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SPECTRA ROUTING

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Abstract: This document describes the architecture and design for the Spectra Routing application that being developed for Smart Personal CO2 free Transport. Routing service is a routing application that provide recommended, shortest and fastest routes in interactive onscreen map. Users simply can route and manage their routes.

Keywords: Routing; Django; MAP APIs; Pelias; Nominatim; ORS.

1 Introduction

Routing is the process of finding the best path between two or more locations with a fixed order in a road. The criterion according to which a path is the best can vary. In Spectra Routing services User can be looking for the shortest path (by distance), the fastest (by travel time), and the recommended path [1-15].

2 Design Goal

There is no absolute measure for distinguishing between good and bad design. The value of a design depends on stakeholder priorities.

The priorities for our design that follows are:

Minimize complexity and development effort.

Use open source components and minimize cost of maintenance.

Use local component rather than requesting to external servers or components to increase performance and decrease cost.

The design shouldn't inhibit reusability. The two previous design goals are more important, but the ability to reuse components is also desirable.

3 Project Technologies

Base on project requirement and design goals following technologies are chosen. Regarding Project goals selection MAP APIs is an important part of project design [15-21]. After days of planning and search following technologies are chosen. The reasons for their selection are explained in next section.

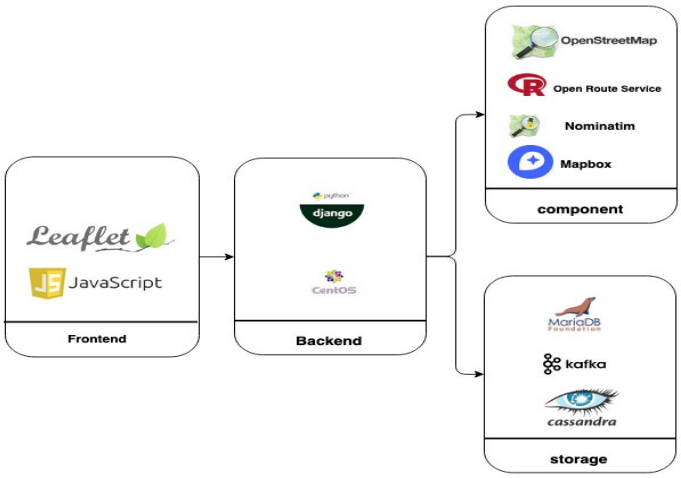

Fig 1. The high-level view to technologies

3.1 Open Street MAP

Main Routing goals is help people get from one place to another and display it on the map. So, first requirement in the routing process is to use proper MAP APIs [21-30]. There are two popular MAP APIs for our purpose:

Open Street Map The free editable map of the whole world. OpenStreetMap is built by a community of mappers that contribute and maintain data

about roads, trails, railway stations, and much more, all over the world. On the other hand, OpenStreetMap provides the following key features: Local Installation, community Driven, open data

Google Map Build highly customizable maps with your own content and imagery. Create rich applications and stunning visualizations of your data, leveraging the comprehensiveness, accuracy, and usability of Google Maps and a modern web platform that scales as you grow. Some of the features offered by Google Maps are: Map Image APIs, Place API, Web Services [31-39].

Free is the primary reason that open street map chosen as Map API of Spectra Routing project.

3.2 OpenRouteService

OpenRouteService (ORS) is an open source route planner with plenty of features, it uses a wide range of services based on OSM data which can be consumed in all different kinds of applications and scenarios [40-52]. List of expecting OSM based services features: Open source, Routing /online, Routing /offline, Customizable scale service, Navigation apps be available for Android

There is several software that available for creating routing application. Base on design goals, open source was first priority for choice routing software. Things is there is some limitation for requesting to online routing. So, the local installation feature was the main reason of choice among technologies. Openrouteservice has good documentation and support for using offline routing. In the next sections, openrouteservice will be explain [53-60].

3.3 Leaflet

Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. Weighing just about 38 KB of JS, it has all the mapping features most developers ever need. Main requirement for our project was a good user interface for interactive onscreen map. project needs following key features: Familiar, Clear, Responsive, Efficient, Open source, • Customization Features

3.4 Nominatim

To implement interactive map, Project should provide ability of clicking on map to specify source and destination. Friendly interface needs to display

address of targeted places. To provide this feature we need Reverse geocoding, reverse geocoding is the process to convert the latitude and longitude coordinates to a readable address.

There are plenty services that provide these features but project needs open source software with local installation ability. Because per routing process at least needs 2 request and it will send huge request to server, so local installation is best option for the project [61-65].

Nominatim is an open source search engine for OpenStreetMap data with local installation ability. It is based around the Postgresql import utility osm2pgsql using the alternative gazetteer output option. Indexing and search are performed using a combination of C, plpgsql and PHP.

In its default setup Nominatim is configured to import the full OSM data set for the entire planet. Such a setup requires a powerful machine with at least 32GB of RAM and around 800GB of SSD hard disks. The good news is Depending on project use case there are various ways to reduce the amount of data imported. In these project Salamanca and Santander OSM data are extracted to save RAM and disk requirement. In Nominatim installation section we will discuss more.

3.5 Pelias

Project needs autocomplete part to users search places, it needs OSM database search engine. The searching of the database is an important step towards routing. So, this is about approaches to search OSM. The good search needs following features: fields Geocoding, autocomplete search, proper filter for country, bbox, OSM Tags, Place type [66-71].

As described in pervious section Nominate is OSM search engine, too. Nominatim reverse geocoding APIs are perfect, but Using Nominatim for Autocompletion might be not the best idea. Auto-complete search not yet supported by Nominatim and we must not implement such a service on the client side using the API. Also, it is not really useful to use Nominatim API for autocompletion, because if you type «Ber» you would expect something like «Berlin» but Nominatim searches for places **exactly** known as «Ber» and suggests «Ber, Tombouctou, Timbuktu, Mali».

So, We choice Pelias APIs, Alternative of Nominatim Search. Pelias is a modular, open-source geocoder built on top of Elasticsearch for fast and

accurate global search. Geocoding is the process of taking input text, such as an address or the name of a place, and returning a latitude/longitude location on the Earth's surface for that place. Its online API with proper filter for country, bbox. Below picture is example of Pelias response.

Regarding following address, we used bounding box, country flag, result limitation to enhance geocoding suggestions:

```
http://<IP>:4000/v1/autocomplete?size=8&boundary.country=es&
                                 text=p&focus.point.lat=40.977209&
                                 focus.point.lon=-5.666977&api_key=xx&
                                 boundary.rect.min_lat=40.921745235773&
                                 boundary.rect.min_lon=-5.7334899902344&
                                 boundary.rect.max_lat=41.021838620757&
                                 boundary.rect.max_lon=-5.5872344970703
```

bbox. A bounding box, is an area defined by two longitudes

Country. we filtered search to Spain country.

Language. language of response result.

Limit. limitation of results count.

3.6 Cassandra

Project needs to store all of related routing data in NoSQL database for feature process. When it comes to NoSQL databases, MongoDB and Cassandra are first choice, but according to available resources, Cassandra selected.

Apache Cassandra is a highly scalable, high-performance distributed database designed to handle large amounts of data across many commodity servers, providing high availability with no single point of failure.

4 High-Level Design

The high-level view or architecture consists of 5 major steps:

1. Client specified source and destination on map and request to route.
2. Django application, return specified locations address by requesting to local Nominate.

3. Django application request to local open route service to get recommended / fastest / shortest paths.
4. Django application store OSR response to Cassandra DB.
5. Django application return OSR response to draw them on map.

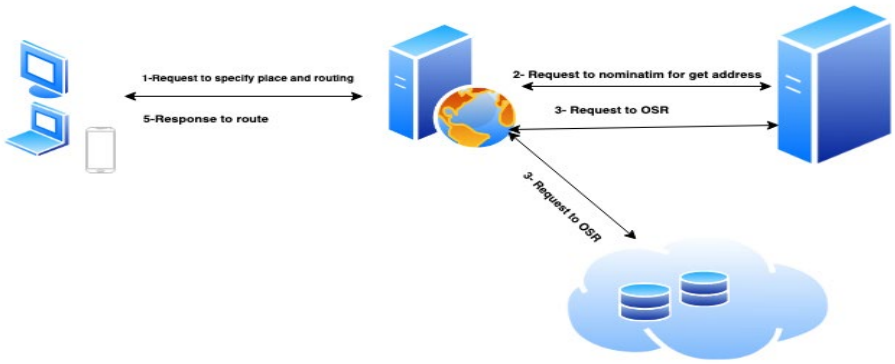

Fig 2. The high-level view to technologies.

5 Platform Overview

Routing service is a routing application that provide recommended, shortest and fastest routes in interactive onscreen map [72-80]. Users simply can route and manage their routes. The application also shows a steepness of routes in chart. This Platform has several services that we described Routing part in this article. is developed by Django framework. Project defines 3 roles for access to the services:

Super user This kind of user is native Django user that has access to every service.

controller user Platform provide limited management services for these kind of user

Regular user Platform provide new That can use limited services.

Routing Interface is available for all type of users.

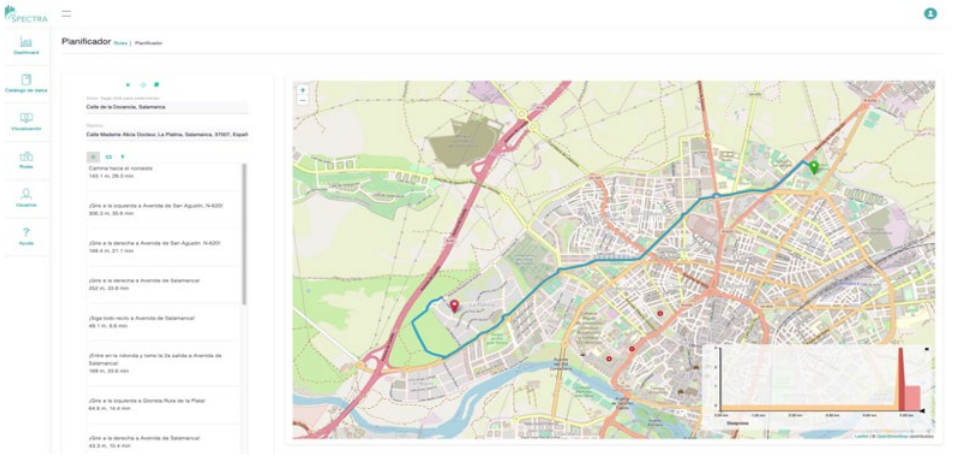

Fig. 3. Routing Interface

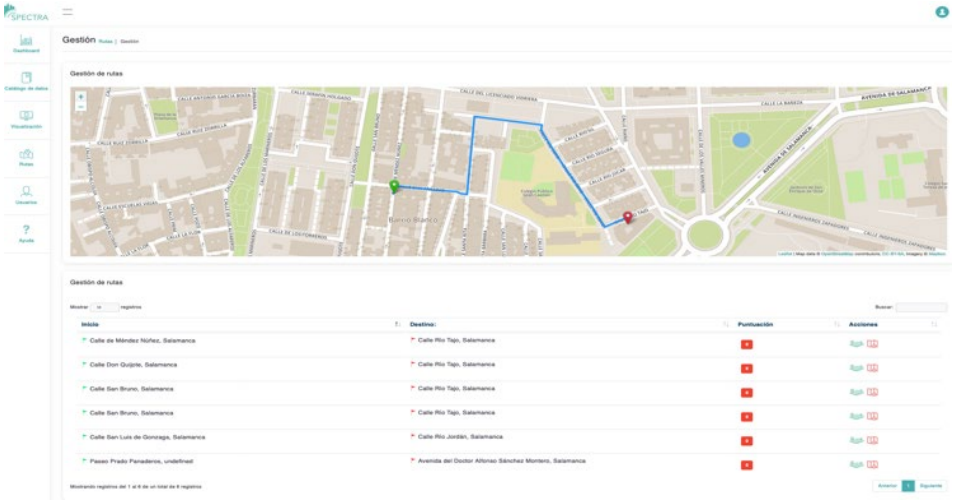

Fig. 4. Routing Management

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