EV Charging Stations Network Analysis

city of Milan

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IMB Data Science Professional Certificate – Capstone Project

Introduction

The Mobility and Automotive sector are facing crucial changes both in term of business and technologies. **These changes are led by the introduction of the Electric Vehicles (EV).**

Since these vehicles require a public and private charging network the institutions and governments need to enlarge and create efficient charging points networks.

In particular, to gives to the people the chance of charging the EV during the day and to enable them to make long travel without coming back home, **it is important to have the right number of public charging point in the cities.**

Moreover, these infrastructures must be localized inside strategic area. In the future, people who travel from a city to another or even in the same city will need to charge the EV for short time in order to store the energy needed to come back home or to another charging point.

For this reason, the charging point must be localized near infrastructures that allows the people to stay for less than one hours working or enjoying a meal or drink.

The Approach

In my project, I will analyze the actual charging network in the city of **Milan**. I will divide the network in different clusters based on the proximity of the charging stations to interesting POI like bars and restaurants.

I will also take in consideration the reputation of that POI and the number of available charging point in that cluster. In this way, **I will be able to find the best location (and cluster) to charge the EV during the day.**

This analysis has a different scope for different stakeholders:

1. It could help people to find the best charging spot
2. It could help the municipality to orientate the charging network development
3. It could orientate the opening of new bars and POI near the more isolated charging stations

The Data Sources

For my project I used three main kind of data

Charging points

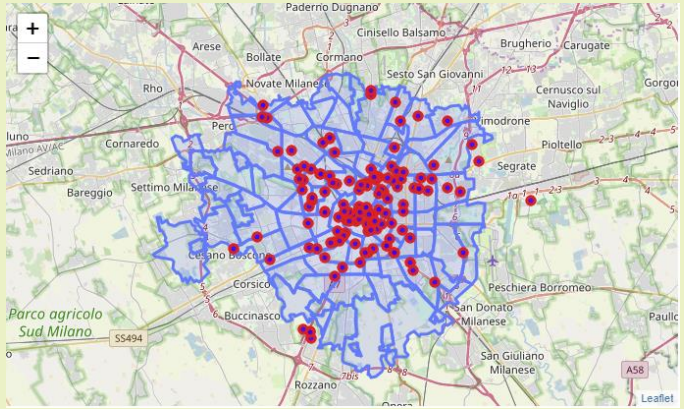
Open source website **openchargemap.org** which offer an open source API service, to download the charging station data and localization

Venues data

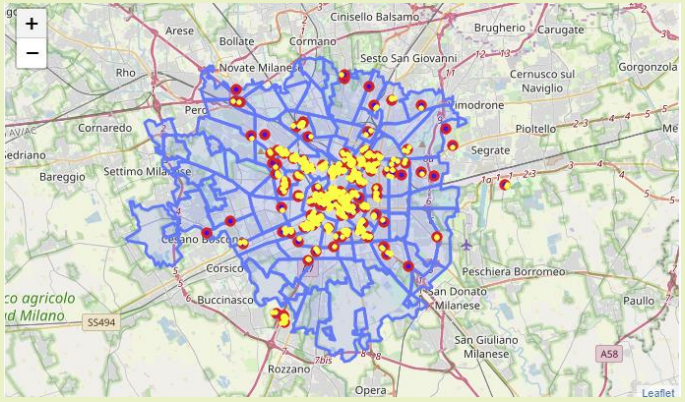
Foursquare API service to download the data related to the Venues which are close to each charging stations, including also the '**Likes**' data for each venue.

Suburbs Data

Reverse geocoding process based on the **OpenCage API to** dowload the suburbs where are located the charging station.



Charging Stations in Milan



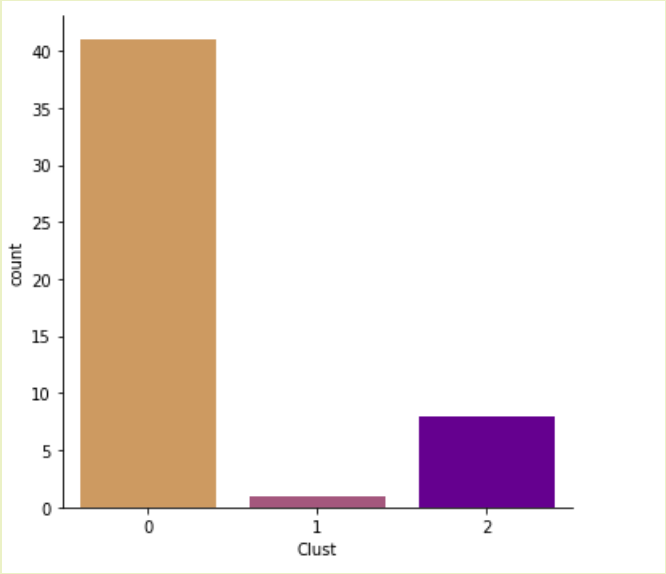
Charging Station (red) and selected Venues (yellow)

Methodology

In order to pursue the analysis phase I decided to apply a **K-means clustering model**. I used the Final Database grouping all the records by the Suburbs

My aim was to divide the suburbs in clusters characterized by the same features. **In this way it was possible to determine which suburbs cluster was the best in term of Charging Station network in relation to the closest venue and their reputation.**

Running the model with 3 cluster I obtained the distribution on the figure below



The Results

Most of the suburbs are included in the cluster 0 (41). Then the cluster 2 (8) and finally the cluster 1 (1).

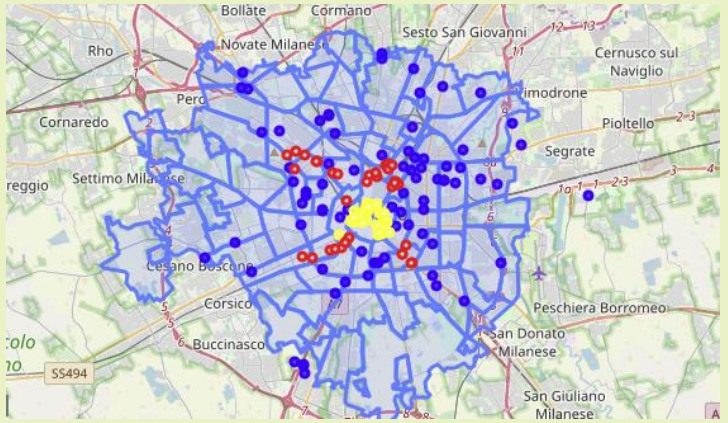
It is clear that the **best cluster is the number 1 with many charging points and with many venues with high rate.** Moreover, there are more Bar and Café respect to the other cluster. The second best is the cluster 2 with a good number of venues and charging points.

At the opposite, the cluster 0 includes suburbs with a smaller number of charging points and most important with not many venues around them (also with less reputation!). This mean that this cluster repress the suburbs where the charging network is not well developed and ready to support a dynamic charging trend of the EV owner.

	Cluster 0	Cluster 1	Cluster 2
Likes	207	11.580	2.128
Numb of Points	20	398	126,5
Bar	1	43	9,4
Food Court	0,2	4	1,5
Restaurant	4,8	114	31,6
Cafè	1,3	35	4,1

Clusters Avarage

Charging point by cluster



If we take a look to the singles charging station, we can see how the ones in the cluster 1 (in yellow) are in the Historic Centre suburb. While, the station in the cluster 2 (in red) are in the suburbs around the center and on the main road converging to the heart of the city.

The cluster 0 (in blue) even if includes most of the suburbs like we have seen before it has few charging stations. The peripheric suburbs other that not having many venues around the charging station they have less charging points in comparison with the suburbs in the other clusters.

Conclusions

The model shows clearly the limit of a charging infrastructure development plan which do not follow the potential clients needs but it only aims to make easy and sure profit where their EV are already popular.

The municipality should encourage the development of the charging network also outside the city center. This will start a virtuous cycle by spreading the use of the EV and convincing the investor to build new venues around the charging stations.