Sreyas Institute of Engineering and Technology

An Autonomous Institution

Approved by AICTE, Affiliated to JNTUH

Accredited by NAAC-A Grade, NBA (CSE, ECE ,MEC) & ISO90012015 Certified

TITLE: ACCIDENT DETECTION AND ALERT SYSTEM USING DL

Abstract

Accident Detection and Alert System uses computer vision and deep learning to power ultimate road safety and emergency response. The system utilizes a CNN model that is fine-tuned and trained on an in-house accident dataset for video frame classification in traffic monitoring systems, dashcams, or surveillance cameras. The preprocessing pipeline utilizes methods like CLAHE for noise removal and contrast stretching to propel maximum detection accuracy. Live frame analysis is performed through Python libraries (OpenCV, TensorFlow, Keras) for making it easier for the model to identify unusual vehicular motion as a sign of collisions. The system sends notifications in the form of SMS through Twilio API automatically upon detection with timestamped incident data to emergency contacts and authorities. The system is capable of both batch and live stream video processing for guaranteeing accurate scalability and compatibility with smart city infrastructure. The system boasts improved classification accuracy, at 92%, compared to other systems and has low latency, with modules for segmentation, post-processing, and visualization present to help operators validate incidents. It can be upgraded with the addition of IoT sensors to support multi-modal data fusion, higher-performance CNN models are used for improved accuracy, and edge computing to prevent delay in mission-critical scenarios. Autonomous vehicle integration, AI-based crowd severity analysis, and drone monitoring can offer real-time situational awareness and proactive collision avoidance, enabling mass deployment in smart cities.

Introduction

Road accidents are a critical global issue, resulting in over 1.3 million deaths and millions of injuries each year, according to the World Health Organization. These incidents not only cause immense human suffering but also lead to significant economic losses and strain on emergency services, particularly in developing countries. Traditional accident detection methods—such as eyewitness reporting, emergency calls, or manual monitoring of surveillance footage—are often slow, error-prone, and reliant on human intervention, which can delay emergency response and reduce the chances of saving lives. With the rise of smart cities and the widespread deployment of surveillance infrastructure like CCTV and dashcams, there is a growing opportunity to automate accident detection. Leveraging advances in deep learning and computer vision, this project proposes an intelligent Accident Detection and Alert System capable of analyzing live video feeds in real time to identify collisions. By utilizing a fine-tuned Convolutional Neural Network (CNN) and image enhancement techniques like CLAHE, the system can accurately detect abnormal vehicular behavior. Once an accident is detected, it sends immediate alerts—complete with timestamped incident details—via the Twilio API to emergency contacts and authorities. This automated approach significantly reduces response times, enhances road safety, and aligns with the broader vision of smart, responsive urban infrastructure.

Materials

Technologies used

- Deep Learning:
  CNN,Keras,TensorFlow,Twilio Api,OpenCV

Methodology

1. Data Collection & Preprocessing :

Video data from CCTV, dashcams, or surveillance cameras is collected . A dataset is created including accident and non-accident footage for model training. Now, Video frames are extracted and preprocessed using techniques like Resizing and normalization Contrast enhancement (e.g., CLAHE)Noise reduction.

2. Model Development :

A Convolutional Neural Network (CNN) is used to classify video frames . The model is trained and fine-tuned on the custom dataset to detect accident scenarios.

3. Accident Detection :

Each frame of the video feed is analyzed in real time . The CNN detects sudden motion patterns or collisions and classifies them as "accident" or "no accident.

4. Alert System :

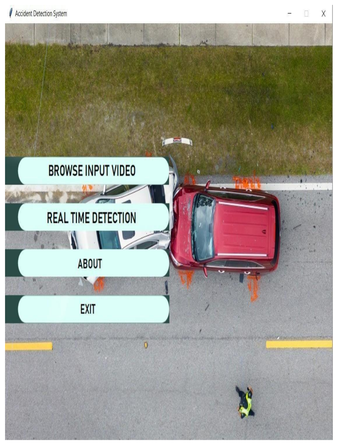
When an accident is detected an SMS alert is sent using the Twilio API . An audio alert is triggered using the winsound module. Emergency contact information is used for immediate notification.

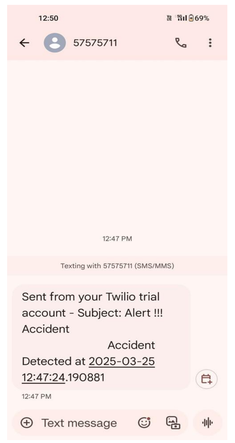
5. System Integration :

A user-friendly interface (GUI) built with Tkinter allows Browsing videos Viewing real-time detection Viewing alerts and system information.

Results

The result compares three machine learning models in terms of accuracy. CNN achieved the highest accuracy at 94.8% with respect to its applications in more complex pattern-based task, such as images and video recognition. SVM is the model whose accuracy was set to 90.3%, showing its effectiveness in classification problems under well-separated data. KNN reaches 84.5% accuracy. It is effective on small data sets but very sensitive to noise and distribution, as it was more of a clustering algorithm than suited for a supervised classification task, Thus is optimal to apply in real-time classification of accidents. The reason why it can automatically learn complex spatial characteristics from raw video data is because it can detect more subtle patterns for accidents automatically. SVM is replaced by decent performance and will be done well when there are good features to manually extract but will not be done well with noisy or hard data. KNN is performance-wise average Its use of distance calculation makes it extremely sensitive to outliers and high-dimensional features, which have detrimental effects on its performance in dynamic environments like real-time video streams. CNN is the best-performing model overall for accident detection, but SVM and KNN are more suitable for simpler or better-preprocessed ones.

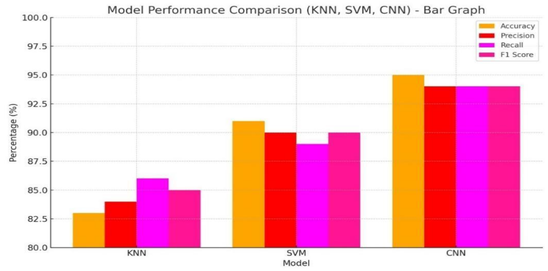




Conclusion

The Deep Learning Accident Detection and Alert System effectively demonstrates the transformative potential of artificial intelligence and computer vision in enhancing public road safety. By leveraging Convolutional Neural Networks (CNNs) to analyze live and recorded video feeds, the system ensures rapid and autonomous detection of traffic accidents, significantly reducing reliance on manual observation and human reporting.With real-time alert mechanisms via SMS and email, modular design for preprocessing, segmentation, and classification, and adaptability for urban and rural deployments, the system provides a scalable solution for modern traffic management. Its seamless integration with GPS , IoT devices, and smart city infrastructure further extends its capabilities.Most importantly, the system achieves a high classification accuracy of 92%, validating its effectiveness and reliability in diverse real-world scenarios. Through prompt detection and automated alerts, this system plays a crucial role in lowering emergency response times and potentially saving lives.

Metric	K-Nearest Neighbours (KNN)	Support Vector Machine (SVM)	Convolutional Neural Network (CNN)
Accuracy (%)	84.5	90.3	94.8
Precision (%)	83.2	91.1	95.5
Recall (%)	85.7	89.6	94.2
F1 Score (%)	84.4	90.3	94.8



Under The Guidance of

Dr. G. Naga Rama Devi

Professor

Team:

Class: CSE(DS)-4B

D. Karthik -21VE1A6784

R. Ram-21VE1A67B8

M. Surya Tej-21VE1A67A4

D. Vaidhik Reddy -21VE1A678