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Machine Learning based Road Crash Data Analysis

Adithya Subramanya Raje Urs, Mrs Chaithra J P

Student, Department of MCA, Visvesvaraya Technological University, The National Institute of Engineering, Mysore, India

Assistant Professor, Department of MCA, Visvesvaraya Technological University, The National Institute of Engineering, Mysore, India

ABSTRACT: The escalating global health concern of road crashes disproportionately affects the vulnerable road users, including pedestrians' cyclists, and two-wheeler riders, with developing nations bearing the brunt of this issue. While government stakeholders and various institutions are working diligently to ameliorate the situation, the potential contribution of educational institutions in addressing this problem cannot be underestimated. Notably, there is a significant dearth of road safety research conducted in low and middle-income countries. This proposed work aims to provide an overview of the application of Machine Learning Classification Algorithms in analysing traffic crash data, with the objective of identifying factors contributing to road accidents. Current systems relying on classical learning models have proven to be inefficient and imprecise, lacking the accuracy and processing speed of the proposed model. However, it is important to note that these existing works are primarily theoretical models, lacking practical application in real-time scenarios. In contrast, our project endeavors to develop a functional application incorporating a model capable of identifying factors influencing road crashes. The proposed system is designed as a real-time traffic solution, offering practical utility for both traffic departments and the general public. The development of this system utilizes Microsoft tools, specifically Visual Studio and SQL Server, to create a robust and efficient platform for road safety analysis.

I. INTRODUCTION

The rapid expansion of urban expressways has improved transportation convenience but raised traffic safety concerns, as evidenced by over 6,000 accidents on the Shanghai Expressway in just three months in 2014. Research into accident causes has traditionally focused on isolated factors such as driver behavior, road conditions, traffic flow, and weather. However, the emergence of data science has opened new avenues for comprehensive analysis. Association rule mining, in particular, offers the potential to uncover hidden relationships among accident-influencing factors, providing a more holistic understanding of traffic safety issues. Despite its promise, existing mining techniques often require tedious parameter determination and manual result screening, limiting their practical application in intelligent transportation systems.

To address these challenges, a novel approach is proposed to automate parameter determination and extract strong rules from association rule mining results. This could be achieved through clustering techniques or by automatically filtering out weak rules based on expert knowledge. The ultimate goal is to develop an automated algorithm that optimizes the implementation of association rule mining in intelligent transportation networks. By leveraging this advanced data analysis method, transportation authorities can gain deeper insights into the complex interplay of factors contributing to traffic accidents, enabling more effective and targeted safety measures to be implemented on urban expressways.

II. OBJECTIVES

- Proposed system is a government sector application.
- Proposed system is a real time application.
- The proposed system discovers strong rules embedded in these frequent item sets. This often uncovers the associations between factors that influence accidents, which can then be used to reduce accident occurrence by addressing these factors.
- Proposed system uses traffic accidents data to mine frequent patterns and important factors causing different types of accidents. Proposed system discovers the associations among traffic accidents.
- Proposed system makes use of "Associate Rule Mining" to discover these patterns

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III. LITERATURE SURVEY

[1] "Factors influencing accident severity: an analysis by road accident type"
[2] "Road Accident Analysis using Machine Learning"
[3] "STUDY ON ROAD ACCIDENTS USING DATA MINING TECHNOLOGY"
[4] "Performance Analysis of SVM, ANN and KNN Methods for Acoustic Road-Type Classification"
[5] "Research on Automated Modeling Algorithm Using Association Rules for Traffic Accidents",
[6] "A Survey on Analyses of Factors Related to Road Accidents Using Data Mining Techniques",
[7] "Road Accident Analysis and Prediction of Accident Severity by Using Machine Learning in Bangladesh"
[8]"Prediction Of The Cause Of Accident And Accident Prone Location On Roads Using Data Mining Techniques"
[9] "Mining Road Traffic Accident Data to Improve Safety: Role of Road-related Factors on Accident Severity"
[10] "Classification of Road Traffic Accident Data Using Machine Learning Algorithms"

IV. METHODOLOGY

- Association Rule Mining: A fundamental data science technique that establishes correlations between items, often applied in market-basket analysis to uncover purchasing patterns.
- Apriori Algorithm: An efficient and versatile algorithm used in this project to predict relationships between risk factors and traffic accidents using a traffic dataset.
- Dataset Analysis: The algorithm scans the accident dataset to determine the support of each item and generate frequent item sets.
- Candidate Generation: Uses Lk-1 to join and generate the set of candidate k-item sets, calculating support for each candidate.
- Frequent Item Set Identification: Adds the frequent item sets to the results until no further candidate sets can be generated.
- Subset Generation: For each item in the frequent item set, generates all non-empty subsets.
- Confidence Determination: Calculates the confidence for each non-empty subset, adding those meeting the threshold to the set of Strong Association Rules.
- Association Discovery: Efficiently discovers associations between different parameters in the dataset, helping in the extraction of meaningful insights.
- Decision Support: The extracted association rules can be used for decision-making and prediction tasks in traffic safety analysis.
- Versatility: The Apriori algorithm is suitable for analyzing datasets across various domains such as medical, education, and agriculture.

V. TECHNOLOGY USED

Software

- Operating System : Windows7 and above
- Design Tool : Visual Studio 2010
- Front End : ASP .NET 4.0
- Language : C#
- SQL Server : Microsoft Sql Server 2005
- Data Access Technology : ADO .NET

Hardware

- Processor : Intel i3 7gen and above
- Processor speed : 3.90GHz
- RAM : 2GB+
- Har Disk : 40GB+

VI. CONCLUSION

The integration of data mining techniques with extensive historical accident data, encompassing factors such as weather and road conditions, represents a pivotal strategy in advancing road safety practices. This study, driven by the analysis of a significant dataset of road accidents, employs sophisticated in-memory data processing methods to uncover crucial trends and patterns. By correlating environmental variables with accident occurrences, the research aims to refine

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accident prevention strategies and optimize emergency responses. The scalability and efficiency of modern computational approaches not only facilitate real-time analysis but also enable proactive measures in road safety management. Ultimately, this integrated approach underscores the transformative potential of leveraging comprehensive accident data and advanced data processing methodologies to enhance overall road safety standards, contributing significantly to the reduction of accidents and the promotion of safer driving environments.

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