EV Charging Station Network Analysis – the city of Milan

IMB Data Science Professional Certificate – Capstone Project

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Abstract

My capstone project is focused on the analysis of the Electric Vehicle (EV) charging station network within the city of Milan. In order to consider the attractiveness of a charging station I will consider the proximity between them and other POI like bars, restaurant and cafe. Since the average EV owner will need to make quick charge stop during the day the best clusters will be the ones with a good concentration of bar and other venues near the charging point where the EVs owners could spend their time during the charging process. I will use a clusterization model (DBSCAN) to find 4 cluster with different characteristic and I will identify the best ones following my assumptions.

Introduction: Business Problem

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 enabling them to make long travel without coming back home, it is important to have the right number of 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. To do that, 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.

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.

Therefore, I am interested to find the clusters where the charging infrastructures (and the charging points) are close to a high number of popular bars and restaurant.

This analysis has a different scope for different stakeholders:

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

The Data - sources

For my project I used two main kind of data. The first are the data related to the charging point distribution in the city of Milan. The second are the Venues data in the city.

In the first case I chose to use the open source website openchargemap.org which offer an open source API service, to download the charging station data and localization

In the second case, I used the 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.

The Data – feature selection and database creation

In order to build the dataset used for the analysis I started from the charging station. I download the data of all the Italian charging stations then I selected only the ones related to the city of Milan using the postcodes.

The database that I obtained includes the ID for each charging station, the number of charging point and the glocalization.

ChargePointID	NumbOfPoints	PostCode	Longitude	Latitude
150098	6.0	20139	9.237619	45.433683
149126	6.0	20123	9.172799	45.455730
148120	2.0	20158	9.164095	45.503988

Table 1: Charging Stations DB

Afterwards I moved to the Venues. First, I used the geodata of each charging station to download the Venues which are localized around them (radius of 200m). Once I obtained the closest Venues, I eliminated the ones which are not in the Restaurant, Bars od Café categories. Then I grouped the remained records in four macro categories: bars, restaurant, café and food courts. Then, I used the Venue ID filed to download the 'likes' data for each Venues. In this way I created a new column including the number of likes that the client have assigned to each venue. This allow to consider the popularity of each Venues.

ChargePointID	VenueID	Venue Latitude	Venue Longitude	Venue Category	Likes
149126	4f36d248e4b0e313d2e4eca7	45.455556	9.171689	Restaurant	142
23314	4f36d248e4b0e313d2e4eca7	45.455556	9.171689	Restaurant	142
149126	4b05887ff964a520b4c922e3	45.455482	9.173333	Restaurant	52

Table 2: Venues DB

Finally, I merged the Venue data and the charging station data using the Charging Point ID as key. In this way I obtained a database where each record represents a Venues which is close to a specific charged station. The last step was to obtain the dichotomic variable for the Venue category and to group the data by the charging point ID.

The final database contains the number of venues divided in four categories for each charging station. Moreover, it contains the number of total charging point and the total number of likes of off the venues around the selected charging station.

ChargePointID	Longitude	Latitude	Likes	NumbOfPoints	Bar	Café	Food Court	Restaurant
21095	9.192996	45.489257	49.0	3.0	0	1	0	2
21138	9.209498	45.447949	53.0	10.0	0	1	1	3
21155	9.192835	45.459366	158.0	12.0	1	1	0	4

Table 3: Final DB

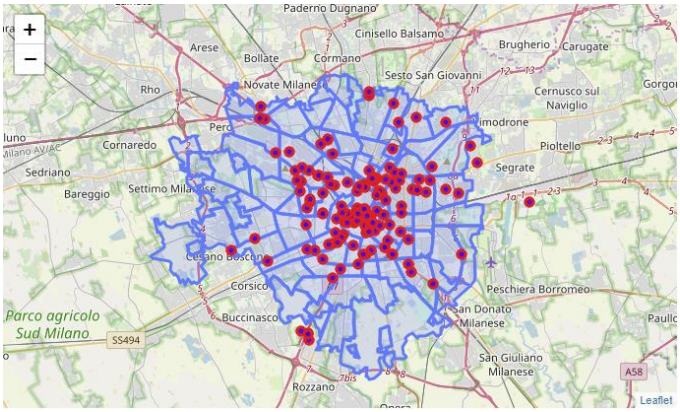

Figure 1: Charging Stations in Milan

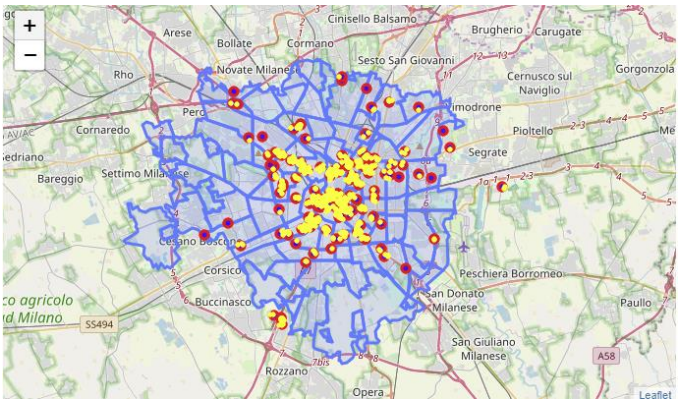

Figure 2: Charging Station (red) and selected Venues (yellow)

How it is clear from the figures, the charging points are located mostly in the center of the city. Only a couple are located near the border and, differently to the ones in the center, they do not have many Venues around them.

They seem to be not suggested for intra day charging stop. Probably this factor is mitigated from the proximity to the main roads however they are the first sign of the lack of a integrated plan able to offer leisure place around the charging station. This lack, how I will analysis, could be the reason for a lack of EV adoption and to the low use of public charging infrastructures.