REVIEW ON AI POWERED SECURITY CAMERA FOR FACE RECOGNITION AND MOTION DETECTION WITH REAL-TIME ALERTS

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Abstract:-
The demand for intelligent surveillance systems has increased accelerating the adoption of Artificial Intelligence (AI) in modern security applications. Conventional CCTV-based surveillance systems require continuous human monitoring, which consumes more time and prone to human error making them inefficient. AI-powered security cameras overcome such limitations by integrating computer vision and edge computing technologies to perform automated face recognition, detect motion and analyse real-time threats. This review paper presents a detailed survey of recent advancements in AI-based security camera systems designed for face recognition and motion detection with real-time alert mechanisms. This review also discusses widely used face recognition techniques, including convolutional neural networks (CNNs), YOLO-based object detection, MTCNN for face detection, and Face Net-based feature extraction, along with motion detection methods using computer vision and PIR sensors. Furthermore, it explores the integration of embedded system platforms such as Raspberry Pi with camera modules to enable real-time monitoring, energy-efficient, low-cost. This paper also highlights the communication technologies for instant real-time alert generation through e-mail, messages, mobile notifications or cloud-based services. A comparative analysis of recent research is presented to evaluate system performance based on detection accuracy, computational efficiency, response time, and implementation cost. Finally, the review identifies the current challenges, which include varying lighting conditions, poor illumination and pose variations and privacy concerns. It also identifies the computational limitations- while discussing future research directions involving edge A Iand secure IoT-enabled surveillance. This review serves as a valuable reference for researchers and developers working on intelligent, cost-effective, and real-time security-monitoring systems.

Keywords: Artificial Intelligence (AI), Face Recognition, Motion Detection, Real-Time Alerts, Intelligent Surveillance, Computer Vision, Deep Learning, Raspberry Pi, Edge Computing, Internet of Things (IoT).

Introduction

The increasing demand for intelligent surveillance systems has accelerated the adoption of Artificial Intelligence (AI) in modern security applications. Traditional Closed-Circuit Television (CCTV) systems primarily record video footage and depend on continuous human monitoring, making them inefficient for identifying suspicious activities in real time. The integration of AI with computer vision has transformed conventional surveillance into intelligent systems capable of automatically detecting, recognizing, and responding to security events with minimal human intervention.

Among the most significant applications of AI in surveillance are face recognition and motion detection. Face recognition enables the identification and verification of individuals by analyzing unique facial features, while motion detection identifies changes within a scene to detect unauthorized movement or suspicious activities. The combination of these technologies enhances security by providing accurate identification, reducing false alarms, and enabling real-time decision-making. Recent advancements in deep learning algorithms, including Convolutional Neural Networks (CNNs), YOLO (You Only Look Once), FaceNet, MTCNN, and OpenCV-based computer vision techniques, have significantly improved the accuracy, speed, and robustness of intelligent surveillance systems.

Edge computing platforms such as the Raspberry Pi have further expanded the deployment of AI-powered surveillance by providing an affordable, compact, and energy-efficient solution for processing video data locally. Performing AI inference at the edge reduces communication latency, minimizes dependence on cloud infrastructure, improves data privacy, and enables immediate response to security threats. These characteristics make AI-based surveillance systems suitable for smart homes, educational institutions, offices, industries, healthcare facilities, transportation systems, and smart city applications.

Despite remarkable progress, AI-powered surveillance systems continue to face several challenges, including variations in illumination, facial occlusion, pose changes, computational constraints of embedded devices, cybersecurity risks, and privacy concerns. Ongoing research focuses on developing lightweight deep learning models, improving detection accuracy under complex environmental conditions, and enhancing the efficiency of real-time edge AI systems.

Literature Review

[1] Title: A Smart Security System Using IoT

Authors: P. Kumar, A. Sharma, R. Singh (2025)

Description:

This IoT-based security system integrates sensors, cloud computing, and intelligent monitoring. It detects threats and sends notifications through mobile applications. The architecture supports secure and scalable remote surveillance.

[2] Title: AI Smart Security Camera for Person Detection, Face Recognition, Tracking and Logging

Authors: V. G. Almeida, J. C. Filipe, H. Oliveira(2024)

Description:

The authors proposed an AI-based surveillance system that performs person detection, face recognition, tracking, and activity logging. It improves monitoring accuracy and automatically records important events with timestamps. The system enhances security but requires high computational resources.

[3] Title: Facial Recognition Robots for Enhanced Safety and Smart Security

Authors: P. Jongsuk, W. Yodsukdee, K. Patcharatanakul (2024)

Description:

The authors developed an autonomous robot with facial recognition for intelligent surveillance. It patrols designated areas, identifies individuals, and monitors suspicious activities. The system improves security coverage while reducing human workload.

[4] Title: Real-Time Criminal Identification Using MTCNN for Security Surveillance

Authors: R. Kumar, S. Patel, A. Singh (2024)

Description:

The proposed system identifies criminals in real time using MTCNN and deep learning techniques. It compares detected faces with a criminal database and sends instant alerts. The method improves public safety and reduces manual identification.

[5] Title: Deep Learning-Powered Face Detection and Recognition for Challenging Environments

Authors: A. O. Adeyemi, F. Nzeh, O. Abiodun (2024)

Description:

The study applies deep learning models for face recognition under poor lighting and varying poses. Image preprocessing improves recognition accuracy in challenging environments. However, the

system requires powerful hardware and large datasets.

[6] Title: Smart Surveillance Camera Using AI

Authors: M. Hassan, A. Raza, U. Farooq (2024)

Description:

This AI-powered surveillance camera detects motion, recognizes faces, and analyzes suspicious activities. It records only significant events and sends instant notifications. The approach reduces storage usage and improves monitoring efficiency.

[7] Title: Implementation of a Multitudinous Face Recognition Using YOLOv3

Authors: V. Suresh, M. Harini, P. Janardhan (2022)

Description:

The proposed system uses YOLOv3 to detect and recognize multiple faces simultaneously. It provides fast and accurate real-time performance in crowded environments. GPU hardware is required for optimal operation.

[8] Title: Automated Face Recognition by Smart Security System Using AI & ML Algorithms

Authors: S. Ramya, K. Priya, G. Karthick (2021)

Description:

The authors developed an AI and machine learning-based face recognition system for automated surveillance. It accurately identifies individuals while minimizing human intervention. The system is suitable for homes, offices, and educational institutions.

[9] Title: Video-Based Real-Time Intrusion Detection System Using Deep Learning for Smart City Applications

Authors: S. S. Patil, S. Phulari, C. Patil (2020)

Description:

The proposed system detects unauthorized intrusions using deep learning-based video analysis. It continuously monitors surveillance footage and generates real-time alerts. The method achieves higher accuracy than conventional motion detection.

[10] Title: Face Recognition Based Surveillance System Using FaceNet and MTCNN on Jetson TX2

Authors: J. Binu, B. Kareem (2019)

Description:

This system uses FaceNet and MTCNN for accurate real-time face recognition on the Jetson TX2 platform. It provides high recognition accuracy with low processing delay. The approach demonstrates efficient embedded AI surveillance.

[11] Title: IoT-Based Facial Recognition Security System

Authors: C. Ngo, T. Tran, H. Nguyen (2018)

Description:

The system combines facial recognition with IoT and cloud technology for remote monitoring. Users can access surveillance data through smartphones and computers. The approach enhances accessibility but introduces cybersecurity concerns.

[12] Title: Face Recognition in Multi-Camera Surveillance Videos

Authors: O. Arandjelovic et al. (2013)

Description:

The system combines multiple camera views to improve face recognition and tracking accuracy. It minimizes blind spots and recognizes faces from different angles. However, it increases hardware cost and implementation complexity.

[13] Title: Real-Time Video Surveillance System Using Motion Detection

Authors: B. K. Saho, M. Fujii (2012)

Description:

The system records video only when motion is detected using background subtraction techniques. This reduces storage requirements and processing time. However, it cannot identify individuals and may produce false alarms.

[14] Title: YOLO Architectures and their Applications-AReview

Authors: Bhargavi Vijendra Sangam; Swetha V.; Ananya T. (2026)

Description:

Bhargavi Vijendra Sangam et al. (2026) carried out a review on the evolution of the You Only Look Once (YOLO) object detection framework with shows on different versions of YOLO from YOLOv1 through YOLO11. The authors discussed the development of the architecture design and improvements in terms of accuracy, speed, multi-scale feature detection, anchor free detection, and real-time operations. Furthermore, the authors noted the numerous applications of the YOLO system ranging

from surveillance, healthcare, autonomous cars, agriculture, and industrial automation. The authors argued that the current architecture of YOLO is a good combination of computational efficiency and accuracy of detections and, thus, can be used for efficient real-time intelligent surveillance systems. This conclusion makes YOLO a promising technology for AI surveillance cameras with face and motion detection features.

Conclusion

The AI-Powered Security Camera for Face Recognition and Motion Detection with Real-Time Alerts is an advanced surveillance system designed to provide intelligent, automated, and reliable security. Unlike traditional CCTV cameras that only record video, this system uses Artificial Intelligence (AI) to analyze live video streams, recognize authorized and unauthorized faces, detect motion, and instantly notify users whenever suspicious activity is detected. This reduces the need for continuous human monitoring while improving the speed and accuracy of threat detection.

The integration of face recognition technology allows the system to identify registered individuals and distinguish them from unknown persons. This feature is particularly useful in homes, offices, schools, banks, hospitals, and industries where access control and identity verification are important. At the same time, the motion detection module continuously monitors the surroundings and records only when movement is detected, which helps save storage space and makes it easier to review important events.

One of the major advantages of this system is its real-time alert mechanism. Whenever an unknown person is detected or unusual motion occurs, the system immediately sends notifications to the user's mobile phone or computer along with images or video clips. This enables users to take quick action, even when they are away from the location. The combination of AI algorithms and real-time communication significantly improves security and reduces the chances of theft, unauthorized access, or other criminal activities.

The proposed system is cost-effective, scalable, and easy to deploy, making it suitable for both small-scale and large-scale applications. It minimizes manual surveillance, increases operational efficiency, and provides continuous monitoring with higher accuracy than conventional security systems. The project also demonstrates the practical application of AI, computer vision, and machine learning in solving real-world security challenges.In the future, this system can be further enhanced by integrating cloud storage for secure data backup, IoT devices for smart home automation, multiple camera support, license plate recognition, emotion detection, object tracking, voice-based alerts, and predictive analytics. These improvements will make the surveillance system even more intelligent, efficient, and adaptable to modern security requirements.

In conclusion, the AI-Powered Security Camera for Face Recognition and Motion Detection with Real-Time Alerts is an effective, intelligent, and future-ready security solution. It combines AI, computer vision, and real-time communication technologies to provide accurate face recognition, instant threat detection, continuous monitoring, and immediate alerts. It not only enhances safety and security but also demonstrates the growing importance of Artificial Intelligence in developing smart surveillance systems for homes, businesses, educational institutions, and public spaces.

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