

# Project - CCTV-Based Criminal Detection System Using Deep Learning

## 1. Project Foundation & Evolution

This project presents a comprehensive, AI-powered surveillance system that analyzes live CCTV footage to detect criminal activities and recognize known offenders in real-time. By integrating facial recognition and behavioral anomaly detection, the system enhances public safety through automation, accuracy, and rapid response.

- Real-time video capture from multiple CCTV cameras.
  - Human detection and behavior analysis using deep learning (CNN + RNN).
  - Facial recognition using MTCNN for detection and FaceNet for identity matching.
  - Anomaly detection of 12+ criminal behaviors (e.g., assault, theft, explosion).
  - Instant alerts to authorities with location, time, and suspect details via SMS (Twilio).
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## 2. Research Contributions & Implemented Work

### ✓ Facial Recognition Module

- **Face Detection:** Using MTCNN to detect and crop faces from live CCTV feeds.
- **Face Recognition:** Using FaceNet to generate embeddings and match with a criminal database.
- **Alert System:** Integration with Twilio to send SMS alerts with suspect details and location.

### ✓ Behavior-Based Anomaly Detection

- **Action Recognition:** Using CNN (InceptionV3) to extract spatial features from video frames.
- **Temporal Analysis:** Using RNN (LSTM) to detect abnormal activities like assault, theft, or vandalism.
- **Real-Time Classification:** Classifies video clips into 13 categories (12 anomalies + 1 normal).

### ✓ Real-Time Video Processing

- **OpenCV & Decords:** For frame extraction, manipulation, and streaming.
- **Multiprocessing:** For parallel handling of video input and inference to reduce latency.

### ✓ Model Training & Accuracy

- Trained on annotated video datasets with 672 training samples and 5000+ test videos.
  - Achieved up to **89.6% accuracy** in anomaly detection.
  - Used transfer learning with InceptionV3 to reduce training time and improve performance.
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## 3. Key Features of the System

Feature	Description
Live CCTV Integration	Captures and processes real-time video from multiple cameras.
Human Detection & Tracking	Identifies people and tracks their movements across frames.
Facial Recognition	Matches faces with a criminal database using deep learning.
Anomaly Detection	Detects 12+ suspicious behaviors (e.g., abuse, explosion, robbery).
Instant Alerts	Sends SMS/email notifications to authorities with event metadata.
Real-Time Dashboard	(Optional) Visual interface for monitoring alerts and camera feeds.
Privacy & Security	Ensures secure handling of video data and compliance with privacy laws.

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#### 4. Challenges Faced in Implementation

Challenge	Explanation
False Positives/Negatives	Misclassifying normal behavior as suspicious or missing actual threats.
Model Complexity	Deep models require high computational power and memory.
Video Quality Variability	Low-light, occlusion, or poor resolution can affect detection accuracy.
Real-Time Constraints	Ensuring low-latency processing for real-time alerts.
Privacy Concerns	Handling sensitive footage ethically and legally.
Integration with Legacy Systems	Adapting the system to work with existing CCTV infrastructure.

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#### 5. Successes Achieved So Far

- High accuracy in detecting both known criminals and suspicious activities.
  - Real-time alerting system successfully tested with SMS integration.
  - Scalable architecture that can handle multiple camera feeds.
  - Modular design allows for easy upgrades and feature additions.
  - Demonstrated potential to reduce manual monitoring and improve public safety.
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The CCTV-based Criminal Detection System using Deep Learning is a powerful step toward smart, automated public safety. It combines facial recognition and behavior analysis to detect threats in real-time, reducing human workload and improving response times. With continued research and integration, this system has the potential to become a cornerstone of modern urban surveillance and crime prevention.

OR

How Can We Make It Even Better?

- Add facial emotion detection (to spot fear, anger, etc.).
- Use cloud servers so it can work from anywhere.
- Add GPS to show exact location of the crime.
- Predict where crimes might happen next using past data.
- Create a mobile app for police to get alerts on their phones.

This project shows how AI can make our cities safer. It saves time, reduces human error, and helps police respond faster. With more improvements, it can become a powerful tool for crime prevention and public safety.