Road Traffic Accident Severity Prediction Using Machine Learning

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***Abstract*—** This paper delivers into the significant research road accidents represent a global challenge resulting in fatalities, injuries, and significant economic losses. Various countries and international bodies have implemented technologies, systems, and policies aimed at accident prevention. The integration of big traffic data and artificial intelligence holds promise for predicting and mitigating accident risks. Existing research predominantly explores the influence of road geometry, environmental conditions, and weather on accidents, often neglecting crucial human factors such as alcohol and drug use, age, and gender, which significantly impact accident severity. This study addresses these factors comprehensively, employing a range of single and ensemble machine learning (ML) methods to predict accident severity. Comparative analysis reveals that Random Forest (RF) consistently outperforms logistic regression (LR), K-nearest neighbor (KNN), naive Bayes (NB), extreme gradient boosting (XG Boost), and adaptive boosting (AdaBoost), achieving accuracy rates of 86.64% for binary and 67.67% for multiclass classifications. Ensemble methods generally surpass single-mode ML techniques in accuracy, with RF, XG Boost, and AdaBoost demonstrating superior performance. These findings contribute valuable insights into accident factors and severity assessment, offering potential applications in traffic safety and risk management.

***Keywords*—** Road traffic accidents, Severity prediction, Accident analysis, Machine learning, Predictive modeling, Traffic safety, Risk assessment, Data mining, Feature engineering, Decision trees, Random forest, Neural networks, Crash severity, Injury prediction, Traffic collision, Accident classification, Feature selection, Pattern recognition, Predictive analytics, Accident investigation.

I. INTRODUCTION

Road traffic accidents (RTAs) remain a significant global public health issue, resulting in substantial loss of life, injuries, and economic costs. Despite efforts to improve road safety through measures like infrastructure enhancements and public awareness campaigns, accurately predicting accident severity is crucial for mitigating their impact.

Predicting the severity of road traffic accidents serves several critical purposes. Firstly, it helps emergency services allocate resources more efficiently by prioritizing cases based on expected severity. Secondly, it assists policymakers and transportation authorities in identifying high-risk areas and implementing targeted interventions to reduce severity. Additionally, it informs the public about potential hazards on specific routes, encouraging safer driving practices.

Traditionally, severity prediction relied on manual observation and subjective judgment by accident investigators. However, advancements in technology and the availability of extensive data have introduced powerful predictive modeling techniques, particularly those driven by machine learning algorithms, to this domain.

This introduction sets the stage for exploring the application of machine learning and data-driven approaches to predict road traffic accident severity. By leveraging diverse data sources such as historical accident records, road conditions, weather data, and vehicle characteristics, predictive models can classify accidents into various severity levels.

This study aims to investigate methodologies for accident severity prediction, encompassing data preprocessing, feature selection, model training, and evaluation. Furthermore, it seeks to analyze factors influencing accident severity and their significance in predictive models.

Enhancing our understanding of accident severity determinants and developing robust prediction models contributes to ongoing efforts to improve road safety and mitigate the broader impacts of road traffic accidents on individuals and society.

II. LITERATURE SURVEY

1. A road classification approach based on road traffic severity analysis:
   Résumé—Every day, road accidents result in human and material losses, becoming one of the world's most pressing issues. The National Observatory for Road Safety in Tunisia (NORS) has reported a significant year-over-year increase in the number of accidents. The severity of the current road safety situation in Tunisia is underscored by the rise in accidents from 5,089 in 2021 to 5,715 in 2022. To combat this problem and improve road safety in Tunisia, we propose a road classification approach based on road traffic severity analysis. Our method offers a new way to classify roads according to their danger levels based on accident history. Our goal is to assist NORS in directing their efforts to enhance road safety.

2. Road Traffic Assignment Algorithm Based on Computer Vision:

   As the social economy develops, increasing attention is being paid to traffic issues. Efficiently allocating road resources and reducing traffic accidents have become prominent topics. Traffic information is crucial for road traffic management. Currently, urban vehicle dispatching in China relies primarily on a combination of manual calculations and static planning. However, computer vision technology can enhance efficiency and reduce labour costs. Therefore, this paper utilizes MATLAB software to design an algorithm for road resource allocation. Initially, the concept and importance of road traffic allocation are introduced, followed by an explanation of computer vision. Based on this foundation, the road traffic allocation algorithm is examined and its performance tested. The final results indicate that the algorithm achieves low average delay and road allocation times, along with high allocation accuracy. This demonstrates that the computer vision-based road traffic assignment algorithm performs well.

3. Predicting Traffic Accidents Using the Conflict Coefficient

   The article discusses theoretical approaches to developing a methodology for predicting road accidents caused by collisions between two or more vehicles. This predictive methodology relies on real-time data from transport detectors. One key advantage of this method is its applicability in both real-time and forecast scenarios. This technique can be used for a comprehensive assessment of road safety on public roads, in real-time applications, for developing control algorithms for highly automated vehicles, and for creating intelligent transport systems.

4. Research on Road Traffic Accident Scene Investigation Technology Based on 3D Real Scene Reconstruction

Investigating road traffic accident scenes is crucial for understanding the causes of accidents and subsequently enhancing road traffic safety. Traditional methods for investigating these scenes are often time-consuming, difficult to revisit, and lack precision. To address these issues, this paper explores the use of 3D real scene reconstruction technology for road traffic accident investigations. It introduces the UVA tilt photography process model and the 3D model construction method tailored for various accident scenes. Additionally, an accuracy inspection method is designed for the investigation and measurement of accident scenes based on real 3D models. The model construction and accuracy verification are demonstrated through specific accident cases. The research indicates that using real 3D models for accident scene investigations can meet accuracy requirements, providing an efficient and realistic reproduction of the scene to assist in investigations.

5. Modern Approach to the Road Traffic Management in Cities of Ukraine: Case Study of Kyiv Municipal Company "Road Traffic Management Center"

   Key indicators of sustainable development in urban areas (cities, towns, and settlements) include the number of road accidents within the street and road network. Over the past three years, the Kyiv Municipal Company "Road Traffic Management Center" has been developing and implementing an advanced approach to road traffic management in Kyiv, Ukraine. This approach leverages modern Geographic Information System (GIS) technologies, spatial databases, and web cartography. This paper describes a case study conducted by the company using a pilot project to explore the potential for developing a comprehensive Road Traffic Management Scheme for the city. The study aims to facilitate planning, analysis, and decision-making processes in road traffic management activities.

III. EXISTING SYSTEM

Developing an accident prediction model (APM) is highly complex due to various factors such as road geometry, environmental conditions, human behavior, and vehicle characteristics. It stands as a crucial aspect of road safety

design. Implementing APM successfully enables the prediction of accidents within specific regions, allowing dissemination of this information to nearby road users for precautionary measures. Existing studies commonly approach road accident prediction either as a regression or a classification problem.

IV. PROPOSED SYSTEM

Recent research has focused on using ML-based models to investigate the relationship between road accidents and their contributing factors. This study primarily aims to evaluate several commonly employed ML algorithms in terms of their predictive accuracy under varying contributing factors. The objective is to compare the performance of these algorithms in predicting road accident severity. The research treats predicting accident severity as a classification problem, distinguishing between Grievous and Non-Grievous categories initially, representing a binary classification task. Subsequently, the study expands to real-world scenarios where accident severity is further categorized into Fatal, Serious, Minor, and Non-Injury incidents, constituting a multiclass classification challenge. This approach involves employing multiclass classification algorithms to explore the intricate relationship between contributing factors and accident types.hyaluronan receptor 1 (LYVE1) is a protein that may facilitate tumor spread.

V. CONCLUSION

This study presents empirical findings that demonstrate the effectiveness of various machine learning (ML) algorithms when applied to road accident data. The research evaluates three single-mode classification algorithms—Logistic Regression (LR), K-Nearest Neighbors (KNN), and Naive Bayes (NB)—as well as three ensemble-mode classification algorithms—Random Forest (RF), XGBoost, and AdaBoost—in predicting both binary and multiclass injury severities. Unlike previous studies that primarily focused on accident frequency and contributing factors, this research emphasizes the impact of driver attributes such as age, gender, and alcohol or drug consumption on accident severity. Based on the experimental results, it is concluded that these driver attributes significantly influence injury severity. The comparison of algorithms in this study indicates that Random Forest (RF) performs best among the considered ML algorithms. Furthermore, the study suggests that ensemble-mode ML algorithms generally outperform single-mode algorithms. These findings are valuable for enhancing road safety measures and raising community awareness to mitigate road accidents.

VI. REFERENCES

1. "Road traffic injuries." [Online]. Available: https://www.who.int/news- room/fact-sheets/detail/road-traffic-injuries
2. M. of Transport, "Temarutau-nga-tatauranga a¯-tau: Safety - annual statistics." [Online]. Available: http://www.transport.govt.nz/statistics- and-insights/safety-annual-statistics/summary/
3. D. Briggs, K. Mason, and B. Borman, "Rapid assessment of environ- mental health impacts for policy support: The example of road transport in new zealand," International journal of environmental research and public health, vol. 13.
4. "Improving global road safety — general assem-bly of the united nations." [Online]. Available: https://www.un.org/pga/74/2020/08/31/improving-global-road-safety
5. D. Lord and F. Mannering, "The statistical analysis of crash-frequency data: A review and assessment of methodological alternatives," Trans- portation research part A: policy and practice, vol. 44, no. 5, pp. 291– 305, 2010.