RESEARCH PAPER

Securescape: Deep Vision-Based Framework For Behavioral Crime Detection And Face Intelligence

Dr. Annapoorani .B [1*], Sujith S [2*], Thirumalai Harish M [3*], Tharashan K G [4*]

[1*] Assistant Professor, Department of Computer Science and Engineering, V.S.B College of Engineering Technical campus, kinathukadavu, Coimbatore, Tamilnadu, India.

[2*] UG Scholar, Department of Computer Science and Engineering, V.S.B College of Engineering Technical campus, kinathukadavu, Coimbatore, Tamilnadu, India

[3*] UG Scholar, Department of Computer Science and Engineering, V.S.B College of Engineering Technical campus, kinathukadavu, Coimbatore, Tamilnadu, India.

[4*] UG Scholar, Department of Computer Science and Engineering, V.S.B College of Engineering Technical campus, kinathukadavu, Coimbatore, Tamilnadu, India.

Abstract— The rapid advancement of artificial intelligence and deep learning technologies has profoundly impacted the evolution of contemporary surveillance and security systems. Intelligent monitoring systems are now more in demand to address the increasing security concerns in public spaces, financial institutions, and urban environments. This paper aims to present an intelligent suspicious activity detection and crime face recognition system using AI technology for enhanced automatic surveillance systems. The system incorporates intelligent pose estimation, anomaly detection, and object detection mechanisms for detecting abnormal human activities such as aggressive movements, loitering, and the presence of dangerous objects in the monitored area. For accurate object detection, the system incorporates a YOLO based intelligent object detection model for detecting suspicious objects such as weapons and dangerous items in real-time scenarios. In addition to activity analysis, the system incorporates a Grassmannian-based intelligent facial recognition system using CNN architectures for accurate criminal face recognition based on facial feature analysis with a criminal database. The framework continually processes video streams from surveillance systems, detects unusual activities, and sends out alerts when unusual behavior or identified offenders are detected. The automated notification systems help in efficient response from security authorities. The inclusion of intelligent surveillance systems and face recognition helps in efficient monitoring by reducing manual surveillance activities and increasing accuracy in potential threats

Keywords— Anomaly Detection, Crime Surveillance, Deep Learning, Facial Recognition, Object Detection, Suspicious Activity Detection, YOLO.

How to cite this article: Annapoorani B, Sujith S, Thirumalai Harish M, Tharashan KG. Securescape: deep vision-based framework for behavioral crime detection and face intelligence. Int J Drug Deliv Technol. 2026;16(74s): 2030-2036. DOI: 10.25258/ijddt.16.74s.162

I. INTRODUCTION

The rapid advancement of artificial intelligence and deep learning technologies has significantly transformed modern surveillance and security infrastructures. Traditional monitoring systems based on conventional CCTV cameras mainly depend on continuous human observation, which often leads to inefficiencies due to human fatigue, limited attention span, and delayed response to critical events. As urban environments continue to expand and public spaces become more crowded, the demand for intelligent and automated security solutions has increased considerably. Advanced computer vision techniques have emerged as effective tools for analysing visual data in real time, enabling the detection of abnormal activities and potential threats without constant manual supervision. The integration of intelligent algorithms into surveillance systems provides the capability to monitor multiple environments simultaneously while improving the accuracy and speed of threat identification[11]. Recent developments in deep learning have enabled significant improvements in object detection, human behavior analysis, and facial recognition technologies. Modern algorithms are capable of extracting complex visual patterns from surveillance footage, allowing accurate identification of suspicious movements, dangerous objects, and unusual behavioral patterns[12]. Object detection frameworks such as YOLO have demonstrated strong performance in recognizing objects in real time, including weapons or suspicious items that may indicate potential criminal activity.

In addition to object detection, facial recognition techniques supported by convolutional neural networks provide reliable identification of individuals by analysing facial features and comparing them with stored records[4]. These advancements contribute to the development of intelligent monitoring systems capable of supporting law enforcement agencies in identifying suspects and preventing criminal incidents[14]. This research introduces an AI driven suspicious activity detection and crime face recognition framework designed to enhance automated surveillance capabilities. The presented system integrates object detection, pose estimation, anomaly detection, and facial recognition to analyse surveillance footage and identify potential threats effectively. A Grassmannian-based approach combined with deep learning architectures is employed to improve facial feature extraction and matching accuracy. Continuous monitoring of video streams enables the identification of aggressive behavior, loitering activities, and the presence of dangerous objects, while an automated alert mechanism notifies authorities when suspicious events are detected[2]. Such an intelligent surveillance framework strengthens public safety measures, improves situational awareness, and supports proactive crime prevention strategies in modern security environments.

Remainder of the paper is organized as follows. Section 2 discusses the related work in AI-based surveillance systems, focusing on deep learning approaches for object detection, suspicious activity recognition, and facial identification for enhanced public safety. Section 3 describes the proposed methodology, section 4 presents the experimental analysis section 5 concludes the paper.

II. RELATED WORKS

Mukto, Md Muktadir, et al. [1] proposed a real-time crime monitoring system that utilizes deep learning techniques to enhance automated surveillance and improve public safety. The research focused on integrating computer vision models with video surveillance to identify suspicious activities and criminal behavior in real time. The system processes continuous video streams captured from surveillance cameras and applies deep learning algorithms to detect abnormal events such as violent movements or unusual interactions among individuals. Convolutional neural networks were employed to extract visual features from video frames, enabling accurate classification of activities. The framework emphasizes the importance of real-time monitoring to reduce response delays in security operations. The proposed approach also highlights the capability of intelligent systems to analyse large volumes of visual data efficiently. Experimental observations demonstrate that automated monitoring systems significantly outperform traditional manual surveillance in terms of detection accuracy and operational efficiency.

Mandalapu, Varun, et al. [15] presented a comprehensive review of machine learning and deep learning techniques applied to crime prediction and analysis. The study analysed various predictive models designed to identify crime patterns and support proactive law enforcement strategies. The research examined different algorithms including decision trees, support vector machines, neural networks, and deep learning frameworks used in crime prediction tasks. The authors discussed how historical crime data and environmental factors can be analysed using advanced computational techniques to identify patterns associated with criminal activities. The review also explored the role of big data analytics in improving the accuracy of crime prediction models. Several challenges such as data imbalance, model interpretability, and real-time prediction capabilities were highlighted in the study. The research emphasized the importance of combining multiple data sources such as demographic information, geographic data, and surveillance footage to enhance prediction accuracy.

Rendón-Segador, Fernando J., et al. [3] introduced CrimeNet, a neural structured learning framework designed for detecting violent activities in video surveillance data. The research utilized vision transformer architectures to improve the accuracy of violence detection in complex environments. The proposed model analyses spatial and temporal information from video frames to identify aggressive actions or abnormal human behavior. The transformer-based approach enhances feature extraction capabilities by capturing long-range dependencies between video frames. The system was trained on datasets containing different forms of violent activities such as fights, assaults, and physical conflicts. Experimental evaluation demonstrated that the proposed architecture achieved higher performance compared with traditional convolutional neural network models. The research highlighted the advantages of transformer-based networks in understanding contextual information present in video sequences. Improved recognition of violent events enables more reliable security monitoring in crowded environments

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Negre, Pablo, et al. [13] conducted an extensive literature review on deep learning approaches for violence detection in video surveillance systems. The study analysed a wide range of models designed to detect aggressive behavior and abnormal interactions among individuals in public environments. Various deep learning architectures including convolutional neural networks, recurrent neural networks, and hybrid models were examined in the research. The survey discussed the advantages and limitations of each approach in terms of detection accuracy, computational complexity, and real-time performance. Particular emphasis was placed on the importance of analysing both spatial and temporal features in surveillance videos. The study also explored the challenges associated with recognizing violent activities in crowded environments where multiple individuals interact simultaneously. Data availability and dataset diversity were identified as major factors influencing model performance. The research further highlighted the role of transfer learning in improving detection accuracy with limited training data.

Boukabous, Mohammed, et al. [5] proposed a deep learning framework for crime prediction using image and video analysis techniques. The research focused on integrating object detection algorithms with visual data analysis to identify potential criminal activities. The system processes surveillance footage to detect suspicious objects and behaviours that may indicate security threats. Advanced object detection models were employed to recognize weapons, dangerous items, and abnormal interactions among individuals. The framework also analyses patterns in visual data to support early detection of criminal incidents. The study demonstrated that deep learning-based surveillance systems can significantly improve the ability to monitor complex environments. The research also emphasized the importance of real-time detection for effective security management. Experimental results indicated improved performance in identifying suspicious objects within video frames.

Ma, Tianxiang, et al. [6] investigated abnormal behavior analysis using a multi-modal data fusion approach to improve the reliability of automated monitoring systems. The research focused on analysing behavioral patterns by combining information from different data sources. The proposed framework integrates visual data, sensor information, and system logs to identify unusual behavior in monitored environments. Machine learning algorithms were applied to analyse these multi-modal datasets and detect deviations from normal patterns. The system demonstrated the ability to recognize abnormal activities that may indicate potential security threats or operational issues. Data fusion techniques were used to enhance detection accuracy by combining complementary information from multiple sources. The study also discussed the importance of anomaly detection in maintaining secure and reliable systems. Experimental evaluation showed that the fusion based approach significantly improved the detection of abnormal behavior. The research contributes to the development of intelligent monitoring systems capable of analysing complex data environments.

Wastupranata, Leonard Matheus, et al. [7] presented a survey on deep learning techniques used for abnormal human behavior detection in surveillance videos. The research reviewed several computer vision models designed to analyse human actions and detect suspicious activities in public environments. Various deep learning architectures such as convolutional neural networks, recurrent neural networks, and spatiotemporal networks were examined in the study. The survey highlighted the importance of motion analysis and activity recognition in detecting abnormal behavior. Different datasets used for training behavior detection models were also analysed in the research. The study discussed several challenges including occlusions, complex backgrounds, and variations in human posture. Techniques for improving detection accuracy through feature extraction and motion analysis were presented.

Nwakeze, Osita Miracle, et al. [8] explored the role of behavioral analysis and machine learning techniques in improving risk management and security monitoring systems. The research focused on analysing human behavior patterns to identify potential security risks in digital and physical environments. Machine learning algorithms were applied to behavioural datasets to detect anomalies that may indicate suspicious or malicious actions. The study emphasized the importance of incorporating human behavioral factors into security frameworks to enhance threat detection capabilities. The proposed approach analyses behavioral trends and deviations to identify unusual patterns. The research also discussed the significance of integrating behavioral analytics with automated monitoring systems. Improved detection of abnormal activities contributes to more effective security management strategies.

Jinnuo, Zhu, et al. [9] conducted an analysis of various techniques used in human emotion and behavior recognition through machine learning and deep learning models. The study examined several algorithms designed to analyse facial expressions, body movements, and emotional patterns in visual data. The research highlighted the importance of behavioural analysis in applications such as surveillance, healthcare, and human–computer interaction. Deep learning models were used to extract features related to emotional expressions and behavioral patterns from images and videos. The framework demonstrated the ability to classify different human emotions and actions with improved accuracy. The study also discussed the challenges associated with interpreting complex human behaviors in real-world environments. Feature extraction and pattern recognition techniques were identified as critical components of behavior analysis systems. The research contributes to the development of intelligent systems capable of understanding human behavior through visual data analysis.

Nadar, Ali, et al. [10] investigated the integration of artificial intelligence services with machine learning model provisioning to enhance data analytics functions in communication networks. The research focused on improving the deployment and management of machine learning models within large-scale systems. The proposed framework enables efficient integration of AI models into existing infrastructures to support intelligent data analysis. The study discussed methods for optimizing model performance and ensuring reliable operation within distributed environments. Advanced analytics techniques were employed to process large volumes of data generated by network systems. The framework also highlighted the importance of scalable architectures for deploying AI-based solutions in real-time applications. Improved data analytics capabilities support the development of intelligent monitoring and decision-making systems. The research contributes to the advancement of AI-driven analytics platforms that support various applications including surveillance and security monitoring.

III. PROPOSED METHODOLOGY

A. Overview

The increasing demand for intelligent security systems has encouraged the development of automated surveillance technologies capable of identifying potential threats in real time. This research presents an AI-driven suspicious activity detection and crime face recognition framework designed to enhance public safety and improve monitoring efficiency in surveillance environments. The proposed approach integrates advanced computer vision techniques such as object detection, facial recognition, pose estimation, and anomaly detection to analyse video streams captured from surveillance cameras. A YOLO-based model identifies dangerous objects and suspicious items, while a Grassmannian-based facial recognition mechanism extracts facial features and compares them with stored criminal records for accurate identification. Behavioural analysis further enables the recognition of abnormal human activities such as aggressive movements or unusual loitering patterns. An automated alert and notification mechanism ensures that security authorities receive immediate warnings when suspicious events are detected. The combination of intelligent activity monitoring and facial identification significantly enhances situational awareness, reduces reliance on manual surveillance, and supports proactive crime prevention in modern security infrastructures. The overall architecture of the proposed framework is shown in Fig. 1.

B. System Architecture

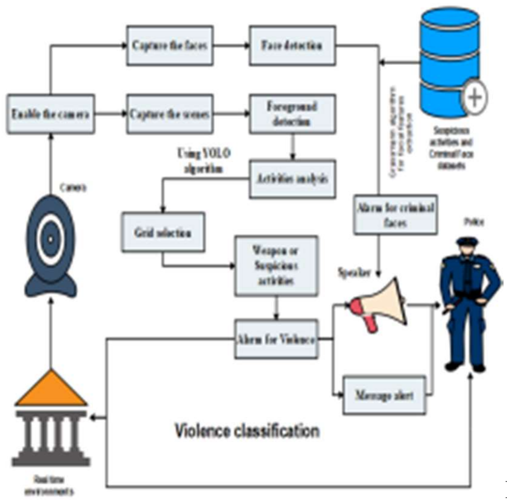

Fig. 1. System Architecture

C. METHODOLOGY

Surveillance Data Acquisition

The initial stage of the framework involves capturing real-time video streams from surveillance cameras installed in monitored environments. Continuous video frames are obtained and forwarded to the processing module for further analysis. The captured data forms the primary input for activity detection and facial recognition tasks. This stage ensures that visual information from multiple locations can be monitored simultaneously, enabling effective observation of public areas, financial institutions, and other sensitive locations. High-quality frame acquisition improves the reliability of subsequent detection and recognition processes.

Face Detection and Feature Extraction

Facial detection is performed to identify human faces present within the captured video frames. Once a face region is detected, important facial features are extracted for recognition purposes. A Grassmannian-based feature representation combined with convolutional neural network architectures is applied to capture discriminative facial characteristics. This approach improves recognition performance by representing facial patterns in a compact and robust feature space, allowing reliable identification even when variations in lighting, pose, or partial occlusions occur.

YOLO-Based Object Detection

Object detection plays an essential role in identifying suspicious items within the surveillance environment. A YOLO-based detection model is employed to locate and classify objects such as firearms, knives, or unattended bags in real time. The algorithm processes each frame and predicts bounding boxes around detected objects while assigning class labels and confidence scores. Rapid detection capabilities enable the system to identify potential threats instantly, supporting immediate security responses.

Foreground Extraction and Activity Analysis

Foreground detection techniques are applied to separate moving objects, particularly human subjects, from the background scene. Once the foreground is extracted, activity analysis algorithms evaluate movement patterns and body posture to understand behavioral characteristics. Pose estimation methods assist in identifying abnormal body movements, gestures, or unusual interactions within the monitored area. This analysis helps detect suspicious behaviors that may indicate potential criminal activity.

Violence and Threat Classification

Behavioral patterns identified from activity analysis are further processed through a classification model to determine whether the detected activity represents a potential threat. The classification stage analyses motion intensity, gesture patterns, and interaction dynamics to recognize violent actions or aggressive behavior. Suspicious events such as fighting, sudden aggressive movements, or threatening gestures are categorized and marked as potential security risks.

Criminal Face Identification and Database Matching

Detected facial features are compared with a pre-existing criminal database to identify known offenders. Feature vectors extracted from the detected faces are matched against stored records using similarity measurement techniques. When a match is identified, the system confirms the presence of a known suspect within the monitored location. The database management component ensures secure storage and efficient retrieval of criminal records for accurate identification.

Alert Generation and Security Notification

The final stage of the methodology involves generating alerts when suspicious activities or criminal identities are detected. An automated notification mechanism activates alarms and sends real-time alerts to security personnel or law enforcement authorities. Additionally, event reports containing details such as detected faces, objects, and activity descriptions are generated for further investigation. This mechanism enables rapid response and enhances overall security management within surveillance environments.

ALGORITHM 1.

YOLO-Based Object Detection Algorithm

Step 1: Capture video frames from surveillance cameras installed in the monitored environment.
Step 2: Perform image preprocessing to resize frames and normalize pixel values for efficient model processing. Step 3: Input the processed frame into the YOLO detection network for feature extraction.
Step 4: Divide the image into multiple grid cells where each cell predicts bounding boxes and object confidence scores.
Step 5: Detect objects such as weapons, suspicious bags, or other harmful items by assigning class labels.
Step 6: Apply confidence thresholding to remove weak predictions and retain highly probable detections. Step 7: Use Non-Maximum Suppression (NMS) to eliminate duplicate bounding boxes and refine detection results. Step 8: Display the detected objects with bounding boxes and forward threat

information to the activity analysis module.

ALGORITHM 2.

Grassmannian-Based Face Recognition Algorithm

Step 1: Capture input frames from the surveillance video stream containing human faces.
Step 2: Detect facial regions within the frame using a face detection model.
Step 3: Extract the detected face region and convert it into a normalized facial image.
Step 4: Apply convolutional neural network layers to extract deep facial feature representations.
Step 5: Represent extracted facial features in Grassmannian Features space for robust dimensional representation. Step 6: Generate feature vectors and compare them with stored facial feature vectors in the criminal database.
Step 7: Compute similarity scores to determine whether the detected face matches any stored record.
Step 8: Identify the person if a match is found and forward identification results to the alert system

IV. PERFORMANCE ANALYSIS

The experimental evaluation was conducted to analyse the effectiveness of the intelligent surveillance framework in detecting suspicious activities and identifying criminal faces within surveillance environments. Performance analysis focused on detection accuracy, response time, automation capability, and reliability in identifying potential threats. The evaluation considered different surveillance scenarios where abnormal behavior, weapon presence, and facial identification tasks were processed by the system. Results demonstrate that the integration of deep learning models for object detection, behavior analysis, and facial recognition significantly improves the overall performance of security monitoring systems.

Automated analysis of surveillance footage reduces dependency on manual observation and enables rapid identification of potential threats in real time.

A comparative analysis between conventional surveillance approaches and the AI-driven framework highlights substantial improvements in detection accuracy and operational efficiency. Traditional monitoring systems mainly depend on manual supervision, which often leads to delayed responses and missed suspicious activities. In contrast, the intelligent framework continuously processes video streams and performs automated threat detection. The incorporation of YOLO-based object detection and Grassmannian-based facial recognition enhances the ability to detect dangerous objects and identify individuals even in complex environmental conditions. Experimental observations indicate improved reliability, faster threat identification, and reduced false alarms when compared with conventional monitoring methods.

TABLE I
COMPARATIVE ANALYSIS OF THE EXISTING AND PROPOSED SYSTEM

Performance Metric	**Existing System (%)**	**Proposed System (%)**
Detection Accuracy	72	94
Facial Recognition Accuracy	70	93
Suspicious Activity Detection Accuracy	68	92
Weapon Detection Accuracy	65	91
False Alarm Rate	28	9
Response Efficiency	60	90

The performance evaluation highlights significant improvements achieved by the intelligent surveillance framework when compared with conventional monitoring approaches. Detection accuracy and facial recognition performance demonstrate notable enhancement due to the integration of deep learning algorithms and advanced feature extraction techniques. Suspicious activity and weapon detection rates show higher reliability because of the YOLO-based object detection mechanism and behavior analysis modules. In addition, the false alarm rate is considerably reduced, which improves the overall reliability of the surveillance process. Faster response efficiency is achieved through automated alert generation and real-time threat identification.

Fig. 2 . Surveillance System Performance Comparison

Fig. 2 presents the radar chart visualization of the comparative performance between the conventional surveillance system and the proposed AI-based intelligent surveillance framework. The evaluation considers multiple metrics including detection accuracy, facial recognition accuracy, suspicious activity detection accuracy, weapon detection accuracy, false alarm rate, and response efficiency.

Each metric is represented along a radial axis, enabling simultaneous comparison of system performance. The proposed framework demonstrates significantly higher performance across most evaluation parameters due to the integration of deep learning–based object detection and facial recognition techniques. Additionally, the reduced false alarm rate and improved response efficiency highlight the reliability of the automated monitoring framework in real-time surveillance environments. As shown in Fig. 3, the proposed system achieves improved performance across evaluation metrics.

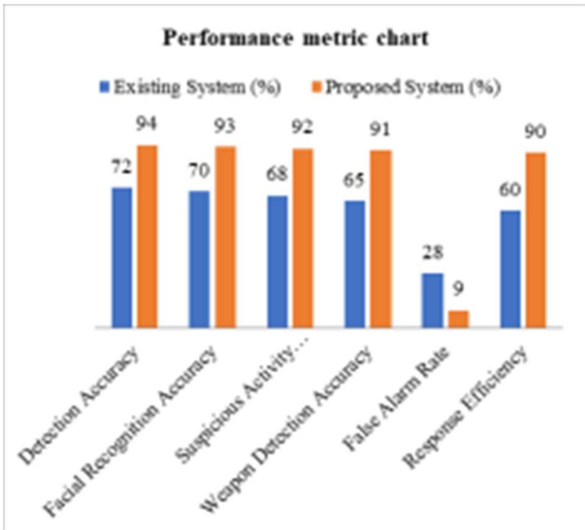

Fig. 3. Performance metric chart representation

V. CONCLUSION

Optimized routing decisions have not only led to a The integration of artificial intelligence and deep learning techniques has significantly improved the capabilities of modern surveillance systems. This research presented an intelligent framework for suspicious activity detection and criminal face recognition that enhances automated security monitoring in surveillance environments. By combining object detection, behavioural analysis, and facial recognition mechanisms, the system is capable of identifying potential threats in real time. The implementation of a YOLO-based object detection model enables accurate identification of dangerous objects, while the Grassmannian-based facial recognition approach improves the reliability of identifying individuals from surveillance footage. Behavioural analysis further supports the detection of abnormal movements and suspicious activities, allowing security authorities to respond quickly to potential security risks. Experimental observations demonstrate that the intelligent surveillance framework provides higher detection accuracy, faster response time, and improved reliability when compared with traditional monitoring systems. Automated analysis of surveillance footage reduces the dependency on manual observation and enables continuous monitoring of multiple locations simultaneously. The integration of real-time alerts and notification mechanisms supports rapid response and enhances situational awareness for law enforcement agencies. Such an advanced surveillance solution contributes to improved public safety, efficient crime prevention strategies, and the development of smarter security infrastructures for modern urban environments. We can do work on the surveillance system to make it work better in the real world. The surveillance system can be improved by adding deep learning models and using more kinds of data, like sound and heat. This can help the system find things accurately. We can also think about using edge computing and methods to keep data private. This way the surveillance system can work quicker. Be more secure. The surveillance system needs to work and keep data safe when people are using it. We need to make sure the surveillance system and edge computing work to keep data private and secure.

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