Intelligent Crowd Density Monitoring System Using Computer Vision

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ABSTRACT- ***An Intelligent Crowd Density Monitoring System using Computer Vision is designed to automatically detect, count, and monitor the density of people in public areas using surveillance cameras and deep learning techniques. The system processes real-time video streams to identify individuals, estimate crowd density, and classify areas as low, medium, or high density. It can generate instant alerts when overcrowding exceeds predefined thresholds, helping authorities improve public safety, crowd management, and emergency response. By reducing manual monitoring and providing accurate real-time analysis, the proposed system offers an efficient, reliable, and cost-effective solution for smart surveillance in places such as railway stations, shopping malls, stadiums, airports, and public events.***

KEYWORDS: Computer Vision, Crowd Density Monitoring, Deep Learning, Object Detection, Real-Time Surveillance, Crowd Counting, Artificial Intelligence (AI), CCTV Video Analysis, Public Safety, Smart Surveillance System.

INTRODUCTION

The Intelligent Crowd Density Monitoring System using Computer Vision is designed to monitor and analyze crowd density in real time using surveillance cameras and deep learning techniques. The system automatically detects and counts people, helping authorities improve public safety, prevent overcrowding, and manage crowded areas efficiently.

LITERATURE SURVEY

Recent studies show that computer vision and deep learning techniques have significantly improved the accuracy of crowd detection and density estimation. Researchers have used object detection models such as YOLO and CNN-based approaches to monitor crowded areas in real time, enabling efficient surveillance, public safety, and effective crowd management.

RELATED WORK

Several existing crowd monitoring systems use image processing and deep learning models to detect and estimate crowd density from CCTV footage. Advanced object detection algorithms such as YOLO and CNN have improved detection accuracy and real-time performance, making them suitable for applications in public safety, traffic management, and smart city surveillance.

EXISTING SYSTEM

Existing crowd monitoring systems mainly rely on manual surveillance or basic image processing techniques to estimate crowd density. These methods often struggle with accuracy in highly crowded environments, require continuous human supervision, and are less effective in providing real-time alerts for overcrowding situations.

PROPOSED SYSTEM

The proposed system implements AI-driven face recognition for secure user authentication in a smart home environment. The proposed Intelligent Crowd Density Monitoring System using Computer Vision uses deep learning and computer vision techniques to detect, count, and analyze people in real time from CCTV or surveillance video. The system accurately estimates crowd density, classifies congestion levels, and generates alerts when overcrowding is detected. This improves public safety, reduces manual monitoring, and enables efficient crowd management.

SYSTEM ARCHITECTURE

The proposed Intelligent Crowd Density Monitoring System using Computer Vision begins by capturing live video through a CCTV or surveillance camera. The video is divided into individual frames, which are preprocessed to improve image quality and prepare them for analysis. A deep learning-based object detection model, such as YOLO, detects and counts the number of people present in each frame.

Based on the detected people, the system estimates the crowd density and classifies the area as low, medium, or high density. If the crowd exceeds a predefined threshold, an alert is generated to notify the concerned authorities. The processed results, including the crowd count and density level, are displayed in real time, enabling efficient crowd monitoring and improving public safety.

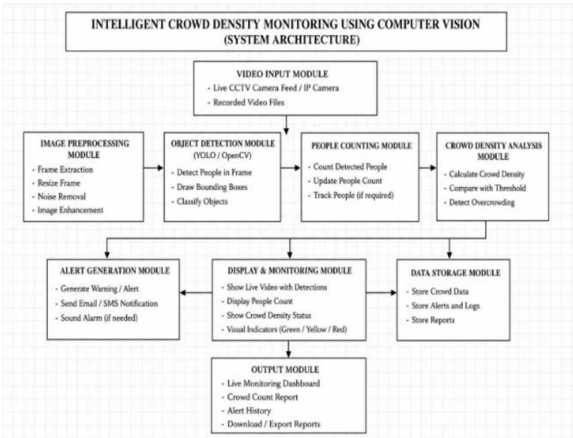

Fig 1: System Architecture

METHODOLOGY DESCRIPTION

The proposed system captures live video from a surveillance camera and uses a deep learning model to detect and count people in real time. Based on the detected count, it estimates crowd density and generates alerts when overcrowding is detected, ensuring efficient crowd monitoring and public safety.

RESULTS AND DISCUSSION

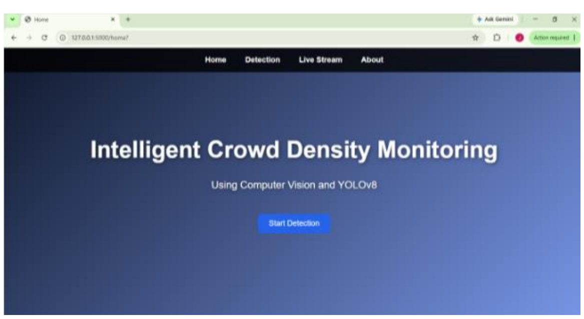

Fig. 2: Home Page of Crowd Density MonitoringSystem

The home page provides the main interface of the application, allowing users to access the crowd monitoring system and start real-time surveillance using video input.

Fig.3: Detection Module

The system captures live video from a CCTV camera or uploaded video and processes each frame using a deep learning model. People in the scene are detected and highlighted with bounding boxes.

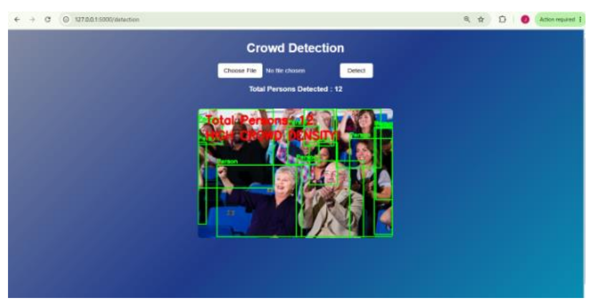

Fig. 4: Crowd Density Estimation Result

The detected people are counted to estimate the crowd density in real time. The system classifies the crowd as low, medium, or high density and displays the current crowd count.

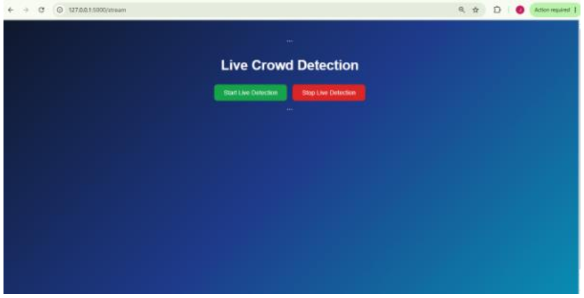

Fig. 5: Stream Page

When the number of people exceeds the predefined threshold, the system automatically generates an alert. This enables timely action by authorities, improving crowd management and public safety.

CONCLUSION

The proposed Intelligent Crowd Density Monitoring System using Computer Vision provides an efficient and accurate solution for real-time crowd monitoring and density estimation. By automatically detecting overcrowding and generating alerts, the system improves public safety, reduces manual monitoring, and supports effective crowd management.

FUTURE SCOPE

The proposed system can be enhanced by using advanced deep learning models for higher detection accuracy and faster processing. Future improvements may include integrating drone-based surveillance, cloud-based monitoring, and predictive analytics to support smart city applications and large-scale crowd management.

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