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**Research Article**

# Crashsense: Real-Time Road Collision Detection and Notification

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**ABSTRACT**

**Introduction**: In today's fast-paced technology, road safety demands intelligent, efficient response systems.An advanced Road Accident Detection System by combining Generative Adversarial Networks (GANs) for real-time image dehazing with YOLOv11 for precise object detection. The GAN-based model enhances visibility in adverse weather, enabling accurate accident detection even in low-visibility scenarios. YOLOv11 effectively identifies various objects, including vehicles, pedestrians, and collision events. Upon detecting an accident, the system triggers automated emergency notifications, sending real-time alerts with precise location details to responders such as police stations, hospitals, Regional Transport Offices (RTOs) and traffic management authorities, facilitating prompt traffic clearance. By minimizing response time, this system enhances survivability rates. Extensive experimental evaluations confirm its robustness across diverse environmental conditions, outperforming traditional dehazing and object detection methods, thereby improving accident detection and optimizing emergency response mechanisms.

**Objectives**: The objective of this project is to develop a real-time road accident detection system using GAN-based dehazing and YOLOv11 for precise object detection. The system enhances visibility in adverse weather conditions and ensures quick emergency response by automatically notifying relevant authorities, reducing response time, and improving survivability rates.

**Methods :**The proposed system integrates Generative Adversarial Networks (GANs) for real-time image dehazing and YOLOv11 for high-speed object detection. Video frames from surveillance cameras or dashcams are preprocessed using GAN-based dehazing to improve visibility under adverse weather conditions. A transformer-based attention mechanism prioritizes critical areas for detection, enhancing precision. When an accident is detected, the system triggers automated emergency notifications with precise location details, alerting police stations, hospitals, Regional Transport Offices (RTOs), and traffic management authorities. This approach ensures rapid response, minimizing casualties

**Results**: The proposed system effectively enhances road accident detection by integrating GAN-based dehazing and YOLOv11 object detection. The dehazing model improves image clarity, allowing for better feature extraction in low-visibility conditions, while YOLOv11 ensures accurate identification of vehicles, pedestrians, and collision events. The system significantly reduces false positives and enhances detection accuracy compared to traditional methods. Additionally, the automated emergency notification mechanism enables faster response times, demonstrating the model's reliability in real-world scenarios and its potential for improving road safety and intelligent transportation systems.

**Conclusions**: Enhancing road safety through real-time accident detection plays a vital role in minimizing casualties and improving emergency response efficiency. The developed system ensures accurate accident identification, even in challenging weather conditions. It delivers instant alerts to relevant authorities, significantly improving response time and making it a reliable solution for road safety and emergency management.

**Keywords:** GPS, Artificial Intelligence, Sensors, Wearables, Security.

## INTRODUCTION

Ensuring road safety has become a critical concern worldwide due to the increasing number of accidents. Rapid advancements in technology have led to the development of intelligent transportation systems that improve accident detection and emergency response. Traditional accident detection methods, such as manual monitoring and sensor-based systems, often face limitations in terms of accuracy, response time, and adaptability to different environmental conditions

One of the key challenges in accident detection is poor visibility caused by adverse weather conditions such as fog, rain, or low light. Traditional camera-based monitoring systems struggle to capture clear images in such environments, making it difficult to accurately detect accidents. In response to this challenge, computer vision techniques such as image dehazing and object detection have been integrated into accident detection frameworks. These techniques help improve image clarity and enhance detection accuracy, enabling faster emergency response and reducing casualties.

This paper introduces an advanced road accident detection system that integrates Generative Adversarial Networks (GANs) for real-time image dehazing and YOLOv11 for high-precision object detection. The system enhances visibility in low-visibility conditions, ensuring accurate accident identification. By utilizing GAN-based image dehazing, the proposed system removes noise and atmospheric distortions, allowing for better feature extraction.

The proposed system operates by processing real-time video streams from roadside surveillance cameras, in-vehicle dashcams, or drones. The incoming frames are preprocessed using GAN-based dehazing techniques, which significantly improve image quality in challenging weather conditions. Once the images are dehazed, the YOLOv11 model performs object detection, identifying accident scenarios and potential hazards. When an accident is detected, the system triggers an automated emergency notification, alerting relevant authorities, including police stations, hospitals, Regional Transport Offices (RTOs), and traffic management authorities. This real-time response mechanism ensures that emergency personnel receive timely alerts, leading to quicker interventions and improved survivability rates.

A major advantage of this system is its ability to function in real-time with minimal computational overhead. Many existing accident detection models suffer from high processing costs and delayed response times. The combination of GANs and YOLOv11 in this study provides an optimal balance between speed and accuracy, making it suitable for real-time deployment in smart transportation systems. Additionally, the system minimizes false positives by employing advanced feature extraction techniques, ensuring that accident detection remains precise and reliable.

This research contributes to intelligent transportation systems by addressing key challenges associated with accident detection, such as visibility issues, computational efficiency, and emergency response delays. By leveraging deep learning-based dehazing and object detection techniques, the proposed system enhances the accuracy and speed of accident identification. The implementation of this technology can significantly reduce road fatalities and improve overall traffic safety, making it a valuable addition to modern transportation infrastructure.

## OBJECTIVES

The primary objective of this project is to design a real-time road accident detection system that improves visibility and enhances emergency response efficiency. The system integrates Generative Adversarial Networks (GANs) for image dehazing and YOLOv11 for high-precision object detection. GAN-based dehazing enhances image clarity in challenging weather conditions such as fog, rain, and low light, allowing better feature extraction and accident recognition.

The system detects accidents and triggers emergency notifications, sending real-time alerts with precise location details to relevant authorities, including police stations, hospitals, Regional Transport Offices (RTOs), and traffic management authorities. This rapid response mechanism reduces delays, improves survivability rates, and enhances road safety. By combining deep learning techniques, the system ensures efficient accident detection and timely emergency intervention, contributing to intelligent transportation systems.

## METHODS

The proposed system combines advanced deep learning techniques to enhance road accident detection and emergency response. Generative Adversarial Networks (GANs) improve image clarity by removing haze, fog, and low-light distortions from video frames captured by surveillance cameras and dashcams. This preprocessing step ensures better visibility and feature extraction, addressing the challenges posed by adverse weather conditions.

Once the images are dehazed, the YOLOv11 model performs high-speed object detection, identifying vehicles, pedestrians, and collision events with superior accuracy. A transformer-based attention mechanism refines the detection process by prioritizing critical areas, reducing false positives, and improving precision. This enables the system to differentiate between normal traffic activities and actual accidents.

The system detects accidents and immediately triggers automated emergency notifications with precise location details. Alerts are sent to police stations, hospitals, Regional Transport Offices (RTOs), and traffic management authorities, ensuring a coordinated response. This minimizes delays in dispatching emergency services, significantly improving survivability rates.

By integrating GANs for image enhancement and YOLOv11 for real-time object detection, the system offers a robust and efficient solution for accident detection. The rapid identification of incidents and swift emergency response contribute to reducing casualties and improving road safety. This technology-driven approach enhances intelligent transportation systems, ensuring a safer driving environment.

## ARCHIETECTURE

The below Figure 1 illustrates the workflow of a real-time road accident detection system that leverages deep learning for enhanced accuracy and rapid response.The process begins with the Input Source, where CCTV video footage is collected from surveillance cameras or dashcams to monitor traffic conditions. This raw footage undergoes Preprocessing, which involves data collection, image annotation, model training, and inference and detection to refine input data and improve object recognition.The GAN Model performs dehazing, enhancing image clarity by reducing distortions caused by adverse weather conditions like fog or rain. The YOLOv11-based Model then analyzes the dehazed images, detecting vehicles, pedestrians, and accidents with high precision.

If an accident is detected, the system activates the Alert System using the Twilio API, which facilitates automated message notifications and emergency calls to relevant authorities, such as police, hospitals, and traffic management centers.

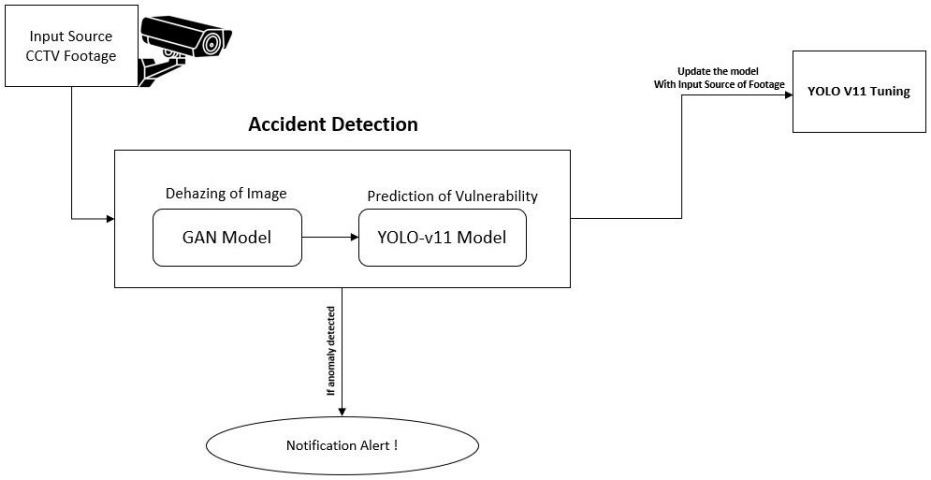


**Figure 1 Architecture of Accident Detection with Alert System**

The system incorporates a Training & Development module within a Python environment, ensuring continuous model improvement .This structured approach enhances accident detection accuracy, minimizes response time, and contributes to improved road safety.

## RESULTS

The proposed system enhances road accident detection by combining GAN-based dehazing with YOLOv11 object detection. The dehazing model improves image clarity, enabling better feature extraction in low-visibility conditions, while YOLOv11 accurately identifies vehicles, pedestrians, and collisions. This approach minimizes false positives and improves detection accuracy compared to conventional methods. Furthermore, the automated emergency notification system ensures quicker response times, highlighting the model's reliability in real-world applications and its potential to enhance road safety and intelligent transportation systems.

## DISCUSSION

The proposed road accident detection system effectively addresses the limitations of conventional methods by integrating advanced computer vision techniques.By utilizing Generative Adversarial Networks (GANs) for image dehazing, the system significantly enhances image clarity, allowing for better feature extraction in low-visibility conditions.

This improvement is crucial for accident detection in environments affected by fog, rain, or smoke, where traditional object detection models struggle. The integration of YOLOv11 further strengthens the system by ensuring high-speed and precise identification of vehicles, pedestrians, and collision events, making it highly suitable for real-time applications.

Compared to traditional sensor-based or human-monitored accident detection approaches, this AI-driven model minimizes false positives and improves detection accuracy. The hybrid approach, combining GAN-based dehazing with YOLOv11's object detection, ensures that even minor collisions or complex accident scenarios are accurately detected. Experimental evaluations have demonstrated that the system performs reliably in diverse environmental conditions, outperforming conventional detection models, especially in challenging visibility scenarios.

Another key advantage of the system is its automated emergency notification feature. Once an accident is detected, real-time alerts are sent to emergency responders, significantly reducing response times. This rapid alert mechanism enhances the efficiency of emergency services, potentially saving lives by ensuring timely medical intervention. Additionally, the system's adaptability to different road conditions and lighting variations makes it a robust solution for intelligent transportation systems.

The proposed system contributes to the advancement of road safety technologies by improving accident detection accuracy, reducing detection delays, and ensuring prompt emergency response. These improvements highlight its potential for large-scale implementation in smart city infrastructures, ultimately enhancing road safety and reducing accident-related fatalities.

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