

## **Integrated Analysis of Skid Resistance, Texture, and Geometric Factors for Enhanced Road Safety on the Southern Expressway**

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Road safety is a critical concern worldwide, particularly on high-speed roads such as expressways, where traffic flow is dense and road geometries can be complex. The Southern Expressway in Sri Lanka, the country's first expressway, has significantly reduced travel time and promoted economic development. However, it has also been linked to a considerable number of road accidents, raising serious concerns about safety. This research aims to explore the factors that contribute to the severity of accidents on the Southern Expressway. It will focus on the impacts of road geometry, surface conditions, environmental factors, and lighting. The study analyses data collected over a decade, from 2012 to 2022, by the Expressway Operations, Maintenance, and Management Division (EOM & M). The dataset includes various accident characteristics, such as the time and location of accidents, weather conditions, and lighting, along with road geometry parameters like horizontal curvature, vertical alignment (K-value), and surface texture. The research utilises a combination of statistical techniques and machine learning models to identify the key factors influencing accident severity and to predict the outcomes of accidents. The study found that road geometry, particularly curves, gradients, and poor lighting conditions, significantly affects the severity of accidents. Wet weather conditions were also identified as a crucial factor, as they reduce skid resistance effectiveness, leading to a higher risk of accidents. The analysis emphasized the importance of road surface conditions, including skid resistance, which is vital for preventing accidents in adverse weather. To streamline the dataset and identify the most significant contributing factors, Principal Component Analysis (PCA) and K-means clustering were employed. Furthermore, machine learning models such as Random Forest, Logistic Regression, and Support Vector Machines (SVM) were used to predict accident severity effectively. The Random Forest model achieved an accuracy rate of 91.5%, demonstrating its potential to accurately predict accident severity and identify high-risk zones. The study highlights the importance of improving road design, especially in high-risk areas. Enhancing road surface conditions, such as increasing skid resistance and upgrading lighting in poorly lit zones, could significantly reduce the severity of accidents. Additionally, incorporating real-time traffic and weather data into predictive models would allow for timely interventions and better safety management. The research also advocates for the use of advanced technologies, such as GIS-based hotspot analysis and digital road signs, to enhance driver awareness and promote safer driving behaviours. In conclusion, this research highlights the importance of adopting a comprehensive approach to road safety management on expressways. This approach should combine improved road design, predictive modelling, and real-time data integration. By implementing these recommendations, the safety performance of the Southern Expressway can be greatly enhanced, ultimately reducing accident severity and contributing to safer transportation. The findings provide valuable insights for enhancing road safety.

**Keywords:** Accident severity, Hotspot analysis, Machine learning, K-mean clustering

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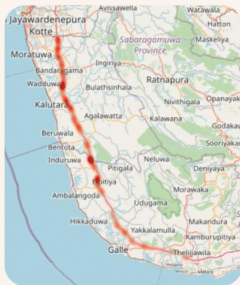
## DATA COLLECTION

- Accident data (2012 – 2022)
- Skid Resistance Data
- Geometric Data

## HOTSPOT ANALYSIS

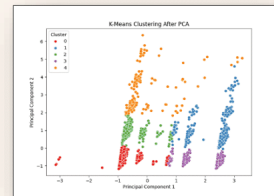


- Using QGIS



## CLUSTERING

Apply Principal Component Analysis (PCA) to reduce the dimensionality. After that, cluster by using K-mean clustering method



## IMPACT OF FACTORS

Examine how light conditions, weather, road surface conditions, K value, and curvature value affect accidents

## MACHINE LEARNING

Using several ML models and getting higher accuracy from the **Random Forest** model (91%)

## RECOMMENDATION

Improve **lighting**, maintain **skid resistance**, enhance road geometry, and use **real-time signage** to reduce crash risks

## IMPACT

Targeted safety measures reduce severe crashes on Southern Expressway