**Report:3**

**Date: 9th to 15th March 2025**

**Group-1**

**Project Title: Hard stop and momentary stop using vehicle trajectory dataset**

**Target: Understanding Overall flow, and DBSCAN algorithm.**

**Team Members:**

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**Introduction:**

This report targets the entire project flow after the preprocessing step, outlining the use of DBSCAN (Density-Based Spatial Clustering of Applications with Noise) to cluster the vehicle trajectories from velocity data. Following the preprocessing and plotting of all the vehicle trajectories, DBSCAN is used to cluster vehicles showing similar stop behaviors, for instance, hard stops and momentary stops.

**Overall flow:**

Data Division:

* The first step is to divide the entire dataset into individual trajectory files, where each file represents the velocity data of a single vehicle across multiple frames.

Data Preprocessing (Interpolation):

* After splitting the data, we apply interpolation to each vehicle's dataset (Excel file) to fill in any missing velocity values. This ensures that each vehicle's trajectory is continuous and complete, allowing for more accurate analysis.

Plotting Vehicle Trajectories:

* Once the data is preprocessed, we plot all the individual vehicle trajectories on a single graph. This visualization helps in identifying patterns in the velocity data and potential stop events for each vehicle.

Clustering with DBSCAN:

* We then apply the DBSCAN (Density-Based Spatial Clustering of Applications with Noise) algorithm to group the trajectories based on their velocity patterns. DBSCAN helps identify clusters of vehicles that exhibit similar stopping behaviors, such as hard stops and momentary stops.

Alternative Clustering Algorithms:

* If DBSCAN does not yield satisfactory results (e.g., poor clustering or outliers), we will experiment with other unsupervised clustering algorithms, such as K-Means or Agglomerative Clustering, to form meaningful clusters based on vehicle velocity patterns.

Superimposing Clustering Results on Video Frames:

* After successful clustering, we will superimpose the clustering results on the video frames, identifying the vehicles’ trajectories as hard and momentary stops t. The method of superimposition is yet to be finalized.

**About DBSCAN algorithm:**

DBSCAN categorizes points as:

Core Point: Has at least minimum samples within epsilon distance.

Border Point: Lies within eps of a core point but doesn’t have enough neighbors.

Noise Point: Doesn’t belong to any cluster.

Now to set the value of epsilon and minimum distance:

First, find the average distance between consecutive points which will help estimate epsilon.

Use the K-Distance Graph that will help identify the "elbow point" for epsilon.

Adjust minimum samples based on expected stop duration. This will be done by setting a number and then tune it as needed.

DBSCAN will cluster data points based on X, Y coordinates and optionally on velocity.

Stops occur when multiple consecutive points have low velocity and are close together.

Moving points will be ignored because they are not part of any dense cluster.

Hard stops are identified as clusters where velocity drops suddenly and remains low.

Momentary stops are clusters where velocity is low but not zero.

**Future scope:**

1. Plotting of trajectories(velocity v/s frame graph) on a single graph
2. Implementation of DBSCAN algorithm on this graph for finding the clusters.
3. Also, the research and implementation of other unsupervised clustering algorithms for comparison.

References:

1. <https://ieeexplore.ieee.org/abstract/document/9356727?casa_token=bE-GpoKD4UYAAAAA:MWfySFyC8222IMJ2ghlPFd7P2z6MMkdreLU_k6Zcylzf8msJu8nXTHoyF25vetmheHvKEbxbKQWG>
2. <https://www.youtube.com/watch?v=2eDFjw456AM>