**Geographic Information System And Machine Learning-Based Expressway Accident Modelling**

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***ABSTRACT***

Although expressways play a significant role in the country's economy, increasing usage often leads to a rise in accidents. Research on expressway accidents in Sri Lanka has been limited, highlighting the need to investigate their causes and identify accident-prone areas proactively. This study aimed to utilise Geographic Information Systems (GIS) and Machine Learning (ML) techniques to model expressway accidents, with a specific focus on the Southern Expressway in Sri Lanka. The dataset used was collected from the Southern Expressway Operation Maintenance and Management Division (EOMMD) and underwent preprocessing, including encoding, oversampling, and feature selection. Machine Learning algorithms—Random Forest (RF), Support Vector Classifier (SVC), and Decision Tree (DT)—were used to identify accident-prone locations and assess the severity of accidents. The performance of the three models was evaluated using metrics such as the Receiver Operating Characteristic (ROC) curve, Area under the ROC Curve (AUC), Mean Absolute Error (MAE), and Mean Square Error (MSE). RF demonstrated the highest accuracy with an accuracy score of 81.19%, followed closely by SVC with 79.8% and DT with 69.7%. RF also had the lowest MAE and MSE values, and an impressive AUC value of 0.86, indicating superior prediction accuracy and strong discrimination capabilities. Maps were generated to visualise the results, and an operational dashboard was developed to facilitate data analysis and improve safety management on expressways.This study provides valuable insights into the modelling of expressway accidents using GIS and machine learning techniques, which can be used to enhance safety management practices and prevent accidents.

**Keywords:** Expressway Accidents, GIS, Machine Learning, Road Safety Management