AI-Powered Smart CCTV with Real-Time Object Detection and SaaS-Based Analytics

Final Year Project Proposal

2025

Abstract

This project proposes the development of a scalable AI-powered CCTV platform capable of real-time object detection, activity recognition, and analytics for retail shops, hospitals, and security-sensitive areas. The system uses camera-specific unique identifiers (UIDs) for secure access and streams live video feeds to a web-based SaaS platform. Advanced computer vision models, specifically YOLO (You Only Look Once), are integrated to detect human activities, monitor customer behavior, and identify anomalies such as patient falls or unauthorized intrusions. The platform aims to provide shop owners, healthcare institutions, and enterprises with real-time insights accessible remotely from anywhere in the world.

1 Introduction

Conventional CCTV systems primarily record video without providing actionable insights. Shop owners and healthcare managers face challenges in monitoring activities effectively, counting footfall, or detecting abnormal events in real-time. This project addresses these limitations by combining IoT-based video capture with AI-driven analytics delivered through a SaaS platform.

2 Problem Statement and Motivation

- Traditional CCTV systems lack intelligence; they only store footage for manual review.

- Shop owners want to track customer entries, purchases, and behavioral patterns.

- Hospitals require fall detection and patient monitoring to improve safety.

- Security-sensitive environments demand real-time anomaly detection.

The motivation is to build a next-generation smart surveillance system that goes beyond recording by providing insights, alerts, and remote accessibility.

3   Objectives

- To develop a real-time video streaming system accessible via a web portal using camera UIDs.

- To integrate YOLO-based object detection for identifying people and activities.

- To implement analytics for customer counting, activity tracking, and anomaly alerts.

- To design a scalable SaaS architecture supporting multiple shops/hospitals.

- To ensure security through UID-based access and encrypted data streams.

4   Real-World Significance

- **Retail:** Customer counting, sales conversion analysis, and heatmaps of busy areas.

- **Healthcare:** Patient fall detection, unauthorized entry alerts, and crowd monitoring.

- **Security:** Intrusion detection and suspicious behavior recognition.

- **Global Access:** Shop owners and hospital administrators can monitor their premises remotely.

5   Proposed Solution

Unique Identifier (UID) for Each Camera

Each installed camera is assigned a UID (e.g., CAM-12345), which is stored in the backend database along with stream details. Owners use this UID to securely access their live feed.

YOLO-Based Object Detection

YOLO models (e.g., YOLOv8) enable real-time detection of humans and activities. Using tracking algorithms such as DeepSORT or ByteTrack, the system counts customer entries, monitors interactions with shelves, and detects abnormal activities like patient falls.

SaaS Web Platform

The platform provides multi-tenant dashboards where users can:

- View live feeds by entering camera UIDs.

- Monitor statistics such as number of customers entered or alerts triggered.

- Access analytics reports from anywhere in the world.

6   System Architecture and Workflow

1. **Video Capture:** Cameras (IP cameras, Raspberry Pi, or Jetson Nano) capture live feeds.

2. **Streaming Server:** Streams are sent to a central media server using protocols like RTSP or WebRTC.

3. **UID Mapping:** Each camera stream is mapped to its UID in the backend.

4. **AI Processing:** Frames are processed using YOLO models for object detection and tracking.

5. **Data Storage:** Analytics events are stored in a database (PostgreSQL/MongoDB).

6. **Frontend:** Web dashboard built with React/Next.js fetches analytics and streams.

7. **User Access:** Owners authenticate and enter UIDs to view their camera feeds.

7   Features and Advantages

- Real-time monitoring and AI-driven insights.

- UID-based secure access to live feeds.

- Scalable cloud-based SaaS platform supporting multiple clients.

- Custom analytics for retail and healthcare use cases.

- Remote accessibility from any device with internet connectivity.

8   Expected Outcomes

- Prototype demonstrating live streaming and YOLO-based detection.

- A working web platform showing analytics dashboards.

- Real-world application potential in retail shops, hospitals, and enterprises.

- Improved safety, efficiency, and decision-making for end-users.

9   Future Scope

- Integration with Point-of-Sale (POS) systems for conversion analysis.

- Advanced activity recognition using pose estimation.

- Cloud auto-scaling for handling hundreds of camera feeds.

- Mobile app for real-time alerts and notifications.

- Startup potential as a commercial SaaS product.