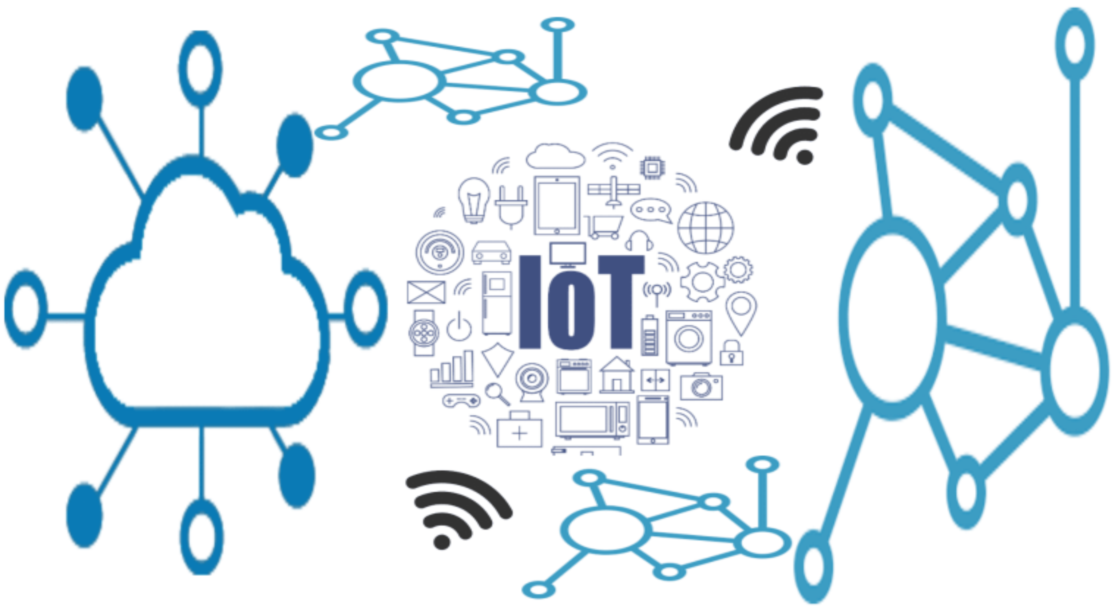
MCT449 Selected topics in Industrial Mechatronics



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Introduction:

Smart city is an urban area that utilizes advanced technologies to make life easier for its citizens. Smart cities focus on improving the quality of services provided to individuals through the management of public resources, convenience, maintenance, and sustainability. They can overcome issues related to the fields of health, education, environment, governance, economic, and transportation. By 2025, it is expected that there will be 88 smart cities around the world. Based on the global smart cities index, the top ten smart cities in terms of smart infrastructure, economy, and governance are London, New York, Paris, Berlin, Tokyo, Los Angeles, Singapore, Seoul, Chicago, and Hong Kong

One of the steps to build a smart city is to make the vehicles in it smart too. And this can be done by building a reliable V2X communication, which means that vehicles can communicate with everything around them allowing them to send and receive data that helps vehicles to make a decision.

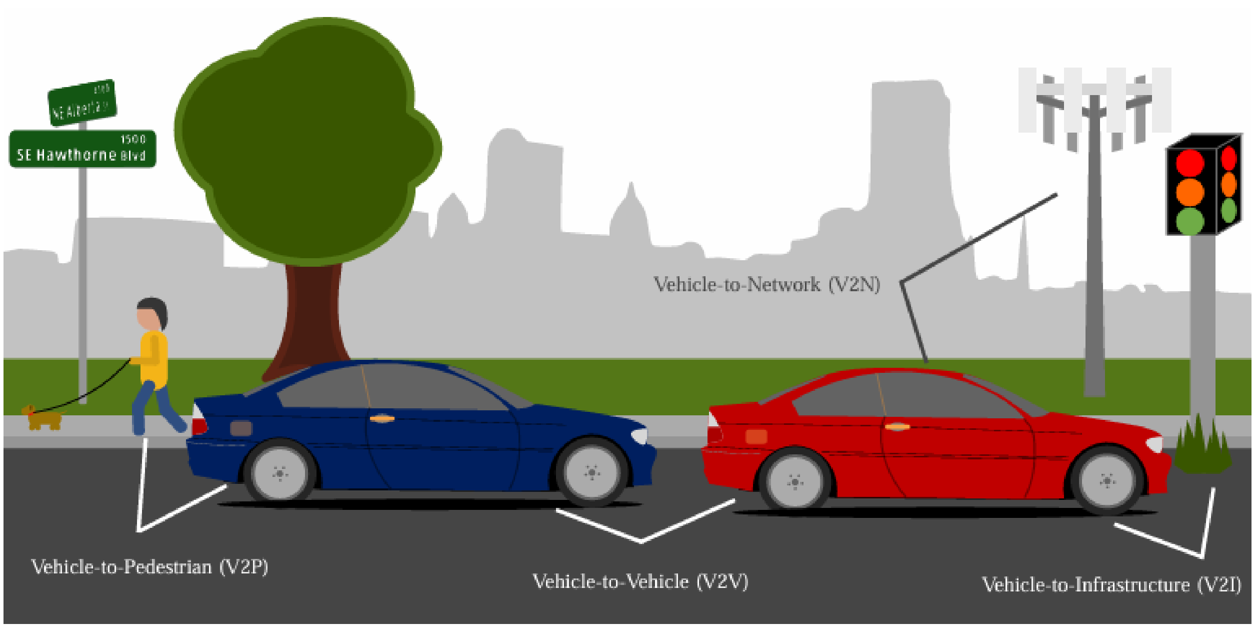


Figure 1: Examples of Vehicle to things communication.

Problem:

The main problem or in other words; the main purpose is to allow vehicles to send and receive data from things around it, for example, sending and receiving data from and to base stations in order to manage and organize the vehicles movement in streets (autonomous vehicles).

One of the very useful applications of autonomous driving is the intersection management applications. Which helps in accelerating reaching destinations without stopping.

Benefits of Intersection Management Systems:

- Reduced congestion and travel times: Optimized traffic flow and fewer red lights can lead to faster commutes.
- Improved safety: Collision avoidance systems and better traffic management can decrease accidents.
- Lower emissions: Reduced idling and smoother traffic flow can contribute to lower fuel consumption and emissions.
- Increased efficiency: Dynamic systems can respond to changing traffic conditions, improving overall network performance.

Dataset:

street_name	lat	lon	azimuth	kspeed
S Los Angeles St	34.05293	-118.241	32.62818	15
S Los Angeles St	34.05249	-118.242	34.62264	15
S Los Angeles St	34.05237	-118.242	32.19778	20
S Los Angeles St	34.05212	-118.242	33.30925	30
S Los Angeles St	34.05183	-118.242	32.35762	20
S Los Angeles St	34.05149	-118.242	35.68073	40
S Los Angeles St	34.05134	-118.242	33.26183	35
S Los Angeles St	34.0511	-118.243	33.53764	40
S Los Angeles St	34.05105	-118.243	31.35058	10
S Los Angeles St	34.05071	-118.243	35.38157	15
S Los Angeles St	34.05064	-118.243	31.40428	35
S Los Angeles St	34.05045	-118.243	31.40434	30

Dataset Elements:

1. STREET_NAME: The name of the Los Angeles Street where the vehicle sample is located.
2. LAT: The latitude coordinate of the vehicle, which indicates the north-south position of the vehicle on the Earth's surface.
3. LON: The longitude coordinate of the vehicle, which indicates the east-west position of the vehicle.
4. AZIMUTH: The azimuth of the vehicle, which refers to the angle between the vehicle direction and the north, in degrees.
5. KSPEED: The speed of the vehicle in kilometers per hour (km/h).

DataSet Link: https://github.com/Ibtihal-Alablani/Vehicle-Dataset-in-Los-Angeles

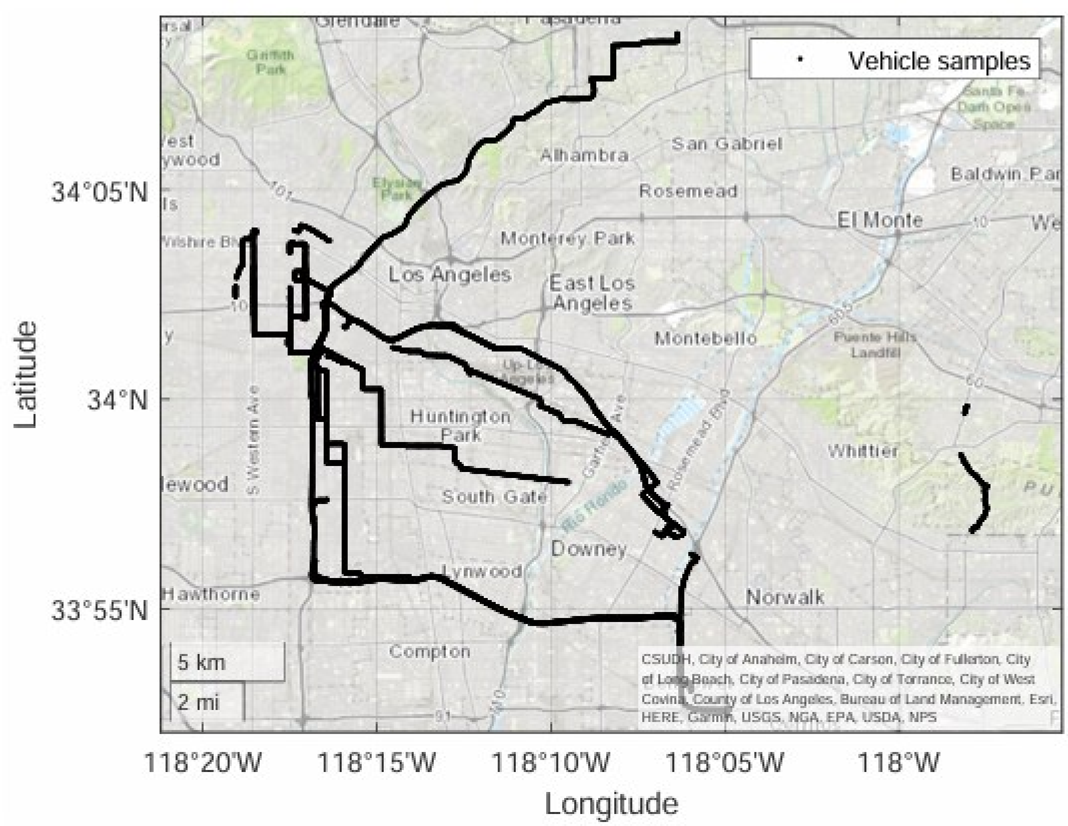


Figure 2: Illustration on the LA map of vehicle samples.

Dataset Generation Method:

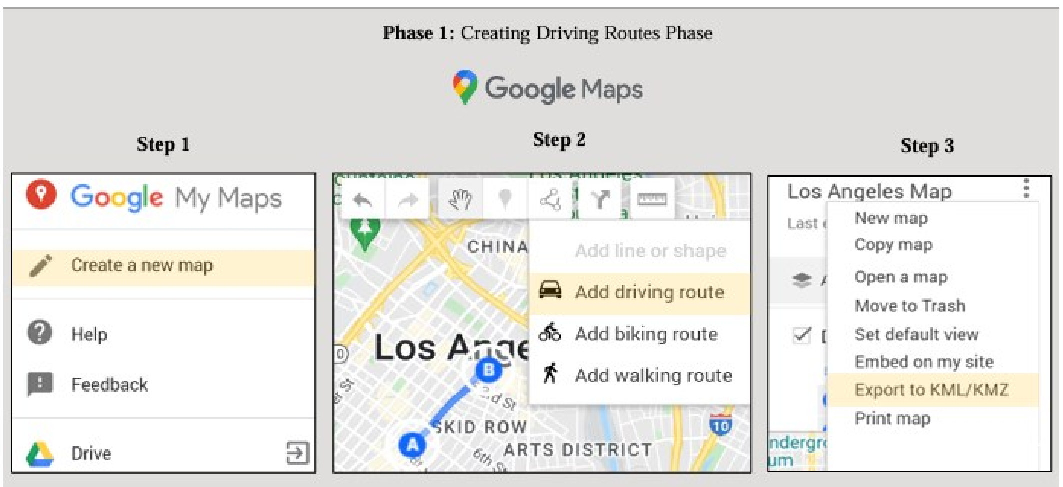
A real vehicle dataset in the city of Los Angeles is proposed. The VehDS LA was generated by utilizing Google Maps and the MATLAB R2021b simulator. The database production process is divided into two main phases:

Phase1: Creating Driving Routes: This phase was implemented through Google Maps. It includes three steps: –

Step 1: Creating a new map of the city of Los Angeles.

Step 2: Adding driving routes for all the selected streets (15 streets in this study).

Step 3: Exporting a Keyhole Markup Language (KMZ) file for each driving route. An example of the contents of a KMZ file.

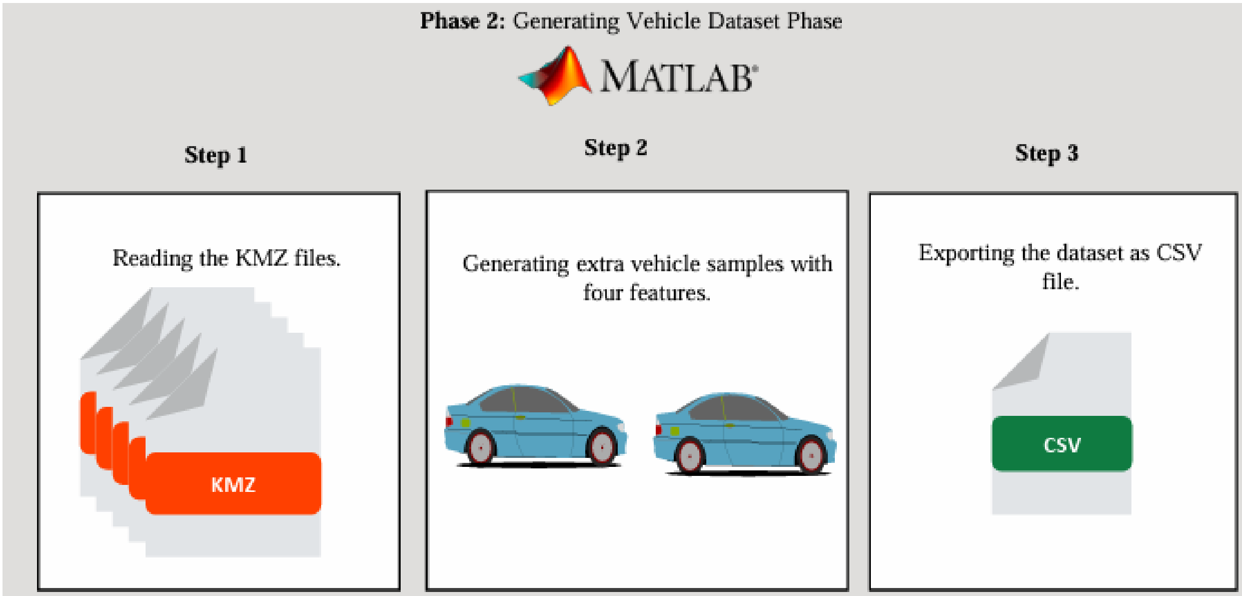


Phase2: Generating the Vehicle Dataset: This phase was performed using the MATLAB simulator. This phase has three steps: –

Step 1: Reading the KMZ files and converting them into structure objects.

Step 2: Generating extra vehicle samples so that the distance between two samples is small (0.25 m in this study). For each vehicle sample, four features were assigned: (1) latitude coordinate, (2) longitude coordinate, (3) vehicle speed, and (4) vehicle azimuth. The speeds were generated randomly in the range from 10 to 40 km per hour (km/h).

Step 3: Exporting the proposed VehDS-LA as a comma-separated values (CSV)file.



The Advantages of the Proposed Dataset

- Generating the database does not require a long time, as in the related works, where it took days and months.
- The accuracy of the positions of vehicle samples which were produced based on Google Maps and the MATLAB simulator. It was verified that the samples are located on the LA streets without any deviation.

• Thereisnoneedtoinstall special equipment and devices in the vehicle, such as a GPS receiver, small computer, or smartphone.

• The number of dataset samples is large, and each sample has four features, which are the most important features of a vehicle for traffic simulation purposes.

• The method of generating the proposed VehDS-LA dataset introduces a general mechanism that can be followed in generating new databases in any region of the world on the basis of Google Maps.

References:

https://www.mdpi.com/2076-3417/12/8/3751