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REAL-TIME CCTV ANALYTICS FOR UNKNOWN PERSON CLASSIFICATION

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ABSTRACT

Unknown person detection using CCTV cameras is an advanced surveillance system that leverages artificial intelligence and computer vision techniques to enhance security in public and private spaces. Traditional CCTV systems rely heavily on human monitoring, which is often inefficient and prone to errors. The proposed system automates the detection of unidentified individuals by analyzing live video feeds in real-time. It uses face detection and recognition algorithms to compare captured facial features with a pre-existing database of authorized individuals. If a match is not found, the system classifies the individual as “unknown” and triggers alerts to security personnel.

Deep learning models, particularly Convolutional Neural Networks (CNNs), are employed for accurate facial feature extraction and classification. The system also integrates motion detection and tracking mechanisms to continuously monitor suspicious activities. This approach significantly improves response time and reduces manual effort. The solution is applicable in areas such as airports, railway stations, offices, banks, and smart cities where security is a critical concern.

Keywords: Unknown person detection, CCTV surveillance, computer vision, face recognition, deep learning, Convolutional Neural Networks (CNN), real-time monitoring, image processing, artificial intelligence, biometric identification, security systems, anomaly detection, video analytics, smart surveillance, public safety collectively describe the core concepts of the system.

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I. INTRODUCTION

In today's rapidly evolving world, ensuring safety and security in public and private spaces has become a major concern. The increasing number of criminal activities, unauthorized access incidents, and security breaches has highlighted the limitations of traditional surveillance systems. Conventional Closed-Circuit Television (CCTV) cameras are widely deployed for monitoring purposes; however, they rely heavily on human operators to continuously observe video feeds. This manual monitoring is time-consuming, prone to fatigue, and often results in delayed or missed detection of suspicious activities.

To overcome these challenges, intelligent surveillance systems based on artificial intelligence and computer vision have been developed. Unknown person detection using CCTV cameras is one such advanced approach that automates the identification of individuals who are not recognized or authorized. The system captures real-time video streams and applies face detection and recognition techniques to identify known individuals by comparing their facial features with a pre-defined database. If the system fails to find a match, it classifies the person as "unknown" and generates alerts for further investigation.

The integration of deep learning algorithms, especially Convolutional Neural Networks (CNNs), has significantly improved the accuracy and reliability of face recognition systems. These models can effectively handle variations in lighting conditions, facial expressions, and angles, making them suitable for real-world surveillance scenarios. Additionally, modern systems incorporate object tracking and behavioral analysis to monitor the movement and activities of individuals over time, enabling proactive threat detection.

II. LITERATURE REVIEW

Several research studies have explored the use of computer vision and deep learning techniques for intelligent surveillance and unknown person detection. Early works primarily relied on traditional image processing methods such as Haar cascade classifiers for face detection and Eigenfaces or Fisherfaces for recognition. While these approaches were computationally efficient, they lacked robustness under varying lighting conditions, facial expressions, and occlusions. With the advancement of deep learning, researchers began adopting Convolutional Neural Networks (CNNs) for feature extraction and classification, significantly improving accuracy. Modern systems utilize pre-trained models such as FaceNet, VGG-Face, and DeepFace, which generate high-

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dimensional embeddings to represent facial features and enable reliable comparison with stored databases. Additionally, some studies have integrated object tracking algorithms like Kalman filters and SORT (Simple Online and Realtime Tracking) to continuously monitor individuals across frames. Recent literature also highlights the use of anomaly detection and behavioral analysis to identify suspicious activities beyond just facial recognition. Furthermore, cloud-based and edge computing solutions have been proposed to handle large-scale video data efficiently and enable real-time processing. Despite these advancements, challenges such as privacy concerns, dataset bias, and performance under low-resolution or crowded environments still remain areas of active research.

III. EXISTING SYSTEM

The existing system for surveillance using CCTV cameras is primarily based on manual monitoring, where security personnel continuously observe video feeds to identify suspicious activities or unauthorized individuals. These systems record and store video data for later review, but they lack the capability to automatically detect or recognize unknown persons in real-time. In some cases, basic motion detection techniques are used to highlight movement; however, they cannot differentiate between authorized and unauthorized individuals. Traditional face recognition methods, if implemented, often rely on simple algorithms that are sensitive to variations in lighting, pose, and facial expressions, resulting in low accuracy. Additionally, the dependency on human operators leads to fatigue, reduced attention span, and increased chances of missing critical events. As a result, existing systems are reactive rather than proactive, making them less efficient in preventing security threats and ensuring immediate response.

PROPOSED SYSTEM

The proposed system introduces an AI-based unknown person detection model using CCTV cameras to improve real-time security monitoring. In this system, live video from CCTV cameras is captured and processed using computer vision techniques. The system first detects human faces from the video frames and then extracts facial features using deep learning algorithms such as Convolutional Neural Networks. These extracted features are compared with a stored database of known or authorized persons. If the detected face matches with the database, the person is marked as authorized. If no match is found, the person is classified as an unknown person.

When an unknown person is detected, the system automatically generates an alert message to security staff or administrators. It

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can also store the image, time, date, and location details for future investigation. The proposed system reduces manual monitoring work, improves detection accuracy, and provides faster response to security threats. It is useful for schools, colleges, offices, banks, airports, railway stations, and smart city surveillance environments.

METHODOLOGY

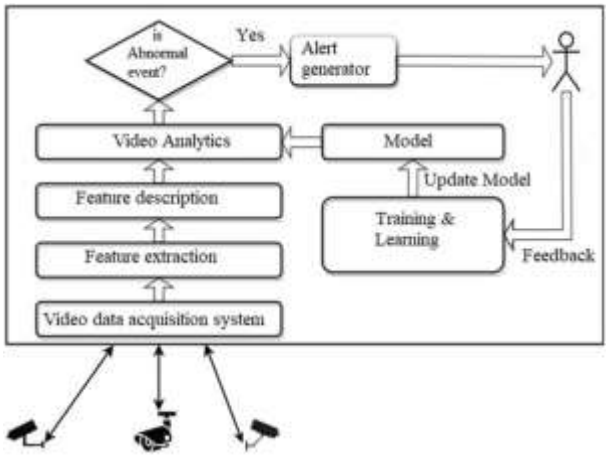
The proposed unknown person detection system using CCTV cameras follows a systematic approach that integrates computer vision and deep learning techniques for real-time surveillance. The methodology begins with video acquisition, where live footage is captured from CCTV cameras installed in the target area. The video stream is then divided into frames for further processing.

In the next step, face detection is performed on each frame using algorithms such as Haar Cascade or deep learning-based detectors like MTCNN or SSD. Once faces are detected, the system proceeds with feature extraction, where Convolutional Neural Networks (CNNs) are used to extract unique facial features and convert them into numerical embeddings. These embeddings represent the identity of individuals in a compact and efficient form.

After feature extraction, the system performs face recognition by comparing the extracted features with a pre-stored database of authorized individuals. Similarity measures such as Euclidean distance or cosine similarity are used to determine whether a match exists. If the similarity score exceeds a predefined threshold, the person is identified as known; otherwise, the system labels the individual as unknown.

VI. SYSTEM MODEL

System Architecture



IV. RESULTS AND DISCUSSIONS

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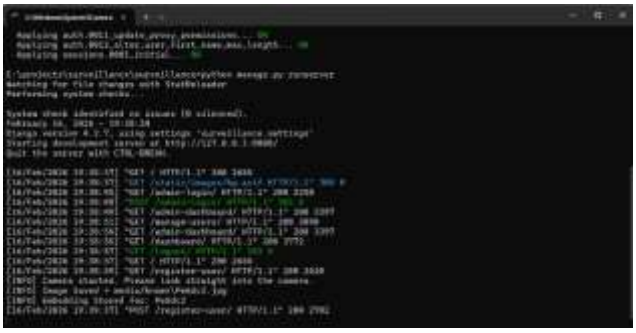

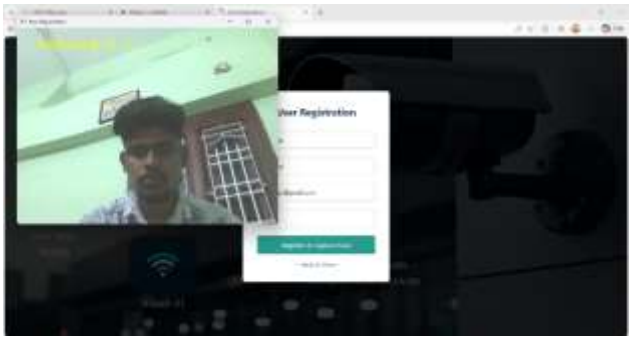

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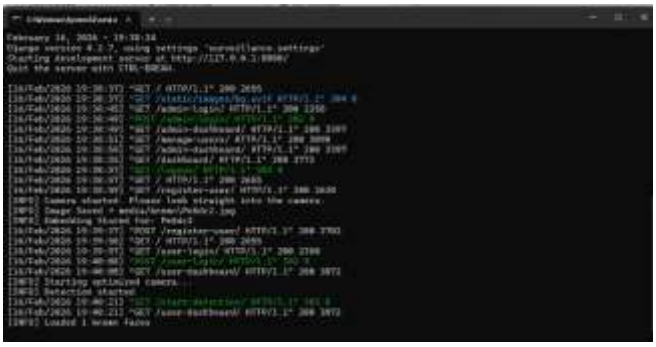

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Overall, the system contributes significantly to improving safety, preventing potential threats, and building a more secure and reliable surveillance infrastructure.

VIII. CONCLUSION

The unknown person detection system using CCTV cameras provides an intelligent and efficient solution for modern security challenges. By integrating artificial intelligence, computer vision, and deep learning techniques, the system overcomes the limitations of traditional surveillance methods that rely heavily on manual monitoring. It enables automatic detection and identification of individuals in real-time, ensuring quick recognition of unauthorized or suspicious persons.

The proposed system improves accuracy, reduces human effort, and enhances response time through automated alerts and continuous monitoring. Its ability to store and analyze data further supports investigation and decision-making processes. This makes it highly suitable for applications in public places, organizations, and smart city environments where security is a top priority.

IX. FUTURE WORK: Future work for this

The unknown person detection system using CCTV cameras can be further enhanced by incorporating advanced technologies and improving its overall performance and scalability. One important direction for future work is the integration of more robust deep learning models that can handle challenges such as low lighting conditions, occlusions (e.g., masks, glasses), and crowded environments with higher accuracy. Continuous training with large and diverse datasets can also help reduce bias and improve generalization.

Another improvement can be the inclusion of behavioral analysis, where the system not only detects unknown persons but also identifies suspicious activities based on movement patterns and actions. Integration with biometric systems such as fingerprint or iris recognition can further strengthen security. Additionally, implementing real-time alert

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systems using mobile applications, SMS, or IoT-based devices can enhance responsiveness.

Future systems can also focus on edge computing to process data locally on cameras or embedded devices, reducing latency and dependence on cloud infrastructure. Privacy-preserving techniques, such as data encryption and anonymization, should be considered to address ethical and legal concerns. Furthermore, integration with smart city infrastructure and centralized surveillance systems can enable large-scale monitoring and better coordination among security agencies.

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