Road Accident Severity Prediction System

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Abstract

Traffic accidents remain a critical challenge to road safety, with severe accidents causing significant casualties and damage, particularly in developing countries. This project aims to enhance road safety through advanced predictive analytics by integrating machine learning techniques with real-time data analysis. Utilizing a comprehensive dataset that includes accident reports, weather conditions, and road infrastructure data from the USA, we applied a combination of Random Forest and Convolutional Neural Network models (RFCNN) to accurately predict accident severity. The RFCNN model achieved an impressive accuracy of 0.991, precision of 0.974, recall of 0.986, and F-score of 0.980, demonstrating its effectiveness in forecasting accident outcomes. Building upon these insights, we introduced predictive maintenance alerts to further improve road safety. The first component focuses on infrastructure maintenance, where we analyze high-risk accident areas to recommend targeted improvements such as enhanced lighting and road repairs. The second component provides vehicle maintenance suggestions, leveraging telematics data to identify maintenance needs for vehicles frequently involved in severe accidents, thereby reducing their risk of future incidents.

Existing System

Overview: Traditional approaches to managing road safety primarily rely on historical accident data and reactive measures. Current systems often involve periodic inspections, manual data analysis, and general safety recommendations without integrating advanced predictive analytics.

Limitations:

- **Reactive Approach:** Safety measures are often implemented after accidents occur rather than predicting and preventing them beforehand.
- **Limited Data Integration:** Existing systems may not fully integrate diverse data sources, such as weather conditions and vehicle telematics, leading to incomplete risk assessments.
- **Manual Analysis:** Many systems rely on manual review of accident reports and infrastructure conditions, which can be time-consuming and less accurate.
- **Lack of Real-Time Insights:** Traditional systems typically do not provide real-time risk assessments or maintenance alerts based on the latest data.

Proposed System

Overview: The proposed system enhances road safety by leveraging advanced machine learning techniques to predict accident severity and provide actionable maintenance alerts. It integrates diverse data sources, including accident records, weather conditions, and telematics data, to offer a comprehensive safety solution.

Key Features:

- **Predictive Analytics:** Utilizes an ensemble of Random Forest and Convolutional Neural Network models (RFCNN) to accurately predict the severity of traffic accidents.
- **Infrastructure Maintenance Alerts:** Analyzes accident patterns to identify high-risk areas and recommend targeted infrastructure improvements, such as better lighting and road repairs.
- **Vehicle Maintenance Suggestions:** Uses telematics data to identify and suggest necessary maintenance for vehicles frequently involved in high-severity accidents.
- **Real-Time Risk Assessment:** Provides real-time alerts and recommendations to enhance proactive safety measures and informed decision-making.

Benefits

- Proactive Safety Measures
- Integrated Data Analysis
- Targeted Interventions

Methodology

Data Collection:

- **Accident Records:** Data on traffic accidents from the USA, including details on severity, location, and contributing factors.
- **Weather Conditions:** Data such as temperature, wind chill, humidity, visibility, and wind direction.
- **Road Infrastructure:** Data on road conditions, lighting, signage, and other relevant infrastructure features.
- **Telematics Data:** Vehicle health metrics including brake wear, tire pressure, and engine performance.

Data Analysis:

- Feature Selection using Random Forest
- Pattern Identification using clustering algorithms

Model Development:

- RFCNN Model: Combining Random Forest and Convolutional Neural Networks
- Predictive Maintenance Algorithms for vehicle maintenance

Implementation

- **Infrastructure Maintenance Alerts:** Recommendations for improvements in high-risk areas.
- **Vehicle Maintenance Suggestions:** Alert system for maintenance actions based on predictive models.

Evaluation and Optimization

- **Model Performance:** Assess accuracy, precision, recall, and F-score.
- **Impact Assessment:** Monitor changes in accident rates and vehicle maintenance outcomes.
- **Refinement:** Continuously refine models and recommendations based on feedback and new data.

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Thank You!