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HUMAN INTRUSION DETECTION AND ALERT GENERATION SYSTEM THROUGH AI

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ABSTRACT

Security for restricted areas is crucial for asset protection and safety. Traditional systems often fail to verify if someone is unauthorized. This project introduces a real-time face recognition and suspicious action detection system that continuously monitors restricted zones. It uses OpenCV, SCRFD, YOLO, and ArcFace to identify individuals and distinguish between authorized users and trespassers. If an unauthorized person is detected, the system sends three alerts via email, text, and phone. If there's no response, it forwards the trespasser's details to the nearest police station and also the recording will be store to the manufacturing company. Additionally, the system compares the trespasser's photo with criminal records and includes this information in alerts. A user-friendly graphical interface is created with Python's Tkinter for ease of use.

KEYWORDS

Computer Vision, Machine Learning, Deep Learning, Human Intrusion Detection, Face Recognition, Rule-based Notification, Real-time Monitoring, Surveillance System, Image Processing.

I. CONTENT

A. Background

The extensive use of closed-circuit television (CCTV) cameras highlights the vital importance of surveillance systems in maintaining the security of private areas. However, manually distinguishing between authorized and unauthorized individuals and identifying potential trespassers within a large network of CCTV cameras presents considerable challenges. Traditional security systems, which are responsible for protecting valuable assets and maintaining security in restricted areas, often struggle to accurately verify identities. This difficulty is particularly noticeable when trying to differentiate between authorized personnel and potential trespassers, revealing a clear need for a more advanced and efficient surveillance solution. Existing monitoring techniques further complicate these issues, often proving inefficient and inaccurate in responding quickly to intrusions.

This gap underscores the need for a new, automated solution that leverages state-of-the-art Computer Vision and Machine Learning technologies. The project focuses on rushing the detection of unauthorized

access and immediately notifying security personnel, aiming to enhance monitoring capabilities, strengthen security measures, and ensure a rapid response to potential threats. The objective is to advance surveillance analytics, improve security protocols, and enhance intrusion response capabilities through the integration of facial recognition technology and real-time processing. By addressing the shortcomings of traditional monitoring methods, the project aims to significantly improve the effectiveness of security operations, enabling a more proactive and responsive approach to potential threats. Implementing a real-time, face recognition-based surveillance system represents a significant step forward, with the potential to greatly impact and improve surveillance, security, and emergency response efforts.

B. **Motivation**

This project seeks to solve key security issues in restricted areas by developing a real-time surveillance system based on facial recognition. Traditional security methods often have difficulty verifying the identities of individuals, which can leave valuable assets and sensitive areas at risk. Unlike standard CCTV cameras that require constant monitoring, this system uses advanced algorithms for facial detection and recognition to quickly identify unauthorized individuals. It also features a real-time alert mechanism that notifies designated authorities through multiple communication channels, allowing for a prompt response to any potential threat.

By addressing the limitations of manual monitoring, this system significantly improves the effectiveness and accuracy of surveillance operations. Additionally, the development of a user-friendly graphical interface ensures that the technology is accessible and easy to use, further enhancing the security and integrity of restricted areas. The motivation for this project is to create a more reliable and proactive security solution that provides faster, more efficient protection for sensitive environments.

C. **Aim and Objective**

The project aims to create a real-time detection and alert system that improves traditional CCTV systems by incorporating advanced technologies such as machine learning and computer vision. The main focus is on effective face detection, detecting suspicious activity of intruder and recognition, enabling the system to automatically identify unauthorized individuals in designated areas. This approach is designed to provide early warnings to administrators and security professionals, enhancing the overall effectiveness and dependability of security measures in private spaces.

Key Objectives:

- User-Friendly Interface: Develop an intuitive graphical interface (GUI) using Python's Tkinter library to allow administrators to easily monitor and manage the system, view alerts, and access security status.
- Real-Time Detection and Immediate Response: Build a system capable of detecting unauthorized human presence in real-time and triggering immediate responses upon detection. The system will quickly notify security personnel and administrators through multiple channels—such as email, text messages, and direct phone calls—to ensure swift action against potential security threats.
- Integrated Face Recognition Surveillance: Conduct thorough evaluations of the system's performance across various surveillance scenarios, including both indoor and outdoor settings. The system's robustness and adaptability will be assessed under different lighting conditions and potential obstructions to ensure it functions effectively in a range of real-world situations suspicious.

- Face Recognition API: Develop a flexible Face Recognition API aimed at providing a scalable, interoperable solution that can be easily integrated into various systems. The API will offer reliable and efficient facial recognition capabilities, enhancing security and user identification across multiple applications and platforms.
- Criminal Record Integration: Implement a feature that matches the captured images of trespassers against a database of criminal records to determine if the individual is a known suspect. If a match is found, the system will immediately notify both security personnel and the police with the relevant details.
- Real-Time Face Recognition and Action Detection: Implement a system that continuously monitors restricted areas, using both facial recognition and suspicious action detection to accurately identify individuals and detect unusual behaviour
- Automated Police Notification: Create an automated protocol to notify the nearest police station with the trespasser's information and location if no response is received after three alerts, ensuring swift action.

This project seeks to bridge the gaps in existing surveillance methods by employing cutting-edge technology to deliver a more proactive and reliable security solution.

Used Technologies and their work in System:

The rise in real-time face recognition for CCTV systems is driven by the need for enhanced security, especially in warehouses. Recent innovations have utilized machine learning and deep learning to automate this process, significantly improving security effectiveness.

A notable study introduced a real-time face recognition system using the ArcFace algorithm, which, when paired with SCRFD for face detection, demonstrated strong performance in various conditions. This system proved effective in real-world scenarios and inspired further research into automated monitoring systems for warehouses. These systems combined YOLO for object detection with ArcFace for facial recognition, providing continuous monitoring and swift alerts for unauthorized access.

Advancements in real-time object detection and tracking have also emerged, using synthetic data and deep neural networks for accurate tracking of fast-moving objects. This improvement enhances CCTV capabilities and emphasizes the importance of computational efficiency for real-time monitoring.

Recent research has focused on attribute-based person search and recognition, using machine learning for refined searches based on personal traits and specifics. Additionally, deep learning facial recognition systems, such as those using the VGG16 architecture, have shown exceptional results, with models achieving high accuracy in gender and age prediction, demonstrating significant progress in facial recognition technology.

The surveillance system starts by capturing or uploading images of authorized personnel for training, using techniques like Haar cascade and ArcFace to establish a baseline for accurate identification. The system stores these features in a reference database for comparison during live monitoring. CCTV cameras, equipped with YOLO for object detection and SCRFD for face detection, continuously scan for faces and suspicious activities.

When combined, these two models create a robust security system that not only detects human presence with speed but also ensures precise face recognition. This allows for real-time alerts and responses, ensuring that intrusions are not only detected quickly but also with high accuracy, reducing false alarms. The system can trigger timely actions like sending alerts to security personnel, locking down the area, or activating additional surveillance measures.

YOLO's real-time detection combined with SCRFD's ability to detect small and distant faces enhances the system's ability to track individuals over time. This is particularly useful for long-term monitoring, as the system can reliably follow the movements of an individual throughout the surveillance area.

Ultimately, YOLO's speed and SCRFD's accuracy make them a highly effective pair for building advanced intrusion detection systems that balance both efficiency and precision, crucial for any real-world security application.

How the System will work:

When users log in, they are presented with the default live camera feed, enabling real-time monitoring for intrusion detection. The security administrator or system owner has the ability to register authorized individuals by either capturing images directly through the platform or uploading images to train the facial recognition model. This customized process ensures a more precise approach to user authentication, improving the system's ability to accurately identify authorized personnel

Users have the option to choose between two main operating modes: Face Recognition Intrusion Detection and Intrusion Detection. The Face Recognition mode utilizes sophisticated facial recognition technology to improve accuracy in identifying people, while the Intrusion Detection mode is designed to detect any unauthorized entries in the monitored space. This flexibility allows users to tailor the system to meet different security needs and preferences.

Incorporating new CCTV cameras into the surveillance system is straightforward thanks to the intuitive interface, which allows users to effortlessly enter the camera's IP address for smooth integration.

Furthermore, users can oversee their camera inventory with the ability to add or remove cameras as needed. This feature ensures the system can grow and adapt to meet evolving security demands

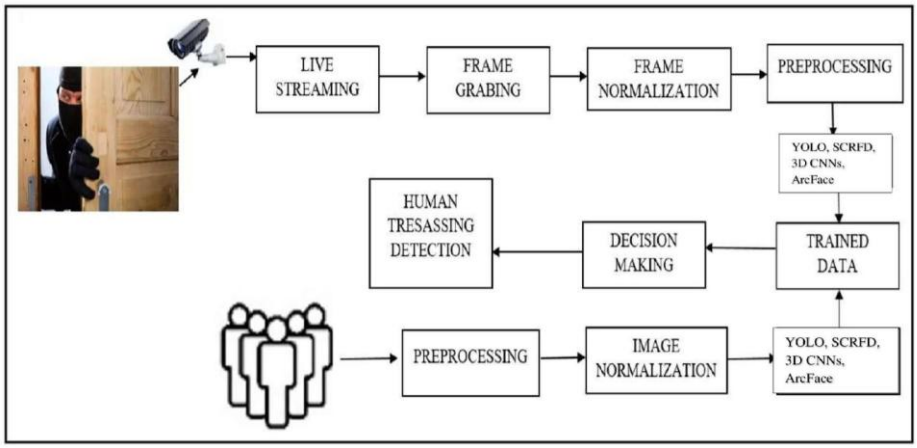


Fig 1: Workflow of Surveillance system with Human Intrusion Detection

II. CONCLUSION

The Human Intrusion Detection and Alert generation system through AI project has successfully overcome the limitations of traditional security systems by introducing a real-time face recognition-based surveillance and detecting suspicious activity solution. Using advanced algorithms and the OpenCV Python library, this system offers strong surveillance for restricted areas. Its key feature is the ability to differentiate between intruders and authorized individuals, thereby significantly boosting the security and reliability of monitored zones. By combining SCRFD and YOLO for face detection with ArcFace for recognition and 3D CNNs for detecting specific suspicious activities, the system has achieved a high accuracy rate of over 90%. However, the accuracy can vary depending on the quality of the dataset and the surveillance camera used. Additionally, the development of a user-friendly graphical interface using Python's Tkinter improves the system's accessibility, making it versatile for different applications. This project's success demonstrates the rapid progress in face recognition technology, with ongoing efforts to enhance accuracy and reduce processing demands. The API developed in this project has the potential for broad adoption in systems that require effective face recognition capabilities.

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