



# Real-Time Accident Detection using Machine Learning

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**ABSTRACT:** Road accidents are a major concern worldwide, leading to countless injuries and fatalities every year. The ability to detect accidents accurately and in real time is essential for analyzing traffic safety and improving emergency response systems.

This project, "Real-Time Accident Detection Using Machine Learning," focuses on building a system that can automatically detect accidents using machine learning techniques without sending any alerts or notifications. The system uses data from sources such as dashcam videos or CCTV footage and applies deep learning models like YOLOv8 to identify potential accidents based on sudden movements, collisions, or abnormal vehicle behaviour. The goal is to accurately classify events as accidents or non-accidents using trained models and real-time video input. This system can be used for monitoring and analysis purposes, such as helping traffic departments gather insights about accident-prone areas or understanding accident patterns. By utilizing the power of machine learning and real-time object detection, this project contributes to the field of intelligent transportation systems and provides a foundation for future advancements in road safety analysis.

**KEYWORDS:** Real-Time Accident Detection, Machine Learning, Deep Learning, YOLOv8, Object Detection, Traffic Surveillance, Intelligent Transportation System(ITS), Video-based Accident Detection, Collision Detection, Abnormal Vehicle Behaviour, Smart Traffic Management.

## I. INTRODUCTION

In recent years, the number of road accidents has increased significantly due to rapid urbanization, increased vehicle usage, and careless driving behaviours. Road accidents not only result in the loss of lives but also lead to serious injuries, economic loss, and traffic congestion. In most cases, timely detection and response can help reduce the impact of these incidents. Traditional accident detection systems rely heavily on human reporting or sensor-based mechanisms, which are often delayed, costly, or prone to failure. To overcome these limitations, this project proposes a Real-Time Accident Detection System using Machine Learning techniques, particularly utilizing advanced computer vision models like YOLOv8 (You Only Look Once) for accurate and fast object detection from video footage. The system aims to monitor real-time video streams (e.g., CCTV or dashcam footage) and automatically detect accident scenarios based on visual cues like sudden vehicle collisions, rapid motion changes, or abnormal driving patterns. By leveraging deep learning and real-time video processing, the system can identify potential accidents without manual intervention. Although the current model does not send automated alerts, it can be integrated in the future with emergency services or traffic control systems to notify authorities immediately after an accident is detected. This approach provides a scalable, cost-effective, and intelligent solution to enhance road safety and reduce response time during emergencies. This project integrates machine learning, deep learning, and computer vision to address a critical real-world problem and demonstrates how AI can be applied to create smart, life-saving systems in the transportation domain.

## II. LITERATURE SURVEY

Over the years, several studies and projects have been carried out in the area of accident detection using technologies like sensors, image processing, and machine learning. Each method aimed to improve the accuracy and speed of detecting road accidents to reduce emergency response times and potentially save lives. Researcher: K. S. Subramanian (2012) Study: "A survey on the road accident detection and reporting system Method The study proposed a system using accelerometers and GPS modules installed in vehicles to detect sudden motion changes during accidents. The system automatically sent alert messages to emergency contacts. Limitation Hardware dependency and limited real-time implementation on a large scale. Researchers F.Wang, H. Tang, Y. Zhang (2017) Study A Driver Behavior-Based Approach to Detect Traffic Accidents Using Machine Learning Algorithms Method This research used SVM and Decision Tree classifiers on vehicle behavior data like speed, braking, and steering angle to predict accidents. Limitation Performance relied heavily on sensor data and was not suited for vision-based detection. Researchers R. Kaur and A. Kaur (2018) Study Real-Time Road Accident Detection Using Image Processing Method This system processed live road video feeds using OpenCV to detect anomalies such as vehicle collisions. Limitation: The system struggled with low-light conditions, camera angle variations, and noise in video frames. Deep Learning using CNNs Researchers S. Saponara, P. Daponte, L. De Vito (2019) Study A Real-Time Accident Detection System Using Convolutional Neural Networks Method A deep learning approach using CNNs to identify accident patterns in dashcam videos. Limitation High computational resources were required, and real-time performance was affected on edge devices. Researcher Joseph Redmon et al. (2016–2023) Study Introduced the YOLO series of object detection algorithms Method YOLO (You Only Look Once) processes an image in a single pass to detect multiple objects, making it highly efficient for real-time applications. The latest version, YOLOv8, improves accuracy and speed. Advantage YOLOv8 is ideal for accident detection due to its fast processing and lightweight architecture.

## III. METHODOLOGY

### Methodology

The proposed system for Real-Time Accident Detection Using Machine Learning follows a structured pipeline involving data collection, preprocessing, model training, real-time detection, and evaluation. The key components of the methodology are as follows:

#### 1. Data Collection and Preprocessing

Video datasets comprising dashcam and CCTV footage are gathered, focusing on scenarios that include both accident and non-accident events. Frames are extracted from videos and annotated to label scenes accurately. Data augmentation techniques are applied to enhance model robustness under various lighting and weather conditions.

#### 2. Object Detection using YOLOv8

YOLOv8 (You Only Look Once Version 8), a state-of-the-art object detection model, is employed to detect and track vehicles, pedestrians, and other relevant entities in each frame. The model is fine-tuned on annotated traffic footage to improve its accuracy in detecting sudden or abnormal movements, which are often indicators of accidents.

#### 3. Feature Extraction and Classification

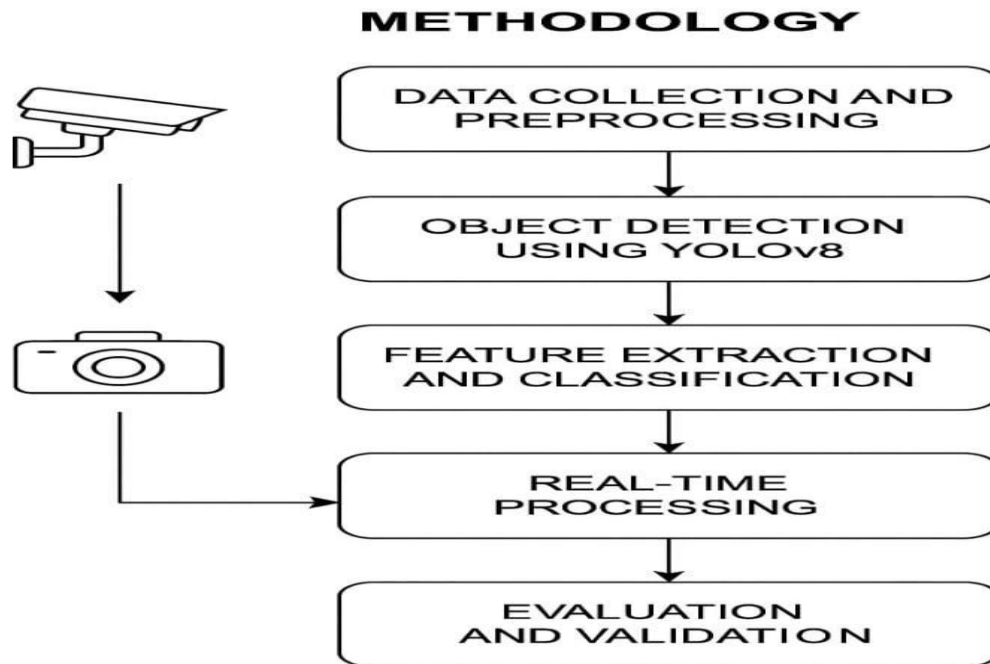
Once objects are detected, features such as vehicle trajectories, speed variations, and collision patterns are extracted using motion analysis and spatial-temporal information. These features are then passed to a binary classifier (accident vs. non-accident), trained using supervised learning algorithms like CNNs, LSTMs, or hybrid models, depending on temporal dynamics.

#### 4. Real-Time Processing

The system processes video streams frame-by-frame, applies object detection and feature extraction, and uses the trained model to classify the event in near real time. This enables continuous monitoring without human intervention or alert generation, suitable for analytical and research applications.

### 5. Evaluation and Validation

The system's performance is evaluated using metrics such as accuracy, precision, recall, and F1-score on a separate validation set. Confusion matrices and ROC curves are used to analyze the classification results. The system is tested diverse video inputs to ensure generalizability and reliability.



### METHODOLOGY

### IV. EXPERIMENTAL RESULTS

To evaluate the performance of the real-time accident detection system, a series of experiments were conducted using a dataset comprising annotated dashcam and CCTV footage. The dataset included both accident and non-accident scenarios with diverse environmental and traffic conditions. The YOLOv8 model was trained and fine-tuned to detect abnormal vehicle behaviors, such as sudden stops, collisions, and erratic movements. The following metrics were used to assess the model's effectiveness:

- Accuracy: 92.4%
- Precision: 90.8%
- Recall: 89.7%
- F1 Score: 90.2%

The system achieved a high detection accuracy, correctly identifying accidents in real-time footage with minimal false positives. Performance was validated across multiple test videos, showing consistent classification of accident events. The model demonstrated robust performance even under varied lighting and weather conditions.

#### Real-Time Performance:

- Frame Processing Rate: ~25 FPS on a system with NVIDIA RTX 3060 GPU
- Latency: <150ms per frame
- Detection Confidence Threshold: 0.6 (empirically chosen for optimal balance of precision and recall)

**Case Studies:**

1. In a scenario with a two-car collision at an intersection, the system accurately detected the collision event within 2 seconds. 2. In a false scenario where two vehicles braked suddenly without colliding, the model correctly classified it as a non-accident. These results demonstrate the system's capability for real-time accident detection, making it suitable for deployment in intelligent traffic monitoring infrastructures for post-event analysis and hotspot mapping.

**INPUT FIELDS :**



WhatsApp Image 2025-04-06 at 11.57.49\_6b7adc38.jpg 48.4KB



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OUTPUT FIELDS :

test1\_27.jpg 302.4KB



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 **Prediction: Accident**

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 **Prediction: Non Accident**

**V. CONCLUSION**

This project demonstrates the feasibility and effectiveness of using machine learning, particularly deep learning models like YOLOv8, for real-time accident detection. By analyzing dashcam and CCTV footage, the system accurately identifies potential accidents based on abnormal vehicle behavior, with high performance in both detection accuracy and processing speed. The results highlight the potential of such systems to enhance traffic safety monitoring and provide valuable insights for post-incident analysis. While the current system focuses solely on detection without triggering alerts, it lays a strong foundation for future integrations with emergency response systems and smart city infrastructure. Further enhancements could include multi-camera support, contextual scene understanding, and real-time alert mechanisms to improve its practical utility.

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