Predicting new Gas Station Location

Problem statement:

We are trying to help a Business owner to open a new Gas Refilling station in any City. The target audience in this Project are obviously People who intend to open new Gas Stations or it can be used by Franchise Gas Companies to select the next location of their station.

The Conventional solution for this problem would be Checking locations of existing gas stations and simply selecting Locations which do not have a gas station for a large radius. This would not be an apt solution for this problem in cases like:

Opening a Gas station in a farming area with Very low Traffic Flow.

Or a Gas Station very close to another close gas Station won't be a good choice.

So, The solution to this problem is not very straightforward and challenging.

Data Sections:

Using Foursquare API we fetch all Gas Stations in New York City with Co-ordinates.

	name	categories	lat	lng
0	BP Gasoline	Gas Station	40.706693	-74.006976
1	Laz Parking	Gas Station	40.705054	-74.010213
2	Wynne Truck Plaza	Gas Station	40.713685	-73.994544
3	Central Parking System	Gas Station	40.708509	-74.016447

In addition to this there is requirement of Traffic volume Flow of all popular Roads in the City. For this I will be using a dataset provided by New York State Government.

This data set includes hourly Traffic Volume counts of almost all roads in New York city.

Using Geocoder, coordinates of these Roads are added to this Dataset to Calculate distance of busy roads with nearest gas stations.

	Name_id	Total	Rd	Direction	Lat	Long
222	CROSS BRONX EXPRESSWAY-EB	2651260	CROSS BRONX EXPRESSWAY	EB	40.8280764	-73.8414339
223	CROSS BRONX EXPRESSWAY-WB	2167675	CROSS BRONX EXPRESSWAY	WB	40.8280764	-73.8414339
135	BELT PARKWAY-EB	2029041	BELT PARKWAY	EB	40.5844494	-73.9273511
138	BELT PARKWAY-WB	2026221	BELT PARKWAY	WB	40.5844494	-73.9273511
308	GRAND CENTRAL PARKWAY-SB	1592929	GRAND CENTRAL PARKWAY	SB	40.7586675	-73.7190057
492	STATEN ISLAND EXPRESSWAY-EB	1509227	STATEN ISLAND EXPRESSWAY	EB	40.6029476	-74.0674953
493	STATEN ISLAND EXPRESSWAY-WB	1429728	STATEN ISLAND EXPRESSWAY	WB	40.6029476	-74.0674953
25	2 AVENUE-SB	1155153	2 AVENUE	SB	40.600834	-74.145898
0	1 AVENUE-NB	1106668	1 AVENUE	NB	40.7704516	-73.9540664

Traffic volume Dataset, NYC (2017-2018)

Methodology:

As discussed in the problem statement there are many featured to be considered while setting up a new Gas station. But location is key and undoubtedly the most important.

So, first we check all existing Gas stations in the Neighborhood of the city using Foursquare API. These are locations near which we don't want our Prediction to be. So we will take into Consideration the location of the nearest gas station while selecting the predicted locations. In short locations far from the nearest gas station are preferred.
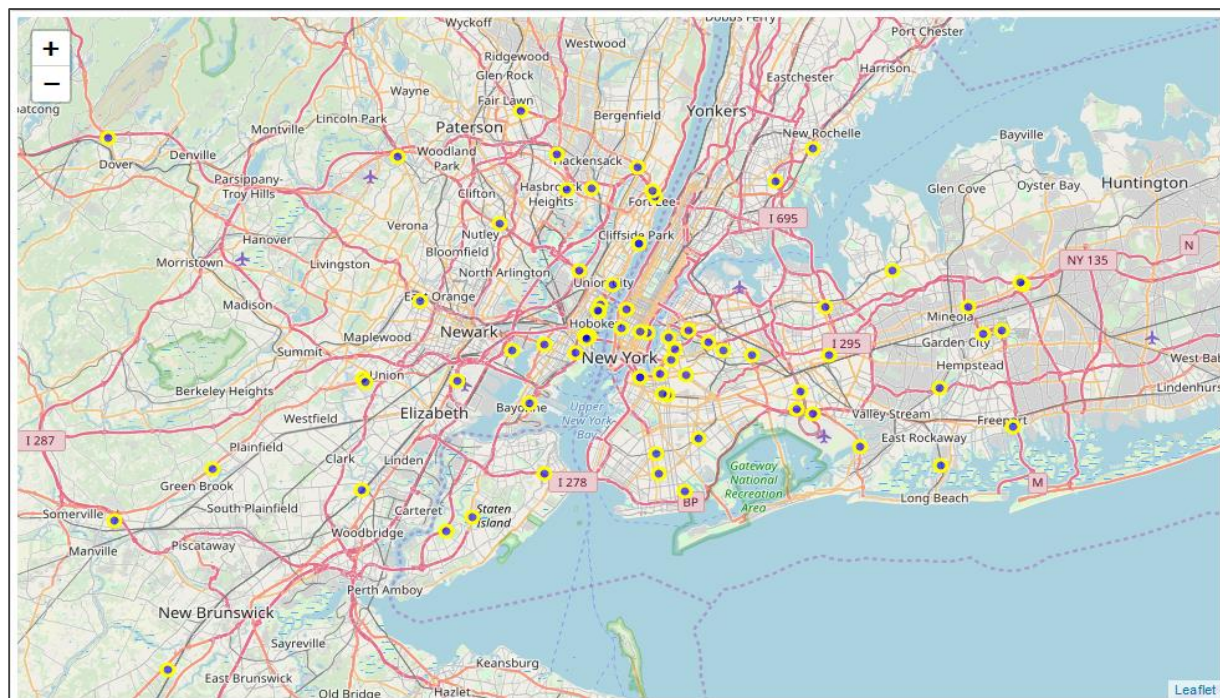
Map shows existing Gas stations in yellow spread across New York.

Secondly, we don't want to select a location with low traffic flow as it will generate less revenue. So we move to the second dataset available of traffic volume counts in the New York. More the traffic volume better for the possible revenue.

Then we take the 20 busiest roads and find their distance to the nearest data set. Both these parameters are Directly proportional to the success of selected station Location. We want to select a spot far from other Gas stations and with high Traffic volume. These values are then normalized.

Ranking for Each location are calculated based on these Two parameters and principle of proportionality. The trade-off is set to 1 and both parameters have equal weightage.

	Name_id	Total	Rd	Direction	Lat	Long
222	CROSS BRONX EXPRESSWAY-EB	2651260	CROSS BRONX EXPRESSWAY	EB	40.8280764	-73.8414339
223	CROSS BRONX EXPRESSWAY-WB	2167675	CROSS BRONX EXPRESSWAY	WB	40.8280764	-73.8414339
135	BELT PARKWAY-EB	2029041	BELT PARKWAY	EB	40.5844494	-73.9273511
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493	STATEN ISLAND EXPRESSWAY-WB	1429728	STATEN ISLAND EXPRESSWAY	WB	40.6029476	-74.0674953
25	2 AVENUE-SB	1155153	2 AVENUE	SB	40.600834	-74.145898
0	1 AVENUE-NB	1106668	1 AVENUE	NB	40.7704516	-73.9540664
369	MADISON AVENUE-NB	1045637	MADISON AVENUE	NB	40.8120663	-73.9359874
36	3 AVENUE-NB	1037760	3 AVENUE	NB	40.600409	-74.144941
56	5 AVENUE-SB	982101	5 AVENUE	SB	40.58660115957447	-73.98561242553191
62	6 AVENUE-NB	915038	6 AVENUE	NB	40.586454700000004	-73.98552706362662
1	10 AVENUE-NB	843325	10 AVENUE	NB	40.58660195744681	-73.9856045531915
519	VAN WYCK EXPRESSWAY-SB	829048	VAN WYCK EXPRESSWAY	SB	40.70915	-73.8206405
76	8 AVENUE-NB	825189	8 AVENUE	NB	40.58660163829787	-73.98560770212765
307	GRAND CENTRAL PARKWAY-NB	822053	GRAND CENTRAL PARKWAY	NB	40.7586675	-73.7190057
83	9 AVENUE-SB	811084	9 AVENUE	SB	40.58660179787234	-73.98560612765958
92	AMSTERDAM AVENUE-NB	795877	AMSTERDAM AVENUE	NB	40.8105567	-73.9583246
557	WEST SHORE EXPRESSWAY-NB	776493	WEST SHORE EXPRESSWAY	NB	40.533972	-74.2242959

Top-20 Roads with Co-ordinates

Results:

The location with the highest score is the best location and can be seen in the Map as Marked as Red.
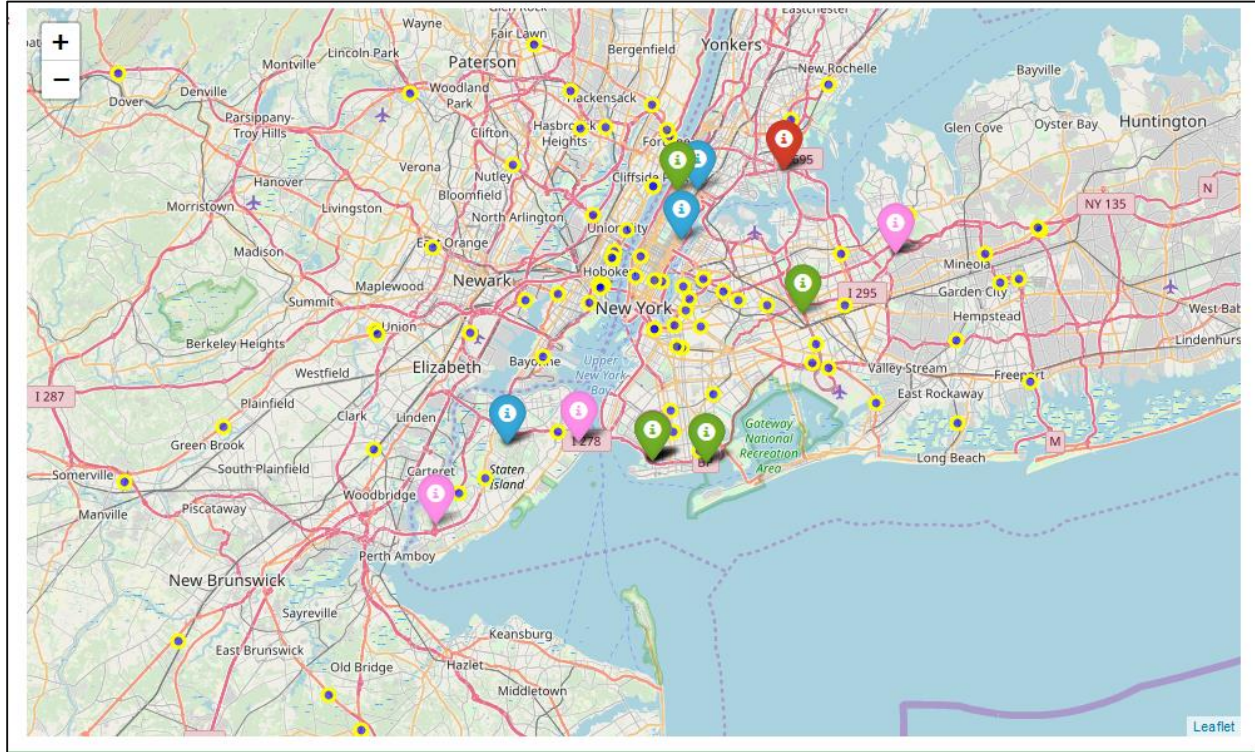
Discussion

The model works fine provided we find adequate datasets in developing countries it might be bit difficult to implement due to this issue. Also, the model can be made more accurate as more features are added. For example population in the neighborhood will be a good constraint

Conclusion

In this project I have successfully identified locations for Gas stations. Location for gas station can be predicted similarly for any city subject to adequate dataset availability constraints.