Geospatially Timed Data Analysis

Enhancing Urban Mobility Using Vehicle Movement Analysis

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Abstract

This study involves analyzing a substantial real-world dataset to extract insights about road safety. It makes use of innovative analytics to find subtle trends and underlying security problems. The research then develops predictive techniques for predicting mobility issues and offers useful, doable solutions. Overall, the use of data analysis and predictive modelling in this work improves road safety and mobility methods.

1 Introduction

Our goal in the field of data analysis is to extract useful information from a real-life dataset. Each of the attributes in this dataset has the potential to reveal important trends and correlations. Considering the analysis of data, our main objective is to sort through the complex layers of this dataset and find significant patterns that can help us understand the areal features better..

There is a world of unexplored information hidden behind each attribute. These characteristics can be carefully examined to reveal connections that might not have been apparent otherwise. Each piece of information, from temporal considerations to geospatial nuances, adds to the overall picture. Our job is to use all possible analytical methods to unravel these complexities and produce a comprehensive viewpoint that can guide wise decision-making and inferences related to mobility on roads.

In a contemporary landscape heavily reliant on data for direction, our efforts carry significant import. By shedding light on the less-explored aspects of the dataset, our intention is to refine raw data into a wellspring of strategic acumen as we embark upon this voyage of data analysis. Our aim is to furnish enterprises with the intellectual resources essential for flourishing amidst intricate landscapes, achieved through a systematic dissection and interpretation of data. This process positions them with a distinctive competitive advantage.

2 Related Works

In the May 2019 issue of the International Research Journal of Engineering and Technology (IRJET), a study conducted by Parth B.Parmar, A.A. Amin, Dr.L.B.Zalautilized GIS software to identify 18 accident-prone areas along Ahmedabad's Sardar Patel Ring Road in India. The research highlighted head-on collisions as a significant concern, particularly during nighttime, and advocated for its findings' application by the Ahmedabad Municipal Corporation and Gujarat government. The study also explored contributing factors such as road design, condition, driver behavior, and interactions with pedestrians and cyclists, proposing multifaceted interventions to bolster road safety.[5]

The paper "Road Accident Analysis Using Q-GIS and Road Safety Auditing" by Fayaz, Reddy, Hussain, and Raza explores the effectiveness of GIS and road safety audits in analyzing road accidents in Bengaluru. The findings endorse these methods as valuable tools for improving road safety, with recommendations for wider implementation in Indian cities. The paper outlines the methodology, benefits, and limitations of the approach and advocates for broader adoption to enhance road safety.[6]

Choudhary, Ohri, and Kumar (2017) used GIS to identify accident hot spots in Varanasi, India. They found that there are a number of accident hot spots in the city, particularly in the central and southern parts. They also found that the severity of accidents is higher at some hot spots than others. The authors suggest that the results of their study can be used to develop targeted interventions to improve road safety in Varanasi. They also suggest that further research is needed to improve the accuracy and effectiveness of GIS-based methods for identifying accident hot spots.[7]

3 Analysis

We conducted an extensive EDA review on the provided data and plotted individual features from the dataset in order to identify underlying patterns in relation to the frequency of each. This was done to guarantee that the data provided was accurate and consistent. Then, we plotted a few complementary features against one another to better understand their relationship. This revealed that the majority of the alerts, which were mostly discovered between the hours of 6-8 am and 4-6 pm and above the speed of 50 kmph, most of which were caused by the vehicle "805". hmw is the most occuring warning along with ldw as path taken by vehicles was mostly the highways. ldw occur more about higher speeds, fcw and hmw alerts occur around the similar average speeds, pdw has relatively very low average speeds. June-21 has the most occuring alerts throughout the given dataset. The most common warning, along with ldw, is hmw because highways are where most vehicles travel. Given this brief explanation, monitoring is necessary during these times .

Then, to carefully examine each attribute and draw positional conclusions during analysis, we mapped other attributes onto a geostationed map according to given latitude and longitude positions. This extensive review identified instances where a few standout matches and patterns were discovered.

Addressing all the warnings:

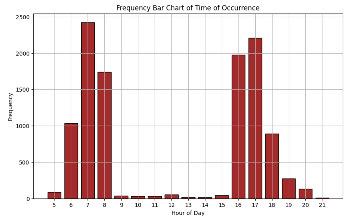
'PCW' are more in cities, inner small roads, mall and school areas. To reduce this, more safety measures like zebra cross or flyovers can be made near roads, proper parking or motion paths for vehicles can be constructed in such institutions.

'FCW' is more common near roads that merge at higher vehicle speeds, where collision rates are high because of poor visibility, and in areas with heavy traffic and congested areas. Better traffic monitoring systems, such as speed limits or dynamic signals in adjusted areas and high alert vehicle approach systems close to merging areas, can be implemented to prevent this. 'FCW' frequently result in accidents, and while there are hospitals close by to such high accident risk areas, there aren't any facilities for immediate medical attention, so it would be better to bring in intermediate help centres.

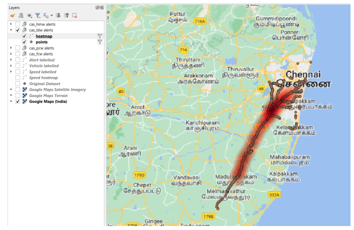
Due to the lack of a lane that begins earlier and the fact that vehicles must cross these lanes only when necessary, airport areas are more likely to experience LDW warnings. To prevent this, the airport-specific lane should be marked far in advance for minimised lane switches in the middle. Additionally, you can find these warnings close to circular crossings, flyovers, and merging lane roads near high vehicle density areas like railroads or highways. Less directional markings or signalling may be the primary cause, so more signals and demarkations of regions can be provided to prevent this. Highways lack specialised monitoring, so drivers can easily and carelessly switch lanes. Monitoring tools can be offered here to help prevent this.

'HMW' alerts are more prevalent in densely populated areas with high population densities, such as metros and junctions. Such alerts mainly target NH48, as can be seen. This might be because of heavy traffic, poorly maintained roads, or impatient drivers. We can offer local sensors that can identify which vehicles violate the rules in order to reduce the likelihood of such incidents happening. Another group of locations with a high alert density is cross-over bridges, where there are no alternate routes for moving vehicles. These areas might provide suitable vehicle distance maintenance measures.

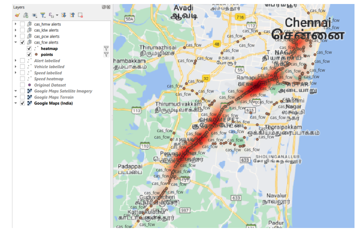
General lookouts, which are concentrated in high traffic areas, are the main areas of 'HMW' and 'FCW'. Less cars will be on the road and travel costs will decrease if carpooling programmes are promoted in this area. Traffic-powered wind turbines can be installed to take advantage of the high speed of vehicle motion in certain areas along the Vandalur to Ramapuram section of the Chennai-Trichy highway. The same power generated can be used to install intermediate accident care electronic devices because the same area is in a high alert state for all alerts other than 'PCW'.



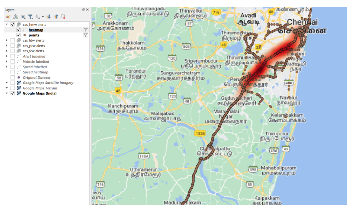
Time of occurence



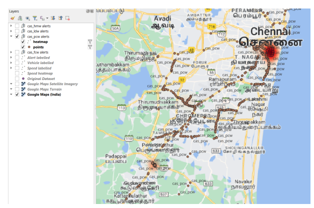
Lane Departure Warning



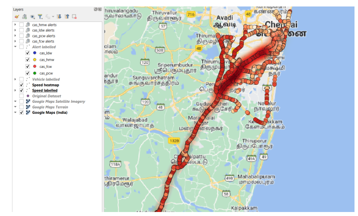
Forward Collision Warning



Headway Monitoring and Warning



Pedestrian Collision Warning



Speed map

4 References

(1) *https://geoawesomeness.com/analyzing-mobility-patterns-using-geospatial-data/*

(2) *https://www.analyticsvidhya.com/blog/2023/02/implementing-geospatial-data-analysis-in-data-science-techniques-challenges-trends-and-best-practices/*

(3) *https://data.humdata.org/*

(4) *https://www.youtube.com/watch?v=X17RP3uUrh8*

(5) *Black Spot Analysis Using QGIS for S.P. Ring Road, Ahmedabad (Ch.: 00.00 Km to Ch.: 76.30 Km)- Parth B.Parmar, A. A. Amin , Dr. L. B. Zala*

(6) *ROAD ACCIDENT ANALYSIS USING Q-GIS AND ROAD SAFETY AUDITING- Fazil Fayaz, Bharat Reddy E, Ashraf Hussain, Abdullah Raza*

(7) *Identification of Road Accidents Hot Spots in Varanasi using QGIS-Jayvant Choudhary, Anurag Ohri, Brind Kumar*

For more explanation and image details:
Github: https://github.com/MinMint01/IntelUnnatiGrandChallenge _TeamClover