Sustainable Transportation in Charlottesville: EV Charging Stations

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March 3, 2020

Introduction: Business Problem

Transportation emissions account for 29% of the greenhouse gas (GHG) emissions in the U.S., making it the largest contributor to Earth's warming atmosphere and climate change. Traditional gasoline powered vehicles burn fossil fuels and release carbon dioxide, a powerful greenhouse gas, into the atmosphere.[1] In Virginia, nearly half of all GHGs come from the transportation sector.[2] Switching from a gasoline powered vehicle to an electric vehicle could reduce GHG emissions by 73%.[3] Incentives for people to choose sustainable transportation methods are needed to help decrease fossil fuel use in the transportation sector.

As more people switch to electric vehicles, they shop, dine, and visit areas that make it easy for them to charge their vehicle. This project explores the various EV charging stations in Charlottesville, Virginia to determine the top 10 venues that are within a radius of 400 meters (.25 miles) of each EV charging station. Next, it determines the ten most common venue categories near each station. The project groups the EV charging stations into clusters using k-means clustering and visualizes EV charging station locations in Charlottesville and their clusters.

This project is targeted to EV owner stakeholders who would like to charge their vehicle while dining, shopping, or visiting the local area near the EV charging station. The resulting ten common venue categories near each station will help EV owners choose the best charging station to use for their needs. This project helps an EV owner answer questions such as "Which EV charging station should I use if I want to get pizza while my car charges?" and "Which EV charging station should I use if I want to do some shopping while my car charges?".

Data

This project uses the following two data sources:

- Charlottesville Open Data - Green Infrastructure (Transportation) dataset
- Foursquare dataset

Specifically the project uses the following data:

1. Locations of EV charging stations in Charlottesville, VA expressed in latitude and longitude. This data is extracted from the CSV file on the Charlottesville Open Data portal located at https://opendata.arcgis.com/datasets/4c9a19905e3b43bba02b9a540685b3e2_71.csv. An example of this type of data looks like the following:

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[1] EPA. Carbon Pollution from Transportation. Retrieved March 6, 2020 from https://www.epa.gov/transportation-air-pollution-and-climate-change/carbon-pollution-transportation.
[2] EIA. Energy-Related Carbon Dioxide Emissions by State, 2005-2016. Retrieved March 6, 2020 from https://www.eia.gov/environment/emissions/state/analysis/pdf/stateanalysis.pdf.
[3] DOE. Emissions from Hybrid and Plug-In Electric Vehicles. Retrieved March 6, 2020 from https://afdc.energy.gov/vehicles/electric_emissions.html.

X	Y	OBJECTID	Webmap	Entry	Type	Description	Address
-78.49324869	38.03193056	4	EV Support	The Flats at West Village	EV Charging Station	Tesla Charger	852 W Main St

2. Types of venues near each charging stations. This data is extracted using the Foursquare API. The Foursquare RESTful API can be accessed at https://api.foursquare.com/v2. An example of this type of data looks like the following:

'venue': {'id': '4b4429abf964a52037f225e3',
'name': "Arturo's",
'location': {'address': '5198 Broadway',
'crossStreet': 'at 225th St.',
'lat': 40.87441177110231,
'lng': -73.91027100981574,
'labeledLatLngs': [{'label': 'display',
'lat': 40.87441177110231,
'lng': -73.91027100981574}],
'distance': 240,
'postalCode': '10463',
'cc': 'US',
'city': 'New York',
'state': 'NY',
'country': 'United States',
'formattedAddress': ['5198 Broadway (at 225th St.)',
'New York, NY 10463',
'United States']},
'categories': [{'id': '4bf58dd8d48988d1ca941735',
'name': 'Pizza Place',
'pluralName': 'Pizza Places',
'shortName': 'Pizza',
'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/pizza_',
'suffix': '.png'},
'primary': True}],
'delivery': {'id': '72548',
'url': 'https://www.seamless.com/menu/arturos-pizza-5189-broadway-ave-new-york/72548?affiliate=1131&utm_source=foursquare-affiliate-network&utm_medium=affiliate&utm_campaign=1131&utm_content=72548',
'provider': {'name': 'seamless',
'icon': {'prefix': 'https://fastly.4sqi.net/img/general/cap/',
'sizes': [40, 50],
'name': '/delivery_provider_seamless_20180129.png'}}},
'photos': {'count': 0, 'groups': []}},
'referralId': 'e-0-4b4429abf964a52037f225e3-0'},
{'reasons': {'count': 0,
'items': [{'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason'}]},

Methodology

This project explores the Foursquare venue data around Charlottesville, Virginia EV charging stations. The project displays the top 10 nearby venues and clusters and visualizes the 10 most common venue categories within a radius of 400 meters (.25 miles) of each EV charging station

1. Import and prepare the data: The Charlottesville Green Infrastructure dataset contains sustainable transportation infrastructure including public transit, bike and pedestrian infrastructure, ride sharing and

alternate fueling locations. Download and convert the Charlottesville Green Infrastructure CSV file into a Pandas dataframe. Next, slice the data frame to extract EV Charging Station entries.

2. Visualize the EV Charging Stations: To visualize the EV charging stations, create a map of Charlottesville and add markers to display the locations of the EV Charging Stations.

3. Display nearby venues: Create Foursquare credentials and display the top 10 venues that are within a radius of 400 meters (.25 miles) of each EV Charging Station.

4. Analyze the venues: Create a dataframe with each venues name, latitude, longitude, and category. Calculate the number of unique venue categories. Calculate the mean of the frequency of occurrence of each category.

5. Display the most common venues: Display each EV Charging Station along with the 10 most common venues.

6. Cluster and visualize EV Charging Station clusters: Run k-means to cluster the neighborhood into 4 clusters. K-means was chosen to group EV charging station areas with similar characteristics together. K-means minimizes intra-cluster distances and maximizes inter-cluster distances. Visualize the resulting clusters and add markers to the map. Examine each cluster to display the 1st-10th most common venues.

Analysis

Import and prepare the data

The Charlottesville Green Infrastructure dataset contains sustainable transportation infrastructure including public transit, bike and pedestrian infrastructure, ride sharing and alternate fueling locations.

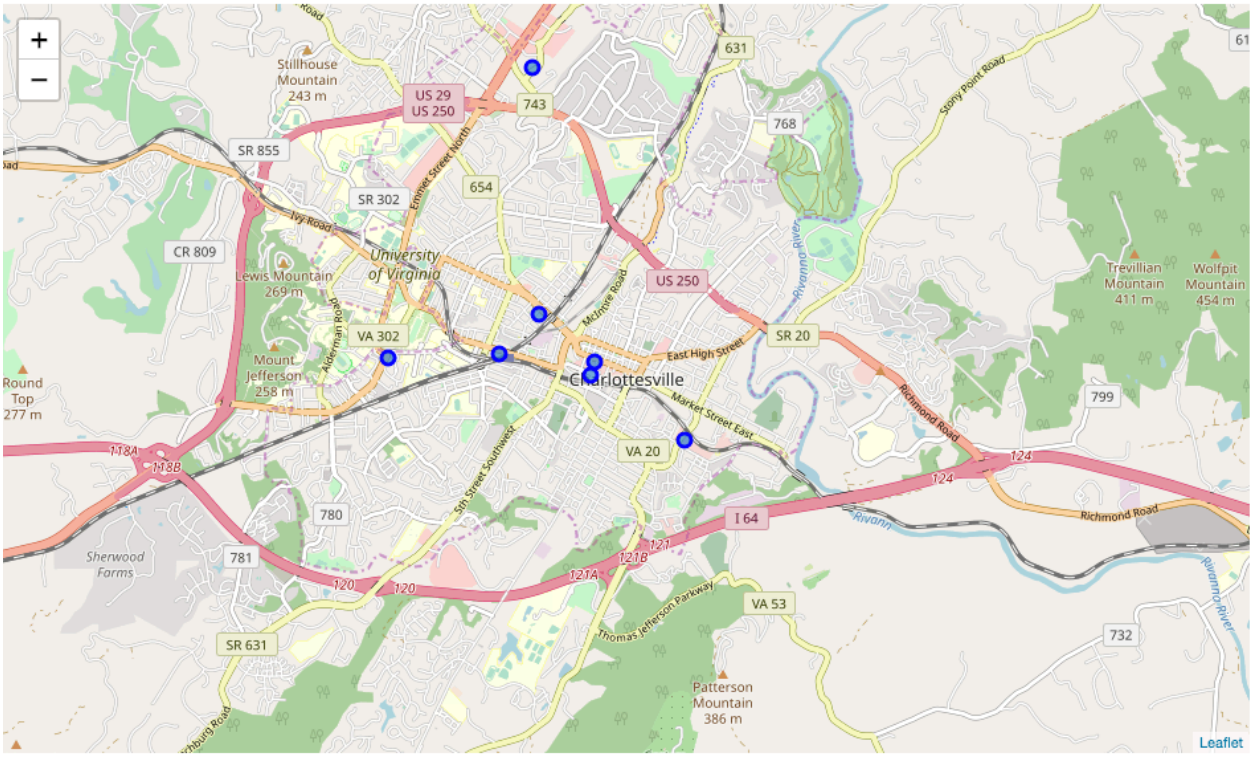
	X	Y	OBJECTID	Webmap	Entry	Type_	Description	Address
0	-78.486762	38.032283	1	Bike Support	Carver Recreation Center	Bike Fix-it Station	A fix-it station is a temporary or permanent f...	233 4th St NW
1	-78.477374	38.029038	2	Bike Support	Downtown Transit Center	Bike Fix-it Station	A fix-it station is a temporary or permanent f...	615 Water St E
2	-78.454631	38.024054	3	Bike Support	Riverview Park	Bike Fix-it Station	A fix-it station is a temporary or permanent f...	end of Chesapeake Street
3	-78.493249	38.031931	4	EV Support	The Flats at West Village	EV Charging Station	Tesla Charger	852 W Main St
4	-78.480905	38.031099	5	EV Support	First and Market Parking Garage	EV Charging Station	Level 2, DC Fast	104 1st St N
5	-78.481435	38.029704	6	EV Support	Water Street Parking	EV Charging Station	DC Fast	Water Street
6	-78.507632	38.031464	7	EV Support	Oakhurst Inn	EV Charging Station	Level 2	100 Oakhurst Circle
7	-78.469102	38.023136	8	EV Support	Martin Horn	EV Charging Station	Level 2	210 Carlton Rd
8	-78.488893	38.061129	9	EV Support	Homewood Suites	EV Charging Station	DC Fast	2036 India Rod
9	-78.487974	38.035969	10	EV Support	Timbercreek Market	EV Charging Station	Level 2	722 Preston Ave
10	-78.477308	38.029074	11	Alt Transportation Resources	CAT Bus Transfer Station	Other	NaN	615 East Water Street
11	-78.470931	38.014089	12	Alt Transportation Resources	Jaunt	Other	JAUNT, Inc. is a regional transportation syste...	104 Keystone P
12	-78.491947	38.031397	13	Alt Transportation Resources	Charlottesville Train Station	Other	The Charlottesville AmTrack Station is served ...	810 W Main St
13	-78.485868	38.030134	14	Alt Transportation Resources	Greyhound	Other	NaN	310 West Main St
14	-78.471155	38.028278	15	Alt Transportation Resources	Starlight Express LLC	Other	NaN	1117 E Market St #H

Slice the data frame to extract EV Charging Station entries.

	X	Y	OBJECTID	Webmap	Entry	Type_	Description	Address
0	-78.493249	38.031931	4	EV Support	The Flats at West Village	EV Charging Station	Tesla Charger	852 W Main St
1	-78.480905	38.031099	5	EV Support	First and Market Parking Garage	EV Charging Station	Level 2, DC Fast	104 1st St N
2	-78.481435	38.029704	6	EV Support	Water Street Parking	EV Charging Station	DC Fast	Water Street
3	-78.507632	38.031464	7	EV Support	Oakhurst Inn	EV Charging Station	Level 2	100 Oakhurst Circle
4	-78.469102	38.023136	8	EV Support	Martin Horn	EV Charging Station	Level 2	210 Carlton Rd
5	-78.488893	38.061129	9	EV Support	Homewood Suites	EV Charging Station	DC Fast	2036 India Rod
6	-78.487974	38.035969	10	EV Support	Timbercreek Market	EV Charging Station	Level 2	722 Preston Ave

Visualize the EV Charging Stations

To visualize the EV charging stations, create a map of Charlottesville and add markers to display the locations of the EV Charging Stations.



Display nearby venues

Create Foursquare credentials and display the top 10 venues that are within a radius of 400 meters (.25 miles) of each EV Charging Station. The following is an example of the First and Market Parking Garage EV Charging Station nearby venues. All EV Charging Station location nearby venues are shown in the results section.

	name	categories	lat	lng
0	Continental Divide	Mexican Restaurant	38.031748	-78.491036
1	Sugar Shack Donuts & Coffee	Donut Shop	38.032918	-78.494927
2	Wild Wing Cafe	Wings Joint	38.031532	-78.491995
3	Peloton Station	Sports Bar	38.033243	-78.494078
4	Mel's Cafe	Southern / Soul Food Restaurant	38.031678	-78.490575
5	Hardywood Pilot Brewery & Taproom	Brewery	38.032496	-78.495093
6	Doma Korean Kitchen	Korean Restaurant	38.031693	-78.489938
7	The Draftsman, Autograph Collection	Hotel	38.032613	-78.496445
8	Potbelly's	Sandwich Place	38.032570	-78.494050
9	Snowing In Space Coffee	Coffee Shop	38.031559	-78.489936

Analyze the venues

Create a dataframe with each venues name, latitude, longitude, and category.

	Entry	Entry Latitude	Entry Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	The Flats at West Village	38.031931	-78.493249	Continental Divide	38.031748	-78.491036	Mexican Restaurant
1	The Flats at West Village	38.031931	-78.493249	Sugar Shack Donuts & Coffee	38.032918	-78.494927	Donut Shop
2	The Flats at West Village	38.031931	-78.493249	Wild Wing Cafe	38.031532	-78.491995	Wings Joint
3	The Flats at West Village	38.031931	-78.493249	Peloton Station	38.033243	-78.494078	Sports Bar
4	The Flats at West Village	38.031931	-78.493249	Mel's Cafe	38.031678	-78.490575	Southern / Soul Food Restaurant
...	...	...	...	...	...	...	...
58	Timbercreek Market	38.035969	-78.487974	Random Row Brewing Co.	38.035058	-78.486472	Brewery
59	Timbercreek Market	38.035969	-78.487974	Ace Biscuit & Barbecue	38.038035	-78.484864	BBQ Joint
60	Timbercreek Market	38.035969	-78.487974	Sticks Kebob Shop	38.038308	-78.489803	Middle Eastern Restaurant
61	Timbercreek Market	38.035969	-78.487974	Integral Yoga Natural Foods	38.038881	-78.489677	Health Food Store
62	Timbercreek Market	38.035969	-78.487974	Cafe 88	38.038918	-78.489844	Chinese Restaurant

Calculate the number of unique venue categories.

Entry	Entry Latitude	Entry Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
First and Market Parking Garage	10	10	10	10	10	10
Homewood Suites	10	10	10	10	10	10
Martin Horn	9	9	9	9	9	9
Oakhurst Inn	4	4	4	4	4	4
The Flats at West Village	10	10	10	10	10	10
Timbercreek Market	10	10	10	10	10	10
Water Street Parking	10	10	10	10	10	10

Calculate the mean of the frequency of occurrence of each category.

	Entry	American Restaurant	Art Gallery	BBQ Joint	Bagel Shop	Bakery	Bar	Beer Garden	Bookstore	Brewery	...	Pub	Sandwich Place	Shopping Mall	Soup Place	Southern / Soul Food Restaurant	Speakeasy	Sports Bar	Thai Restaurant	Wine Shop	Wings Joint
0	First and Market Parking Garage	0.0	0.000000	0.0	0.00	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.000000	0.1	0.0
1	Homewood Suites	0.1	0.000000	0.0	0.00	0.0	0.000000	0.0	0.0	0.0	...	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.1	0.0
2	Martin Horn	0.0	0.111111	0.0	0.00	0.0	0.111111	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.111111	0.0	0.0
3	Oakhurst Inn	0.0	0.000000	0.0	0.25	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0
4	The Flats at West Village	0.0	0.000000	0.0	0.00	0.0	0.000000	0.0	0.0	0.1	...	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.000000	0.0	0.1
5	Timbercreek Market	0.0	0.000000	0.1	0.10	0.1	0.000000	0.1	0.0	0.1	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0
6	Water Street Parking	0.0	0.000000	0.0	0.00	0.0	0.000000	0.0	0.1	0.0	...	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.000000	0.0	0.0

Display the most common venues

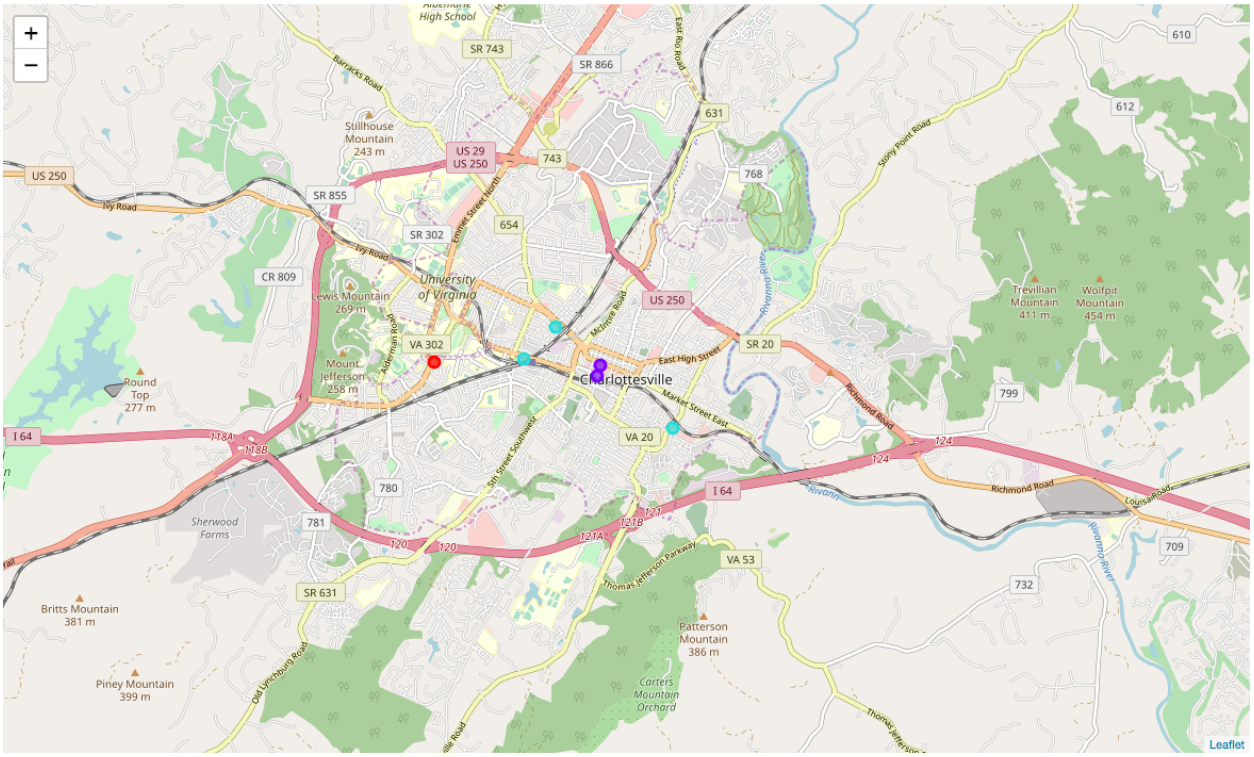
Display each EV Charging Station along with the 10 most common venues. The following is an example of the First and Market Parking Garage EV Charging Station most common venues. All EV Charging Station locations most common venues are shown in the results section.

```
----First and Market Parking Garage----
                venue  freq
0         Music Venue   0.2
1        Dessert Shop   0.1
2           Wine Shop   0.1
3           Speakeasy   0.1
4          Soup Place   0.1
5       Shopping Mall   0.1
6        Burger Joint   0.1
7      Farmers Market   0.1
8           Pie Shop   0.1
9  American Restaurant   0.0
```

	Entry	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	First and Market Parking Garage	Music Venue	Shopping Mall	Dessert Shop	Wine Shop	Burger Joint	Pie Shop	Farmers Market	Soup Place	Speakeasy	Café
1	Homewood Suites	Grocery Store	Indian Restaurant	American Restaurant	Wine Shop	Hotel	Pub	Mediterranean Restaurant	Dumpling Restaurant	Café	Dessert Shop
2	Martin Horn	Farmers Market	Thai Restaurant	Art Gallery	Bar	Comfort Food Restaurant	Pizza Place	Laundry Service	Chinese Restaurant	Business Service	Café
3	Oakhurst Inn	Café	Hotel	Bagel Shop	Coffee Shop	Wings Joint	Farmers Market	Dumpling Restaurant	Donut Shop	Dessert Shop	Comfort Food Restaurant
4	The Flats at West Village	Wings Joint	Sandwich Place	Hotel	Coffee Shop	Korean Restaurant	Mexican Restaurant	Brewery	Donut Shop	Sports Bar	Southern / Soul Food Restaurant
5	Timbercreek Market	Health Food Store	BBQ Joint	Bagel Shop	Bakery	Beer Garden	Juice Bar	Brewery	Garden Center	Middle Eastern Restaurant	Chinese Restaurant
6	Water Street Parking	Music Venue	Bookstore	Burger Joint	Dessert Shop	Speakeasy	Soup Place	Shopping Mall	Coffee Shop	Farmers Market	Donut Shop

Cluster and visualize EV Charging Station clusters

Run k-means to cluster the neighborhood into 4 clusters. K-means was chosen to group EV charging station areas with similar characteristics together. K-means minimizes intra-cluster distances and maximizes inter-cluster distances. Visualize the resulting clusters and add markers to the map. Examine each cluster to display the 1st-10th most common venues.



Cluster 1

	Entry	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
1	First and Market Parking Garage	Music Venue	Shopping Mall	Farmers Market	Wine Shop	Burger Joint	Pie Shop	Dessert Shop	Soup Place	Speakeasy	Bakery
2	Water Street Parking	Music Venue	Shopping Mall	Dessert Shop	Coffee Shop	Burger Joint	Bookstore	Farmers Market	Soup Place	Speakeasy	Bakery

Cluster 2

	Entry	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	The Flats at West Village	Wings Joint	Sports Bar	Coffee Shop	Southern / Soul Food Restaurant	Hotel	Sandwich Place	Korean Restaurant	Donut Shop	Brewery	Mexican Restaurant
4	Martin Horn	Business Service	Thai Restaurant	Art Gallery	Comfort Food Restaurant	Bar	Chinese Restaurant	Pizza Place	Farmers Market	Wings Joint	Donut Shop
6	Timbercreek Market	Garden Center	Chinese Restaurant	Health Food Store	BBQ Joint	Bagel Shop	Bakery	Beer Garden	Brewery	Juice Bar	Middle Eastern Restaurant

Cluster 3

	Entry	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
3	Oakhurst Inn	Amphitheater	Hotel	Bagel Shop	Coffee Shop	Café	Wings Joint	Business Service	Dumpling Restaurant	Donut Shop	Dessert Shop

Cluster 4

	Entry	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
5	Homewood Suites	Grocery Store	Indian Restaurant	Pub	Dumpling Restaurant	Wine Shop	Hotel	Mediterranean Restaurant	American Restaurant	Sandwich Place	Bookstore

Results

The results of the top 10 nearby venues for each EV Charging Station are shown in the tables below:

EV Charging Station: The Flats at West Village
Continental Divide
Sugar Shack Donuts & Coffee
Wild Wing Cafe
Peloton Station
Mel's Cafe
Hardywood Pilot Brewery & Taproom
Doma Korean Kitchen
The Draftsman, Autograph Collection
Potbelly's
Snowing In Space Coffee

EV Charging Station: First and Market Parking Garage
The Jefferson Theater
Charlottesville Historic Downtown Mall
Jack Brown's Beer & Burger Joint
Revolutionary Soup
The Paramount
The Alley Light
Charlottesville City Market
The Pie Chest
Market Street Wineshop Downtown
Splendora's Gelato

EV Charging Station: Water Street Parking
The Jefferson Theater
Charlottesville Historic Downtown Mall
Jack Brown's Beer & Burger Joint
Revolutionary Soupn
The Paramount
The Alley Light
Charlottesville City Market
Splendora's Gelato
Blue Whale Books
Mudhouse

EV Charging Station: Homewood Suites
Homewood Suites by Hilton
Charlottesville Pub
Whole Foods
Trader Joe's
Maharaja
Mezeh Mediterranean Grill
Marco & Luca Noodle Shop
Burtons Grill
Milan Indian Cuisine
Wine Warehouse

EV Charging Station: Martin Horn
Beer Run
Red Lantern
Belmont Pizza and Pub
Pad Thai
Firefly
Cavalier Produce
The Glass Palette
Frontrunner Sign Studios

EV Charging Station: Timbercreek Market
Kardinal Hall
MarieBette
The Juice Laundry
Bodo's Bagels
Fifth Season Gardening Co.
Random Row Brewing Co.
Ace Biscuit & Barbecue
Sticks Kebob Shop
Integral Yoga Natural Foods
Cafe 88

EV Charging Station: Oakhurst Inn
Oakhurst Inn
Starbucks
Einstein Bros. Bagels
West Range Cafe
McIntire Amphitheatre

The results of the 10 most common venue categories for each EV Charging Station are shown in the tables below:

First and Market Parking Garage
Music Venue
Wine Shop
Speakeasy
Farmers Market
Soup Place
Shopping Mall
Burger Joint
Dessert Shop
Pie Shop
American Restaurant

Homewood Suites
Grocery Store
Indian Restaurant
Dumpling Restaurant
Wine Shop
Pub
Mediterranean Restaurant
Hotel
American Restaurant
Bookstore
Sandwich Place

Martin Horn
Comfort Food Restaurant
Art Gallery
Thai Restaurant
Bar
Farmers Market
Business Service
Pizza Place
Chinese Restaurant
American Restaurant
Mediterranean Restaurant

Oakhurst Inn
Café
Bagel Shop
Amphitheater
Coffee Shop
Hotel
Sports Bar
Pie Shop
Juice Bar
Wine Shop
Korean Restaurant

The Flats at West Village
Wings Joint
Coffee Shop
Korean Restaurant
Sports Bar
Southern / Soul Food Restaurant
Mexican Restaurant
Donut Shop
Brewery
Sandwich Place
Hotel

Timbercreek Market
Chinese Restaurant
Beer Garden
Health Food Store
Middle Eastern Restaurant
Garden Center
Brewery
Juice Bar
Bakery
BBQ Joint
Bagel Shop

Water Street Parking
Music Venue
Speakeasy
Farmers Market
Soup Place
Bookstore
Shopping Mall
Burger Joint
Dessert Shop
Coffee Shop
American Restaurant

Discussion

This project shows the variety of different venues and venue categories located within 400 meters (.25 miles) of each EV Charging Station in Charlottesville, VA. It enables EV owner stakeholders to decide which EV Charging Station to use based on their needs. The current EV Charging Stations are located to take advantage of amenities in the areas of downtown, midtown, uptown, the "Corner", and Woolen Mills.

The k-means clustering to visualize clusters with similar venue categories could help city and business planners to determine new locations for EV charging stations that will address any gaps in EV charging station area amenities. For example, only one EV charging stations was within walking distance to a grocery store. This could incentivize a grocery store to install an EV charging station to attract a new customer base. Additionally, those who are interested in starting a new business could view the most common venues for each EV charging station to determine what type of business would be a complementary category for each area and to determine competition. For example, if a coffee shop is the most common venue for an EV charging station area, it would indicate current, established competition for the business of coffee shops.

Conclusion

The purpose of this project was to assist EV stakeholder owners with their travels and errands by exploring the various EV charging stations in Charlottesville, Virginia to determine the top 10 venues that are within a radius of 400 meters (.25 miles) of each EV charging station. Next, it determined the ten most common venue categories near each station. The project grouped the EV charging stations into clusters using k-means clustering and visualized EV charging station locations in Charlottesville and their clusters.

The analysis and results in this project not only benefit EV owner stakeholders to choose the best EV charging station for their needs, it also benefits city planners and current and future business owners for planning services and amenities near current and proposed EV charging stations. Future work for this project could be to add location information for proposed new EV charging stations to view the nearby venues and the most common venues for the area. The proposed new EV charging stations can also be added to the k-means clustering to determining similarities and differences in the venue categories.

This project helps an EV owner answer questions such as "Which EV charging station should I use if I want to get pizza while my car charges?" and "Which EV charging station should I use if I want to do some shopping while my car charges?". This project also helps current and new business owners answer questions such as "What competition is located near each EV charging station?" and "What gaps in services are opportunities at each EV charging station?". The project lends itself well to future research to answer the question "Where should new EV charging stations be installed to fill gaps in services and amenities located nearby?".