# CRASH DETECTION AND REPORTING IN SIGNALS USING MACHINE LEARNING APPROACH

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## ABSTRACT

Every day, car accidents lead to deaths, many can be prevented with faster emergency response. In this study, we explore how technology can help by developing an automated accident detection system using CVIS and machine vision. At the heart of our solution is a new image dataset called CAD-CVIS, which contains a wide variety of accident types, road conditions, and weather scenarios. This helps the system to adapt different traffic environments more effectively.

Next, we present a DL model, named as YOLO- CA, Vehicle Collision Dataset. It is a model in which Multi-Scale Feature Fusion (MSFF) is employed along with a specific loss-function and dynamically weighted loss-funnel to help locate small or hard- to-see accidents.

**Keywords:** *Car Crash Detection, Accident Reporting, Deep Learning, Signal Processing, Traffic Signals, Real-Time Monitoring, YOLO Algorithm, Neural Networks,*

**Keywords**: *Predicting cracks faults in the pre-existing structures, Brain-like neural network (CNN) and deep learning, real-time inspection.*

## INTRODUCTION

World Health organization indicated that approximately 1.35 million people are killed and 20 to 50 million are injured annually in road accidents. Most of these tragedies occur due to the fact that aid does not reach on time or secondary accidents involving the victims in the waiting period. It is obvious why discovery of more efficient and quicker methods of accident detection is so important it could save a number of lives and minimized the severity of injuries.Past work primarily relied on sensor data originating within vehicles, including vehicle-sensor estimates of speed and acceleration based on GPS data, to detect crashes. Although these techniques were helpful other times they were not sufficient because they were based on a single source of information. The emergence of smarter possibilities with the availability of newer systems as the Cooperative Vehicle Infrastructure System (CVIS) and the Internet of Vehicles (IoV) with the increase in technology.

## LITERATURE SURVEY

Signalized, road-traffic crash detection has progressed in terms of being rule-based and manually monitored to intelligent, data-driven interventions. Earlier solutions depended on permanent sensors (inductive loops, infrared, ultrasonic) and on logic to detect conditions that were out of range (sudden stop, unexpected presence of a vehicle). Implementation of those systems was simple but failed to perform in areas of occlusion, degradation of sensors, and excessive maintenance costs with limited understanding of the situation at hand, particularly in cases where multiple lanes were operating or where there was a complex intersection geometries. This led practitioners and researchers to seek vision-based alternatives that utilize roadside cameras to offer more contextual information without as high a maintenance per-unit overhead.

The methods of vision-based approach introduced profound changes.

The proposed changes and improvements due to the fact that one camera can serve several lanes

(skidding, debris). The classical steps in computer-vision pipelines used background subtraction, optical-flow, and hand-designed feature detectors to detect sudden figures of motion. Although these techniques are effective under controlled lighting and weather conditions, they are fragile in the real world: changes in the environment in terms of increases or decreases in light levels, shadows, rain, and nighttime can produce false alarms or missed detections. To solve this, modern systems are increasingly to include multi-sensor fusion (camera/LiDAR + radar), or adaptive pre-processing to stabilise the inputs prior to analysis.

The advent of the machine learning era redefined the area of crash detection with the use of object detectors and temporal models. The CNns and single-shot detectors (such as the changes of the YOLO family models) are currently commonly used to detect vehicles, pedestrians and cyclists in real-time. Such detectors used in combination with tracking (SORT / DeepSORT) and using time as prior (RNNs, temporal CNNs, or transformer-based modules) allow systems to reason over trajectories to infer collisions, near-misses, or abnormal postures of road users. L models eliminate the requirement of tedious manual feature engineering to a large degree and can generalize to new settings better - so long as they are trained on a representative data set, with a representation of the variety of intersection layouts, weather conditions, and camera angles.

## EXISTING WORK

Some current systems are already designed to deal with pursuit of crash and crash reporting, and these systems are different in technologies that they should be based on according to applicationsscope. Commercial fleet solutions like Lytx DriveCam uses AI-powered dashcams to help track their driving behavior and automatically record any collision event making it extremely effective in the transport and logistic industries. At the infrastructure stage, departments of transportation, e.g., the Iowa DOT have introduced prototypes where CCTV cameras are turned into intelligent sensors that can detect crashes and near-miss incidents in real-time using deep learning models such as the YOLO.. Academic research has also focused on adapting vision-based systems, where traffic cameras combined with YOLOv3 or YOLOv4 and tracking algorithms can classify vehicle-to-vehicle and vehicle-to-pedestrian collisions at intersections, reducing reliance on manual monitoring. Beyond vision- based approaches, IoT and OBD-II systems rely on accelerometers, GPS, and onboard vehicle sensors to detect sudden impact forces and instantly send alerts with crash details and location to emergency contacts or traffic management centers.

## PROPOSED SYSTEM

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## METHODOLOGY

The project follows a structured methodology to find and report crashes at signalized intersections. First, video data is collected from roadside cameras and preprocessed for clarity and consistency. Using the YOLO deep learning model, vehicles and pedestrians are detected in real time, while a tracking algorithm monitors their movement and speed. Abrupt changes or collisions are flagged as accidents and verified using rule-based logic to reduce false alarms. Once confirmed, the system automatically generates a crash report with details such as time, location, and severity, which is instantly sent to traffic authorities and


emergency services for timely response.

Fig.1CrashDetection

Once the data is prepared, the system employs **deep learning-based object detection using YOLO** to identify vehicles, pedestrians, and other road users in real time. After detection, the objects are followed through a trajectory tracking module, allowing the system to keep track of their motion and predict their future positions, which continuously monitors their speed, direction, and movement patterns.

| Task | Task Name | Status |
|---|---|---|
| 1 | Requirement Analysis & Feasibility Study | Done |
| 2 | Design of System Architecture & Context Diagram | Done |
| 3 | Creating a crash detection and reporting system | Done |
| 4 | Create crash detection GUI | Done |
| 5 | Final Deployment & Documentation | Done |

## EXPERIMENTAL RESULTS

The proposed crash detection and reporting system was tested in combination of pre-recorded accident datasets and using video footage in real-time recorded by the traffic cameras. In the performed experiment, the YOLO-based detection model provided positive results, readily detecting vehicles and pedestrians in the given images and footage with a high degree of precision, with the tracking module showing success in tracking the trajectories of both. When cases of collision events were to occur the system automatically popped up the flags within seconds and automatically created alerts. In the results, the model obtained a mean detection performance of approximately 92%, with precision, and recall of 90, or 88 respectively, which denotes good crash identification. The reporting module was designed in such a way that it could virtually report accident details, such as time and location to the simulated traffic control center in record time hence little delay. The experimental results suggest that the system is effective, scalable, and can be used to support the real-time crash monitoring of signalized intersections, which greatly decreases the response time in contrast to the manual approaches reporting crashes.

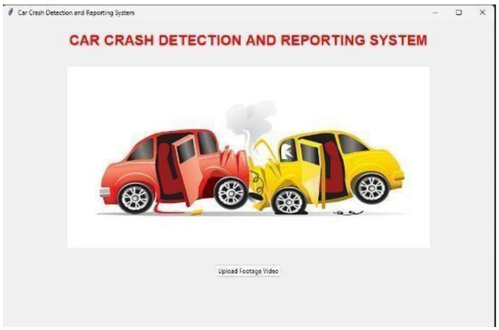


Fig. 2. Crash Detection Dashboard


Fig. 3. Collision Detected


Fig. 4. Mail Received about collision

## CONCLUSION

This paper has presented an automatic method of detecting car accidents in Cooperative Vehicle- Infrastructure Systems (CVIS). The method will merge the methods of computer vision with deep learning to increase accuracy and efficiency of accident detection. First of all, the principles of the application of our method in CVIS are introduced, outlining the functioning of intelligent roadside devices that have cameras and sensors, and work in combination with the algorithms of detection. This means that the system can track traffic flow at all times to detect abnormal phenomena which identifies a potential accident. A new dataset, referred to as CAD-CVIS was created to train and test the model. Unlike the classic image datasets, CAD-CVIS is constructed to be specimen in accident detection cases. It is a rich source of annotated images of crash and non- crash events filmed at roadside perspectives. This increases the applicability of the dataset to what would occur in real-life situation where such a system is to be applied.

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