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SECURE VISION: An AI Based Threat Detection and Alert System

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ABSTRACT: Ensuring safety in public environments such as campuses, transportation stations, banks, and shopping centres has become increasingly important in recent years. Although CCTV cameras are widely used for surveillance, most systems rely on manual monitoring by security personnel, which is inefficient and prone to human error. Continuous observation of multiple video streams can lead to missed events and delayed responses to suspicious activities.

This paper presents “Secure Vision,” an artificial intelligence–based threat detection and alert system that automatically analyses surveillance video to identify abnormal human behaviour. The system combines YOLO for real-time human and object detection, Deep SORT for tracking individuals across video frames, and LRCN (Long-term Recurrent Convolutional Network) for behaviour analysis. By analysing spatial and temporal patterns in video sequences, the system can identify potentially dangerous activities and trigger alerts for security personnel. Detected events are also recorded with timestamps and visual evidence for further investigation. The proposed approach reduces reliance on manual monitoring and improves the efficiency of modern surveillance systems.

KEYWORDS: Artificial Intelligence, Smart Surveillance, Threat Detection, YOLO, Deep SORT, Behaviour Recognition.

I. INTRODUCTION

Security and surveillance systems are essential for maintaining safety in public and private environments such as educational institutions, transportation hubs, banks, shopping malls, and other crowded locations. With the rapid growth of urban infrastructure, a large number of CCTV cameras are deployed to monitor activities and prevent criminal incidents. However, traditional surveillance systems primarily depend on human operators to continuously observe video feeds. Monitoring multiple camera streams for extended periods is challenging and often leads to fatigue, reduced attention, and delayed responses to suspicious activities.

Most conventional CCTV systems only record video footage without providing intelligent analysis of the captured data. As a result, many incidents such as fights, theft, vandalism, or the presence of dangerous objects may go unnoticed until the footage is reviewed after the event. This reactive approach limits the effectiveness of surveillance systems in preventing potential threats.

Recent advancements in artificial intelligence and computer vision have enabled the development of automated surveillance solutions capable of analysing video data in real time. Deep learning techniques can detect objects, track individuals, and recognise human activities with high accuracy.

In this work, we propose Secure Vision, an AI-based threat detection and alert system that automatically identifies suspicious activities in surveillance footage. The system integrates YOLO for object detection, Deep SORT for multi-object tracking, and LRCN for behaviour recognition to analyse spatial and temporal patterns in video sequences. By generating real-time alerts and recording incident data, the proposed system aims to enhance surveillance efficiency and improve public safety.

II. LITERATURE SURVEY

Real-time violence detection in surveillance videos has been explored using deep learning techniques. In [1], a framework was proposed to identify violent activities by analysing spatial and temporal features extracted from video sequences. The study demonstrated that deep learning models can effectively recognise aggressive behaviour patterns in surveillance footage. However, the system primarily focused on violence detection and did not include object tracking or multi-object monitoring.

Object detection algorithms have also played a crucial role in modern surveillance systems. The YOLO (You Only Look Once) algorithm introduced in [2] provides a fast and efficient approach for real-time object detection in images and videos. YOLO performs detection in a single forward pass through the network, enabling high-speed processing suitable for surveillance applications. Despite its efficiency, object detection alone cannot analyse behavioural patterns over time.

To address object tracking challenges, Deep SORT was introduced as an advanced multi-object tracking algorithm. The method presented in [3] combines motion and appearance information to maintain consistent identities of objects across frames. This approach significantly improves tracking performance in crowded environments. However, it mainly focuses on tracking and does not analyse human behaviour.

Anomaly detection in surveillance videos has also been studied extensively. In [4], a deep learning approach was proposed to identify unusual events in surveillance footage by analysing patterns that deviate from normal behaviour. While the method showed promising results, the system required high computational resources and was not optimized for real-time deployment.

In addition to these approaches, several recent studies have explored the integration of deep learning models with intelligent surveillance systems to improve threat detection capabilities. These systems focus on combining object detection, tracking, and behaviour analysis techniques to automatically identify suspicious activities in real-time video streams. Such developments highlight the growing importance of automated surveillance solutions for enhancing public safety and reducing the limitations of manual monitoring systems.

III. METHODOLOGY

The proposed Secure Vision system follows a structured workflow to detect suspicious activities and dangerous objects in surveillance video streams. The overall process is illustrated in Fig. 1. The system begins by capturing video input from CCTV cameras or other surveillance sources. The continuous video stream is then divided into individual frames using the frame extraction process to enable frame-by-frame analysis.

Each frame is processed using the YOLO (You Only Look Once) object detection algorithm to identify humans and potential weapons such as knives or other dangerous objects. YOLO generates bounding boxes and confidence scores for the detected objects in real time.

After object detection, the Deep SORT tracking algorithm is used to track detected individuals across multiple frames. This algorithm assigns unique identities to detected persons and maintains consistent tracking even when people move within the camera view.

The system then performs behaviour analysis to examine the detected objects and interactions between them. The behaviour analysis stage plays an important role in identifying abnormal activities within the surveillance environment. By analysing detected objects and their interactions over time, the system can determine whether a situation represents normal behaviour or a potential threat. This helps the system reduce false alarms while maintaining accurate detection of suspicious situations. If a person is identified holding a weapon or performing abnormal actions, the activity is classified as suspicious. Once suspicious activity is detected, the threat detection module triggers the alert generation process.

The system sends alerts to security personnel and records the detected event. Finally, the detected incidents, along with timestamps and images, are stored in the event logging database for further monitoring and investigation.



Fig 1: Methodology of Secure Vision System

The System Architecture is as follows:

The **Secure Vision system architecture** consists of several interconnected modules that work together to analyse surveillance video and detect potential threats. The architecture is designed to process video data efficiently and provide real-time monitoring of activities in the surveillance environment.

The process begins with the **video input module**, which captures live footage from CCTV cameras installed in the monitored area. The captured video stream is then passed to the **frame extraction module**, where the continuous video is divided into individual frames. This allows each frame to be analysed separately for object detection.

These frames are then processed by the **object detection module**, which uses the YOLO model to detect humans and possible weapons such as knives or other dangerous objects. The detection model generates bounding boxes and confidence scores for each detected object, enabling the system to identify suspicious items in real time.

After object detection, the **tracking module** uses the Deep SORT algorithm to assign unique IDs and track individuals across consecutive frames. This tracking process ensures that each detected person is monitored continuously as they move within the surveillance area.

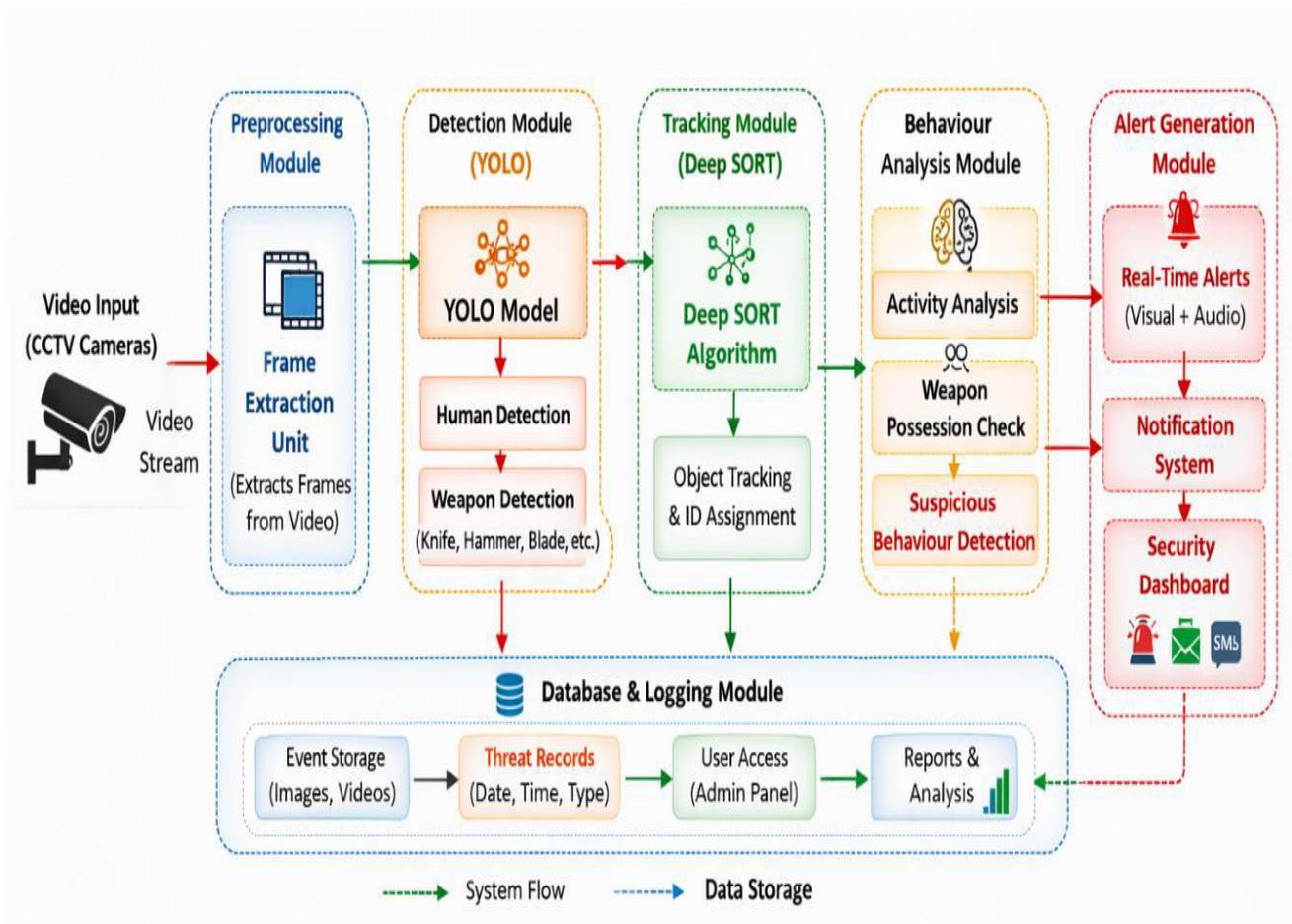


Fig 2: System Architecture

Next, the **behaviour analysis module** evaluates the detected objects and activities to identify suspicious situations, such as the presence of a weapon. When a threat is detected, the **alert generation module** sends notifications to security personnel. Finally, the detected events and related information are stored in the **database module** for logging and future analysis.

IV. EXPERIMENTAL RESULTS

The system interface provides a clear visualization of detected objects and ongoing monitoring activities. Bounding boxes and confidence scores are displayed for each detected object, allowing users to easily understand the detection results. This visual representation helps security personnel quickly identify whether the detected object represents normal activity or a potential threat. The integration of detection, tracking, and alert mechanisms ensures that suspicious events are identified quickly and appropriate action can be taken when necessary. In addition, the monitoring dashboard continuously updates the detection results, enabling users to observe real-time surveillance activity and respond promptly to any unusual situations.

The proposed Secure Vision system was tested using live video input to evaluate its ability to detect normal activities and potential threats in real time. The system processes video frames continuously and identifies humans and suspicious objects using deep learning models. The experimental results demonstrate the system's capability to accurately detect weapons, generate alerts, and store captured evidence for further analysis. The following figures

illustrate the system interface, threat detection results, captured event logs, and alert notifications generated during testing.

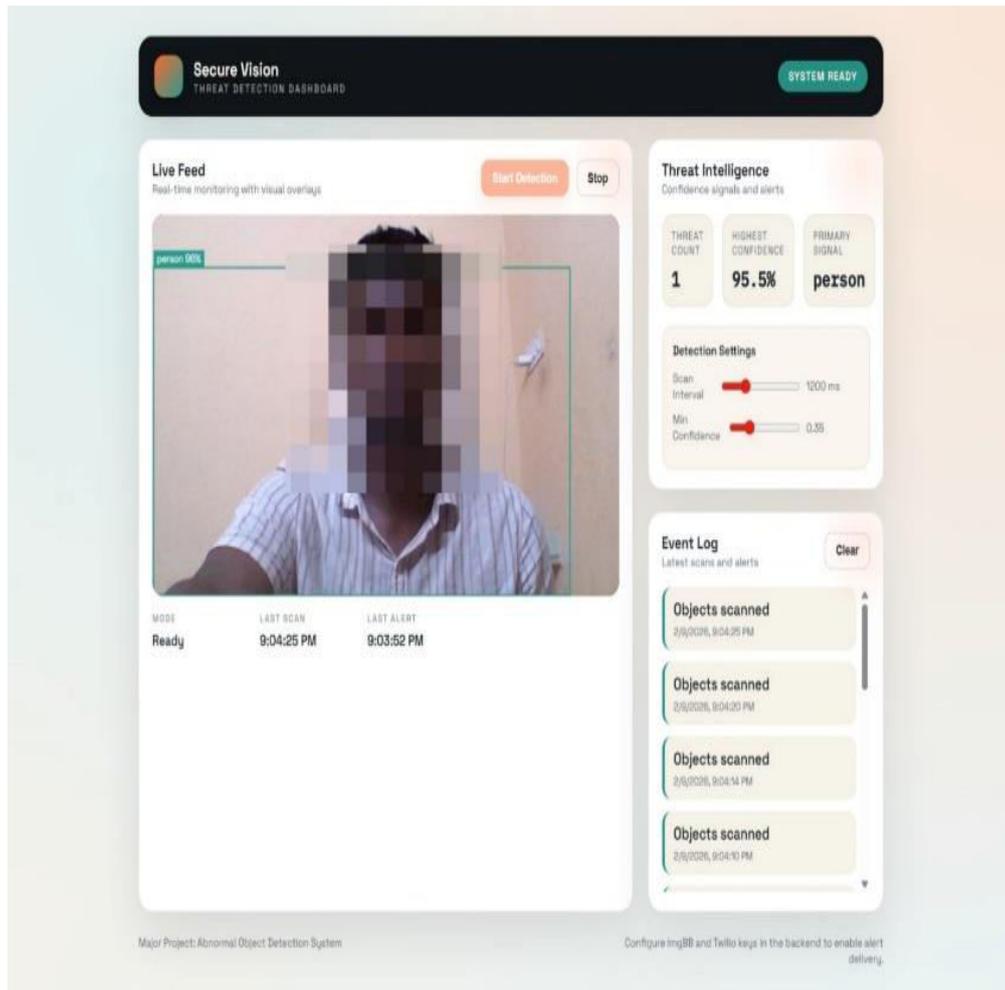


Fig 3: Normal Activity Detection in the Secure Vision Dashboard

Fig. 3 shows the system detecting a person in the live surveillance feed during normal conditions. The YOLO detection model identifies the person and displays a bounding box along with the confidence score for the detected object. This allows the monitoring system to clearly highlight the presence of individuals in the surveillance area. Since no dangerous object or abnormal activity is detected in the frame, the system continues normal monitoring without triggering any alert notifications. The dashboard displays the detection results in real time, enabling users to observe ongoing activities within the monitored environment. This demonstrates the ability of the system to accurately detect objects while avoiding unnecessary threat notifications and ensuring efficient monitoring of normal situations.

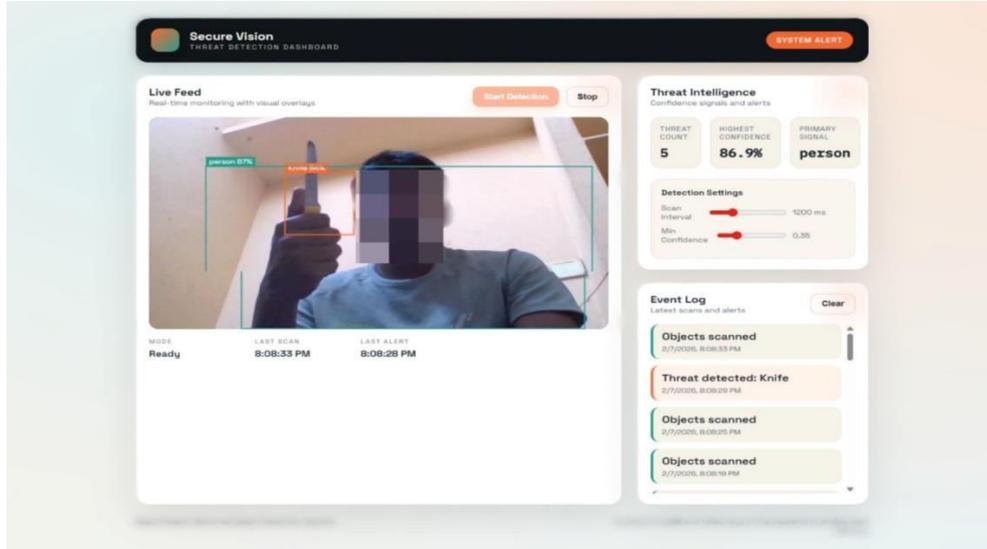


Fig 4: Suspicious Object Detection

Fig 4 shows the alert message generated by the Secure Vision system after detecting a suspicious object. The alert contains information such as the detected threat type, timestamp, and captured evidence image. This notification is sent to the registered security personnel using the messaging service, ensuring a quick response to potential threats.

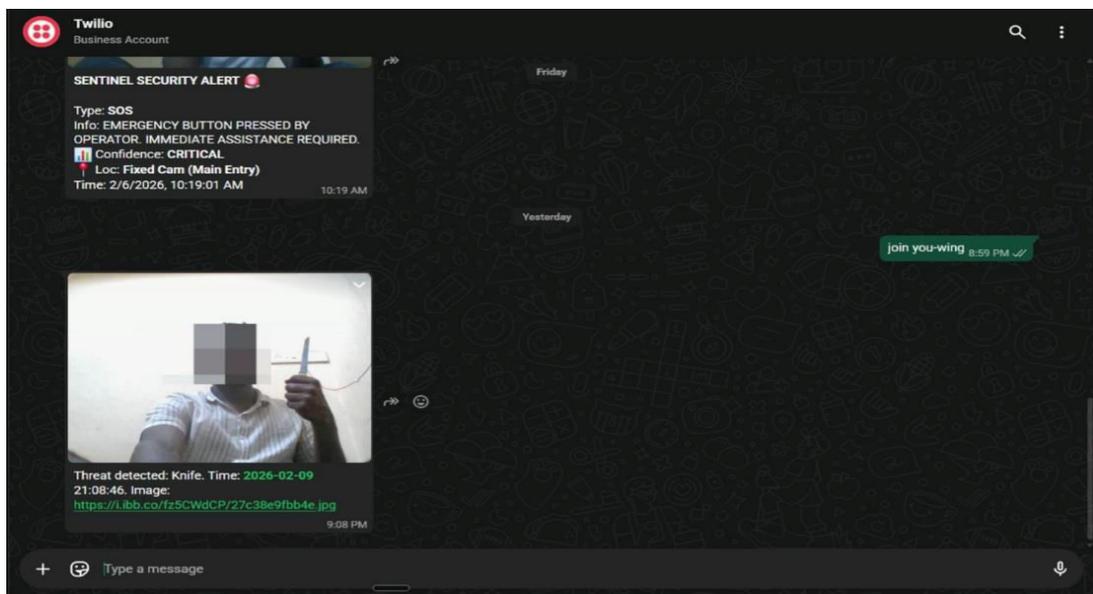


Fig 5: Alert Notification

Fig 5 shows the alert message generated by the Secure Vision system after detecting a suspicious object. The alert contains information such as the detected threat type, timestamp, and captured evidence image. This notification is sent to the registered security personnel using the messaging service, ensuring a quick response to potential threats.

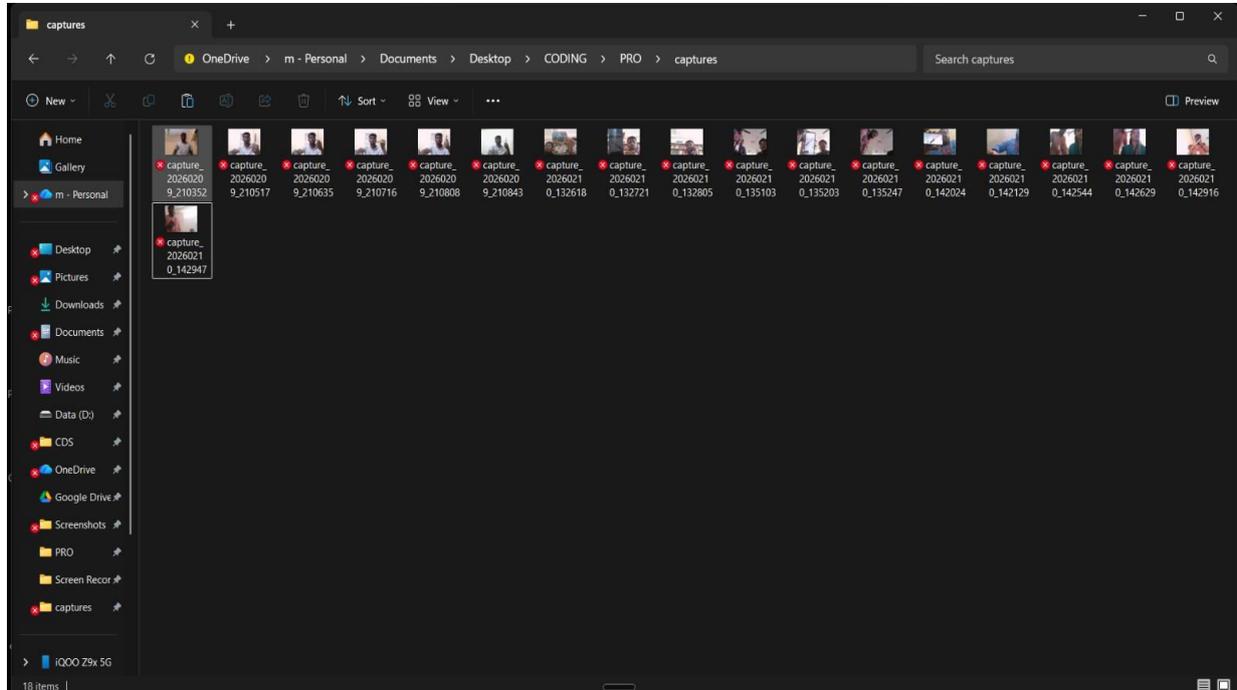


Fig 6: Event Logging and Captured Evidence Storage

Fig 6 presents the storage folder where captured images of detected threats are automatically saved. Each detected event is stored with a timestamped filename, allowing administrators to review past incidents. The stored data can be used for monitoring, analysis, and future improvements to the surveillance system.

V. CONCLUSION

This paper presented Secure Vision, an intelligent surveillance system designed to automatically detect suspicious activities and dangerous objects in real-time video streams. The proposed system integrates deep learning techniques such as YOLO for object detection and Deep SORT for multi-object tracking, enabling accurate identification of individuals and potential threats such as weapons. By continuously analysing surveillance footage, the system is capable of detecting abnormal situations and generating alerts to assist security personnel in maintaining safety in monitored environments.

The experimental results demonstrate that the system can successfully detect both normal activities and suspicious objects, such as knives, from live video input. The monitoring dashboard provides a clear visualization of detected objects along with confidence scores and event logs for each scanned frame. In addition, the system automatically captures and stores images of detected incidents, which can serve as useful evidence for monitoring and further investigation. The alert notification feature further enhances the system by sending immediate warnings to security personnel when a potential threat is detected.

Overall, the proposed framework improves the efficiency of surveillance systems by reducing dependence on manual monitoring and enabling faster detection of dangerous situations. The integration of detection, tracking, and alert mechanisms makes the system suitable for deployment in environments such as campuses, transportation stations, banks, and other public areas where security monitoring is essential.

In future work, the system can be enhanced by supporting multiple camera feeds, improving detection accuracy through advanced deep learning models, and incorporating more sophisticated behaviour analysis techniques. These improvements can further increase the reliability and scalability of the system for large-scale surveillance applications.

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