



# AI Based Crowd Watcher for Public Safety

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**ABSTRACT:** The rapid increase in large-scale public gatherings has made crowd monitoring and management a critical challenge for ensuring public safety. Traditional CCTV systems are passive and rely on human monitoring, which is inefficient and prone to delays. This paper presents AI Based Crowd Watcher for Public Safety, an intelligent real-time crowd monitoring system that uses deep learning and cloud technologies to detect, analyze, and manage crowd density automatically. The system employs the YOLOv8 object detection model to identify and count people from live video feeds. Based on predefined thresholds, crowd density is classified into low, medium, and high risk levels. When critical thresholds are exceeded, automated alerts are generated and transmitted to authorities via Firebase Cloud Messaging. The system integrates a web dashboard for monitoring and an Android application for field response management. Experimental results demonstrate that the proposed system provides accurate detection, low-latency alerts, and efficient coordination, making it suitable for smart city applications, public events, and emergency management systems.

**KEYWORDS:** Crowd Monitoring, YOLOv8, Computer Vision, Public Safety, Firebase, Real-Time Systems, Smart Surveillance.

## I. INTRODUCTION

Crowd management has become a major concern in modern urban environments, especially during large gatherings such as religious events, concerts, and public transport operations. Overcrowding can lead to dangerous situations such as stampedes, accidents, and delayed emergency responses. Traditional surveillance systems depend on human operators to monitor multiple camera feeds, which is inefficient and often results in delayed detection of critical situations.

With advancements in artificial intelligence and computer vision, it is now possible to automate crowd monitoring processes. AI-based systems can analyze live video feeds, detect individuals, and estimate crowd density in real time. However, many existing systems lack integration with real-time alert mechanisms and field response coordination.

To address these limitations, this paper proposes AI Based Crowd Watcher for Public Safety, a full-stack intelligent surveillance system that combines deep learning, cloud infrastructure, and mobile applications. The system automatically detects crowd density, classifies risk levels, and generates alerts to assist authorities in timely decision-making and response.

## II. LITERATURE SURVEY

Recent advancements in computer vision have significantly improved crowd detection and monitoring techniques. YOLO (You Only Look Once) models have been widely used for real-time object detection due to their speed and accuracy. Earlier approaches relied on traditional image processing techniques and manual monitoring, which were

inefficient in handling large-scale surveillance. Deep learning models such as CNN-based detectors and density estimation methods have improved performance in crowded environments.

Several studies have explored crowd counting using neural networks, but many systems lack real-time alert generation and integration with mobile platforms. Cloud-based systems using Firebase have enabled real-time data synchronization and notification delivery, improving system responsiveness. The proposed system builds upon these advancements by integrating YOLOv8 detection, cloud-based alert systems, and mobile response applications into a unified platform.

### III. METHODOLOGY

The AI Based Crowd Watcher for Public Safety system follows a three-tier architecture consisting of AI processing, cloud infrastructure, and client applications.

#### A. Data Acquisition

- Live video frames are captured from cameras and processed at regular intervals.

#### B. Object Detection

- YOLOv8 model is used to detect persons in each frame. The model identifies bounding boxes and counts the number of individuals present.

#### C. Crowd Density Analysis- Based on the detected count:

- 0 persons → Low risk
- 1–9 persons → Medium risk
- 10+ persons → High risk

#### D. Alert Generation - If crowd density exceeds the threshold:

- Alert is generated
- Stored in Firebase Firestore
- Push notification sent via FCM

#### E. Visualization and Monitoring

- Web dashboard displays live feed and heatmaps
- Android app shows alerts and SOS tracking

### IV. EXPERIMENTAL RESULTS

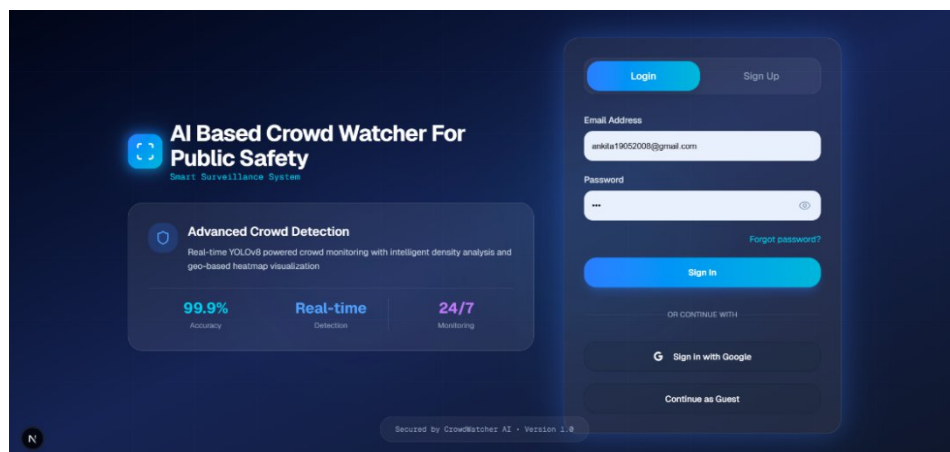


Fig. (a) Login interface of the AI-based crowd watcher system with authentication options including email/password, Google sign-in, and guest access..

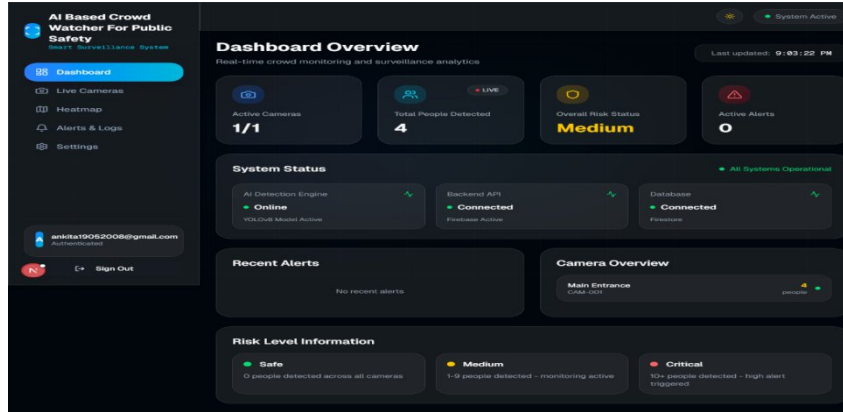


Fig. (b) Main dashboard overview presenting system statistics including active cameras, total people detected, risk status, alerts, and system health.

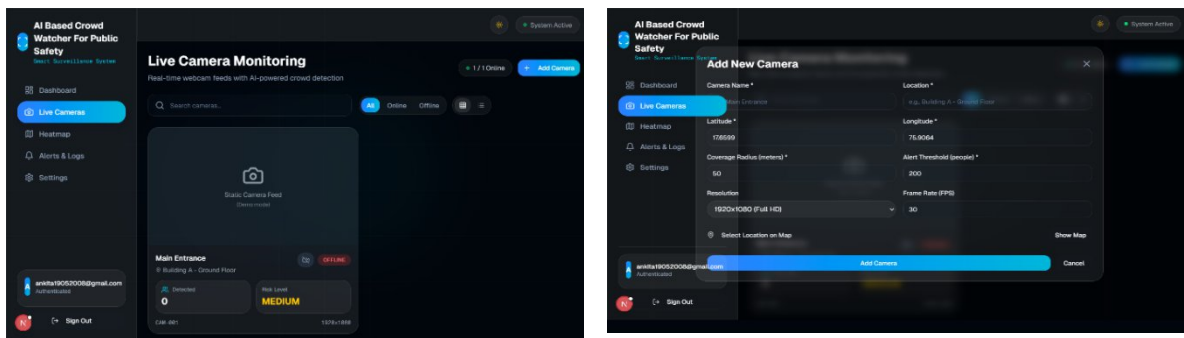


Fig. (c) Live camera monitoring dashboard displaying real-time feed status, detected people count, and risk level for each surveillance camera.

Fig. (d) Add New Camera interface allowing users to configure camera details such as location, coordinates, coverage radius, resolution, and alert thresholds.

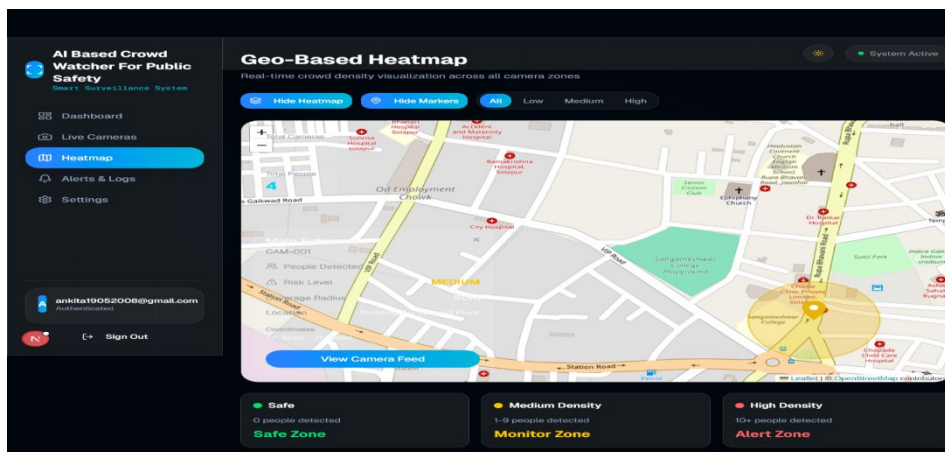


Fig. (e) Geo-based heatmap visualization showing real-time crowd density on a map with zone classification (safe, medium, high) for public safety monitoring.

#### V. CONCLUSION

This paper presents AI Based Crowd Watcher for Public Safety, A crowd monitoring system designed to improve public safety through real-time detection and alert mechanisms. By integrating YOLOv8 with cloud infrastructure and mobile applications, the system provides an efficient and scalable solution for crowd management. The system reduces reliance on manual monitoring, improves response time, and enables proactive decision-making. Future work may include integration with multi-camera systems, advanced crowd behavior analysis, and deployment in large-scale smart city environments.

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