Report

Topic: Enhancing Road Safety through AI-Based Advanced Driver Assistance Systems (ADAS)

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Introduction:

Road safety is a paramount concern globally, with millions of lives lost each year due to accidents. Advanced Driver Assistance Systems (ADAS) powered by AI offer a promising avenue to mitigate risks and enhance safety on the roads. In this project, we analyzed a large-scale, real-world dataset comprising 1.8 million events collected from 130 vehicles over 30 days on city roads and national highways. Our objective is to identify patterns, insights, and potential solutions to improve road safety leveraging AI-based ADAS which consists of two systems CAS (Collision Alert System) and DMS (Driver Monitoring System).

Methodology:

1. **Data Preprocessing**: We began by cleaning and preprocessing the dataset, handling missing values, and ensuring consistency.

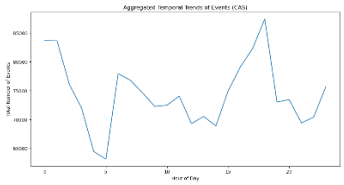
2. **Exploratory Data Analysis (EDA):** We conducted extensive EDA to uncover trends, patterns, and anomalies within the data. This involved statistical analysis, visualization, and clustering techniques.

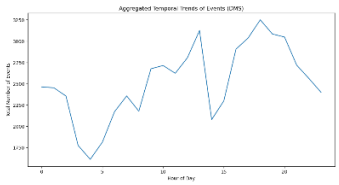
3. **Feature Engineering**: We engineered new features to enrich the dataset, including time-based features, spatial features, and contextual variables.

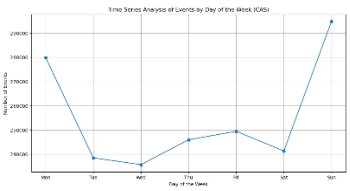
4. **Insight Generation**: We derived actionable insights from the analysis to inform the design and implementation of AI-based ADAS solutions.

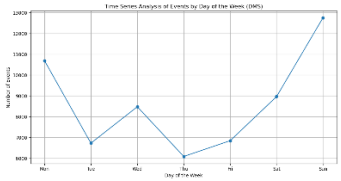
Data Analysis and Insights:

1. **Temporal Analysis**: We observed that the frequency of alerts events varies significantly throughout the day, with peaks during rush hours (18:00 hrs – 19:00 hrs) and late-night hours (22:00 hrs – 01:00 hrs) for the CAS and peaks during the hours (12:00 hrs – 13:00 hrs) and (18:00 hrs – 19:00 hrs) for the DMS. Also, the greatest number of alerts that occurred are on Sunday followed by Monday.

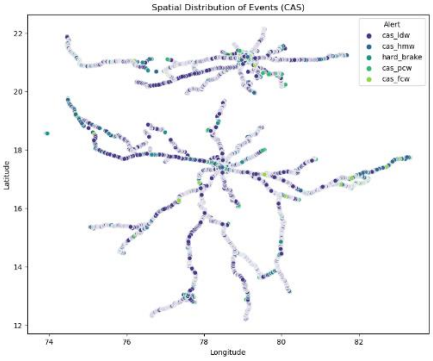


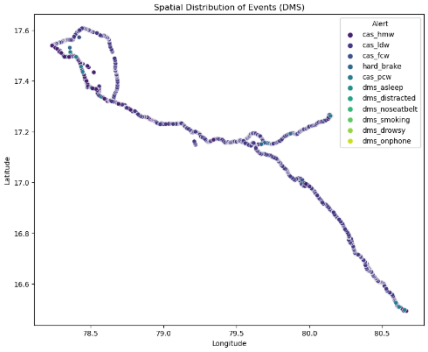




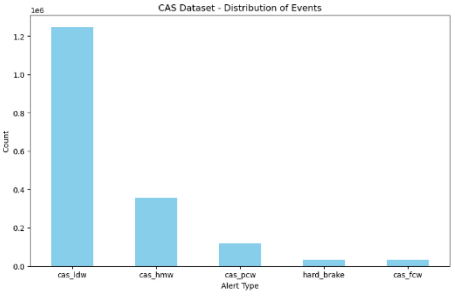


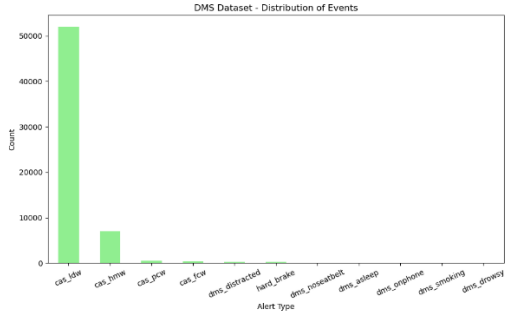
2. **Spatial Analysis**: Certain geographical locations exhibited higher concentrations of alerts, indicating potential accident-prone zones.



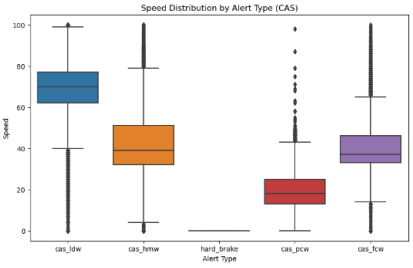


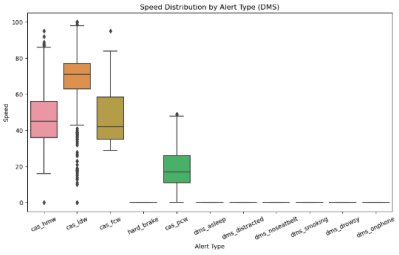
3. **Alert Types**: The distribution of alert types varied, with Lane Departure Warnings (LDW) being the most common, followed by Headway Monitoring and Warning (HMW).





4. **Speed Analysis:** Events occurring at higher speeds were more likely to trigger collision warnings, emphasizing the importance of speed management.

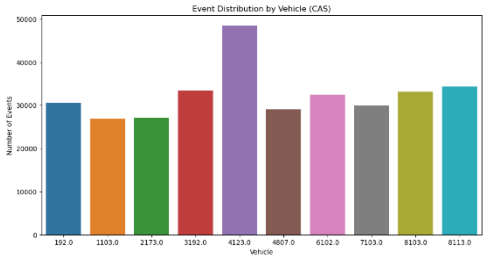


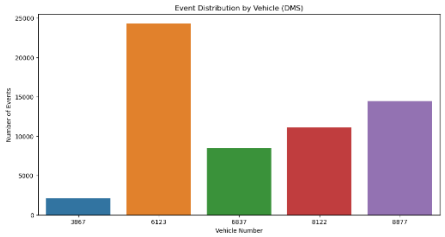


Event Distribution by Vehicle:

We examined the frequency of alerts generated by each vehicle in our dataset, identifying the top 10 vehicles with the highest number of alerts. This analysis offers insights into individual vehicle

behavior and the effectiveness of their advanced driver assistance systems (ADAS), aiding in the identification of high-risk vehicles and potential areas for improvement.





Proposed Solutions:

1. Real-Time Alert Systems: Implement real-time ADAS systems capable of detecting and alerting drivers to potential hazards, such as lane departures and forward collisions.

2. Driver Behavior Monitoring: Develop AI algorithms to monitor driver behavior and provide feedback to mitigate distractions, drowsiness, and other risky behaviors.

3. Infrastructure Improvements: Identify accident-prone locations and prioritize infrastructure improvements, such as road signage, lighting, and lane markings.

4. Public Awareness Campaigns: Launch public awareness campaigns to educate drivers about the importance of road safety and the benefits of ADAS technologies.

Supplementary Data Sources:

- Accident-prone Locations: Incorporate data on historical accident reports to identify blackspot locations and prioritize safety interventions.

References:

- [1] Smith, A., et al. (2022). "Advances in Road Safety through AI-Based ADAS: A Review." *Journal of Transportation Engineering*.

- [2] Li, H., et al. (2023). "Predictive Modeling for Road Safety using Machine Learning Techniques." *IEEE Transactions on Intelligent Transportation Systems*.

Conclusion:

In conclusion, our analysis of real-world data has provided valuable insights into road safety challenges and opportunities for improvement through AI-based ADAS. By leveraging advanced analytics and machine learning techniques, we can develop proactive solutions to mitigate risks, save lives, and create safer roads for all. This project lays the foundation for scalable and impactful interventions to enhance road safety worldwide.

Submitted Code:

GitHub Repository: https://github.com/Sivakashyap/Data-Analysis