

# DEVELOPMENT OF A SUSTAINABLE TOURISM WEB MAP FOR THE CITY OF LONG BEACH USING AN OPEN SOURCE ENTERPRISE GIS ARCHITECTURE

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## Introduction

The objective of this project was to develop a sustainable tourism web mapping application built on an open source enterprise GIS infrastructure and hosted in the cloud.

The study area for this project is the City of Long Beach. The City of Long Beach is one of the most ethnically diverse communities in the United States, offering all the world-class amenities of a large metropolitan city. The city has transformed into an attractive upscale tourist hub owing to its beachside location, waterfront attractions, endless recreational events and numerous point of interests. The City of Long Beach has implemented various sustainable travel initiatives and was designated a Silver-Level Walk and Bike Friendly Community.

The purpose of this project was to set up a centralized integrated sustainable travel GIS platform. Utilizing open source GIS software products has the added benefits of cost, data interoperability, free code use and resource sharing.

Hence, this approach was selected and elements of tourism and geo-informatics were integrated to create a new GIS-supported sustainable tourism planning approach.



Figure 1. Study Area: Long Beach

## Data and Data Sources

Long Beach DataLB is the city's new public GeoSpatial & Open Data Portal for exploring, visualizing and downloading data that has been made publicly available. The Long Beach Open Data Hub provided geospatial data in the form of shapefiles for this project. These datasets are also available as services to be consumed directly with the application. Additional data about tourism related facilities and activities were found on the web.

Table 1. List of data and data sources used in the project

Dataset	Source
Aerial Imagery	USGS National Map
Digital Elevation Data	USGS Earth Explorer
Long Beach City Boundary, Building Roof prints, Parks, Tourist Zones	Long Beach Open Data Hub
Long Beach Major Roads, Bikeways (implemented/proposed)	Long Beach Open Data Hub
Long Beach Points of Interest	ArcGIS MapIt Open Data

## Methodology

The GIS enterprise architecture that I developed consisted of four components: the cloud architecture, the backend database, the GIS server, and the interactive web map.

The process started off with me setting up an Amazon EC2 Cloud instance and installing the required GIS components. These components consisted of PostgreSQL/PostGIS database, QGIS desktop application, GeoServer as the GIS server with published OGC services (WMS, WFS, WMTS), HTML, CSS and JavaScript (MapBox JS) to develop the interactive web map user interface. The website was deployed on AWS IIS Web Server(http, https) with an acquired GoDaddy domain linked to the AWS instance using Amazon Route 53 DNS.



Figure 2. Deployed Cloud Enterprise GIS Architecture

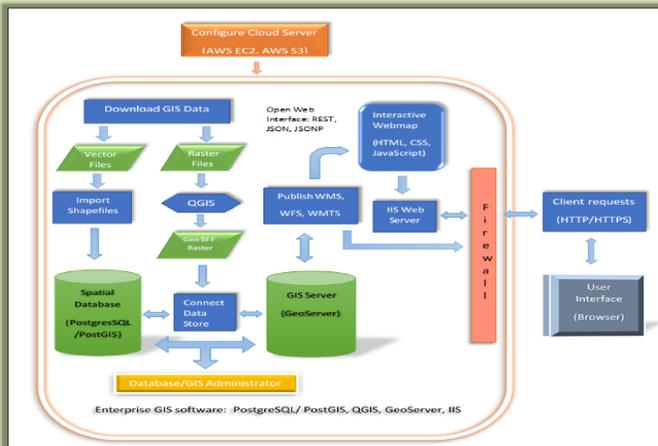


Figure 3. Implemented Method Flowchart

## Timeline

Technical work required	Initial defined timeline	Implemented timeline
Set up the Amazon EC2 Instance.	May 1, 2017	May 1, 2017
Set up PostgreSQL/PostGIS database and GeoServer on the AWS.	May 5, 2017	May 3, 2017
Collect datasets, and define the functionalities to be implemented	May 15, 2017	May 10, 2017
Make data store connection in GeoServer from PostgreSQL database and publish WMS, WFS and WMTS services.	May 18, 2017	May 13, 2017
Buy a domain address, create Amazon Route 53 DNS hosted zone and link it to the domain and the Amazon EC2 instance.	May 20, 2017	May 15, 2017
Install IIS web server on the Amazon EC2 instance, create a trial mapping website and deploy it locally.	May 23, 2017	May 20, 2017
Setup the windows security on the AWS instance.	May 25, 2017	May 25, 2017
Explore ways to create web mapping application (Node.js, OpenLayers, Leaflet, MapBox APIs along with HTML, CSS, JS)	June 3, 2017	June 6, 2017
Create a working application/website, implement the required functionalities, and host it on the web server.	June 10, 2017	June 12, 2017
Perform testing and debugging of codes. Get feedback, work on resolving/implementing additional functionalities.	June 13, 2017	June 13, 2017
Implement security at the database/GIS server/web server level.	June 16, 2017	June 16, 2017
Submit the technical work	June 17, 2017	June 17, 2017

## Results

In the interactive web map, a blue person location marker can be dragged across a map which uses a dynamic buffer radius to highlight the nearest bike stations as red bike marker. On clicking the nearest bike share location, walking route information gets displayed as a green line along with the ETA. The web map has additional routing capability which gives the option to select start and end points on the map and mode of transport (driving, cycling, or walking). This routing information is shown as a blue line on the map along with the driving directions displayed in the direction box. Zooming and full screen capabilities can be found on the top-right side of the map. All the layers can be accessed from the layer list to show the features on the map. The website also contains elevation and slope information which could be useful while choosing a biking route. Location services can only be enabled through the use of the secure 'https' protocol. Additional information can be found from 'About this Map' section. Options for printing, sharing, survey and suggestions are available in the map.

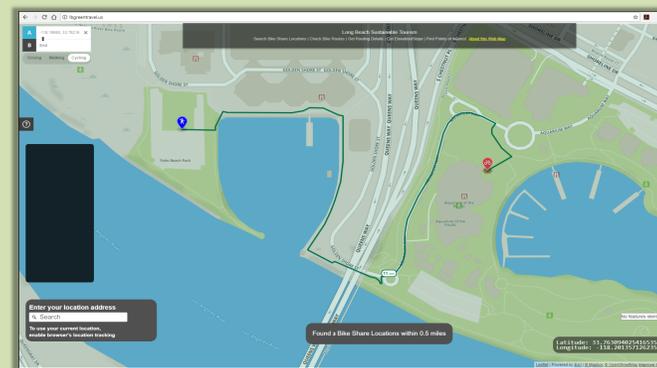


Figure 4. Routing functionality to the nearest bike station

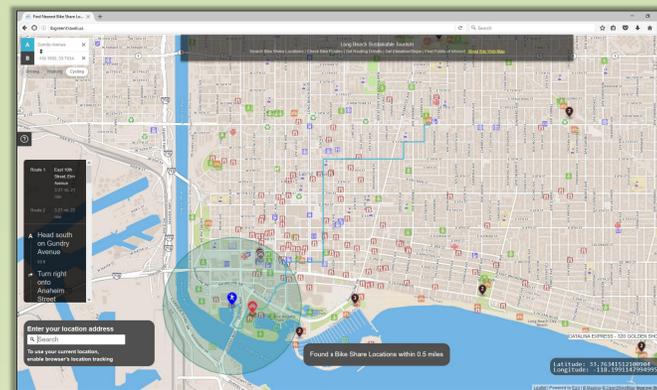


Figure 5. Routing functionality showing start and end points with turn-by-turn directions

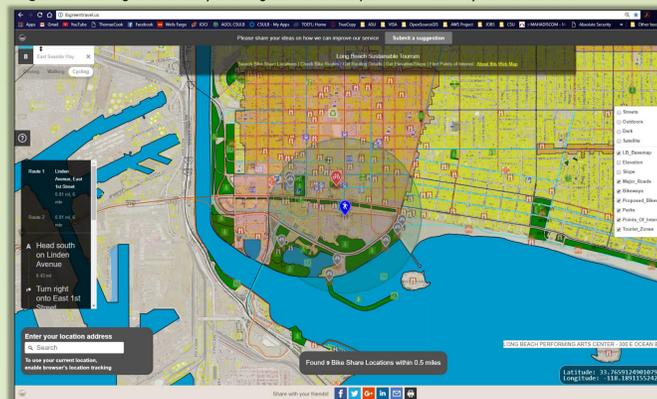


Figure 6. Screenshot of data layers turned on along with the sharing, survey and suggestions options

## Discussion

I tried to create a workflow which would make it possible to setup a multi-user enterprise GIS from scratch. Creating an enterprise GIS using open source technologies is, at times, extremely challenging but the rewards can be substantial in terms of cost advantages, scalability, flexibility, and open collaboration. Since the project was based on the City of Long Beach, datasets were acquired from the web and Open Data portal at no additional cost.

The web map integrated within the website was the most important part of the visualization. Users can move the map around and customize their own experience, so it is easier for them to make the information relevant to them. The web map was a way to visually show the tourist relevant spatial locations and provide sustainable ways of travel with routing capabilities. I integrated Bootstrap to improve the website's dynamic look and feel on different display screens so it should work well for all users regardless of the device that they are using to view the map.

The available resources on the AWS EC2 instance was limited to 1 GB RAM which caused slow loading of the layers when dealing with multiple requests at the same time. The free directions routing capability has a limit of 60 requests per minute and up to 25 waypoints per request.

The desired outcome of this project was to lay the foundation for future research on similar open source enterprise GIS studies. What this study provides is the proof that projects of this nature can be carried out using modern and powerful web-based GIS solutions that are becoming more readily accessible and available to a broader audience.

## Conclusion

Implementing an enterprise level web GIS system was the main motive behind this project and it was found that it is relatively easy to implement an open source web GIS interface. The implemented functionalities worked like a charm. Such web maps help in easily delivering up to date information at almost real time. As such projects deal with client-server interactions, questions about usability, social benefits, and legal constraints are the driving force for its evolution from a basic web map to a completely functional enterprise web mapping application. It can be said that utilizing the open source approach of creating a website with an embedded web map allows for collaborative work as this website has been shared on my GitHub page for further modifications. By sharing the web map on the internet, I will have the ability to reach a much larger GIS and non-GIS audience.

Future work on this project could involve improving the web map and its performance. The functionality of user logins and editing could be utilized to show customized user views. Another option for expanding the web map would be to add user geolocation functionality so that analysis could be performed on their travelling patterns to help in placing new bike and transit stops.

This project was successfully implemented and currently running live.

GO GREEN !

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