1936, Fascist Italy invaded Ethiopia. They planned to construct two marketplaces, Arada and Merkato, as a result of their racist policies. The former is only for Italians, whereas

the latter is only for Ethiopians. Merkato is presently Africa's largest and first open-air market. It is here that one can barter for everything from everyday essentials to relics and curios.

Empress Mennen Girls school: It is the country's first girl's school, founded in accordance with Empress Mennen's wishes. The Complex is shaped like the Ethiopian map from before. It is made up of two structures, one completed in 1930 and the other in 1938. Balanos, a Greek architect, designed it. It's in the Menen neighborhood.

Arada Old Post Office /Cinema Ethiopia: With the support of Alfred Ilg, the modern postal service was introduced in Ethiopia in 1894 E.C. under the reign of Emperor Menelik II. On July 1, 1908, the Old Post Office became Addis Ababa's first modern post office. It was operational until 1935, when it was occupied by the Italians. In 1936, a fire destroyed the magnificent two-story building with surrounding verandas. It was reopened as Cinema Italia in 1941 after undergoing renovations. It now houses Cinema Ethiopia. It may be found in Piazza.

Etege Taitu Hotel: It was the first hotel in the country and accommodated mostlyEthiopian dignitaries, diplomats and foreigners. It was constructed by the order ofEmpress Taitu in 1907 and designed by Minas Kernbergian. It is a public building withtraditional influence. The first manager of the hotel was Muse Frederic Hal. Currentlyit is serving as such. It is located at piazza next to the National Lottery Administration.

Entoto St. Mary's Church: It was the country's first hotel, and it housed largely Ethiopian leaders, diplomats, and foreign visitors. It was built in 1907 on Empress Taitu's decree and designed by Minas Kernbergian. It's a public structure having a traditional feel to it. Muse Frederic Hal was the hotel's first manager. It is currently being used in this capacity. It's right adjacent to the National Lottery Administration on the piazza.

The parliament: Mr. Kamatz, a German architect, planned the structure, which was completed in time to accommodate the Ethiopian Parliament, which was founded in 1931. During the Italian occupation, the hall's original painted panels and embellishments were removed. A massive mosaic of St. George once adorned the facade, but it was taken during the Derg and is now hidden. The House of Peoples Representatives and the House of Federation use it as an office and meeting hall. It's close to the Holy Trinity Church in Arat Kilo.

Emperor Menelik's Monument: The statue represents Emperor Menelik's anti-colonial struggle during the Battle of Adwa. The first Italo-Ethiopian war's climactic battle in 1896 is witnessing Africa's triumph over European colonialism. It was commissioned by Queen Zewditu, Emperor Menelik II's daughter, to commemorate her father. It was designed and manufactured in Germany by German architect Haertal Spengler. Unfortunately, Queen Zewditu died in 1930, before the memorial could be built. Thus, on the eve of Emperor Haile Selassie's coronation in the same year, the then crown prince (Emperor Haile Selassie) inaugurated the monument.Benito Mussolini ordered the monument's destruction and concealment in 1936 in order to erase the humiliating defeat of Italians at the Battle of Adwa at Menelik's hands from the minds of all Ethiopians and the rest of the world. The monument was restored to its rightful location in 1941, when the invaders were forced out of the nation. It is now positioned beside St. George church in a piazza on Emperor Menelik's square.

The Martyr's/ Yekatit 12 Monument: Following the assassination attempt on Viceroy Graziani by two Ethiopians, Abraha Deboch and Moges Asgedom, in February 1937, the Italians killed thousands of innocent Ethiopian residents over three days. In February 1942, the memorial was constructed and dedicated in honor of the martyrs. Angostinsich Anto and Kersnich Fran, two

Yugoslav architects, designed it. This three-sided, 28-meter-long monument depicts countless Ethiopians brutally slaughtered by Italian troops. It is now situated between Yekatit 12 hospital, Addis Ababa University, and the Lion Zoo Park in Sidist Kilo.

Sebastopol Monument: Tewodros, the Emperor of Ethiopia, ascended to the throne in 1855. He aspired to establish a weapons industry in Ethiopia. As a result, he assembled the European missionaries within the country and instructed them to manufacture a cannon that he named Sebastopol. These cannons were only used once before being retired. A bronze replica of these cannon has recently been installed in the Emperor's Square, which is located along Churchill Road.

St George's Catederal

St.George’s Catederal

Museum

Emperor Menilik II palace

Holy Trinity Cathedrals

Figure 6: Pictures of Some of the Tourist Attractions in Addis Ababa.

3.2. Methodology

3.2.1. Data sources and acquisition

The availability, acquisition, and sources of data are all important factors in the development of web GIS for tourism management and promotion. In order to be deemed authentic, the correctness of empirical study conclusions, such as this one, must be supported by accurate and relevant data. Special efforts were taken to thoroughly secure the necessary data in order to ensure the validity of the current study. Both primary and secondary sources were used to achieve this study.

The data for this study were gathered from the concerned government entities, both spatial and non-spatial. Addis Ababa City Administration Culture Tourism Bureau provided the information. Various tourist spots were collected using a Global Positioning System (GPS). Various tourist attractions in Addis Ababa were also visited, with relevant observations made. The administrative border of Addis Ababa was obtained in shape file format from the Global Administrative Areas database version 3.6 (GADM, 2018). Only those GADM lying within the study area were Extracted.Non-spatial data regarding tourist attractions, such as photographs, information, and history, was gathered from a variety of sources, including tourism-related websites and other relevant departments/offices (Ethiopian Ministry of Culture and Tourism and Addis Ababa Culture and Tourism Bureau websites).

Secondary information was gathered from previously published and unpublished literature, tourism journals, newspapers, websites, and brochures. In addition, secondary data was acquired from the Addis Ababa Bureau of the Department of Culture and Tourism (tourist attraction areas and their description). Table 1 provides an overview of data sources and their descriptions.

Table 1: Data type, their Source and Descriptions

Item	Data type	Sources	Description	Softwarefor processing the

				data
1	Boundary of the study area	GADM	Shapefile	ArcGIS 10.5
2	Tourist attractions (GPS data)	Field Survey	Latitude and longitude	

3.2.2. Web GIS development life cycle

Creating a web GIS entails more than just purchasing and installing the necessary hardware and software (Alesheikh et al., 2002). Data development, data organization, and application development are all components of GIS-based project development that are not the same as or equivalent to normal software development procedures (Mir, 2006). The web GIS development cycle is a step-by-step procedure that starts with demand analysis and ends with the continuing use and implementation of the desired portal. Figure 7 depicts the online GIS development cycle, which is divided into six primary activities that begin with requirement analysis and end with web GIS system implementation.

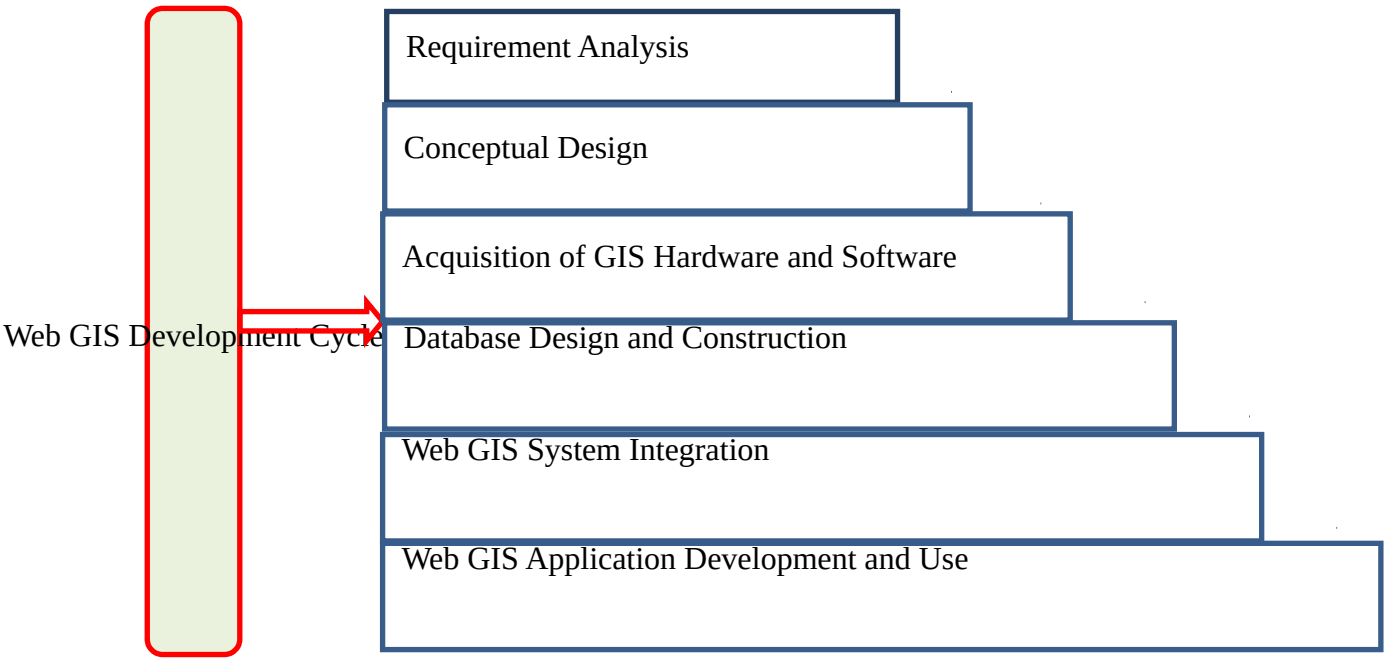


Figure 7: Web GIS Development Cycle (adapted from Alesheikh et al. (2002))

3.2.2.1. Requirement Analysis

The objective of this study is to use the internet to communicate tourism information about Addis Ababa so that travelers can easily access it. As a result, in order to construct the Web GIS and achieve the tourist promotion goals, we concentrated on the following general and preliminary system requirements:

- ☞ The student researcher propose three tourism actors based on the information needed to create the model system. Information providers (private and governmental organizations), information administrators (national promoting bodies), and users (tourists) are among these actors.
- ☞ It requires a web server andinternet as the technological requirements for the access and sharing of tourism informationthrough dynamic and interactive web maps.
- ☞ A list of the functions that are required. Basic visualization functions like Pan and Zoom, as well as more advanced functions like object recognition and geographical query, are necessary. Tourists can utilize these features to get information about a specific location.
- ☞ A master catalog of geographic data that is available or required. Using GPS, several layers of tourism information were gathered. Major tourist destinations that were acquired using GPS were the starting point for this study.

3.2.2.2. Conceptual Design

The data model that defines the entities and their interactions was built when the required data was found. For the implementation of the Web-GIS application, the model uses an open source system architecture. Client and server are required components in Web-GIS systems. As a result, a client contains the web browser on the user's end. The user uses a client to submit requests and view maps and other associated data. A server is made up of four components: a map server, an application server, a web server, and a database server. This is mostly used to connect clients and map servers, as well as to provide customized functions for various mapping applications.Figure 8 depicts a broad System Architecture Design (SAD) used to create a web-based GIS database

for Addis Ababa City's tourism development. To fully implement the major architecture concepts, the conceptual system architecture is built as a three-tiered software architecture.

It is made up of three parts: a web application, a web service, and a spatial database. There are numerous web interfaces for management and a website that uses JavaScript/Openlayers coding to display information with some basic GIS functions. There is a web server that uses Apache Tomcat as a web server in the web service. The spatial data is stored in the database using PostGIS/PostgreSQL.

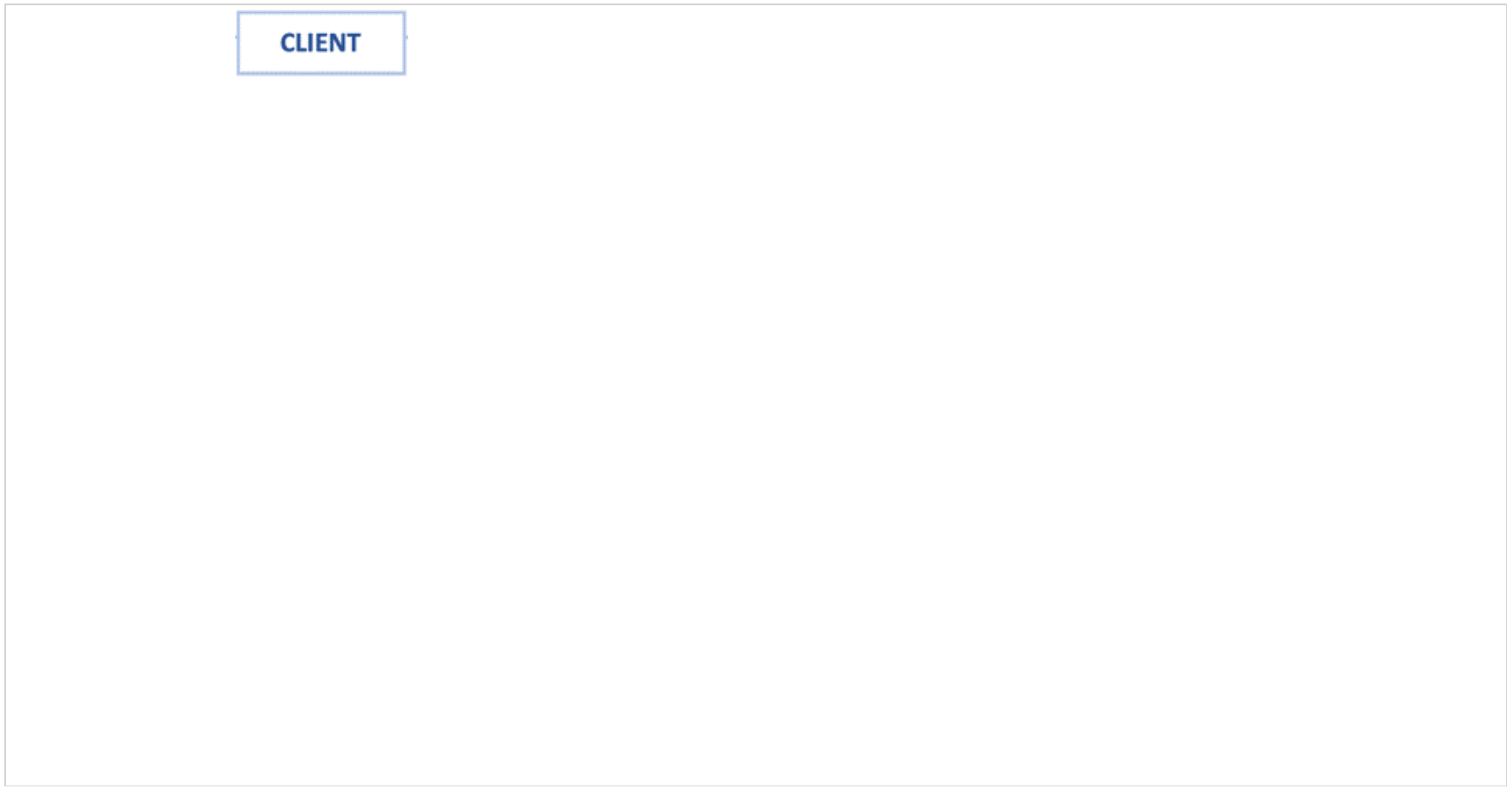


Figure 8: Conceptual System Architecture

3.2.2.3. Acquisition of GIS hardware and software

A successful implementation begins with the selection of appropriate software. Software was assessed based on its usefulness and performance, regardless of the hardware or operating system used (Alesheikh et al., 2002). Currently, Web GIS alternatives based on Free Open Source Software (FOSS) that are consistent with Open Geospatial Consortium (OGC) Open Standards are plentiful (OS). If interoperability difficulties need to be considered, this is a vital aspect of success. Furthermore, adopting standards allows for a more flexible evolution of the application, allowing for the integration of new features and services. Most important FOSS WebGIS projects have all more than one standard compliancy (Calbet, 2011).

We chose OpenGeo Suite from among the several Free Open Source Software (FOSS) because it has a solid and flexible design that allows us to reliably manage and disseminate geospatial data. As a result, PostgreSQL/PostGis, Geoserver, and Openlayers, as well as Apache Tomcat, were used as web servers in this study.

Figure 9: Prototype Software Components

GeoServer

It is a Java-based open-source software server that allows users to share, view, and edit geospatial data. It publishes data from any major spatial data source using OGC standards and is

designed for interoperability (GeoServer, 2010). GeoServer is an Open Source Geospatial Foundation project (OSGeo). OSGeo is a non-profit organization whose mission is to support and promote the development of open geospatial technologies and data in a collaborative manner (OSGEO, 2009). GeoServer is a high-performance certified compliance WMS and the reference implementation of the WFS and WCS standards.

GeoServer is an important part of the Geospatial Web. GeoServer, as opposed to MapServer, supports the majority of GIS capabilities rather than only publishing spatial data (Zhelu, 2009). GeoServer can read data from a variety of spatial data sources, including PostgreSQL/PostGIS,and output to many formats.

PostgreSQL and PostGis

PostgreSQL is a free, open-source object-relational database management system that runs on all major operating systems, including Windows and Mac OS. It is in charge of the construction, upkeep, and use of a database that contains spatial and attribute data. PostGIS is a PostgreSQL extension that adds functionality for geographic items to the database. This means that, for example, a web map service, the database can store georeferenced points, lines, and polygons. PostGIS isn't just a tool for storing geographic data. Other efforts have given it the ability to manipulate geographic data directly in the database.It has an advantage over many commercial alternatives that only act as proprietary data stores because it can manipulate data using simple SQL. Only their proprietary tools can access and manipulate their geographic data, which is encoded (Tyler, 2005). PostGIS is a popular tool for storing and manipulating map data. It's perfect for multi-tasking apps that need to access information at the same time.

pgAdmin

pgAdmin is an open source PostgreSQL administration and development environment. It is compatible with a variety of operating systems, including Mac OS X, Windows, and Linux. The software's user interface makes it simple to administer a PostgreSQL database and build tables, for example. The user can make SQL queries to the database using tools like the SQL Editor in pgAdmin. pgAdmin, like PostgreSQL, is released under the PostgreSQL License.

OpenLayers

It's a JavaScript-based toolkit or API for producing interactive map elements in the HTML environment that's open source. OpenLayers can display and mix geographical content from several sources, such as a WMS created by GeoServer as a vector layer on top of an OSM or Bing Maps base layer. It is loaded into the web browser in order to create GeoWebCache queries to the Geoserver. GeoServer will build the required tile if it does not present in the cache.It supports a variety of data formats and web services, including Keyhole Markup Language (KML), Geography Markup Language (GML), WMS/WFS Services, Web Map/Feature Services, Representational State Transfer requests (REST), Geographic JavaScript Object (GeoJSON), GeoRSS, TileCache web accessible caches, and many other commercial and free web map services, such as Google Maps, Yahoo! Maps, World Wind, and others. JavaScript can be used to display feature information on a map using OpenLayers. This feature data could come directly from a user interface or a GeoJSON feed, or it could come from a GML or KML data source (Ganesan, 2009).

GeoWebCache

It's a simple caching engine for speeding up recurring queries in a multiuser situation where server time is valuable. GeoWebCache is also compliant with the WMS (Web Map Server) standard.

ArcGIS

ArcGIS is a Desktop Geographic Information System (GIS) tool that allows you to create, edit, and visualize geospatial data.

Apache Tomcat

Apache Tomcat is a web server and application server that is free and open source. The web server component of the program is Apache, or Apache HTTP Server. It can also be deployed individually on a database server such as PostgreSQL. By hosting and exchanging web content in the form of HTML documents, Apache can power websites and web services.

3.2.2.4. Designs for tourism geodatabase

Because the geospatial database is one of the most significant assets for any GIS analysis in a project, it is an essential component of the process (Jones, 1997). In order to provide the greatest results to users, a current and accurate database is required. The creation and arrangement of various geographical data such as point, poly line, and polygon objects with their attribute tables is part of the geospatial database design. A geodatabase is a database that organizes spatial data into a hierarchical structure of data elements. Feature classes, object classes, feature datasets, and raster datasets all store these data objects. An object class is a non-spatial data table in a geodatabase.The spatial reference must be present in all geographical data features. The coordinate system, spatial domain, and data precision of the feature are all described by the spatial reference.

Figure 10 depicts a comprehensive geodatabase design that utilizes online base maps. The information gathered was processed and structured into a GIS database for map visualization. As a result, we merged vector (shapefiles) and attribute data as pop-ups on online maps into feature classes by pre-defining data types such as ‘text' for textual information.

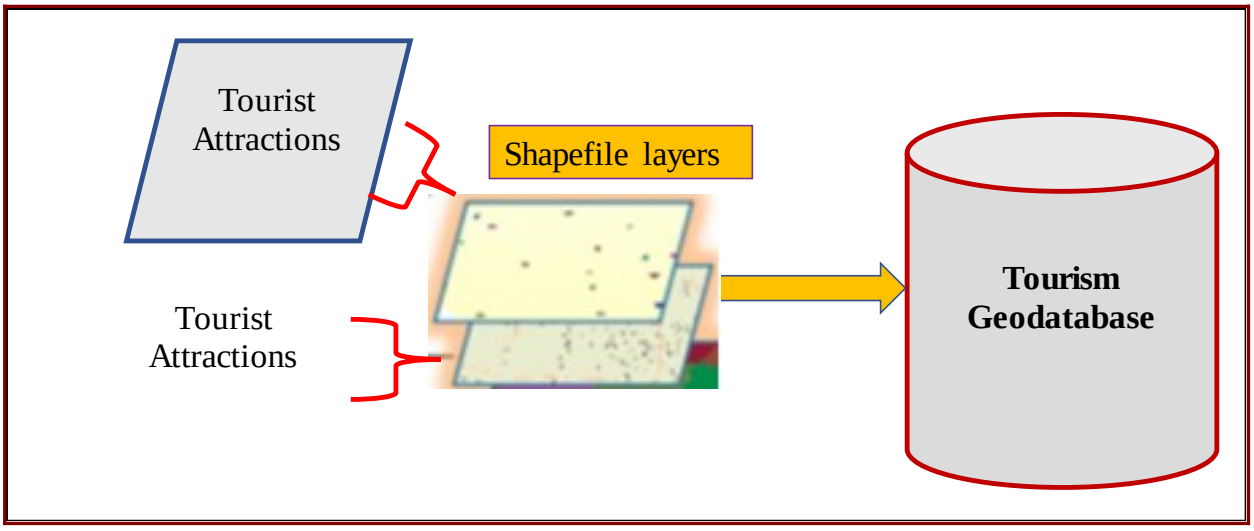


Figure 10: A complete design of the GIS tourism database.

3.2.2.5. Web GIS System Integration

Web GIS hardware and software have been acquired at this point in the development process, and data conversion is complete. The object of this phase was then to integrate varioushardware and software components, test them to ensure they functioned as planned, and commence the operations required to use the GIS (Alesheikh et al., 2002

The basic software for this research, Apache Tomcat, PostgreSQL/PostGis, ArcGIS, Geoserver, and Openlayers, must all be integrated at this phase. The steps that used for installing the software are

- Installing Java
- Installing Apache Tomcat
- Apache Tomcat ships with a web interface for basic configuration and administration tasks. We use it for installing Geoserver. Then, open new browser and point to the base main (http://localhost:8090/). Explore the manager application.Scroll down to the **Deploy** section.
- Unzip the archive file (GeoServer) then press the Browse button in WAR file to **deploy** and select the geoserver.war file. Press the **Deploy** button. After a while you will see the OK response from the manager. Now GeoServer is listed among the web applications deployed in Tomcat. Click on the /geoserver link shown in the column on the left-hand side of the list.
- Installing PostgreSQL and PostGIS. Run the installer.

3.2.3. Data Preparation

The collected boundary shapefile and tourist attraction data were prepared to feed thedata in ArcGIS software. Before exporting to ArcMap with a suitable excel format, the row primary GPS data should be organized. It's also crucial to use the correct coordinate system when exporting data to ArcGIS. According to the EPSG's geodetic parameter registry, Addis Ababa is located in the Adindan UTM zone 37N under the projected coordinate system. The next stage is to project the acquired data after determining Addis Ababa's projected coordinate system. By projecting to Adindan UTM zone 37N in ArcMap, all of the acquired data in excel format was converted to shapefile.The boundary shapefile of Addis Ababa and tourist site point shapefiles

areloaded into PostGIS database using PgAdmin 4. These shapefiles are loaded andconfigured in Geoserver.Figure 11 shows the created and available data for developedweb-based GIS Portal.

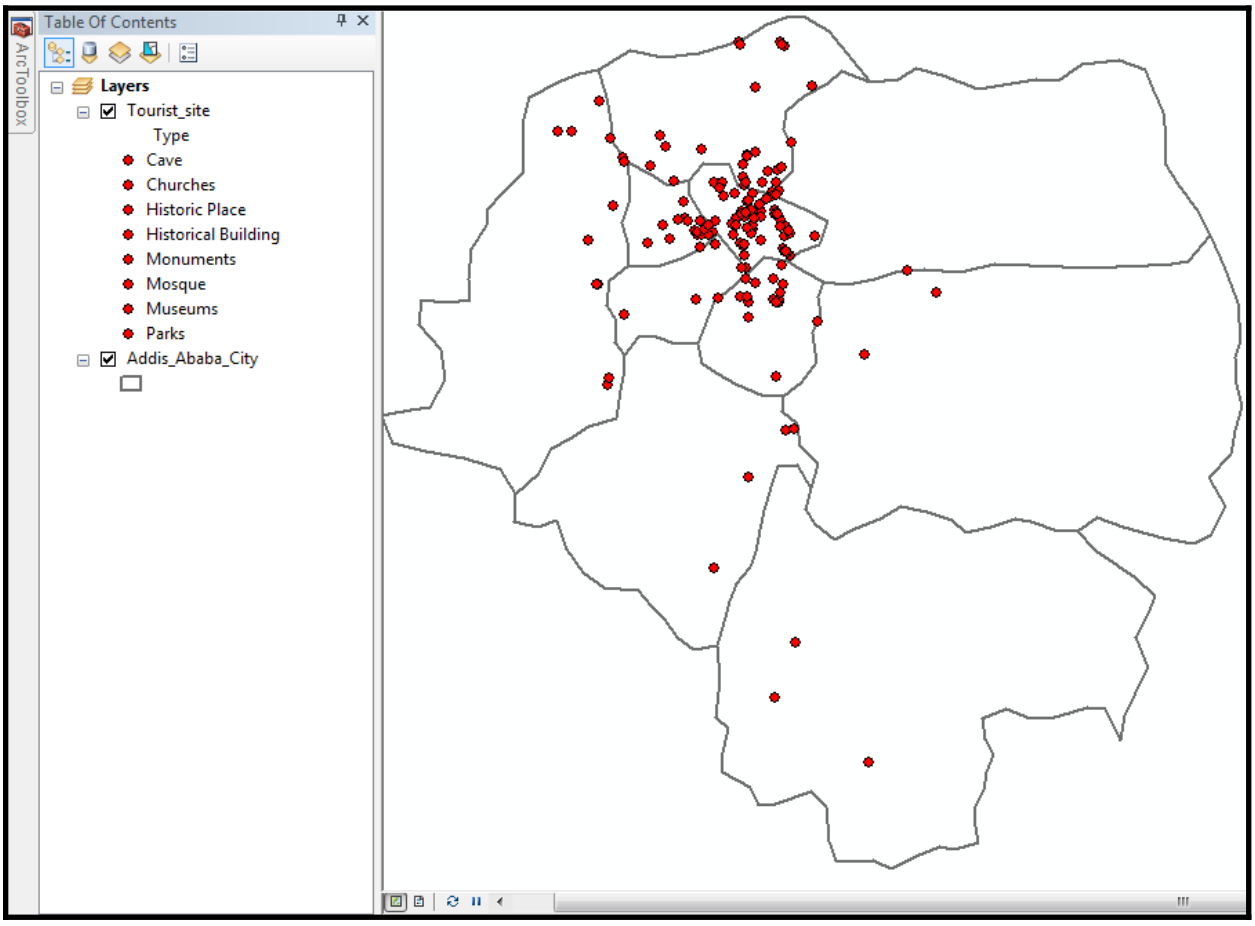


Figure 11: Created and available data for developed Web-based GIS Porta

3.2.4. Configuring GeoServer

To serve map data to the internet we need to install GeoServer on a server connected tothe Internet or localhost. It requires web serving software like Apache web server.Beside this Geoserver also requires more other components.

1. Servlet engine. A servlet engine called Jett which comes with Geoserver. There isanother popular servlet engine called Tomcat which is used in this study.
2. A Java development kit (JDK). To install the Geoserver Java development Kit isrequired.

GeoServer has a web interface where we can configure data. In this web developmentprocess Geoserver is installed in localhost. The default servlet port used by Geoserver is8080 is used in this study.

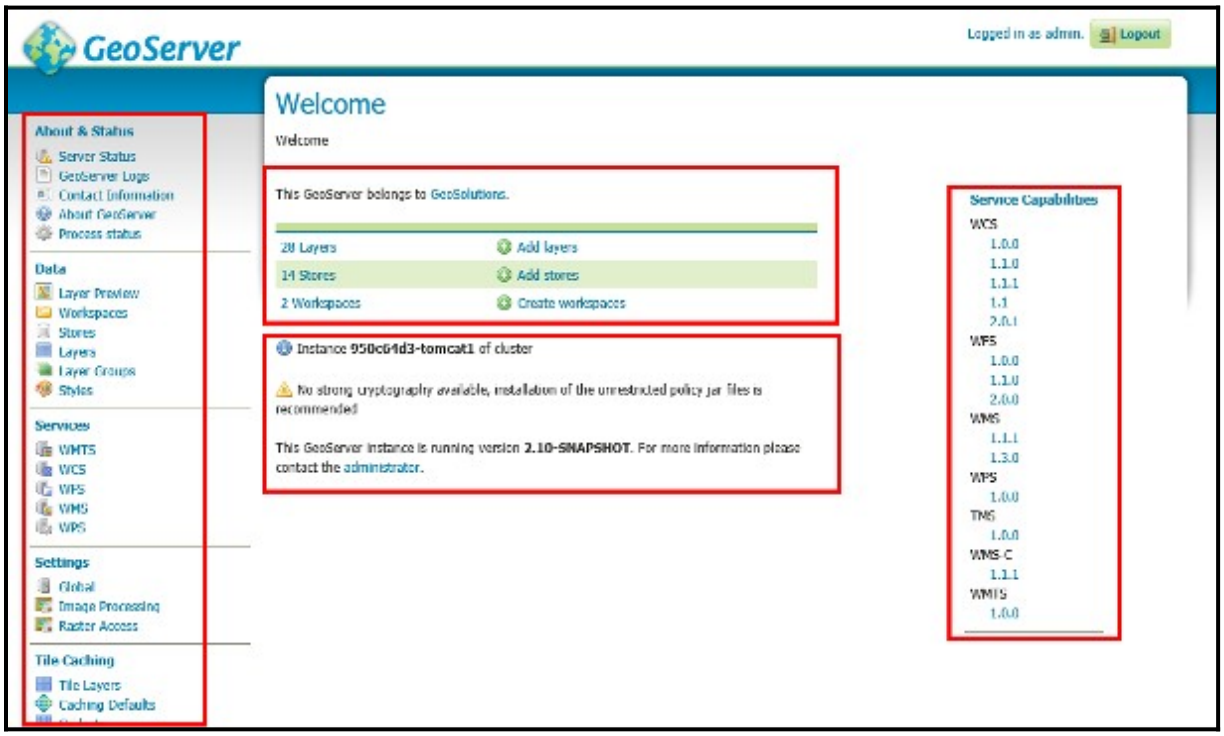


Figure 12: Geoserver Web Administration Interface

3.2.4.1. Data Storage & Management(PostgreSQL/PostGIS)

Data can now be connected to virtual 3D models (Google Earth) as well as web maps such as OpenLayers, Leaflet, and Google Maps using GeoServer. If the data of geographic objects is kept in a relational database, spatial data analysis can be performed effectively. As a result, all of the study area's layers (shapefiles) are translated to their respective tables in a PostgreSQL database. The PostgreSQL (PostGIS) database is directly connected to the GeoServer in this article, allowing all acquired data to be uploaded to the WebGIS server. PostgreSQL is the most popular object-relational database management system on the open-source platform. Therefore, to prepare all the layers with the non-spatial attribute and to create spatial data base, the PostgreSQL/PostGIS data base has been used. This tool accepts a shapefile and creates a table in the PostgreSQL database using a sequence of SQL queries.The resulting table contains all the

attribute of the shapefile including the coordinates that define each feature. To load shape files in database, the Loader utility PgAdmin 4 has been used (Figure 13).

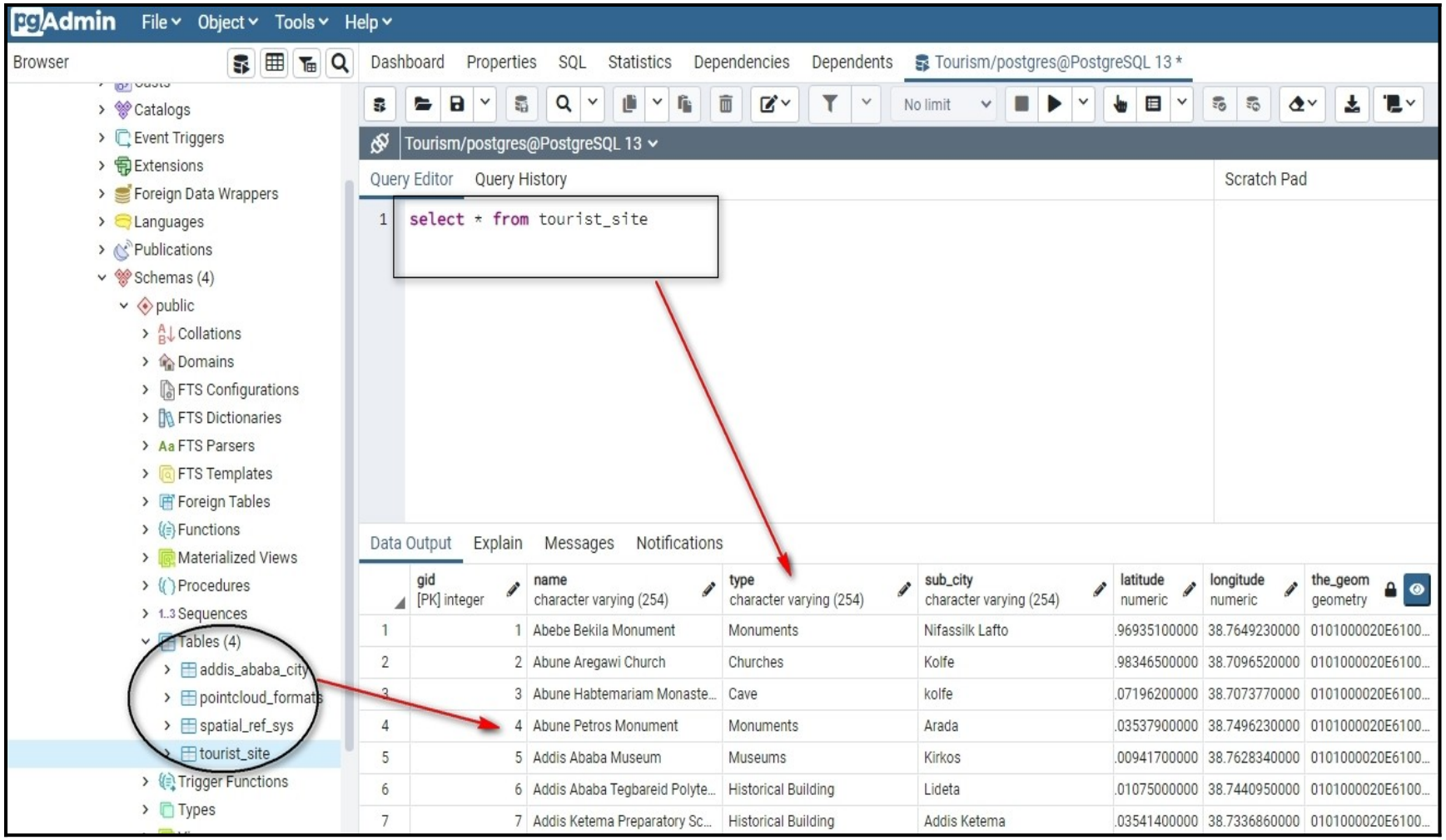
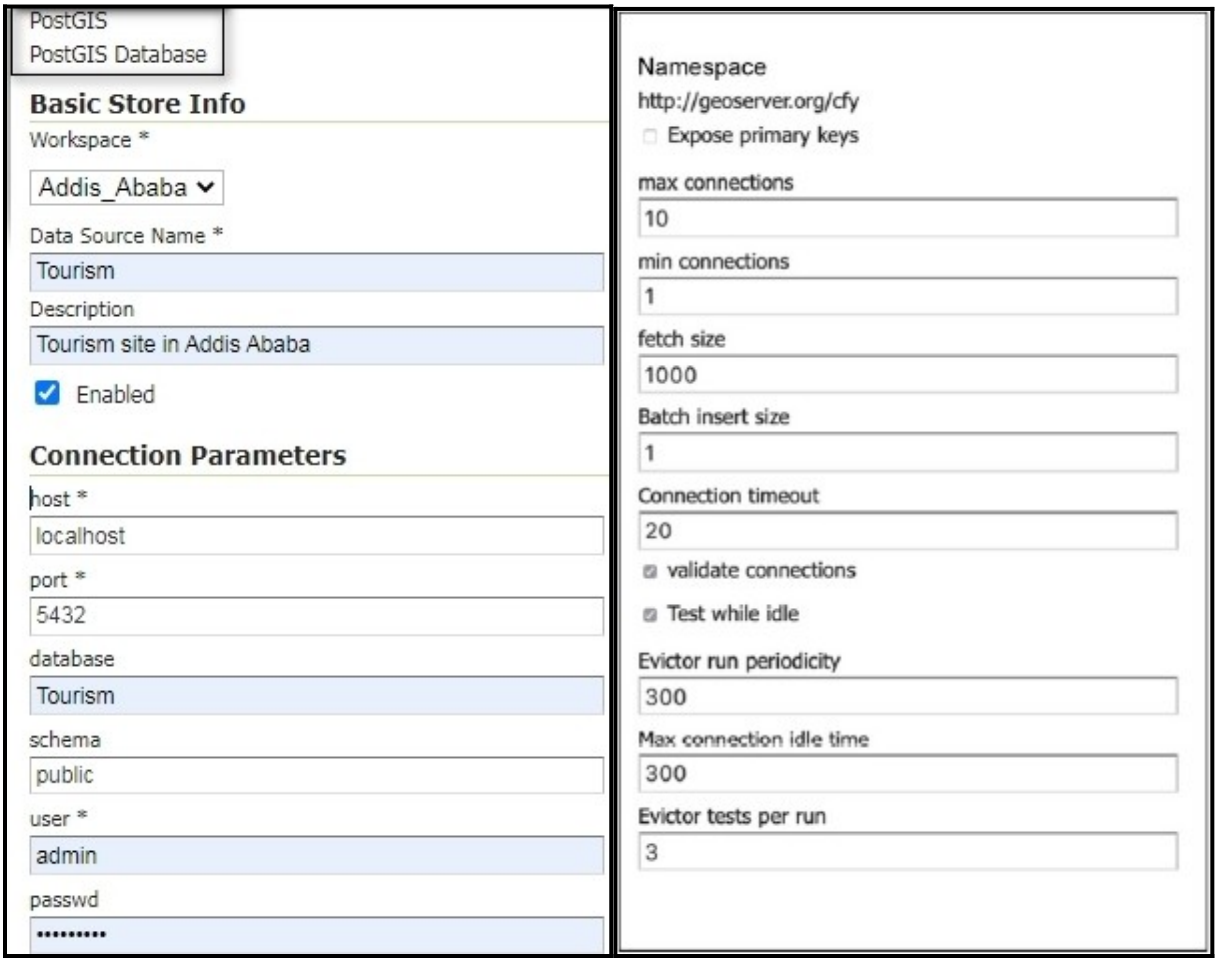


Figure 13: Databases and tables in PostgreSQL using PgAdmin 4

3.2.4.2. Data Processing/Adding Data to GeoServer:

New data can be added in Geoserver through the following steps. Workspace > Data store > Add layers > Styles > Publish. The first step to add data in Geoserver is creating work space. In our case the name of the work space is Addis_Ababa and the Namespace URL is www.etiopia.com (Figure 14). The next step is to manage the stores providing data to GeoServer. To do so PostGIS database has been used to create the store.



Type	Title	Name	Store	Enabled	Native SRS
	addis_ababa_city	Addis_Ababa:addis_ababa_city	Tourism	✓	EPSG:4326
	tourist_site	Addis_Ababa:tourist_site	Tourism	✓	EPSG:4326

Figure 14: Connect the PostGIS database to Geoserver.

In the figure above, the name of the PostGIS database, its host, port, and schema are indicated. As a result, all the tourist site layers are connected to the server. Loading the data from database, localhost was defined as host port 5432 which is the default port of PostgreSQL. To define the new feature type, new feature type as polygon for Addis Ababa boundary and point for tourist site was defined. New SLD is created to the datasets. The main purpose is display overlay maps in Google maps or Bing maps so the SRS is defined as 4326.The SRS WKT (Spatial reference system well known text) is shows the projection and coordinate of the data sets. By selecting bounding box, it generates the minimum and maximum longitude and latitude of the data. Completing this configuration step data will be stored in Geoserver.

3.2.5. Working with OpenLayers

OpenLayers is a Java script library and HTML is used to develop web interface andconnect WMS and WCS. GeoServer is connected to OpenLayers client and CSS definedfor the page to display in browser. Shapefile of boundary and point (tourism site) areloaded from database which can be fetched by GeoServer to OpenLayers. Tourist attraction site points were also determined giving longitude and latitude which can showtourist site parameters value when clicked. It can be easily updated and modified throughdatabase meanwhile OpenLayers also accepts marker points through standard text pagewhich can be changed without any knowledge of database and GeoServer. All the WMSlayers were added to the map as overlay layer using map.

3.2.6. Tile cache

Tile Cache provides a Python-based WMS-C/TMS server, with pluggable cachingmechanisms and rendering back ends. TileCache requires write access to a disk, theability to run Python CGI scripts, and a WMS to be cached. This creates local disk-basedcache of any WMS server, and use the result in any WMS-C supporting client, likeOpenLayers, or any TMS supporting client. The Tile Cache library can speed up accessWMS by factors of 10-100, or more (Metacarta, 2008).

GeoServer supports Tile Cache as a caching layer in front of the WMS. For non-dynamicmapping data in GeoServer using it will help users an experience that comes close tomatching Google Maps in terms of responsiveness and usability (Geoserver, 2010).Tile Cache

client supports multiple different rendering backend. Each rendering backendalso supports the ability to draw 'metatiles', where a large tile is rendered (Metacarta,2008) and then chopped into smaller tiles using the Python Imaging library or Map tiler.Tile cache’s configuration should do in ‘tileche.cfg’ file. Then customization of tilecache in Geoserver and web client (OpenLayers) is required. I used OpenLayers WMS fordisplaying tiled maps.

OpenLayers can create TMS overlay using map tiles. Map tiling technique is initiallyused by Google Map and becoming popular as it is faster to display. Tiles are part of map of equal size. For displaying map in OpenLayers Java script API for standardGoogle maps, Bing map and Open street map were imported in OpenLayers APIOpenlayers.js.

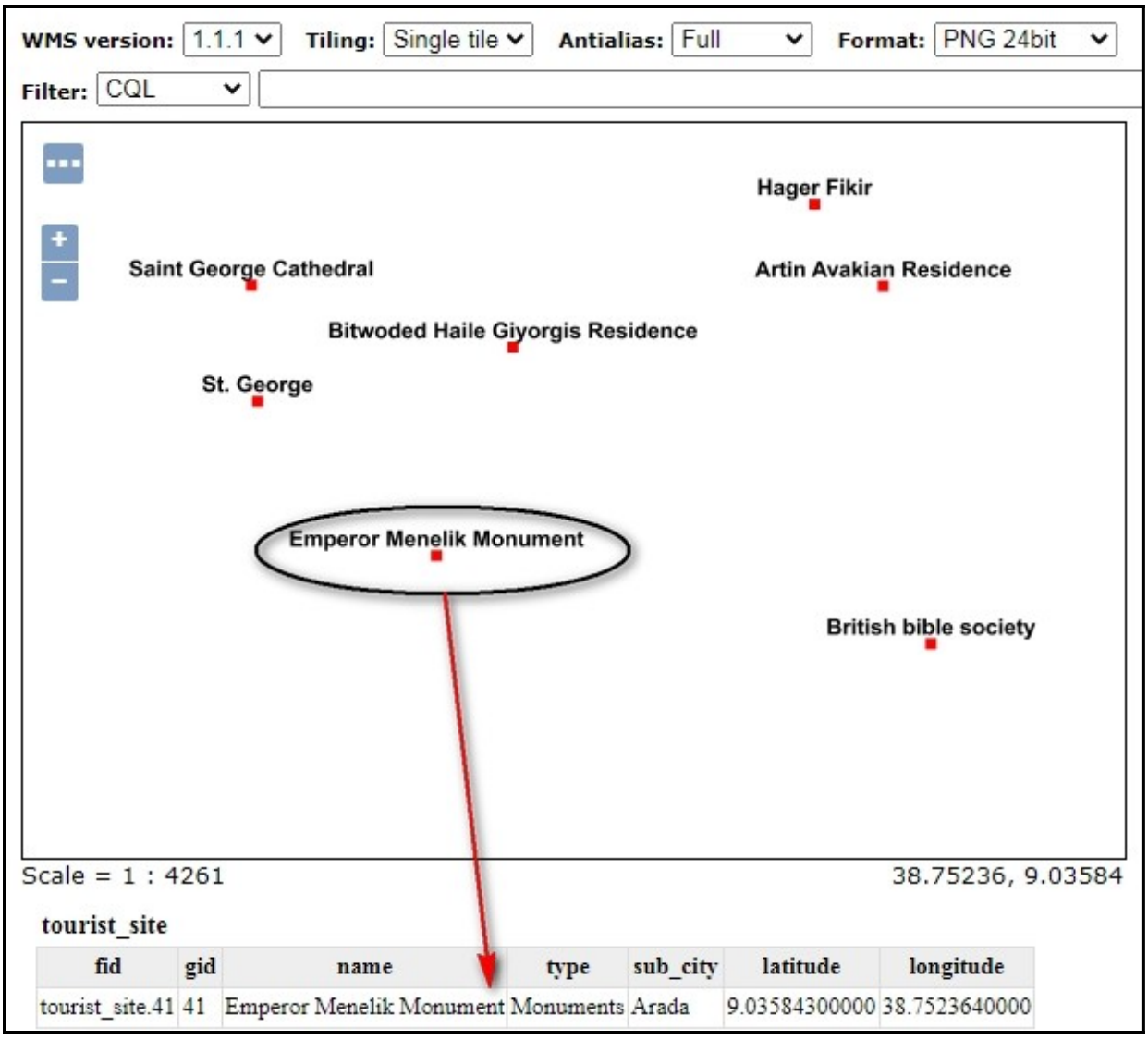


Figure 15: OpenLayers map preview

CHAPTER 4

RESULT AND DISCUSSION

This chapter explains the various steps and procedures followed to configure and create the interface website, followed by the customization of the basic tools for easy utilization of the map. It also covers a discussion upon the functions provided within the application for the users.

Following the successful installation of the required software, the application development process was carried out. To develop the Web-GIS for tourism of Addis Ababa City, the major input GeoServer and web application software were installed as indicated in the above process. The next step is to design Interface to create Web application. This interactive information can be provided to stakeholders, organizations, public with its easy access to information through the internet (i.e., Web-GIS).

4.1. Interface design

The usability of Web GIS portal mostly depends on the interface design. At interface design stage the necessary data for the Web-GIS application development was set at different levels.

The final outputs are determined by the design of the application interface and the subsequent customization procedure. We designed and created an interface that links between client and the web server side where information is stored. It is important to note that, the web server, which also constitutes map server handles all map operations and therefore, our task is to create an interface for accessing hosted information through browsers. In order to have wide options for presenting tourism information via websites, we used the Hypertext Markup Language (HTML) to provide displays of the hosted material with hyperlink effects within Visual Studio Code (VSC). Styles for enhancing structural visualization of the web elements were obtained by cascading Stylesheets (CSS) as the defacto standard for HTML, JQuery to interact with the spatial data and the JavaScript files as seen in Figure 16. The designed interface comprises different parts, with different purposes such for accessing specific types of information, for accessing web maps and for communication and updates of the system.

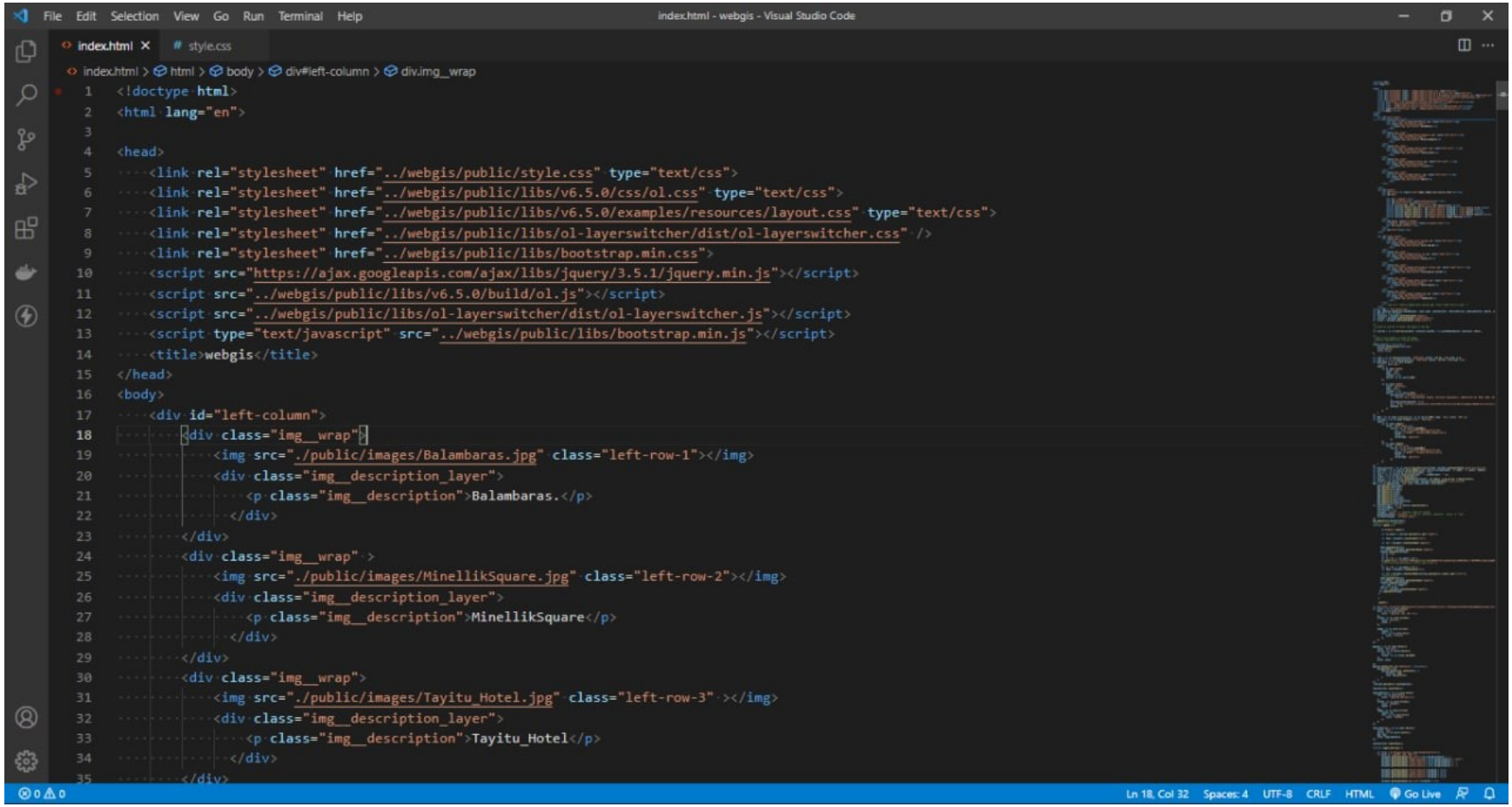


Figure 16: Presenting the coding environments for HTML, CSS and JavaScript in a Visual Studio Code (VSC).

The created web-based GIS by the promoting body synthesizes multiple forms of information organized through web-links and others to display information through pop-ups on web maps. This approach condenses and unites scattered information, which allows tourists to retrieve easily sufficient information. The access for updates and communication to the promoting body serves to provide feedback for the information not found in the website, thus improve service delivery to meet tourists' demands.

We, therefore, think by combing the management and information delivery strategies will sustain tourism industry successfully.The web has two pages one for the administrator and the other for the user. The administrator is a person, a group of people, or a tourism organization with the authority to delete, update, insert, and choose any tourist service and tourist attraction data in the research area. A login to secured tourism information for the area is available on the administrator page. The administrator page has a login to secured tourism information of the area. In the user page tourist can only view the tourist service information data such as all tourist spot with their geographic locations of the tourism information.

4.2. Running the application

For this define the desired address as; http://localhost:8080/webgis/index.html.As a result, the intended Web-GIS application will run on its own. Figure 17 demonstrates the layout of the developed Web-GIS application for Addis Ababa City tourism.

There are important tools used for showing map information on the left, right, bottom and top of the home page. Also this tool indicates information about pane, zoom in, zoom out, scale bare, legend and the whole information about Google street base map and satellite information to identify features. In order to attract the attention of the user, relevant photographs of the tourist interest places from Addis Ababa city were placed on the left and the right side panel of the display window.

The size of the toolbar frame was also lowered to allow for a wider map display. In addition, the functional tools were arranged on the top frame and on the left tab control panel. The functional tools were positioned as buttons with a symbolic representation of their functionality on them.As such, no static names were given to the functional tool buttons. However, wherever the mouse pointer is placed over the tool, respective function will be dynamically displayed in the form of a tool tip.

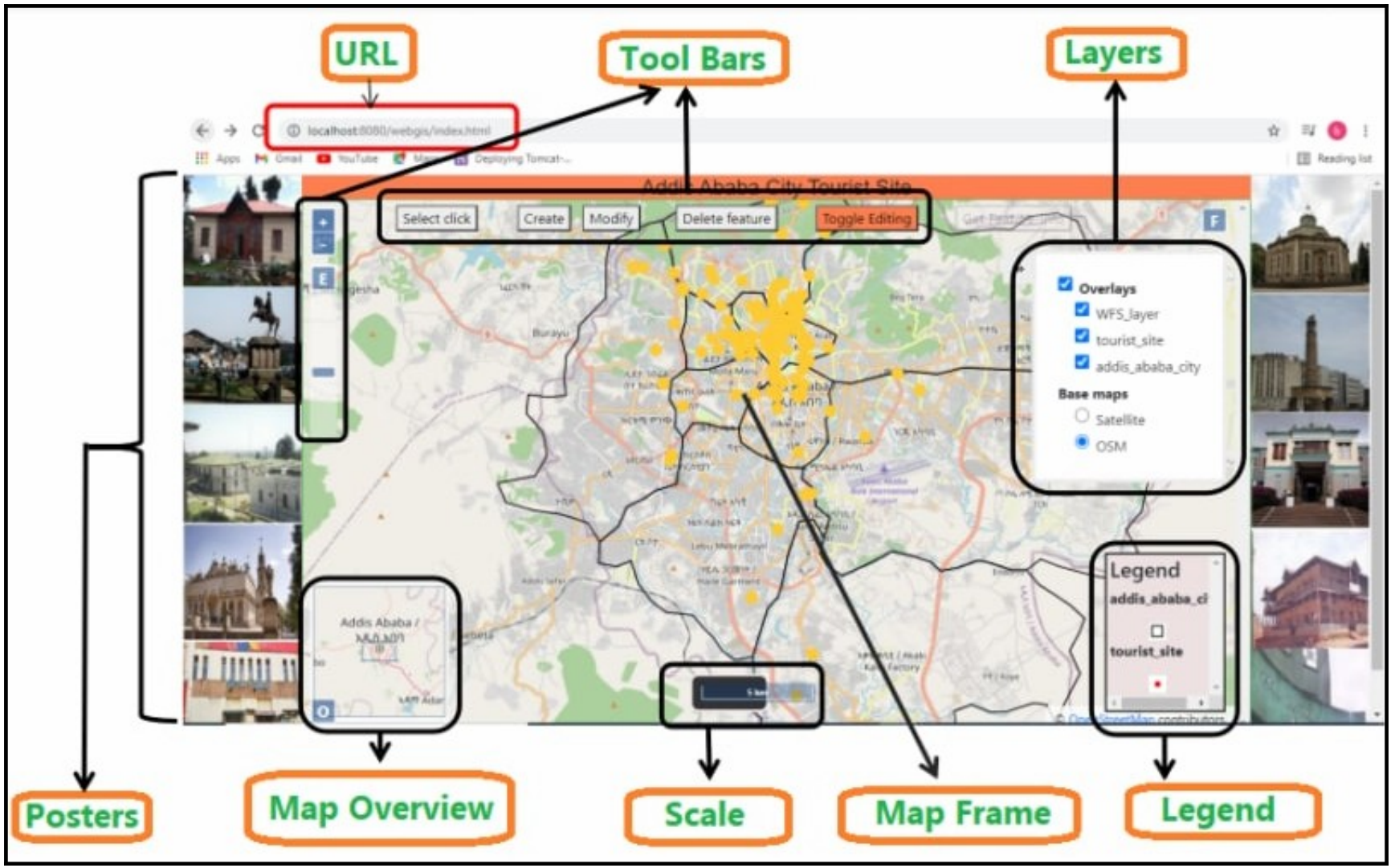


Figure 17: Developed Web based GIS portal of the study area.

Main map

The activated and visible layers are displayed in the main map. The layers are created by Geoserver as an image in shapefile format for displaying on Openlayer application. Since it is an interactive map, every click on it causes parameters being sent to the server and a reloading of the map. Its size can be changed from map size tab. Since the size of the main map influences the position of the legend and reference map, the application starts up with a fixed size allowing the user to customize the application depending on his screen size at any time.

Overview map

It's a main map with a navigation window, as well. It will act as a reference map. The zoomed portion of the main map can be seen on the whole map with a rectangle box highlighted the zoomed area.

Tool bar

These were selected as the essential tools for navigating the map. These tools include zoom in, zoom out, zoom full to extent and zoom to boundary box or point. These tools are available on the top right corner of the home page and the left side of the home page.

Table 2: *Tools in the Tool Bar*

Toolbar	Symbol	Function
Zoom in		A mouse click on the "+" will zoom in the map.
Zoom out		A mouse click on the "-" will zoom out.
Full screen		A mouse clicks on letter "F" will make the map full screen.
Zoom to Full extent		A mouse click on the letter "E" will zoom to the default zoom.
Slider		Up and down movement of the slider zoom in and zoom out the map.

Editing and query Tools:

These tools are very important tool, which can be used to find spatial information. These tools help the user to find out any information in quick and easy way from this large database file. User can get information about tourist destinations by clicking the feature while it displays the description of the spatial feature using selection icon. Tourists can also access linked spatial and non-spatial information with that particular tourist attraction or tourist service feature by clicking at that particular point in the homepage. These tools include click to inset, create, modify, delete and Get feature info. These tools are available on the upper corner of the home page, from where all GIS based HTML documents can be found and all spatial data displayed based on the query filed (Figure 18).

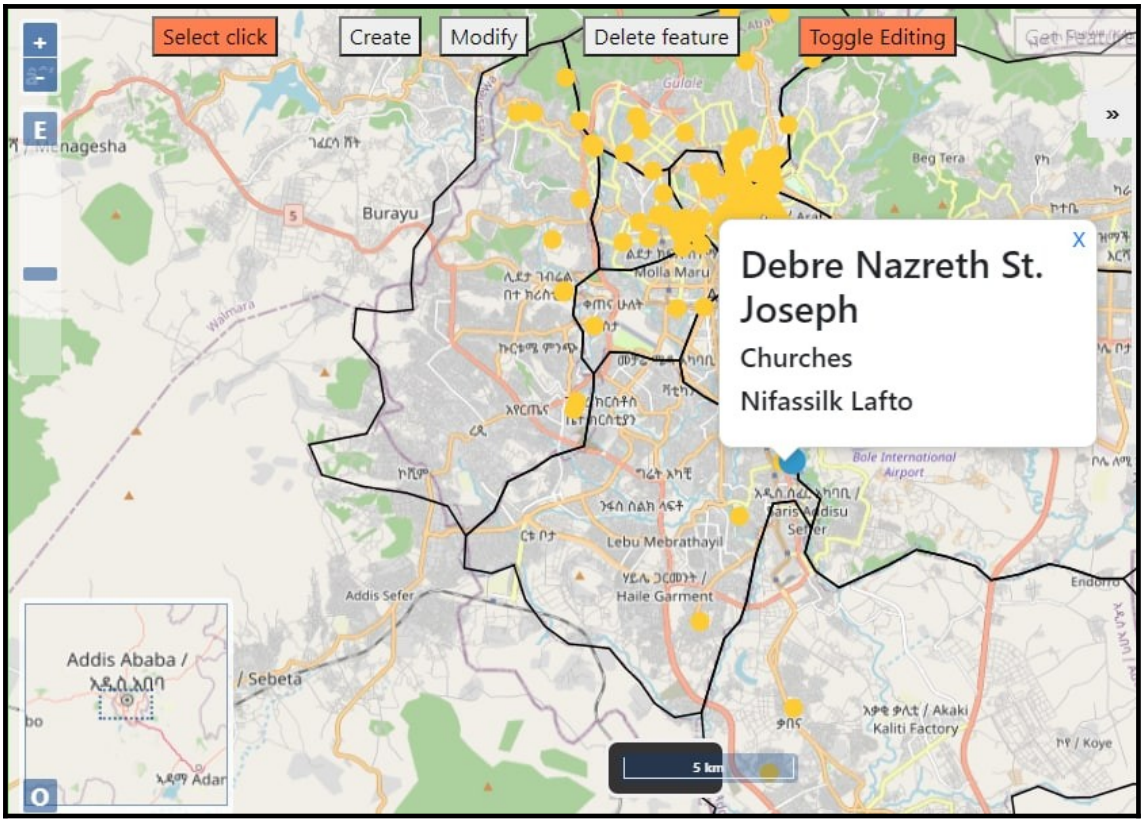
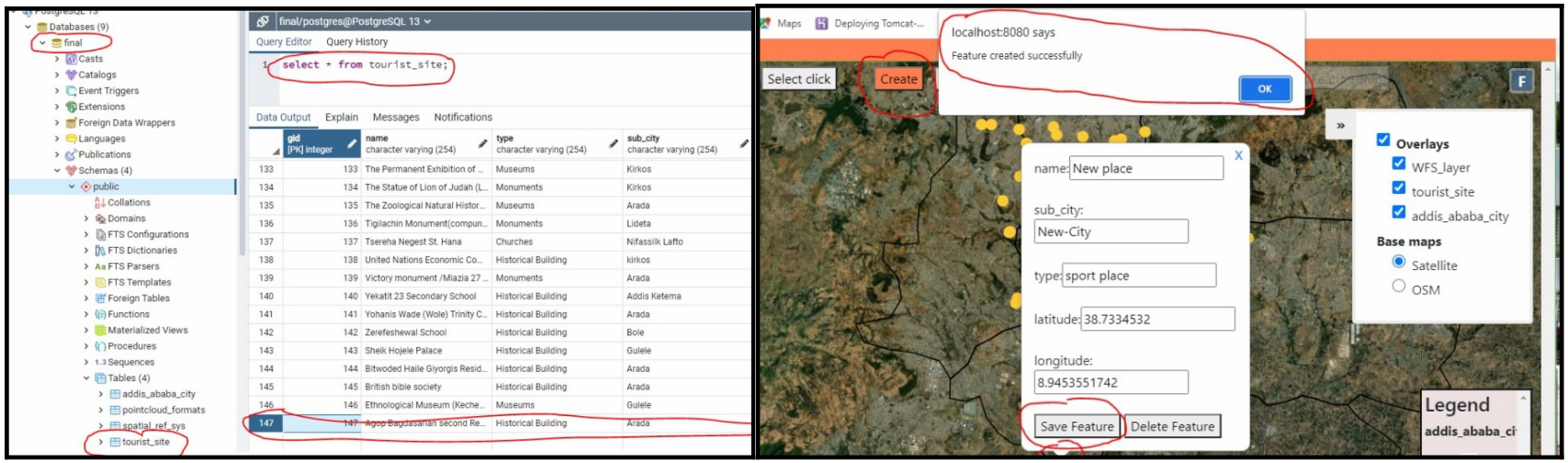


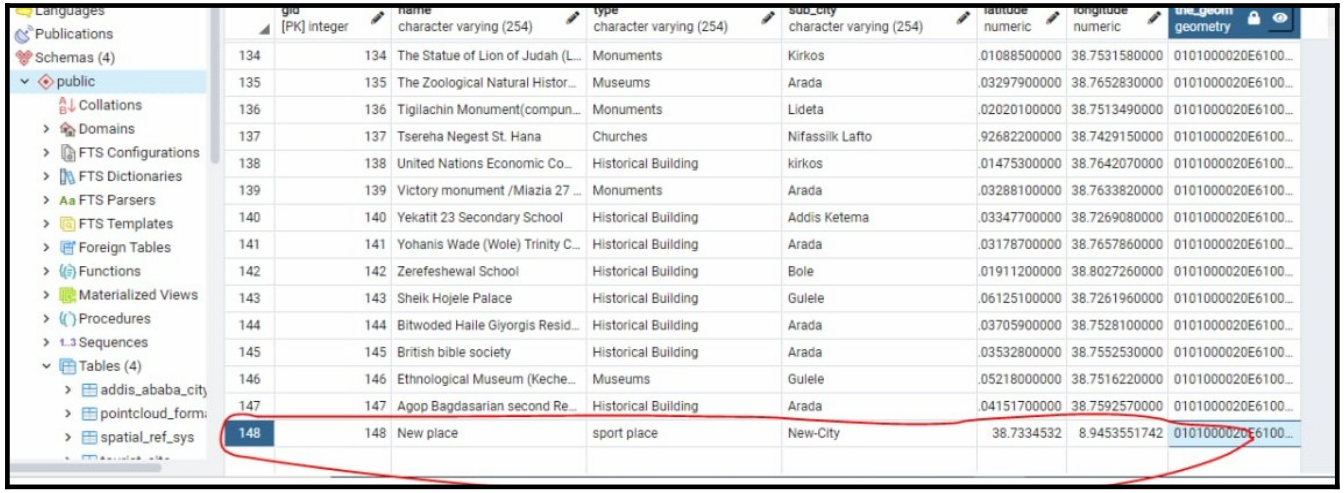
Figure 18: Using the select button in the developed tourism portal for query tourism information

To allow a vector layer to be edited, besides the standard way of layer setup, users have to add property Save strategy which permits changes on the vector layer to be saved. To edit a vector

layer, a control for each edit function is used, in particular, Control “create” to draw new features,



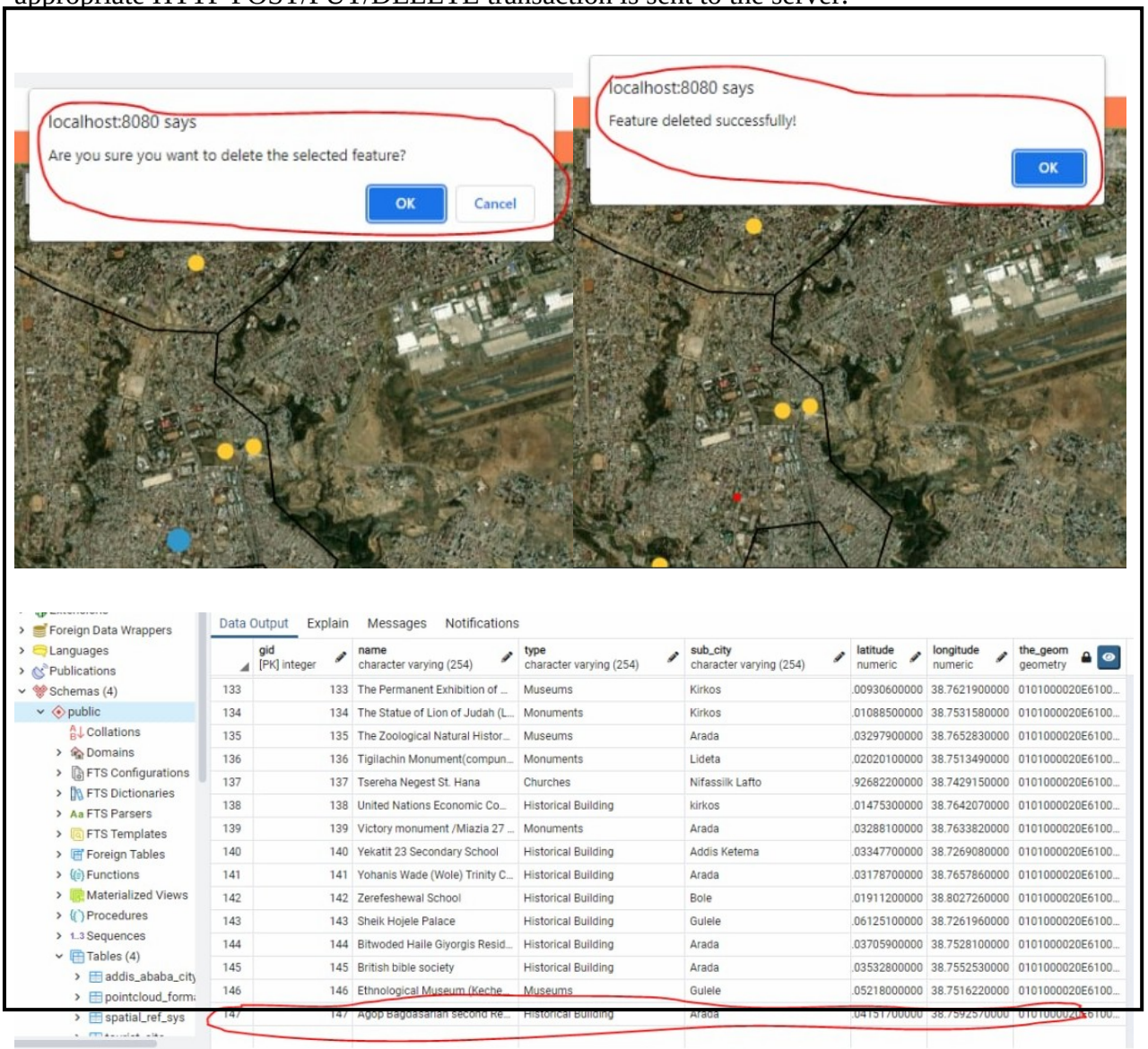
(a) **(b)**



(c)

Figure 19: Using the create button in the developed tourism portal to create new features (a) Existing spatial data in PostgreSQL database before editing, (b) creating new features (C) the new created feature in the database

(Figure 19) control “Modify” to edit existed features and control “Delete feature” to delete features (Figure 20). When a user loads the html page, and makes the changes to features with the above controls; each change sets feature state to 'INSERT', 'UPDATE', or 'DELETE'. Once finished, the user presses the button. This calls Save on the strategy, which in turn calls Commit on the protocol. This goes through each feature, and for each one where state is set the appropriate HTTP POST/PUT/DELETE transaction is sent to the server.



gid [PK] integer	name character varying (254)	type character varying (254)	sub_city character varying (254)	latitude numeric	longitude numeric	the_geom geometry
133	The Permanent Exhibition of ...	Museums	Kirkos	.00930600000	38.7621900000	0101000020E6100...
134	The Statue of Lion of Judah (L...	Monuments	Kirkos	.01088500000	38.7531580000	0101000020E6100...
135	The Zoological Natural Histor...	Museums	Arada	.03297900000	38.7652830000	0101000020E6100...
136	Tigilachin Monument(compun...	Monuments	Lideta	.02020100000	38.7513490000	0101000020E6100...
137	Tsereha Negest St. Hana	Churches	Nifassilk Lafto	.92682200000	38.7429150000	0101000020E6100...
138	United Nations Economic Co...	Historical Building	kirkos	.01475300000	38.7642070000	0101000020E6100...
139	Victory monument /Miazia 27 ...	Monuments	Arada	.03288100000	38.7633820000	0101000020E6100...
140	Yekatit 23 Secondary School	Historical Building	Addis Ketema	.03347700000	38.7269080000	0101000020E6100...
141	Yohanis Wade (Wole) Trinity C...	Historical Building	Arada	.03178700000	38.7657860000	0101000020E6100...
142	Zerefeshewal School	Historical Building	Bole	.01911200000	38.8027260000	0101000020E6100...
143	Sheik Hojele Palace	Historical Building	Gulele	.06125100000	38.7261960000	0101000020E6100...
144	Bitwoded Haile Giyorgis Resid...	Historical Building	Arada	.03705900000	38.7528100000	0101000020E6100...
145	British bible society	Historical Building	Arada	.03532800000	38.7552530000	0101000020E6100...
146	Ethnological Museum (Keche...	Museums	Gulele	.05218000000	38.7516220000	0101000020E6100...
147	Agop Bagdasarian second Re...	Historical Building	Arada	.04151700000	38.7592570000	0101000020E6100...

Figure 20: Using the Delete button in the developed tourism portal to delete features

Beside the above tools, we accessed tourism resource map for performing sample queries of spatial analysis in order to demonstrate the capabilities of retrieving more abstractions from dynamic and interactive web maps (Figure 21). The tool “Get Feature-Info”, in the developed tourism portal, help tourists to extract information about tourist site by a single click on a given feature. This tool helps the user to find out any information in quick and easy way from this large database file. User can get information about tourist destinations by clicking the feature while it displays the description of the spatial feature. Figure 19 shows the sets of specific information retrieved as a result of interaction by using web maps through queries. Such type of information cannot be achieved in static maps due to lack of interaction and too limited resources.

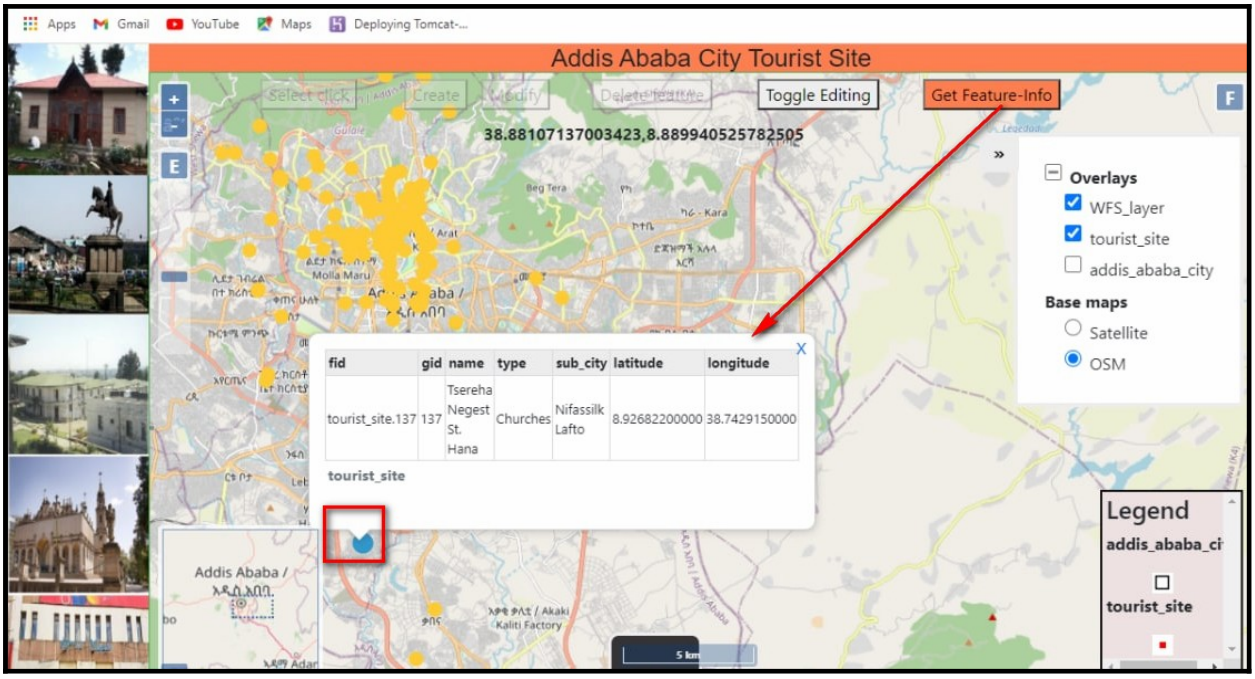


Figure 21: Sample tourist site information results using the Get Feature-Info button (query).

Layer and legend list

Layers and legend list are presented on the right side of the home page. The data in the layers is contained in this section of the map. There are two options for each layer: visible and active. When the map is first downloaded, it is set to display all of the layers. As a result, if a user wishes to make features invisible, he must manually uncheck the check box of the relevant layer

under the visible column and then refresh the page. If the user wishes to conduct tasks such as query and search on the visible layer, they must first make the layer active by clicking the tick box next to the layer in the active column and then refreshing it by clicking the update button.In paper maps, the legend serves as a key, explaining the meaning of the symbols that occur in the map. Dynamic legend is a classic legend function which is also needed in interactive web maps. But, in difference to traditional paper maps, interactive web maps use the technique of thematic layers that can be activated or deactivated by the user.

Scale Bar:

Scale bar shows the current scale of the map.

Google Map (OSM) and Google Satellite image

The Google satellite image and Google map is enriching with good cartographic information which becomes easier for tourist to use as a reference page in the developed portal. Therefore, a tourist might need to verify places while travelling in an unknown area. These base map of the study is on the maps of the tourist attraction and tourist service to access easily the spatial location.

Overall, the simple functionality of the prototype model produced during this study supplied all of the needed meaningful information about tourism interest. As a result, the prototype Web-GIS model built for Addis Ababa City has the potential to be expanded to include information on tourism attractions throughout Ethiopia. Such Web-GIS applications are thought to be one of the most effective ways to promote tourism and attract visitors to the country, which would, in turn, help the tourist sector grow in general.Furthermore, this online tourist information system may assist tourists from distant locations in exploring the country as a whole and planning their tours according to their interests by executing online GIS queries and analyses, as well as obtaining all relevant information. Other expected benefits of Web-GIS systems include increased foreign revenue inflow, better business chances for local tour operators, substantial commercial potential for the hospitality sector, and an increase in domestic and international aircraft services. Moreover, such online Web-GIS tourist systems could serve as a marketing platform for a variety of industries, not just tourism. In general, such Web-GIS applications can be used as a showcase not just for displaying tourism information, but also for highlighting the country's rich

culture and tradition, allowing people all over the world to learn more about Ethiopia over the internet.

4.10. Findings of the Studies

Addis Ababa, Ethiopia's sprawling capital in the highlands bordering the Great Rift Valley is the country's commercial and cultural hub. Its National Museum exhibits Ethiopian art, traditional crafts and prehistoric fossils, including replicas of the famous early hominid, "Lucy." The burial place of the 20th-century emperor Haile Selassie, copper-domed Holy Trinity Cathedral, is a neo-baroque architectural Called "the political capital of Africa" due to its historical, diplomatic, and political significance for the continent, Addis Ababa serves as the headquarters of major international organizations, such as the African Union and the United Nations Economic Commission for Africa.

Until now, the tourist destinations in Addis Ababa city have not been separated by the relevant body and even the few destinations that have been managed do not have tourist destination information supported by technology.

Therefore, all the actors mentioned above in the sector have expressed their opinion that the strengthening of the sector through technology will benefit the country, the city, the residents and the tourists.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

A Web-GIS database is one of the most effective ways to develop tourism potential in modern times, among several options. Such a database could provide all relevant tourist information on the internet, which users from all over the world could easily access. The goal of this research was to create a Web-based GIS database that would allow travelers to use an online interactive guide and give them a modern approach to obtain spatial information about tourist attractions. As a result, a prototype Web-GIS model for Addis Ababa City was created in this study.

The suggested geodatabase serves as a repository for tourism data that can be used to create dynamic and interactive web maps. For tourist databases, GIS and PostgreSQL/PgAdmin/PostGIS is an effective technology for collecting, storing, and analyzing data at a low cost. In our model, this geodatabase serves as the hub for gathering and processing all tourism data, which is then distributed to tourists over the internet in the form of maps.

The developed model provides easy menu and buttons for users to run the application on the internet to derive desired results of their interests.Our findings show that the designed Web GIS model can effectively manage, promote, and sustain the tourism industry.

Finally, such Web-GIS applications are expected to aid in the promotion of tourism and enhance development of tourism sector in the country.Furthermore, such online Web-GIS tourist systems could serve as a marketing platform not only for the tourism industry, but also for related industries such as hospitality, travel agencies/planners, and airline services.

5.2. Recommendations

Based on the findings indicated in this research, the following recommendations are formulated.

- ✓ Additional features should be integrated to improve the system's capability.
- ✓ Tourist service providers and other institutions should promote and use the web-based GIS tour guide method for tourist site selection.
- ✓ This research focused on tourism in Addis Ababa City, which has been steadily gaining popularity in recent years. There are a number of important tourist attractions sites that can use and benefit from the developed web-based GIS after a few adjustments.
- ✓ Furthermore, the results of this study can be utilized to create a web-based GIS tourism information system for the entire country of Ethiopia under the auspices of the Ethiopian tourism organization, which aims to make the country the greatest tourism destination in the world.
- ✓ They should also work to develop cloud web-map servers so that they may self-contain raster and video data properties for automatic pop-up displays, ensuring the independent system's high security and reliability.

- ✓ As I have seen, the studies done on the tourist destinations of different countries have their own weaknesses and strengths, but the information I have found indicates that our country has not been given any attention to the sector.
- ✓ Therefore, I say that this research is sufficient at the level the world has reached now, and it will contribute greatly to the sector and if it is put to work, it will contribute significantly to the development of the sector.

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Appendix

Data used to create Tourist spot Information for developed web GIS portal

Name	Type	Sub City	latitude	Longitude
Abebe Bekila Monument	Monuments	Nifassilk Lafto	8.96935	38.76492
Abune Aregawi Church	Churches	Kolfe	8.98347	38.70965
Abune Habtemariam Monastery Cave	Cave	kolfe	9.07196	38.70738
Abune Petros Monument	Monuments	Arada	9.03538	38.74962
Addis Ababa Museum	Museums	Kirkos	9.00942	38.76283
Addis Ababa Tegbareid Polytechnic College	Historical Building	Lideta	9.01075	38.7441
Addis Ketema Preparatory School	Historical Building	Addis Ketema	9.03541	38.73369
Addisu Mikael church	Churches	Addis Ketema	9.04075	38.73321
Afencho Ber park	Parks	Gulele	9.04587	38.75215
Africa Andenet School	Historical Building	Arada	9.03378	38.74845
Africa park/Addis-Ethio-Africa	Parks	Kirkos	9.02086	38.76373
Agusta park	Parks	Kolfe	9.00557	38.71488

Ahmed Salah/Shashib-Haiset	Historical Building	Arada	9.02769	38.75113
Akaki governmental school	Historical Building	Akaki Kality	8.8662	38.7909
Alfred llg Residence	Historical Building	Arada	9.02884	38.75727
Amesale Genete Palace	Historical Building	Gulele	9.04663	38.7577
Arada Old Post Office /Cinema Ethiopia	Historical Building	Arada	9.03315	38.74964
Arbegnoch Residence	Historical Building	Arada	9.04681	38.74276
Armenian church	Churches	Arada	9.0378	38.75737
Armens Residence	Historical Building	Addis Ketema	9.03118	38.74223
Artin Avakian Residence	Historical Building	Arada	9.03742	38.75497
Asefa Wossen Palace	Historical Building	Gulele/AK	9.03179	38.73679
Bayush Mosque	Mosque	Addis Ketema	9.02659	38.73832
Bessmelian (Muse Yaeqob) Residence	Historical Building	Arada	9.03188	38.7549
Betesaida Hospital /Yekatit 12 Hospital	Historical Building	Arada	9.04364	38.76064

Bhere-Tsege park	Parks	Nifassilk Lafto	8.95499	38.75351
Bitewoded Endalkachew Mekonen Residence	Historical Building	Addis Ketema	9.03503	38.73176
Bole Park	Parks	Bole	8.99318	38.78948
Cheralia Food Complex	Historical Building	Akaki Kality	8.90372	38.76803
Customs Office	Historical Building	kirkos	9.01125	38.75085
Daniel Hotel	Historical Building	Addis Ketema	9.03456	38.73446
De Gaulle Monument	Monuments	Arada	9.03263	38.75406
DebreGelila St. Emmanuel	Churches	Addis Ketema	9.02799	38.72238
Debre Nazreth St. Joseph	Churches	Nifassilk Lafto	8.96978	38.76744
Dej. Bitweded W/Gebriel Residence	Historical Building	Addis Ketema	9.03503	38.73176
Dej. Enqu Selassie Residence	Historical Building	Arada	9.043	38.75468
Dej. Gebre Maryam Gari Residence	Historical Building	Gulele	9.02408	38.75239
Dej. W/Gebriel Residence	Historical Building	Arada	9.02975	38.77426
Dej. Webe H/Marima Residence	Historical Building	Arada	9.04069	38.75323

Dejach Wube Atnafsege Residence (AA Restaurant)	Historical Building	Arada	9.04091	38.7533
Emperor Menelik Monument	Monuments	Arada	9.03584	38.75236
Empire Cinema	Historical Building	Arada	9.03354	38.75468
Empress Menen Girls School	Historical Building	Gulele	9.05016	38.75944
Empress Menen Orphanage	Historical Building	Gulele	9.05601	38.75584
Empress Tayitu Palace	Historical Building	Gulele	9.08916	38.76443
Entoto Atse Dawit Cave	Cave	Gulele	9.09038	38.75061
Entoto museum	Museums	Gulele	9.09014	38.76341
Ethio-Cuba Friendship park	Parks	Lideta	9.02011	38.75148
Ethiopian Postal Museum	Museums	Kirkos	9.01986	38.75273
Ethnological Museum	Museums	Gulele	9.04663	38.7577
Fitawrari HabteGiorgis Residence	Historical Building	Addis Ketema	9.03446	38.74333
Fitawrari HabteGiyorgis Courtyard	Historical Building	Kolfe	9.06247	38.69459
General Wingate Technical and Vocational College	Historical Building	Addis Ketema	9.05424	38.71439

Genete Leul Palace	Historical Building	Gulele	9.04669	38.75771
Gojeb Hotel	Historical Building	Addis Ketema	9.03458	38.73863
Greek Orthodox	Churches	Arada	9.04395	38.76297
Hager Fikir	Historical Building	Arada	9.0379	38.75457
Hakim Workineh Residence	Historical Building	Arada	9.04313	38.74903
Hamel 19 park	Parks	Gulele	9.05911	38.76659
Health Studies Institute /Leuispaster memorial Hospital	Historical Building	Gulele	9.04688	38.73054
Itegue Taitu እቴጌጣይቱሆቴል	Historical Building	Arada	9.03063	38.75428
Kagnew Shaleqa Hotel	Historical Building	Addis Ketema	9.03054	38.73748
Karl Marx Monument	Monuments	Gulele	9.04684	38.76201
Kechene Debre Selam Medhanealem	Churches	Gulele	9.05515	38.75306
Kechene Medhanealem Museum	Museums	Gulele	9.05463	38.75317
Kegnazmach Mekonene Endalkachew Residence	Historical Building	Arada	9.04216	38.76083
Keranio Medhanialem Church	Churches	Kolfe	9.01505	38.70702

Kidane Meheret church (entoto)	Churches	Gulele	9.07675	38.77301
Kidus Paulos Church	Churches	Kolfe	9.02866	38.70365
King Mikael Banquet Hall	Historical Building	Gulele	9.04846	38.7516
Kolfe park	Parks	Kolfe	9.0393	38.71134
La Gare / Ethio-Djibouti Railway Station	Historical Building	kirkos	9.00944	38.75335
Leelet Zenebework/ Alert Hospital	Historical Building	Kolfe	8.98563	38.7103
Lion zoo park	Parks	Arada	9.04287	38.76201
Macato	Historic Place	Addis Ketema	9.03056	38.73889
Mahatma Gandhi (inside Gandhi Hospital)	Monuments	Kirkos	9.01534	38.75562
MarticKervorkoff Residence / Elias Hotel	Historical Building	Arada	9.03228	38.7529
MedehaneAlem School	Historical Building	Gulele	9.05176	38.72306
Mehal Gebeya Adarash No. 1&2	Historical Building	Addis Ketema	9.03128	38.73747
Menebre Patriarch Library Museum	Museums	Arada	9.03679	38.76173
Menebremengist kuskuam	Churches	Gulele	9.07603	38.75544
Menekik Palace /Ghebbi	Historical Building	Arada	9.02594	38.76402

Menelik II Entoto palace/Palace Of Emperor Minilik and Empress Taitu 1883	Historical Building	Gulele	9.08916	38.76443
Menelik II School	Historical Building	Arada	9.03511	38.7635
Menelik Jail	Historical Building	Arada	9.04683	38.74556
Meskayehizunan Medhanealem	Churches	Gulele	9.05056	38.76261
Meskel Square	Historic Place	kirkos	9.01031	38.76141
Mulugeta Abat memorial park	Parks	Kolfe	9.06035	38.71083
National museum	Museums	Arada	9.03801	38.76184
National Palace - 7 th Day Hospital	Historical Building	kirkos	9.01668	38.76102
Nativity Cathedral	Churches	Arada	9.03044	38.74885
Parliament Building	Historical Building	Arada	9.03009	38.76463
Peacock park	Parks	Kirkos	9.00348	38.7751
Petros and Paulos church	Churches	Addis Ketema	9.05318	38.71489
Police Camp	Historical Building	Kolfe	9.01479	38.70656
Ras Mekonen monument	Monuments	Gulele	9.0398	38.75675
Ras Mekonen monument	Monuments	Gulele	9.0398	38.75675

Ras Theater	Historical Building	Addis Ketema	9.03041	38.74095
Ras Desta Hospital	Historical Building	Arada	9.04501	38.74435
Red Terror Martyrs' Memorial Museum	Museums	Kirkos	9.01002	38.76314
Saint George Cathedral	Museums	Arada	9.03742	38.75128
Salo St. George Church	Churches	Akaki Kality	8.88665	38.76156
Sebastopol Mortar Monument	Monuments	Arada	9.02707	38.75159
Seitan Bet mega Amphi Theatre	Historical Building	Arada	9.02736	38.75222
Shauel Dema Residence	Historical Building	Addis Ketema	9.02893	38.72928
Sheger park	Parks	Gulele	9.05692	38.73907
St. Bealewold	Churches	Arada	9.0253	38.76451
St. Egziabhare Abe	Churches	Bole	9.01222	38.81164
St. Estifanos	Churches	Kirkos	9.01216	38.76357
St. Franchesco Catholic	Churches	Kolfe	9.06261	38.69867
St. George	Churches	Arada	9.03675	38.75132
St. Gibi Gabriel	Churches	Arada	9.02393	38.76647
St. Kirkos	Churches	Kirkos	9.00456	38.75353

St. Lideta Mariam	Churches	Lideta	9.01043	38.73705
St. Mary (5 Killo)	Churches	Arada	9.03729	38.76213
St. Mary church (entoto)	Churches	Gulele	9.08953	38.76374
St. Raguel	Churches	Addis Ketema	9.03224	38.73989
St. Raguel church (entoto)	Churches	Gulele	9.08956	38.75113
St. Rufael church	Churches	Gulele	9.0579	38.72764
St. Selassie/ holy trinity cathedral	Churches	Arada	9.03086	38.76643
St. Taka Nigist Beata Mariam	Churches	Arada	9.02489	38.76559
St. Tekel Haimanot	Churches	Lideta	9.02724	38.74333
St. Yohannes	Churches	Arada	9.04213	38.74564
St.Yared	Churches	Kirkos	8.98645	38.76226
Taeka NegestBe'ataLemariam	Museums	Arada	9.02526	38.7651
Teferi Mekonen School	Historical Building	Gulele	9.05147	38.76366
Teshome Berhe Residence	Historical Building	Arada	9.03604	38.75724
The Ethiopian Orthodox Tewahido Church Patriarch Palace	Historical Building	Arada	9.03684	38.76232
The Grand Anwar Mosque	Mosque	Addis Ketema	9.03322	38.74105
The Holy Trinity Cathedral	Museums	Arada	9.0309	38.76644

The Korea Marchers Monument	Monuments	Gulele	9.04646	38.75246
The lion of Emperor H/Selassie I	Monuments	Kirkos	9.01658	38.75244
The Permanent Exhibition of Ministry of culture and tourism	Museums	Kirkos	9.00931	38.76219
The Statue of Lion of Judah (La Gare Center Compound)	Monuments	Kirkos	9.01089	38.75316
The Zoological Natural History Museum	Museums	Arada	9.03298	38.76528
Tigilachin Monument(compund)	Monuments	Lideta	9.0202	38.75135
Tsereha Negest St. Hana	Churches	Nifassilk Lafto	8.92682	38.74292
United Nations Economic Commission for Africa (UNECA)	Historical Building	kirkos	9.01475	38.76421
Victory monument /Miazia 27 monument	Monuments	Arada	9.03288	38.76338
Yekatit 23 Secondary School	Historical Building	Addis Ketema	9.03348	38.72691
Yohanis Wade (Wole) Trinity Colleage	Historical Building	Arada	9.03179	38.76579
Zerefeshewal School	Historical Building	Bole	9.01911	38.80273
Sheik Hojele Palace	Historical Building	Gulele	9.06125	38.7262
Bitwoded Haile Giyorgis Residence	Historical Building	Arada	9.03706	38.75281
British bible society	Historical Building	Arada	9.03533	38.75525

Ethnological Museum (Kechene)	Museums	Gulele	9.05218	38.75162
Agop Bagdasarian second Residence	Historical Building	Arada	9.04152	38.75926