PROJECT REPORT

TEAM 38

Project 4 - Quantification of CFP for Logistic Hubs

Abstract

Global warming and a series of problems have aroused intense concerns of the international community. Man and environment are interrelated , mutually reactive affecting each other in a number of ways and a dynamic equilibrium is possible in between the two. Global climate change is adversely affected by the increasing amounts of greenhouse gases being released. A carbon footprint is historically defined as the total greenhouse gas (GHG) emissions caused by an individual, event, organization, or product, expressed as carbon dioxide equivalent. Greenhouse gases, including the carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, land clearance and the production and consumption of food, manufactured goods, materials, wood, roads, buildings, transportation and other services.Recent Studies show that the process of urban residents improving their living standards and Companies methodologies is also a driving factor in the increase of their carbon footprints.

This is a description of the proposed project pertaining to the carbon footprint emission in transportation which aids the companies and logistics hubs and creates an impact to save the environment .

Problem Statement

Quantifying Carbon Footprint using Geospatial Data for Logistic Hubs

In this project our goal is to make a person handling a logistics hub quantitatively understand the carbon footprint of the hub so as to considerably reduce the carbon footprint with the help of a software system . Furthermore , Provide a city-wise analysis of carbon footprint so as to check on the pollution

Proposed solution

A web app to keep track of the carbon footprint emitted by the logistics hub and every instance the company is engaged in transporting the vehicles provide them with the visualization of different paths between source and destination points along with the carbon footprint along each path . This also includes visualization of hotspots in the city where the carbon footprint is high .

Technologies Used

Users require a browser capable of running JavaScript, handling HTML5 and CSS and an internet connection.

Developers require:

1. **Frontend** - Javascript (React JS - version 7.8.3) and Openlayers version 6(For Maps)
2. **Backend** - Flask (version 1.1.1)
3. **To maintain database** - PostgreSQL version 12.2 (along with an extension PostGIS) and PgAdmin - Version 4
4. **For routing and other network analysis functionality** - Pgrouting (An extension of PostgreSQL)
5. OAuth for Google Authentication.

Implemented Features and Challenges faced:

1) **User Registration** - Users should be able to register specifying their usertype. When the entered details are not in the correct format necessary error statements must be displayed. When the details entered are correct, the data should be pushed into the database.
2) **Login** - Registered users should be able to login to make use of the app. Proper error messages should be displayed if filled fields are not filled or when username is repeated or when an incorrect password is entered. Authentication should be done when the correct details are entered. Login with google is also allowed which asks for the usertype before authentication.

   Issues faced: Usage of OAuth for the Google Authentication was a new concept and took time to grasp.

3) **Upload Data** - Users should be able to Upload the data necessary to make the calculations. Manager should be able to upload nodes (manually or from map),number of trucks. Executive officer should be able to upload the shape and data files. When the data uploaded is in a wrong format, throw an error.
4) **Shortest path between nodes** - Given source and destination as input,find the shortest path between these two and display in the map. Throw an error when the nodes are not valid.

   Issues Faced: We used openlayers for visualising the data on to the map, this being a new feature react has recently included very few resources we available. It included changes in react libraries which have been tried but couldn't incorporate the openlayers as a react component . So ended up running it as another and npm module and then the required integration .
5) **Path with least CFP** - Given the number of trucks, source and destination as input,find the path with least CFP and display in the map.Throw an error when the nodes are not valid.

   Issue faced: The fetched Points when the points are chosen from the map contain coordinates of the but to run the queries the queries
6) **Route-wise CFP calculation** - Based on input provided (Number of trucks) net CFP for the path is printed.

   Issues Faced: The data we are using is a huge geospatial data (1GB) understanding it and writing the corresponding queries required a deep understanding of the Spatial DB.
7) **Net CFP of the company** - To calculate the net carbon footprint of the company in order to take the necessary measures.
8) **Choose nodes from a Map** - Allow the user to choose nodes from the map.

   Issues Faced : For displaying the nodes ,the nodes from the database couldn't be imported into openlayers .It required changing them into geojson objects.After choosing the nodes from openlayers direct transfer of data to react wasn't possible so we ended up storing it in the database and then retrieving them into react .OpenLayers couldn't load large data due to which we kept reducing the data and have finally decided to work for small areas. Only the latitude and longitude were obtained from openlayers these required mapping to the node and area

9) **Log or history** - Storing all the paths chosen and printing the log along with the carbon footprint emission.
10) **Preemptive CFP calculation** - Based on input provided (Number of trucks) and path chosen, net CFP for that path is printed. If the input is not in the correct range, throw an error.

Issues Faced : The Data was in CSV or excel format which required a conversion into a table and then run the corresponding queries

11) **Identifying hotspots with high carbon emission** - Based on the input data, display the hotspots with respect to the selected parameters.

Issues Faced : Heatmaps of openlayers were used to create this visualization, the data we scrapped could the loaded directly it required converting into a table and into a geojson object

12) **Scraping of Data** : For creating the Prototype we choose London and the Different data that we used were street data (OSM) , statistical boundary data from london open data (shp), road transport energy data (excel or csv)

Issues Faced : Choosing the area to build the proptype required searching for areas that made the data needed to build the prototype available , not all the data we needed was made public . We had to integrate all these files in postgres with extension postgis (for osm data that is spatial db) and pgrouting (for queries).

OTHER CHALLENGES FACED

1) Sometimes, the database queries were failing because of its size. Only one of us had the database and only she could run database queries and co-ordinating from remote locations made it difficult.
2) We had to keep transferring the changes we made for integration testing.

Documents

- Software Requirement Specifications Document
- Design Document
- Project Concept Document
- Project Plan

- The steps to install and run the app are in the Readme of GitRepo: README.md

Diagrams

- UML use case diagram
- UML state diagram
- UML class diagram
- Project architectural diagram
- UML sequence diagram
- ER diagram of DB

Demo Video

Link to Video (TO BE ADDED)

Sprint Division

- Sprint 1 - Requirement Analysis
- Sprint 2 - Design Phase.
- Sprint 3 - Design Phase.
- Sprint 4 - Development Phase.
- Sprint 5 - Development Phase.
- Sprint 6 - Development Phase.
- Sprint 7 - Development and Integration Phase.
- Sprint 8 - Integration and Testing Phase.

Milestones

Milestone	Release	Deliverable?
Reviewing carbon footprint literature	R1	Yes
Finalising requirements	R1	Yes

Taking input data	R2	Yes
Setting up pgrouting server	R1	Yes
Importing the London osm data	R1	Yes
Writing pgrouting queries on the imported data	R1	Yes
Visualising the data using OpenLayers	R1	Yes
Login / Logout	R1	Yes
Visualising pgrouting output using OpenLayers	R2	Yes
Find the route with least CFP	R2	Yes
Find the shortest path between 2 nodes.	R1	Yes
Preemptive CFP Calculation	R2	Yes
Calculate CFP of the company	R2	Yes
Display the hotspots in the city	R2	Yes
Final GUI for the webapp	R2	Yes
Use Satellite Data to find hotspot hubs with high carbon emissions **(extension of the project)**	R2	No

Learnings

- **Agile Methodology** : The project was divided into sprints which helped us in being organized and also simulated the real world situations. This methodology was adopted and implemented as shown in the steps below.
- **Iterative Development Process :**
  - Each sprint/milestone begins with division of the Requirements as Features:Stories:Tasks and the tasks/issues are divided as part of the Planning. Each issue was initialised in with a *Dev* tag.
  - Implementation takes place after the first weekly client meet for that sprint. On completion of the issue, the tag was changed from *Dev* to *Testing* and the code snippet or UI image etc. were commented on there.
  - Once implemented the tasks are Tested by us. The client was then asked to verify.
  - All issues/tasks assigned for the sprint are Evaluated and thus closed by the client. If any change was required, the client commented on the issue.

    - Once all issues are closed, by the client the sprint/milestone is closed and hence the sprint is completed.
- **Team communication** : Most of the components in the project are interrelated so team communication was a crucial part of the project. Team meetings are recorded in the MOMs folder for team meets. *It became very hard to do, considering current circumstances, as we were all in remote places and the app could only be run by one of us.*
- **Git** : Git being the most used tool in the real-world the whole team learned how to use the tool to it's best extent. It was also used to adopt the Agile methodology. *Creating issues of the required format was slightly tedious considering that there were more than 60 issues in total.*
- **Real/Professional World Simulations:** The feedback from the client and weekly meetings helped us to create a better application which was able to meet up to the client's expectations. Each meeting was recorded as an MOM which is very professional. *Conducting meetings online were hard due network lags, example while showing the client our demo.*
- **Map APIs:** The used Map APIs being open source, working with these APIs was very hard because of the problems that we faced to integrate with other features. But it had a vast scope to represent solutions to real world problems. *Not being familiar with the Map APIs pushed us to a hard phase of learning and required a lot of guidance from the clients since not a lot of data is available online.*

The overall learning experience was very new and enlightening, though sometimes it felt like we had a lot on our plate. It was very real and surely helped us develop skills much needed later in the industry. Working with the team and collaborating became easier and more fun with time, despite the fact that it was hard to do in the last few sprints. Our interactions with the clients and the mentorship we received from them made us more willing to commit to the project and complete it with full sincerity.

Client Review

Reg: KAIINOS Review on "Quantifying Carbon footprinting for Logistic Hubs"

GS

Gulshan Savanth <gulshan@kaiinos.com>
Fri 24/04/2020 19:01
Shreeya Pahune; Kushagra Agarwal; DAMA SRAVANI; SRIHARSHITHA BONDUGULA; Gunjan Karamchandani; kaushik; gowtham

Dear All,

A hearty **Congratulations** to the team for working relentlessly on successfully developing this product that assesses carbon footprint which creates a positive impact on protecting our environment .

Some key takeaways

- The look and feel of UI is graceful and has responsive modular flexibility that makes it easy to understand with added security as an extra feature.
- Synchronizing and integrating optimal reciprocal concepts of shortest path generation for selective features with a custom carbon footprint calculator from limited datasets in such a short span of time reflects your sincere dedication and efforts.
- As for now, the implementation is completely satisfactory and things can always be improvised. But given the situation, you have performed extraordinaire.
- Even during the lockdown, you have done remarkable and promising work collaboratively as a team from different geographical situations and complete the tasks as per schedule along with timely interactive meetings with us.
- The noteworthy point is you all are able to understand the basics of Web Mapping in a short span and implement solutions.

We are pleased to work with you and wish you for your continued success.

Regards,
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