INAI Data Challenge

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Introduction

This project involves a thorough analysis of 1.8 million real-world driving events extracted from 130 vehicles, particularly focusing on select regions in South India. The primary objective is to **grasp driving patterns and understand the occurrences of alerts** generated by advanced driver assistance systems (ADAS) and driver monitoring systems (DMS). We seek to derive actionable insights from this analysis, shedding light on driving behavior and system performance to **improve road safety**. Furthermore, we intend to formulate recommendations based on the insights garnered, aiming to propose effective solutions that can contribute to safer driving practices. To present the findings and **potential Blackspots** in an accessible and informative manner, an interactive **Power BI dashboard is developed**, facilitating a comprehensive visualization and exploration of trends related to speed, time, and geographic distribution of alerts.

General Trends

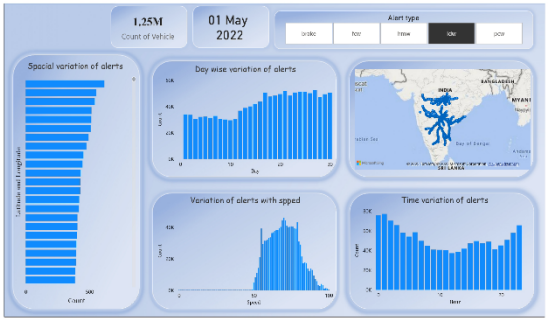
- The dataset primarily covers states such as Telangana, Andhra Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, and Karnataka, specifically within regions around Nagpur and Hyderabad.
- Lane Departure Warning (**LDW**) emerged as the most frequent alert generated, accounting for **1.25 million instances.**
- Following LDW, the alerts for Headway Monitoring and Warning (**HMW**), Pedestrian Collision Warning (**PCW**) and Forward Collision Warning (**FCW**) alerts were observed at frequencies of about **354.74 thousand, 118.92 thousand and 31.8 thousand**, respectively.
- Analysis of the data, gathered during the month of May, revealed consistent patterns across days due to the absence of high traffic densities which is typical of festive seasons on National Highways.
- A more in-depth analysis is available through the following **link.**

Methodology Used

- Applied prominent data analytics methods in Python, utilizing the **Pandas** library for **trend analysis and descriptive statistics** aiding in data understanding.
- Leveraged **Seaborn**, a Python **data visualization** library, to create informative and visually appealing graphical representations aiding in the exploration of data patterns and trends.
- Utilized **Power BI**, a powerful business intelligence tool, to develop interactive dashboards that visually display trends such as **Speed versus Count of alerts, Time versus Count of alerts, Day versus count of hours, and Geographical coordinates (latitude and longitude) versus Count of alerts**.
- **Identified Potential Blackspots** where most of the alerts' spatial coordinates fall within a radius of 111m which falls within the close proximity of Colleges, Hospitals, Bus stops and other similar locations.

Results

1. Lane Departure Warning (LDW):



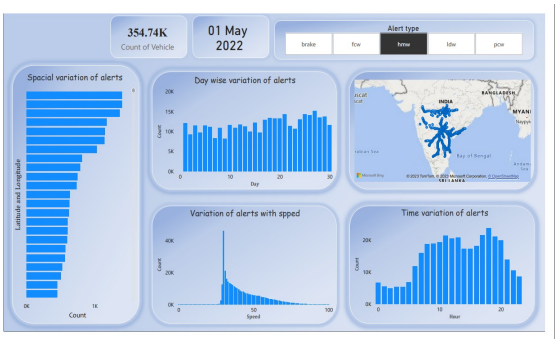
Trends:

- Large density of LDW falls in the range of 50Kmph and 100Kmph.
- Most of the LDWs were generated during night time and continued to increase till morning.
- Top 3 locations: NH65- Munagacherla(AP): 616 instances ,Koradi Road- Vidya Nagar(MH): 552 instances ,NH65-Annavaram(AP): 551

Analysis:

- Road Studs need to be installed because of poor visibility of lanes to drivers especially during night time.
- There might be a possibility of false generation of LDW by ADAS at high speeds, necessitating calibration of ADAS at high speed scenarios.

2. Headway Monitoring and Warning (HMW):



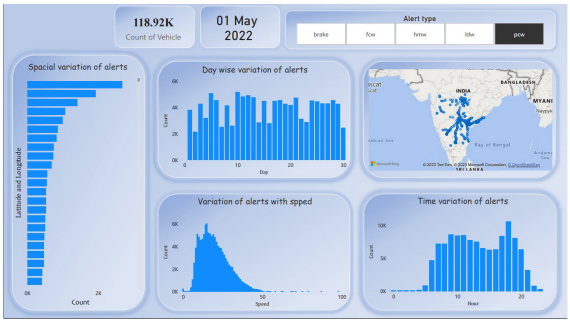
Trends:

- Large density of HMWs falls in the range of 30Kmph and 60Kmph.
- Most of the HMWs were generated from 7:00 Am in the morning till 9:00pm in the night .
- Top locations: SH325- Wardha Road, Nagpur(MH): 1402 instances, SH325 -North Ambazari Road(MH): 1174 instances.

Analysis:

- Certain regions show a high number of HMW alerts, pointing to critical areas for headway monitoring due to traffic density, inappropriate parking of autos, footpaths being occupied by local vendors, damaged sideway fences and inappropriate road design.

3. Pedestrian Collision Warning (PCW):



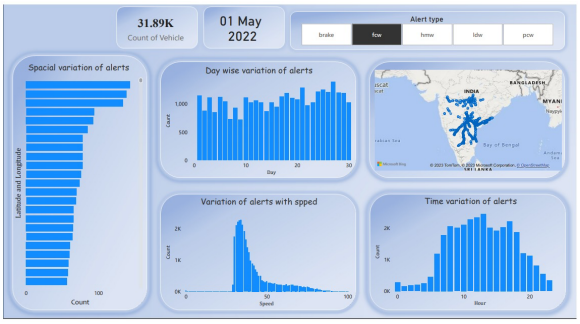
Trends:

- Large density of PCWs falls in the range of 10Kmph and 40Kmph.
- Most of the PCWs were generated from morning 6:00am to 8:00pm night .
- Top 3 locations: SH325- Near Gupta Hospitals, Nagpur(MH): 2673 instances ,SH325 -North Ambazari Road(MH): 1921 instances, SH325 -Near Chatrapati Bus stop(MH): 1411 instances

Analysis:

- Local streets were merged with the roads paving path for animal passes which was observed necessitating fences and rerouting of local street merges.
- Testing ADAS for PCW alerts at higher speeds is necessary since a significant number of alerts are generated at only lower speeds.

4.Forward Collision Warning (FCW) :



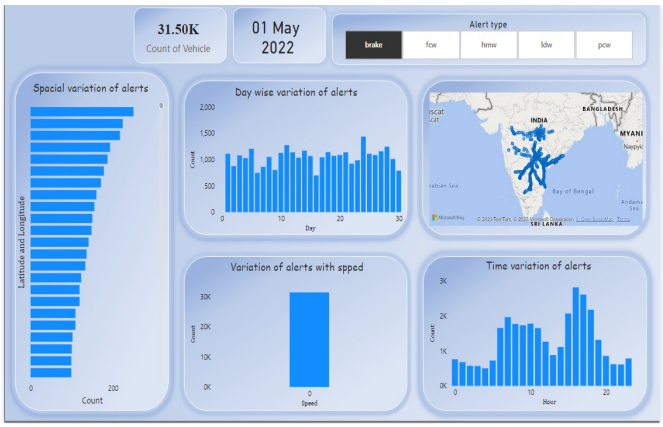
Trends:

- Large density of FCWs falls in range of 10Kmph and 40Kmph.
- FCWs were generated from morning 6:00am to 8:00pm night .
- Top 3 locations: SH325- Near Patwardhan college, Nagpur(MH): 144 instances ,SH325 -North Ambazari Road(MH): 139 instances, SH325 -Near Lata Mangeshkar Hospitals(MH): 134 instances.

Analysis:

- One observation was that the regions under PCW, LDW and FCW were common with heavy traffic density.
- Upon analysis most regions under this category have lower road side width with location of shopping malls and inappropriate parking space necessitating wider roads with separate parking spaces.

5.Brake:



Trends:

- Brake alerts relatively were less generated during night than in the morning. Noticeably large alerts were generated from 4:00pm to 6:00pm.
- Top 3 locations: Civil Line Road, Nagpur(MH): 250 instances ,NH47- Om Sai Nager, Koradi Road,Nagpur(MH): 224 instances, Panjara Colony Koradi Road,Nagpur(MH): 217 instances.

Analysis:

- Most of the brake alerts were observed in regions of Nagpur at cross roads where bus stops were placed just a few meters away from cross roads. This leads to blockage of roads upon which vehicles crossing the turns suddenly come across the large vehicles leading to hard brakes.
- Proper road planning is to be initiated in the areas of hard brake alerts mentioned in the result section which includes positioning of bus stops, rerouting of heavy vehicles and speed control and monitoring systems.

Scalability :

- Model can **accommodate dynamic information** ensuring its usage for add on information.
- Can Identify the alerts variation for a **specific vehicle** and **Location**.
- Identifies regions with **varying radii** ranging from 1.11m, 11.1m, 111m, 1.11km, 11.1km and 111km based on the **areas with the most alerts**.
- This model is designed to incorporate global data, enabling comprehensive analysis of ADAS performance on a **worldwide scale**.
- Model also **accommodates added features** in future like the drivers feedback, sensor information, weather information and vehicle conditions.

Possible Blackspots :

The subsequent locations frequently experienced high alert occurrences, warranting their consideration as potential blackspots.

1. Munagacherla,NH65 ,Nandigama.
2. H325,Hansi Chowk road,Nagpur.
3. North Ambazari Road,Matru seva Sangh Maternity Hospital, Nagpur.
4. North Ambazari Road, Rashtrasant Tukadoji Maharaj Nagpur Medical College, Nagpur.
5. Lata Mangeshkar Hospital , Wardha road, Nagpur.
6. Civil LIne Road , near Vidhan Bhawan Bus stop Cross roads, Nagpur.

Further analysis of the above locations and other possible blackspots can be found in the URL provided below.

URLs for further Exploration:

1. Results
2. Interactive Power BI DashBoard
3. EDA- Python Source Code