

AI Lab Project Proposal

Smart CCTV Surveillance System

Team Members

- Muhammad Mussab (22K-4146)
- Saad Ali Baig (22K-4131)
- Arqam Siddiqi (22K-4142)

Objective:

To develop an intelligent CCTV surveillance system that proactively detects unauthorized vehicle movement, verifies authorized access using facial recognition, and identifies fire/smoke hazards in real time using deep learning models.

Problem Statement:

Traditional CCTV systems lack intelligent monitoring and require manual supervision, making them ineffective against real-time threats such as vehicle theft or fire incidents. This project proposes an AI-powered solution to automate surveillance and minimize human intervention.

Proposed Solution:

The system integrates three deep learning-based components into a unified Django backend application:

1. **Vehicle Movement Detection:**
Detects and tracks the owner's vehicle and raises alerts if unauthorized movement is observed.
2. **Face Authentication:**
Authenticates users using stored facial embeddings to validate access.
3. **Fire/Smoke Detection:**
Identifies potential fire or smoke hazards from camera feeds and sends immediate alerts.

The backend communicates with the frontend using RESTful APIs and real-time alerts via Server-Sent Events (SSE), secured with JWT authentication.

Tools and Technologies:

- **Deep Learning Models:**
 - YOLOv12n (vehicle and hazard detection)
 - YOLOv11n (face detection)
 - InceptionNet (facial recognition, via `facenet_pytorch`)
 - DeepSort (vehicle tracking)
- **Dataset:**
 - 2,500 vehicle images (CCTV, drone, traffic sources)
 - 21,000 fire/smoke images (D-Fire dataset)

Model Workflow Summary

Task	Model	Output	Confidence Threshold
Vehicle detection	YOLOv12n fine-tuned	Vehicle bounding boxes	0.50
Vehicle movement	DeepSORT	Vehicle movement flag	0.50
Hazard detection	YOLOv12n fine-tuned	Fire/smoke present flag	0.40
Face detection	YOLOv11n	Face bounding boxes	0.50
Face authentication	InceptionNet (facenet_pytorch, VGGFace2 pretrained)	Authorized-user flag	0.50

Evaluation Metrics and Results

- **Unauthorized Movement Detection:**
 - Accuracy: 95.2%
 - Low false alarm rate via confusion matrix
- **Hazard Detection:**
 - Accuracy: 92.7%
 - Confidence threshold minimizes false positives

Conclusion:

This project aims to revolutionize traditional surveillance with a smart, AI-driven system. By combining deep learning models for object detection, facial recognition, and hazard alerts into one robust framework, the system offers significant potential to enhance safety and security in sensitive environments.