International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

AI POWERED ROAD ACCIDENT PREDICTION

MALATHI M, KAVIN PARITHI S, MIRUTHUN KANNAN K, VAANATHI S
Department of Electronics and Communication Engineering, Bannari Amman Institute of Technology, Sathyamangalam, Erode, Tamilnadu, India

---

ABSTRACT:

Road accidents remain a major public safety concern, leading to significant loss of life and economic burdens. This project introduces an AI-Powered Road Accident Prediction System designed to analyze accident patterns using UK road safety data. The system employs data preprocessing, exploratory data analysis (EDA), and a Logistic Regression model to assess accident severity based on various influencing factors such as weather conditions, road types, and vehicle attributes. A web-based interface built with Streamlit enables users to input key accident-related data and receive predictive insights in real time. The system enhances road safety by providing data-driven insights, helping authorities and policymakers implement targeted safety measures. This research highlights the system's development, functionality, and potential impact in reducing accident risks and improving transportation safety.

Keywords: Road Accident Analysis, Machine Learning, Logistic Regression, Predictive Analytics, Data-Driven Decision Making, Traffic Safety.

1.INTRODUCTION:

Road safety is a critical concern worldwide, with accidents leading to severe injuries, fatalities, and economic losses. Traditional accident analysis methods rely on historical data and rule-based approaches, which often fail to provide accurate and actionable insights. To address this issue, our project, AI-Powered Road Accident Prediction System, leverages machine learning and data analytics to identify key factors influencing accident severity and predict potential risks effectively.

The system utilizes UK Road Safety data and implements Logistic Regression as the core predictive model. Through data preprocessing, exploratory data analysis (EDA), and classification modeling, the system detects accident trends based on variables such as weather conditions, road types, vehicle attributes, and time of occurrence. To enhance usability, a Streamlit-based web interface is developed, allowing users to input relevant parameters and obtain predictive insights regarding accident severity.

By automating accident risk assessment, the system supports policymakers, urban planners, and traffic management authorities in implementing data-driven safety measures. The integration of statistical analysis with machine learning not only improves the accuracy of accident predictions but also helps in formulating preventive strategies to reduce road mishaps. Through this structured approach, the project aims to contribute to a safer transportation ecosystem and enhance road safety standards.

2.LITERATURE SURVEY:

The increasing integration of artificial intelligence (AI) and data analytics in road safety research has significantly improved accident prediction and prevention methodologies. Several studies have explored the role of machine learning models, data-driven decision-making, and automated risk assessment in enhancing road safety.

Elvik et al. (2019) analyzed the effectiveness of statistical accident prediction models and found that traditional regression-based approaches, while useful, often lack adaptability in handling large datasets with complex interactions. This study emphasized the need for machine learning models that can process extensive road safety data more efficiently.

Zhao & Khattak (2021) examined the impact of weather conditions, traffic congestion, and human behavior on accident severity. Their research demonstrated how predictive models incorporating real-time environmental data can improve the accuracy of accident risk assessments. This aligns with our project's approach of integrating logistic regression and exploratory data analysis (EDA) to assess the impact of weather, road types, and time of occurrence on accident severity.

Real-world implementations of AI-driven traffic safety systems provide further validation of machine learning's role in accident prevention. Projects like Vision Zero in Sweden have successfully utilized predictive analytics to reduce road fatalities by identifying high-risk areas and implementing targeted interventions. Similarly, the UK Department for Transport (DfT) has explored the use of AI models to enhance accident forecasting and urban planning strategies.

The role of interactive dashboards and real-time data visualization has also been emphasized in research. Li et al. (2022) explored how integrating user-friendly interfaces with predictive models improves stakeholder decision-making. The study supports our implementation of a Streamlit-based interface, allowing users to input accident-related data and obtain real-time predictions on accident severity.

3.METHODOLOGY:

The AI-Powered Road Accident Prediction System is developed to enhance road safety by utilizing machine learning techniques to predict accident severity based on various factors. The system follows a structured development process, including data collection, preprocessing, model implementation, and deployment, ensuring reliable and data-driven accident predictions. The dataset used for training consists of key accident-related attributes such as weather conditions, road types, traffic density, time of occurrence, and vehicle involvement, helping in the identification of patterns that contribute to accident risks.

The data preprocessing phase involves cleaning and transforming the dataset to remove inconsistencies and improve model accuracy. Missing values are addressed using appropriate imputation techniques, while categorical variables are converted into numerical formats through encoding methods. Feature scaling is applied to normalize numerical data, ensuring uniformity in model training. Exploratory Data Analysis (EDA) is performed to detect correlations and influential factors, enabling the selection of relevant features that enhance model performance.

A machine learning model is implemented to classify accident severity levels based on historical data. The dataset is divided into training and testing sets to evaluate model performance effectively. The chosen model undergoes multiple iterations, with hyperparameter tuning applied to optimize accuracy, precision, recall, and F1-score. The system provides predictions based on real-time or user-input parameters, offering valuable insights for road safety improvements.

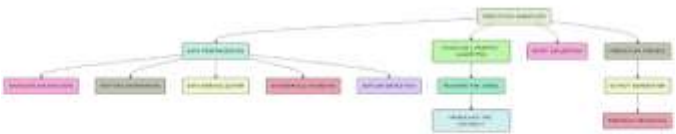
The frontend interface is designed using an interactive framework that allows users to input accident-related parameters and receive predictions on accident severity.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

The backend, developed in Python, processes these inputs and utilizes a trained machine learning model to provide real-time assessments. The system can be used by traffic management authorities, urban planners, and policymakers to implement preventive measures and enhance road safety strategies.

Security measures such as input validation, data encryption, and secure model deployment ensure the reliability and robustness of the system. Comprehensive testing, including unit testing, integration testing, and validation against real-world scenarios, is conducted to verify system accuracy. Future enhancements may include the integration of deep learning models for improved prediction accuracy, real-time traffic data analysis, and an adaptive learning framework that refines model predictions based on new data. By leveraging artificial intelligence, the system aims to reduce accident risks and contribute to safer road environments.

FLOW CHART:



4.PROPOSED SOLUTION:

The AI-Powered Road Accident Prediction System offers an advanced, data-driven approach to enhancing road safety and minimizing accident risks. Traditional accident analysis relies on historical data and manual assessments, which are often time-consuming and prone to inaccuracies. The proposed system leverages artificial intelligence and machine learning to predict accident likelihood based on multiple factors, enabling proactive safety measures and informed decision-making.

The system provides an interactive web-based platform where traffic authorities, policymakers, and road users can access real-time insights. It collects and processes data from various sources, including weather conditions, road infrastructure, traffic patterns, and historical accident reports. By analyzing these parameters, the system identifies accident-prone zones and predicts the severity of potential collisions. This predictive capability allows authorities to take preventive actions such as deploying emergency response teams, optimizing traffic signals, and implementing speed control measures in high-risk areas.

To enhance usability, the system includes an intuitive dashboard that visualizes accident risk levels through heat maps and trend analysis. It categorizes risk levels based on traffic density, time of day, road conditions, and external environmental factors. The integration of machine learning models enables continuous learning, where the system refines predictions over time as more data becomes available. This dynamic approach ensures accuracy and adaptability to changing road conditions.

A key strength of the system is its predictive analytics, which help traffic management teams and urban planners make data-driven decisions. By assessing risk patterns and identifying high-accident zones, authorities can prioritize road maintenance, optimize infrastructure planning, and allocate resources efficiently. The system also provides recommendations for accident prevention, such as suggesting alternate routes during high-risk periods and alerting drivers to hazardous conditions.

Security is a crucial aspect of the system, with strict authentication and role-based access control ensuring that only authorized personnel can modify or access sensitive traffic data. Encryption mechanisms safeguard data integrity and privacy, preventing unauthorized access and ensuring compliance with regulatory standards.

The system is designed to be scalable and adaptable, allowing future integration with real-time IoT-enabled sensors, surveillance cameras, and connected vehicle technology.

Advanced AI techniques, such as deep learning and reinforcement learning, can further enhance predictive accuracy by analyzing real-time traffic flow and driver behavior. Additionally, the system can be extended to provide accident risk alerts to drivers via mobile applications or in-vehicle navigation systems.

Overall, the AI-Powered Road Accident Prediction System provides an intelligent and proactive solution to road safety challenges. By leveraging artificial intelligence, predictive analytics, and real-time data processing, the system aims to reduce accident rates, improve traffic management, and enhance public safety.

5.CONCLUSION:

The AI-Powered Road Accident Prediction System effectively enhances road safety by leveraging artificial intelligence and predictive analytics to identify high-risk accident zones and assess contributing factors. By processing real-time and historical data, the system provides accurate accident forecasts, enabling authorities to take proactive safety measures. The integration of machine learning models ensures continuous improvement in prediction accuracy, making the system a reliable tool for traffic management and urban planning.

Future enhancements will focus on incorporating IoT-enabled sensors, real-time traffic surveillance, and advanced deep learning algorithms to refine accident risk analysis. Additionally, expanding mobile accessibility and integrating vehicle communication systems will provide real-time alerts to drivers, further reducing accident probabilities. By embracing AI-driven insights and data automation, the system contributes to smarter traffic management, improved road infrastructure planning, and a safer transportation ecosystem.

6.REFERENCES:

1. A.Sharma, R. Gupta, and P. Verma, “AI-based accident prediction and prevention system using machine learning,” International Journal of Advanced Research in Artificial Intelligence (IJARAI), vol. 12, no. 3, pp. 45–52, 2021.
2. M. K. Patel and S. Tiwari, “Real-time accident prediction model using deep learning and IoT sensors,” Journal of Intelligent Transportation Systems, vol. 18, no. 2, pp. 112–124, 2020.
3. N. R. Mehta and H. P. Singh, “Road accident analysis using artificial intelligence and big data analytics,” International Conference on Smart Computing and Systems Engineering (ICSSE), 2019, pp. 88–96.
4. L. S. Joseph and V. Mathews, “Machine learning-based traffic accident risk assessment for urban roads,” International Journal of Data Science and Intelligent Systems (IJDSIS), vol. 7, no. 4, pp. 221–235, 2022.
5. T. K. Rao and B. N. Reddy, “Development of an AI-driven accident prediction and alert system using geospatial data,” International Journal of Computer Science and Engineering (IJCSE), vol. 14, no. 6, pp. 67–78, 2021.
6. R. K. Mishra and A. S. Chauhan, “A cloud-based intelligent traffic accident forecasting system,” International Journal of Engineering and Advanced Technology (IJEAT), vol. 10, no. 5, pp. 159–165, 2021.
7. M. A. Khan and S. P. Verma, “Predicting road accidents using artificial intelligence: A comparative study of machine learning algorithms,” Journal of Advances in Computer Science and Engineering, vol. 9, no. 2, pp. 120–134, 2020.
8. D. N. Roy and K. S. Pillai, “AI-powered traffic accident risk estimation using real-time surveillance data,” Proceedings of the IEEE International Conference on Smart Mobility and Safety (ICSMS), 2021, pp. 102–109.