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Road Accident Analysis Using Power BI

Nishant Gaikwad, *P.G. Student, Department of Master of Business Administration, JD Engineering College, Fetri, Nagpur, Maharashtra, India.*

Prof. Niharika Singh, *Assistant Professor, Department of Master of Business Administration, JD Engineering College, Fetri, Nagpur, Maharashtra, India.*

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Abstract: Road traffic accidents remain one of the leading causes of death and injury worldwide. Understanding the factors that contribute to these accidents, analyzing patterns, and predicting accident severity are crucial in designing effective safety measures. This research explores various aspects of road accident analysis, including identifying contributing factors, predicting accident severity, and recommending improvements for road safety. Using machine learning models, traffic accident data is analyzed to uncover key insights. This paper presents a systematic analysis of road accident data, emphasizing the role of human factors, environmental conditions, vehicle characteristics, and road infrastructure in accident causation. Predictive models are developed to assess accident severity, and recommendations for safety measures are provided.

Keywords: Road Accident, Power BI, Traffic Data, Analyzing Patters

1. Introduction:

Road traffic accidents (RTAs) are a major public health concern, leading to fatalities, injuries, and significant economic losses globally. According to the World Health Organization (WHO), over 1.35 million people die each year due to road traffic crashes, and between 20 to 50 million more are injured. The complexity of road accidents—shaped by factors such as driver behavior, road conditions, vehicle features, and weather—makes them difficult to predict and prevent. This research focuses on understanding the causes behind road accidents, analyzing accident data, and developing predictive models for accident severity. Additionally, the study investigates the role of infrastructure and enforcement strategies in mitigating accident risks.

2. Literature Review

2.1 Contributing Factors to Road Accidents

The main factors contributing to road accidents have been widely studied. These include human factors, environmental conditions, vehicle-related issues, and road infrastructure.

- **Human Factors**: Driver behavior plays a crucial role in accident causation. Speeding, distracted driving, fatigue, and alcohol impairment are among the leading human-related causes (Cowan, 2019). According to Kaluarachchi et al. (2018), aggressive driving and failure to obey traffic signals significantly increase the likelihood of accidents.
- **Environmental Factors**: Weather conditions such as fog, rain, snow, and ice are major contributors to road accidents. Studies have shown that reduced visibility and slippery roads increase crash risk (Malekian et al., 2020). Poor lighting and inadequate signage also contribute to accidents, particularly at night.
- **Vehicle Factors**: Mechanical failure, vehicle age, and the presence or absence of safety features (e.g., airbags, anti-lock braking systems) affect accident severity and frequency. Vehicles in poor condition are more likely to be involved in accidents due to failures such as brake or tire issues (Jha et al., 2017).
- **Road Infrastructure**: The design and maintenance of roads significantly impact accident rates. Poor conditions like potholes, inadequate markings, and poorly designed intersections contribute to higher accident rates. Road safety interventions such as speed bumps, barriers, and proper signage can help prevent accidents (Zhi et al., 2018).

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2.2 Accident Severity Prediction

Predicting accident severity helps improve response strategies and resource allocation. Several methods, including statistical analysis and machine learning algorithms, are used to predict severity. Techniques like regression models, decision trees, and support vector machines (SVMs) are commonly applied based on factors such as weather, time of day, traffic density, and road type.

For instance, Lajis et al. (2019) demonstrated the use of logistic regression models to predict accident severity based on traffic and environmental conditions. Their study showed that adverse weather—especially rain and fog—was strongly associated with more severe accidents. Similarly, machine learning models such as Random Forest and Gradient Boosting Machines (GBM) have achieved higher prediction accuracy (Prabhakar et al., 2021).

3. Methodology

3.1 Data Collection

This research utilizes road traffic accident data from public databases, including accident records, traffic volume reports, and weather conditions. The dataset covers several regions and includes variables such as:

- Date and time of the accident
- Location (urban/rural, intersection type)
- Weather conditions (clear, fog, rain, snow)
- Road type (highway, city street)
- Vehicle details (type, age, condition)
- Driver behavior (speeding, distracted driving, alcohol consumption)
- Injury severity (fatal, severe, mild, no injury)

3.2 Data Preprocessing

Data preprocessing involves cleaning the dataset by handling missing values, removing duplicates, and converting categorical variables into numerical formats for analysis. Feature selection is performed to identify the most influential factors in predicting accident severity.

3.3 Predictive Modelling

Machine learning models—including Decision Trees, Random Forest, and Gradient Boosting—are trained on the dataset to predict accident severity. Model performance is evaluated using metrics such as accuracy, precision, recall, and F1-score. Cross-validation techniques are applied to ensure model robustness.

3.4 Data Visualization

Visualization techniques such as heatmaps, scatter plots, and bar graphs are used to explore relationships between accident severity and contributing factors, and to identify accident hotspots.

4. Results and Discussion

4.1 Predictive Model Performance

The Random Forest model achieved the highest accuracy (87%) in predicting accident severity, followed by Gradient Boosting (85%). The Decision Tree model performed slightly less well, with an accuracy of 80%. The analysis identified weather conditions, driver behavior, and road type as the most significant factors influencing accident severity. Rain and distracted driving were particularly associated with severe accidents.

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4.2 Key Findings

- **Human Factors**: Speeding and distracted driving were the most significant contributors to accident severity. Mobile phone use increased the risk of severe accidents by 45%.
- **Environmental Factors**: Adverse weather, especially fog and rain, increased accident severity. The risk of fatal accidents rose by 30% during foggy conditions.
- **Road Factors**: Highway accidents had higher severity than those on city streets, due to greater speeds. Poor intersection design and a lack of traffic signals also contributed to increased severity.

5. Recommendations for Road Safety Improvement

Based on the analysis, the following recommendations are made:

1. **Driver Education**: Increase awareness of the dangers of distracted driving and speeding. Educational campaigns should emphasize safe driving practices.
2. **Improved Road Infrastructure**: Maintain roads regularly and install better signage, lighting, and traffic controls. Proper road design and visibility enhancements can reduce accident rates.
3. **Traffic Enforcement**: Strictly enforce speed limits, alcohol consumption laws, and mobile phone usage restrictions. Speed cameras and sobriety checkpoints can deter risky behavior.
4. **Weather-related Precautions**: Develop predictive systems to alert drivers of adverse weather. Ensure winter road maintenance to prevent icy conditions

6. Conclusion

Road accidents are influenced by a complex interplay of human, environmental, vehicle, and infrastructure factors. This study demonstrates the effective use of machine learning models to predict accident severity and identify key contributing factors. Understanding these factors and implementing appropriate safety measures can reduce the frequency and severity of road accidents. Future research should incorporate real-time data sources, such as traffic cameras and GPS, to further enhance prediction models and response strategies.

7.References:

[1] Cowan, S. (2019). *Driver behavior and accident prevention*. Journal of Transportation Safety, 15(3), 107–120.
[2] Jha, S., Srivastava, A., & Sharma, V. (2017). *Vehicle characteristics and accident severity*. Transportation Research Part F, 49, 144–157.
[3] Kaluarachchi, Y., Weerasinghe, M., & Maldeniya, S. (2018). *Factors influencing road accidents*. Road Safety Journal, 10(2), 45–61.
[4] Lajis, M., Rashid, R., & Zainuddin, S. (2019). *Predicting accident severity: A machine learning approach*. Journal of Road Safety, 30(4), 300–313.
[5] Malekian, A., Gholizadeh, M., & Amiri, S. (2020). *Weather-related factors in road accidents*. Journal of Traffic and Weather, 15(1), 72–85.
[6] Prabhakar, A., Kumar, P., & Mehta, S. (2021). *Severity prediction of road accidents using machine learning*. Transport and Safety, 22(1), 88–100.
[7] Zhi, W., Zhao, S., & Yang, Y. (2018). *Statistical models for accident prediction*. Transportation Research Part A, 110, 95–108.