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AI-Based Road Accident Detection Using Deep Learning

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Abstract: ***Road accidents are one of the major causes of injuries and fatalities worldwide. Early detection of accidents can significantly reduce response time and emergency services reach the location quickly. This paper proposes an AI-based road accident detection system using deep learning and computer vision techniques. The system analyzes traffic video footage to detect vehicles and identify possible accident events. The YOLOv8 object detection model is used to detect vehicles in video frames, while the Deep SORT tracking algorithm tracks vehicle movements across consecutive frames. By analyzing abnormal motion patterns such as collisions or sudden stops, the system identifies potential accident events. When an accident is detected, the system captures the accident frame and generates an alert notification. This approach can help improve road safety by enabling faster accident detection and response.***

Keywords: Road Accident Detection, Deep Learning, YOLOv8, Deep SORT, Computer Vision

I. INTRODUCTION

Road accidents are one of the major causes of injuries and fatalities worldwide. With the rapid increase in the number of vehicles on the road, monitoring traffic and detecting accidents has become more challenging. Traditional accident detection methods rely mainly on manual monitoring through surveillance cameras or reports from witnesses. These methods often lead to delays in accident detection and emergency response.

Recent advancements in artificial intelligence and computer vision have made it possible to develop intelligent traffic monitoring systems. Deep learning models can analyze video data and automatically detect vehicles and other objects present in traffic scenes. By analyzing the movement patterns of vehicles, these systems can identify abnormal events that may indicate accidents.

This paper proposes an AI-based road accident detection system using deep learning techniques. The system processes video footage, detects vehicles using the YOLOv8 object detection model, and tracks vehicle movement using the Deep SORT tracking algorithm. By analyzing sudden changes in vehicle motion and possible collisions, the system can detect accident events and generate alerts.

II. LITERATURE REVIEW

Several researchers have explored the use of machine learning and computer vision techniques for traffic monitoring and accident detection. Convolutional Neural Networks (CNNs) have been widely used for detecting vehicles and analyzing traffic videos.

Some studies focus on detecting accidents by analyzing vehicle speed, trajectory, and collision patterns in traffic footage. Other approaches use sensor-based systems or Internet of Things (IoT) devices to detect accidents automatically. However, these systems often require additional hardware and complex infrastructure.

Recent deep learning-based object detection models such as YOLO (You Only Look Once) have significantly improved the speed and accuracy of object detection in real-time applications. By combining object detection with tracking algorithms like Deep SORT, it becomes possible to monitor vehicle movement and identify abnormal events that may indicate accidents.

III. PROPOSED METHODOLOGY

The proposed system is designed to detect road accidents automatically by analyzing traffic video footage using deep learning techniques. The system takes video input from dashcam recordings or traffic surveillance cameras and processes the video frame by frame. In the first stage, the video is divided into individual frames for analysis. These frames undergo preprocessing to improve image quality and prepare them for object detection. The processed frames are then passed to the YOLOv8 deep learning model, which detects vehicles present in the frame. After detecting vehicles, the Deep SORT tracking algorithm is used to track each vehicle across consecutive frames. This algorithm assigns unique IDs to vehicles and monitors their movement patterns over time.

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A. System Architecture

The system architecture illustrates the workflow of the proposed accident detection system. The input to the system is provided in the form of a dashcam or traffic surveillance video. The video is divided into frames, and each frame is processed individually. The YOLOv8 model detects vehicles in the frames, and the Deep SORT algorithm tracks the movement of vehicles across consecutive frames. By analyzing vehicle interactions and motion patterns, the system detects abnormal events such as collisions. Once an accident is detected, the system captures the accident frame, stores the event details, and generates an alert notification.

By analyzing the motion and interaction between vehicles, the system can identify abnormal behavior such as sudden collisions or abrupt stops. When such events occur, the system detects a possible accident and captures the corresponding frame. The detected accident information is then stored, and an alert notification can be generated to inform the concerned authorities.

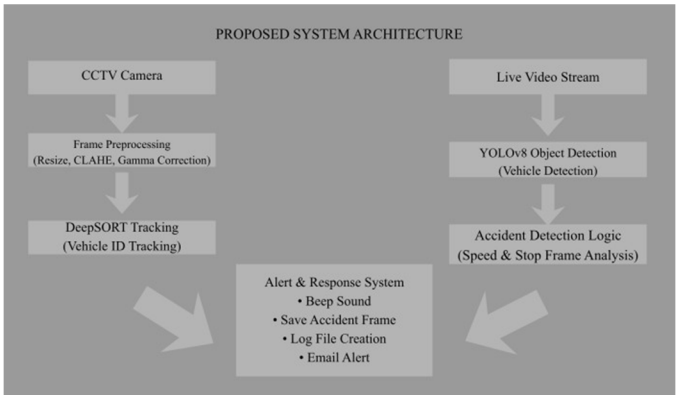


Fig.1 System Architecture of the Proposed Accident Detection System

B. System Modules

The proposed accident detection system consists of several important modules that work together to detect accident events from traffic videos.

The first module is the video input module, which takes dashcam or surveillance video as input. The video is divided into frames so that each frame can be processed individually.

The second module is the vehicle detection module. In this stage, the YOLOv8 deep learning model detects vehicles present in each frame. The model identifies objects such as cars, buses, and trucks with high accuracy.

The third module is the vehicle tracking module. The Deep SORT algorithm assigns unique IDs to detect vehicles and tracks their movement across consecutive frames.

The final module is the accident detection module. By analyzing vehicle motion and interactions, the system detects abnormal behavior such as sudden collisions or abrupt stops. When such an event is detected, the system records the incident and generates an alert notification.

IV. RESULTS AND DISCUSSION

The proposed accident detection system was tested using traffic video footage to evaluate its ability to detect accident events. The YOLOv8 object detection model successfully identified vehicles such as cars, buses, and trucks in the video frames. The Deep SORT tracking algorithm effectively tracked the movement of each vehicle across consecutive frames.

By analyzing the movement patterns of vehicles, the system was able to detect abnormal events such as sudden collisions and abrupt stops. When an accident was detected, the system captured the corresponding frame and stored it in the output folder for further analysis.

The results show that combining YOLOv8 with Deep SORT provides efficient vehicle detection and tracking, which helps improve the accuracy of accident detection in traffic videos. The system demonstrates the potential of deep learning techniques for intelligent traffic monitoring and accident management.

The performance of the proposed system demonstrates that deep learning-based object detection models can effectively analyze traffic video data. The YOLOv8 model provides fast and accurate detection of vehicles in real-time scenarios. The Deep SORT algorithm ensures reliable tracking of vehicles across multiple frames, which helps in identifying sudden motion changes or collision patterns.

These capabilities allow the system to detect accident events more efficiently compared to traditional monitoring systems.

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V. CONCLUSION

This paper presented an AI-based road accident detection system using deep learning and computer vision techniques. The system uses the YOLOv8 model for vehicle detection and the Deep SORT algorithm for tracking vehicle movement across frames.

By analyzing vehicle interactions and motion patterns in traffic videos, the proposed system can detect abnormal events that may indicate accidents. Once an accident is detected, the system captures the accident frame and generates alerts to notify authorities.

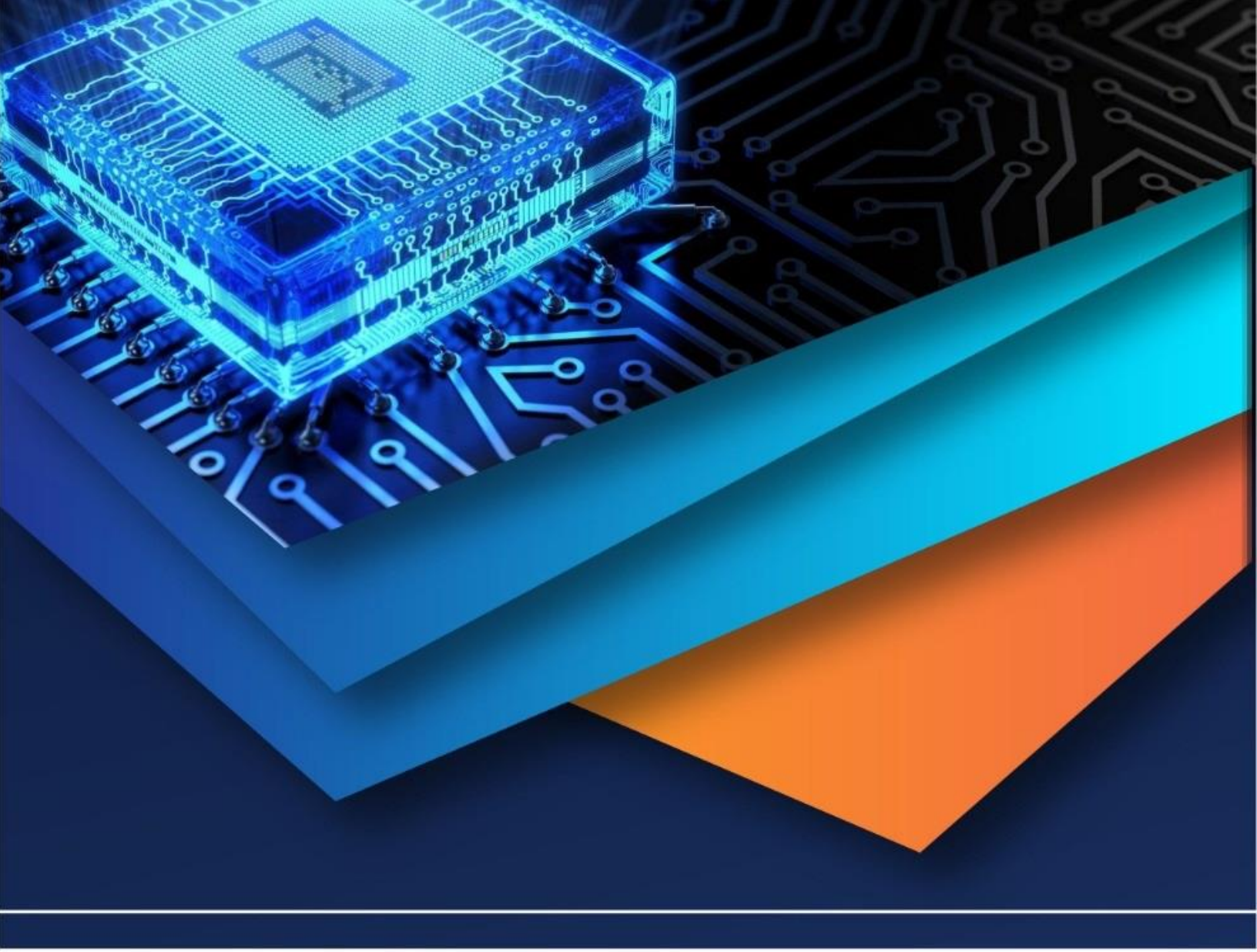
The proposed system can help improve road safety by enabling faster accident detection and response. In future work, the system can be enhanced by integrating real-time traffic camera feeds and improving detection accuracy using larger datasets and advanced deep learning models.

In future work, the proposed system can be improved by integrating real-time traffic camera feeds and advanced deep learning models to enhance detection accuracy. The system can also be extended to automatically notify emergency services and provide location information to ensure faster response to accident events.

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