

Real-Time Traffic Congestion & Accident Prediction

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ABSTRACT

Traffic congestion and road accidents are critical issues in urban mobility. Our project, Real-Time Traffic Congestion & Accident Prediction, leverages live traffic data, machine learning, and geospatial analytics to predict congestion and identify accident-prone areas. We use APIs like TOMTOM and OpenWeather to fetch real-time data, and ML models (RandomForestClassifier, RandomForestRegressor) to make predictions. The system features a Django backend, React.js frontend, and map-based UI to help commuters, traffic authorities, and logistics companies make better decisions. The project has high scalability, real-time performance, and potential to be integrated into smart city infrastructure.

Keywords: Traffic Prediction, Accident Risk, Machine Learning, Django, React.js, Real-Time Analytics, TOMTOM API

1. INTRODUCTION

Rapid urbanization has led to a sharp rise in vehicle numbers, causing frequent traffic congestion and increasing accident risks. Traditional traffic systems are reactive and lack predictive capabilities, relying on manual monitoring and static rules. These limitations result in delayed responses and inefficient traffic flow. There is a growing need for intelligent systems that can analyze real-time data and provide predictive insights to ensure safer and smoother transportation.

1.1 BACKGROUND

Most cities still rely on conventional traffic management methods that do not adapt to live conditions. These systems are often inefficient in handling real-time challenges like sudden congestion, weather disruptions, or accidents. With advancements in data collection (via GPS, APIs, and sensors) and machine learning, it is now possible to build predictive systems that help commuters and authorities act proactively rather than reactively.

1.2 EVOLUTION OF TRAFFIC PREDICTIVE MODELS

Earlier models focused only on Analyzing historical data using basic statistical methods. However, with the rise of machine learning, traffic prediction has become more dynamic and accurate. Modern approaches use algorithms like Random Forest and Neural Networks to process real-time traffic and weather data. These systems not only predict congestion but also highlight accident-prone zones, helping build smarter urban transport networks

2. OBJECTIVES

The primary objective of this project is to develop an intelligent, real-time traffic monitoring system that uses machine learning algorithms, real-time APIs, and environmental data to deliver actionable insights. This system is designed to serve both end-users and traffic management authorities, addressing key urban mobility challenges. The core objectives are:

- **To predict traffic congestion using real-time traffic and weather data:** Accurate congestion prediction allows users to plan their routes in advance, reducing delays and fuel consumption.

- **To identify accident-prone zones using historical and contextual data:** Pinpointing high-risk areas helps authorities take preventive measures and improve road safety infrastructure.
- **To deliver real-time updates and route suggestions through an interactive interface:** Dynamic alerts and alternate path recommendations enhance user experience and responsiveness.
- **To ensure system scalability and efficiency through modular cloud deployment:** The architecture supports expansion to different cities and can handle high volumes of data with minimal latency. Each of these objectives directly addresses critical aspects of urban traffic issues. Together, they form a comprehensive solution that not only reacts to traffic conditions but also anticipates them, enabling smarter and safer transportation networks.

3. SYSTEM DESIGN & ARCHITECTURE

The system follows a modular, scalable architecture integrating machine learning models, cloud-based deployment, and real-time APIs. Each component is designed to operate independently while ensuring seamless data flow and real-time response.

Component	Technology Used	Purpose
Frontend	React.js, Redux	Provides interactive dashboard, visualizes live traffic and prediction data
Backend	Django REST Framework	Handles API requests, ML model integration
Machine	Random	Predicts

Learning	Forest (Classifier & Regressor)	congestion levels and accident risks
Data Sources	TOMTOM API, OpenWeather API	Supplies live traffic flow, speed, road condition, and weather data
Deployment	Render (Cloud Platform)	Ensures scalable, fault-tolerant deployment with load balancing

The entire architecture is built on a microservices-based design, allowing independent scaling and fault isolation. Data flows from APIs to the backend, where ML models process and return predictions to the frontend in real time.

4. WORKING

1. User opens dashboard

The user accesses the system through a web-based dashboard built using React.js. The interface is designed to be responsive and easy to use for both desktop and mobile users.

2. Data is fetched from APIs

The backend system fetches real-time data from third-party APIs like TOMTOM (for live traffic information) and OpenWeather (for weather conditions that affect road safety).

3. ML model runs prediction

Once the data is collected, machine learning models — such as Random Forest Classifier and Regressor — process it to predict congestion levels and accident risk probabilities in real time.

4. Results are displayed on map

The predicted data is sent to the frontend and visualized using Google Maps integration. Different zones are color-coded to indicate traffic conditions and accident-prone areas.

5. Alerts are triggered

If high-risk or highly congested areas are identified, the system sends alerts to users through the dashboard. These can include warning messages, suggested alternate routes, or real-time notifications

5. APPLICATIONS

The Real-Time Traffic Congestion & Accident Prediction system can be applied across a wide spectrum of transportation, logistics, and urban planning domains. It addresses key challenges faced by commuters, law enforcement agencies, and municipal corporations by providing intelligent, data-driven solutions.

Built using a modern full-stack architecture — including Django REST Framework, React.js, and scalable cloud deployment via Render — the system offers a real-time, interactive platform for traffic monitoring and accident risk prediction. Its integration with APIs like TOMTOM and OpenWeather enables the analysis of live road and environmental data, ensuring timely insights for users.

The platform's core features — including congestion forecasting, accident-prone zone detection, smart route suggestions, and dynamic data visualization — are designed to meet the demands of modern urban mobility. Whether it's helping daily commuters avoid delays, assisting traffic authorities with live risk assessment, or empowering logistics companies with efficient route planning, the application provides a robust and impactful traffic intelligence solution.

6. FUTURE SCOPE

• Mobile Application Development

To ensure accessibility on the go, a dedicated mobile application can be developed. It would offer real-time congestion alerts, accident notifications,

and smart route suggestions directly to users' smartphones.

• Offline Access and Caching

In areas with low or no internet connectivity, offline access can be enabled by caching previously fetched data. This would help users navigate using recent traffic insights, even without active data connection.

• Integration with Autonomous Transportation Systems

The system can be extended to communicate with autonomous vehicles. This includes feeding traffic and accident data directly into autonomous vehicle control systems for safer navigation.

• AI-Powered Smart Routing

By incorporating advanced AI algorithms, the system can dynamically suggest optimal routes based on multiple parameters such as traffic conditions, weather, accident probability, and user preferences.

7. CONCLUSION

The proposed system effectively tackles the challenges of traffic congestion and accident prediction by leveraging real-time data and machine learning techniques. It not only provides accurate forecasts but also enables proactive decision-making for both commuters and traffic authorities.

With a modular architecture and cloud-based deployment, the system ensures high scalability and responsiveness. The integration of live APIs, interactive dashboards, and predictive analytics makes it highly practical for real-world applications.

By offering real-time alerts, route optimization, and visual insights into traffic and risk zones, the system serves as a valuable tool in improving urban mobility, reducing delays, and enhancing road safety.

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