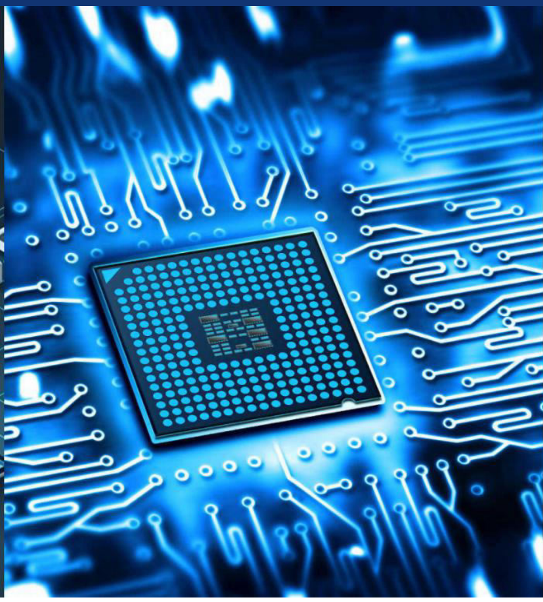
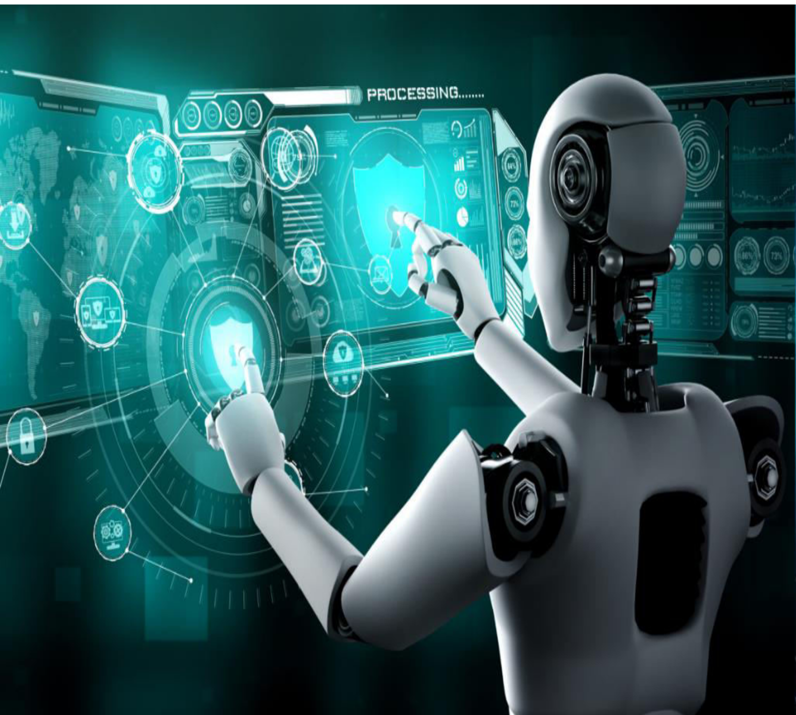
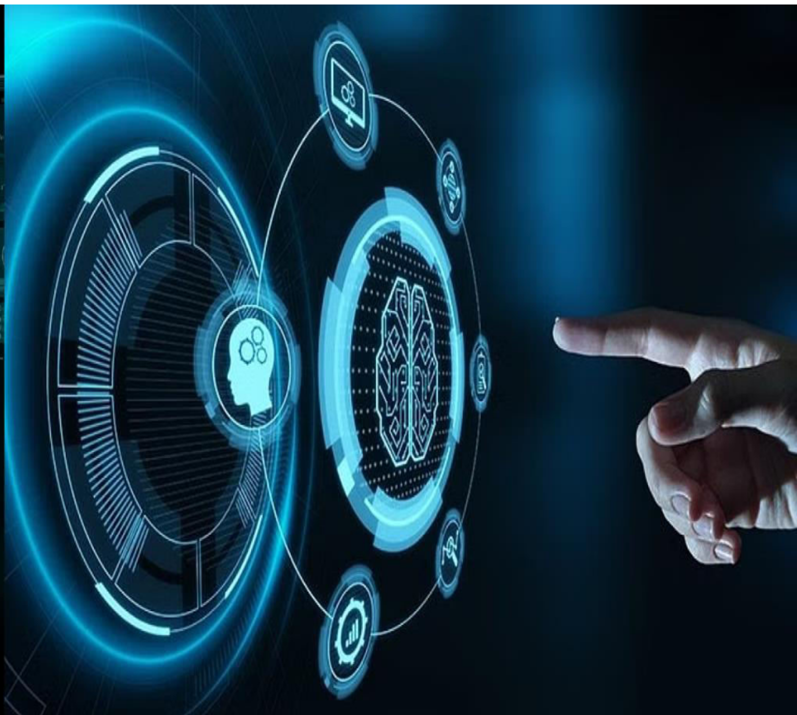
ISSN(O): 2320-9801
ISSN(P): 2320-9798


International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)





Impact Factor: 8.771

Volume 14, Issue 4, April 2026

www.ijircce.com ijircce@gmail.com +91-9940572462 +91 63819 07438

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404108

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Real-Time Tunnel Accident Detection and Tracking Using YOLOv5

Kadamanchi Revathi [1], Ms. G.Naga Sujini [2] ,Dr.V.Subbaramaiah[3] , Dr.K. Rajitha[4]

Student, Department of Computer Science and Engineering, Mahatma Gandhi Institute of Technology, Gandipet, India[1]

Assistant Professor, Department of Computer Science and Engineering, Mahatma Gandhi Institute of Technology, Gandipet, India[2,3,4]

ABSTRACT: Real-Time Tunnel Accident Detection and Tracking Using YOLOv5 is an intelligent traffic monitoring system designed to automatically detect vehicle collisions in tunnel environments using computer vision and deep learning techniques. Traditional tunnel monitoring depends on continuous human observation, which may lead to delayed responses and missed incidents. To overcome this limitation, the system uses the YOLOv5 object detection model to identify vehicles in each frame of recorded tunnel traffic videos. The detected vehicles are then tracked using the DeepSORT tracking algorithm, which assigns unique IDs and follows each vehicle across frames. The tracking information such as frame number, object ID, and bounding box coordinates is stored for further analysis. A collision detection module analyzes vehicle interactions by calculating distance, velocity, and overlap between bounding boxes to determine possible accidents. When a collision is detected, the system highlights it in the output video and records the accident details in a log file. This automated approach reduces manual monitoring and improves traffic safety by identifying accidents efficiently. The final output includes a processed video showing detected collisions along with stored accident information for future analysis.

KEYWORDS: Tunnel Accident Detection, YOLOv5, DeepSORT, Vehicle Tracking, Object Detection, Deep Learning, Traffic Monitoring, Accident Detection, Bounding Box, Motion Analysis, Multi-Object Tracking, OpenCV, PyTorch, Automated Traffic Analysis, Real-Time Monitoring, Accident Detection System.

I. INTRODUCTION

Tunnel safety is a critical aspect of modern transportation systems, as accidents in confined environments can lead to serious consequences and delayed emergency response. Monitoring tunnel traffic is challenging due to limited visibility, lighting variations, and continuous vehicle movement. Traditional CCTV-based systems rely on manual observation, which is time-consuming and may fail to detect accidents quickly.

To overcome these limitations, this project proposes a Real-Time Tunnel Accident Detection and Tracking System using YOLOv5 and DeepSORT. The system detects vehicles in each video frame and assigns unique IDs to track their movement over time. A collision detection module analyzes parameters such as distance, speed, and overlap between vehicles to identify possible accidents accurately.

When an accident is detected, the system highlights the involved vehicles in the output video and records the event details for further analysis. This automated approach reduces manual effort, improves monitoring efficiency, and enables faster accident identification, making it highly useful for enhancing safety in tunnel environments.

II. LITERATURE SURVEY

Tunnel accident detection and intelligent traffic monitoring have gained significant research attention due to their importance in improving road safety and reducing manual observation. F. Hamami, I. Darmawan et al. [1] proposed a system integrating YOLO-based vehicle detection with DeepSORT tracking to compute real-time vehicle speed and inter-vehicle distance. Their approach supports automated safe-distance alerts but requires accurate camera calibration and is sensitive to perspective distortions. E. Elakiya, A. Singh et al. [2] introduced a unified YOLO-based network that performs helmet detection, speed estimation, and number plate recognition simultaneously. While this reduces latency and memory usage, the multi-task framework increases training complexity and may affect performance balance.

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404108

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

S. Subramani V, V. Kumar S et al. [3] developed a smart tunnel traffic control system using IoT sensors and machine learning to manage ventilation, lighting, and traffic conditions. The system provides low-latency monitoring but depends on reliable networking and accurate sensor calibration. R. Devi S. M. et al. [4] presented a real-time traffic violation detection system using DeepSORT tracking combined with rule-based detection. Although scalable, it requires site-specific threshold tuning and may generate false positives.

P. Phiphimai, S. Tantrairatn et al. [5] proposed an autonomous navigation framework integrating object detection, tracking, and trajectory prediction to anticipate hazards. While short-term predictions improve safety, prediction errors increase over longer durations. B. Ding [6] designed an intelligent lighting control system for tunnels using camera-based luminance measurements to improve visibility and energy efficiency, though environmental factors like smoke affect performance.

J. Li et al. [7] introduced a WiFi-based fire detection system using signal variations and machine learning classifiers, which works even when visibility is poor but is sensitive to signal noise and vehicle movement. Q. Liu et al. [8] proposed a multi-modal tunnel inspection system combining computer vision and audio-based abnormal sound detection.

III. PROBLEM DEFINITION

Tunnel environments present several safety challenges due to limited visibility and continuous vehicle movement. Accidents such as vehicle collisions inside tunnels can lead to serious consequences, including traffic congestion and delayed emergency response. Existing monitoring systems mainly depend on manual observation of CCTV footage, which is time-consuming and prone to human error, leading to possible delays in accident detection.

In addition, poor lighting conditions in tunnels make it difficult to clearly identify vehicles and their movements. Traditional systems also lack automated tracking, making it hard to analyze vehicle interactions and detect accidents efficiently.

Therefore, there is a need for an intelligent system that can automatically analyze tunnel traffic videos and detect accidents in real time. By using computer vision and deep learning techniques, the system can track vehicles and analyze their behavior, improving monitoring efficiency and enhancing tunnel safety.

3.1 PROPOSED SYSTEM

Traditional tunnel monitoring systems have several limitations that reduce their effectiveness in detecting vehicle accidents. One major drawback is their dependence on continuous human observation of CCTV footage. Monitoring traffic for long periods can cause fatigue and reduced attention, increasing the chances of missing critical events. It is also difficult for operators to track multiple vehicles simultaneously in such environments.

Another disadvantage is that these systems only record video without automatically analyzing vehicle movement. When an accident occurs, manual review of large video data is required, which is time-consuming. Poor lighting conditions and fast vehicle movement further make detection difficult.

Furthermore, traditional systems do not provide real-time alerts, leading to delays in emergency response. They also lack intelligent analysis of vehicle interactions, making accident detection inefficient. Therefore, an automated system is needed to improve monitoring efficiency and enhance tunnel safety.

IV. EXISTING SYSTEM

Existing tunnel accident detection systems rely on CCTV monitoring and manual observation. Due to long monitoring hours and human fatigue, accidents may not be detected immediately. Basic motion detection methods are limited and cannot accurately distinguish real accidents from normal movement.

These systems also lack advanced deep learning and tracking capabilities. Poor lighting, occlusion, and lack of vehicle tracking reduce detection accuracy and make accident identification difficult.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Furthermore, they do not provide real-time alerts, leading to delayed emergency response and reduced effectiveness in improving tunnel safety.

V. DESIGN AND METHODOLOGY

The tunnel accident detection system consists of multiple layers that work together to identify accidents from traffic videos. The video input layer captures CCTV footage, followed by a pre-processing layer that prepares the frames for analysis. The object detection layer uses YOLOv5 to detect vehicles, and the tracking layer uses DeepSORT to track their movement. Finally, the output layer highlights detected accidents and stores the details for further analysis.

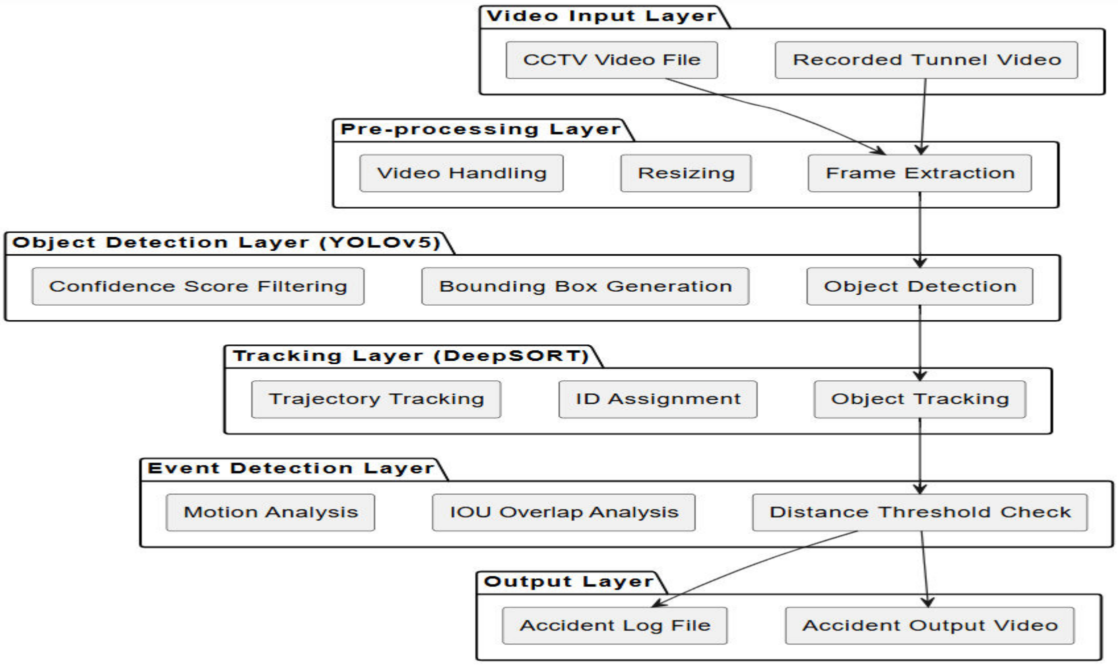


Figure 1: architecture Diagram of Real-time Tunnel Accident Detection and Tracking Using YOLOV5

The tunnel accident detection system consists of multiple classes working together to process video data and detect accidents. The VideoProcessor class manages video input, frame processing, and output display. The ObjectDetection class uses YOLOv5 to detect vehicles, while the MultiObjectTracking class tracks them across frames using unique IDs. The AccidentDetection class analyzes vehicle movement to identify possible collisions, and the AlertSystem generates alerts and stores accident details for further analysis.

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404108

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

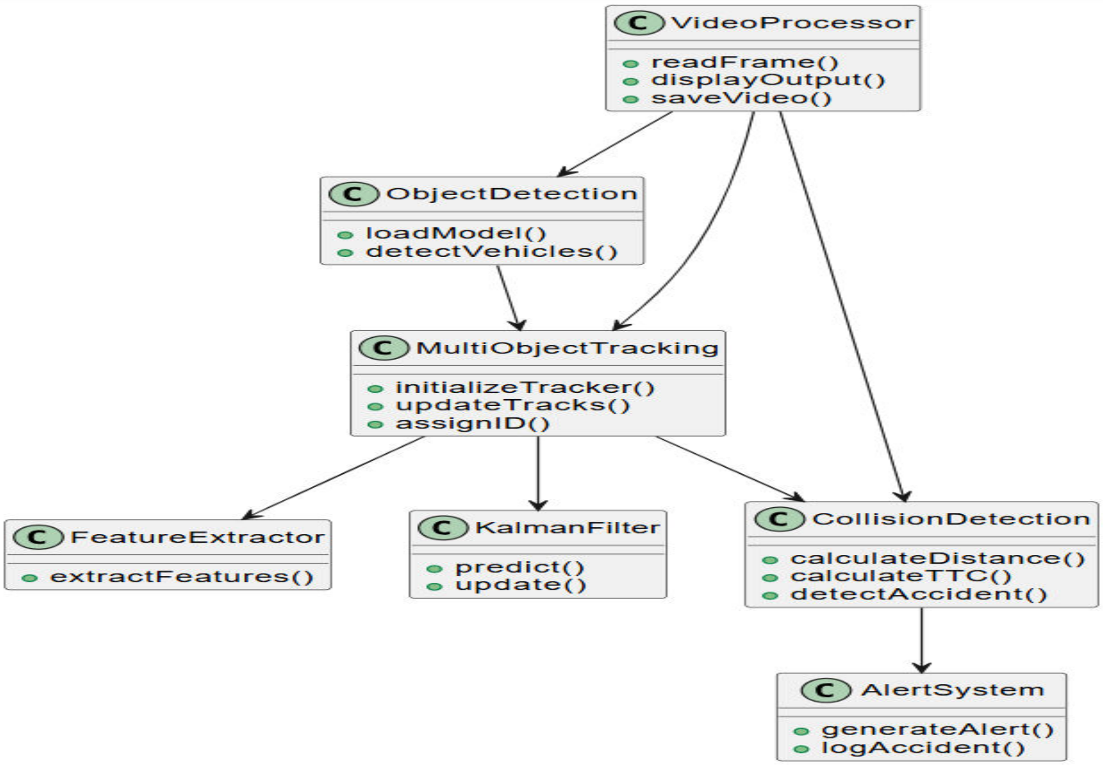


Figure 2: Class Diagram **of** Real-time Tunnel Accident Detection and Tracking Using YOLOV5

VII. IMPLEMENTATION

7.1 Video Input and Preprocessing

The system captures tunnel video from CCTV and processes it frame by frame using OpenCV. Frames are resized, enhanced, and prepared for YOLOv5 detection.

7.2 YOLOv5 Object Detection

Preprocessed frames are passed to YOLOv5 to detect vehicles. Bounding boxes, confidence scores, and class labels are generated, and unnecessary detections are removed.

7.3 DeepSORT Tracking Implementation

Detected vehicles are tracked using DeepSORT. Each vehicle is assigned a unique ID and tracked across frames to maintain continuity.

7.4 Accident Detection and Event Analysis

The system analyzes vehicle movement by checking distance and overlap to identify possible accidents and highlights them.

7.5 Logging Mechanism

Detected accidents are recorded with frame numbers and vehicle IDs in a log file for future analysis.

7.6 Output Video Generation

The system generates an output video showing detection, tracking, and highlighted accident alerts.

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404108

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

VIII.TESTING AND RESULTS

8.1 Input Tunnel Video Frame

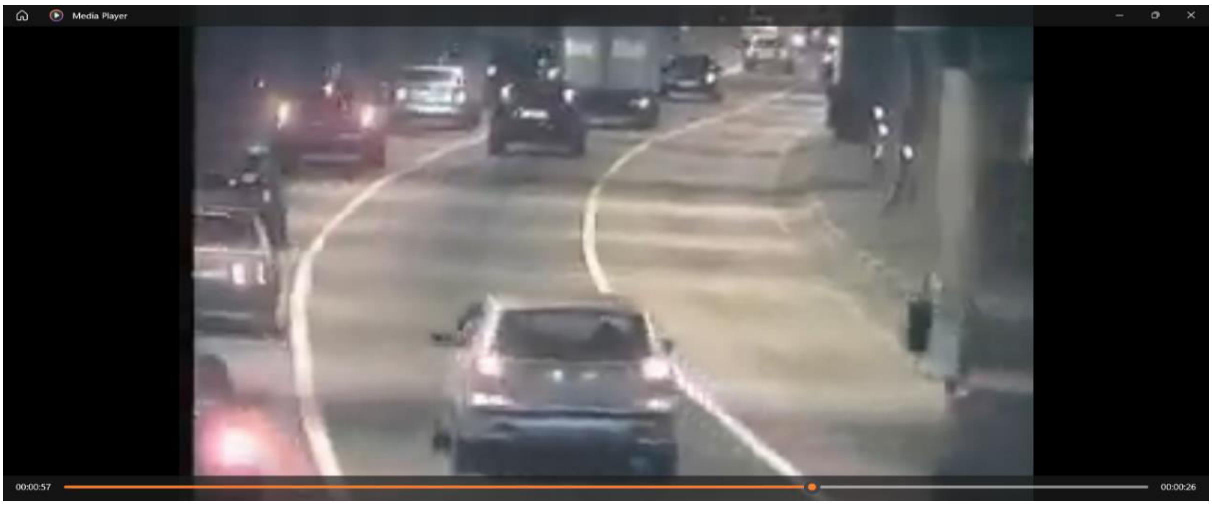


Figure 3: Shows a tunnel traffic scene with multiple vehicles such as cars and trucks moving along curved lanes inside the tunnel.

8.2 YOLOv5 Vehicle Detection Output

Figure 4: Shows the real-time detection output where pedestrians are identified with bounding boxes and confidence scores.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

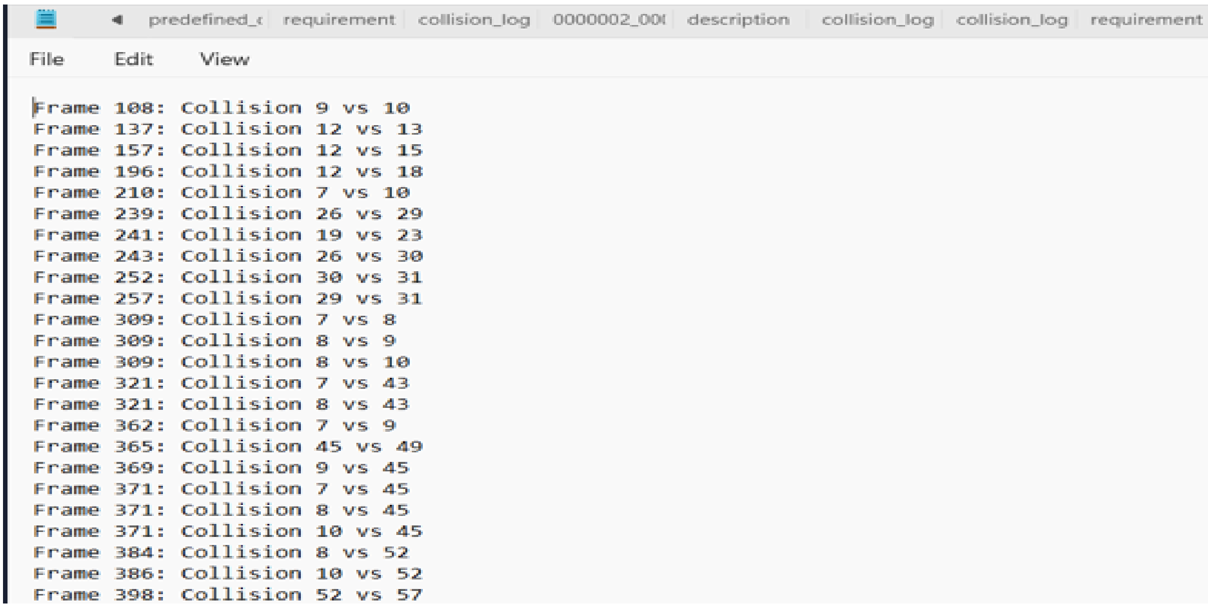
International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

8.3 Accident Detection Output

Figure 5: Shows the accident detection output where objects are highlighted with bounding boxes and an "ACCIDENT" alert is displayed for critical events.

8.4 Accident Log Output




```
Frame 108: Collision 9 vs 10
Frame 137: Collision 12 vs 13
Frame 157: Collision 12 vs 15
Frame 196: Collision 12 vs 18
Frame 210: Collision 7 vs 10
Frame 239: Collision 26 vs 29
Frame 241: Collision 19 vs 23
Frame 243: Collision 26 vs 30
Frame 252: Collision 30 vs 31
Frame 257: Collision 29 vs 31
Frame 309: Collision 7 vs 8
Frame 309: Collision 8 vs 9
Frame 309: Collision 8 vs 10
Frame 321: Collision 7 vs 43
Frame 321: Collision 8 vs 43
Frame 362: Collision 7 vs 9
Frame 365: Collision 45 vs 49
Frame 369: Collision 9 vs 45
Frame 371: Collision 7 vs 45
Frame 371: Collision 8 vs 45
Frame 371: Collision 10 vs 45
Frame 384: Collision 8 vs 52
Frame 386: Collision 10 vs 52
Frame 398: Collision 52 vs 57
```

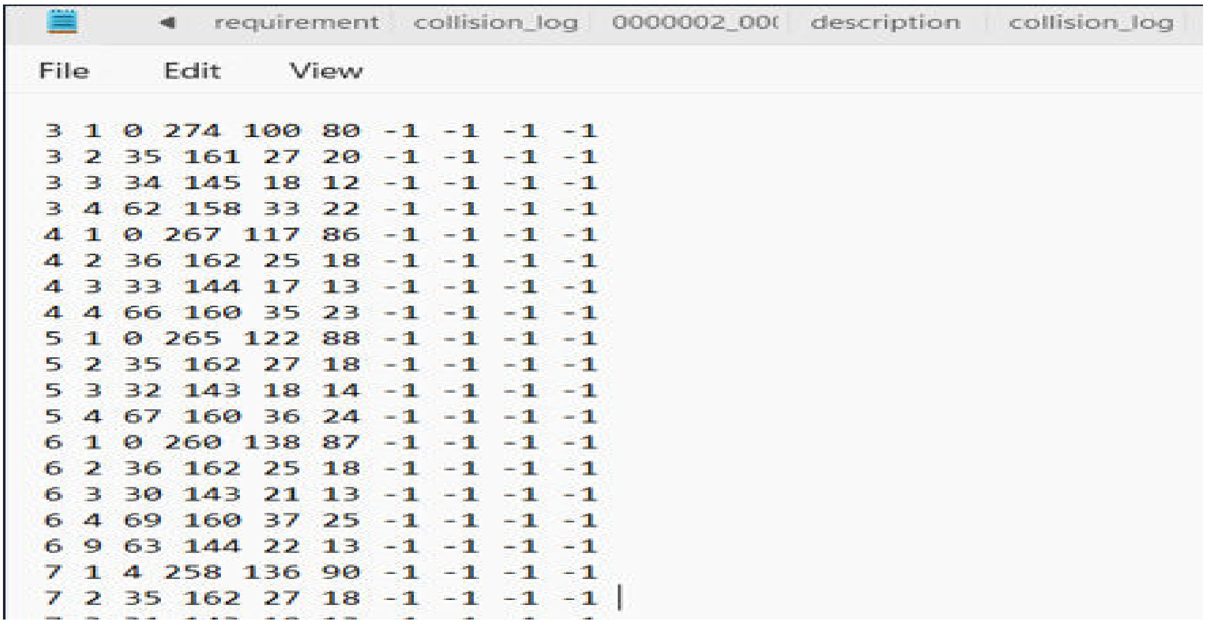
Figure 6: Shows the accident log output where each frame records collisions between object IDs, including frame numbers and involved objects.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

8.5 MOT Tracking Data Output




```
3 1 0 274 100 80 -1 -1 -1 -1
3 2 35 161 27 20 -1 -1 -1 -1
3 3 34 145 18 12 -1 -1 -1 -1
3 4 62 158 33 22 -1 -1 -1 -1
4 1 0 267 117 86 -1 -1 -1 -1
4 2 36 162 25 18 -1 -1 -1 -1
4 3 33 144 17 13 -1 -1 -1 -1
4 4 66 160 35 23 -1 -1 -1 -1
5 1 0 265 122 88 -1 -1 -1 -1
5 2 35 162 27 18 -1 -1 -1 -1
5 3 32 143 18 14 -1 -1 -1 -1
5 4 67 160 36 24 -1 -1 -1 -1
6 1 0 260 138 87 -1 -1 -1 -1
6 2 36 162 25 18 -1 -1 -1 -1
6 3 30 143 21 13 -1 -1 -1 -1
6 4 69 160 37 25 -1 -1 -1 -1
6 9 63 144 22 13 -1 -1 -1 -1
7 1 4 258 136 90 -1 -1 -1 -1
7 2 35 162 27 18 -1 -1 -1 -1
```

Figure 7: Shows the MOT tracking data file generated by the system, where each frame contains object IDs along with their bounding box coordinates.

VIII. CONCLUSION AND FUTURE SCOPE

Tunnel safety is an important aspect of modern transportation systems, as accidents in confined environments can lead to serious consequences and delays in emergency response. Monitoring traffic inside tunnels is challenging due to limited visibility, lighting variations, and continuous vehicle movement. Traditional CCTV-based monitoring systems rely on manual observation, which is time-consuming and may result in delayed detection of accidents. These limitations highlight the need for an automated system that can analyze tunnel traffic videos and detect collisions efficiently. The use of computer vision and deep learning techniques provides a reliable approach for improving tunnel surveillance and reducing human intervention.

The Real-Time Tunnel Accident Detection and Tracking Using YOLOv5 introduces an automated system designed to detect vehicle collisions from tunnel traffic videos. The system uses the YOLOv5 model for object detection to identify vehicles in each frame and the DeepSORT algorithm for multi-object tracking. Each detected vehicle is assigned a unique ID and tracked across frames to analyze its movement. The tracking results are stored in a text file, which is further processed by a accident detection module. This module calculates distance, velocity, and overlap between vehicles to determine possible accidents. When a collision is detected, the system highlights the vehicles in the output video and records the event in a log file. The proposed system reduces manual monitoring and provides an efficient approach for tunnel accident detection using deep learning and video analytics. The final output includes a processed video showing detected collisions along with stored accident details for future analysis. This automated solution improves traffic monitoring and supports faster identification of accidents in tunnel environments.

REFERENCES

1. F. Hamami, I. Darmawan et al., "Optimizing Traffic Safety: YOLOv11 and DeepSORT for Speed Detection and Safe Distance Monitoring," IEEE, 2025, DOI: 10.1109/ICERA66156.2025.11087337.
2. E. Elakiya, A. Singh et al., "AI-Powered Road Safety: A Unified YOLO Network for Real-Time Helmet Detection, Speed Estimation and Number Plate Recognition," IEEE, 2025, DOI: 10.1109/ICIRCA65293.2025.11089859.
3. S. Subramani V, V. Kumar S et al., "Smart Tunnel Traffic Control System using IoT and Machine Learning," IEEE,

2025, DOI: 10.1109/ICVADV63329.2025.10961894.
4. R. Devi S. M. et al., "A Real-Time Multiple Traffic Violation Detection System Using DeepSORT," IEEE, 2024, DOI: 10.1109/AISP61711.2024.10870840.
5. P. Phiphimai, S. Tantrairatn et al., "Enhancing Safety and Efficiency with Autonomous Navigation Systems: Integrating Real-Time Object Detection, Tracking, and Trajectory Prediction," IEEE, 2024, DOI: 10.1109/KST61284.2024.10499659.
6. B. Ding, "Design and Development of Intelligent Lighting Control System for Urban Tunnel," IEEE, 2024, DOI: 10.1109/EI264398.2024.10990847.
7. J. Li et al., "WiFi Sensing Based Fire Detection System for Vehicular Tunnels," IEEE, 2024, DOI: 10.1109/GLOBECOM52923.2024.10901736.
8. Q. Liu et al., "System Design and Research on Traffic Tunnel Inspection System Based on Computer Vision and Audition," IEEE, 2024, DOI: 10.1109/BMSB62888.2024.10608342.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE
SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING