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Real Time Crime Detection Using Yolo Object Detction

Manohar. K[1], Khaseema Bee. N[2], Pushpalatha. K[3], Niveditha. K[4], Sumanth. K[5]
[1]*Student, BTech CSE(AIML) 4th Year, Holy Mary Inst. of Tech. and Science, Hyderabad, TG, India,*
[2]*Student, BTech CSE(AIML) 4th Year, Holy Mary Inst. of Tech. and Science, Hyderabad, TG, India,*
[3]*Student, BTech CSE(AIML) 4th Year, Holy Mary Inst. of Tech. and Science, Hyderabad, TG, India,*
[4]*Student, BTech CSE(AIML) 4th Year, Holy Mary Inst. of Tech. and Science, Hyderabad, TG, India,*
[5]*Assoc. prof, CSE(AIML), Holy Mary Inst. of Tech. and Science, Hyderabad, TG, India,*

ABSTRACT:
This project explains about Real-time crime detection using YOLO. This is intelligent AI-based system utilizing computer vision. YOLO is an acronym of YOU ONLY LOOK ONCE. It is object detection model and it is a strong methodology for monitoring and analyzing criminal offenses. like public places,shopping malls, etc. By combining web camera with YOLO that automatically detect weapons from live video stream.
The system captures camera feeds and process them through open cv and deep learning algorithms (e.g. YOLOv8) and machine learning. Using YOLO we can track the criminal activities like fight, weapons. Further, audio data can be processed with the help of python libraries to identify the criminal activities.Real-time alerts through Email or SMS to receive the response of security personally. Whenever any crime takes place it triggers a buzzer,alaram and sends for higher authority. This Object detection model utilizing convolutional neural network(CNN) to identify object in Images and videos.By combining YOLO with machine learning it classify the crime related activities in real time very quickly.
KEYWORDS: *Crime Detection, YOLO, Object Detection, Weapon Detection,CCTV Footage, Machine learning, Alert Notification.*

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I. INTRODUCTION

Object detection uses a powerful deep learning model to automatically identify potential criminal activities or dangerous objects in live video feeds. In today's changing world, keeping individuals safe in public areas is very important. With the rise of weapon-related crimes, there is a need for technologies that monitor surroundings and respond quickly during emergencies. Normal CCTV footage records video, which leads to delays in reacting to crimes. To address these issues, this project proposes a real-time crime detection system that uses a deep learning model (YOLOv8), computer vision, and machine learning. YOLO is an algorithm that scans video frames in real time. It differs from other algorithms because it uses a single convolutional neural network. The image is predicted as bounding boxes. A webcam connects to the system to continuously capture live video and analyze each frame to detect weapons. YOLO processes the full image in one pass, detects objects like weapons. If a crime is identified, the system starts recording audio and video. It can also be programmed to trigger immediate alerts, such as sounding an alarm, recording footage, and sending an emergency email to nearby police with the live location of the incident. The alert contains the live location, making it easier for help to arrive quickly. This YOLOv8 model mainly focuses on functioning in low light and at night by using infrared cameras.

Furthermore, the growing amount of surveillance data from these cameras creates challenges for human operators. Often, they may miss recognizing suspicious behaviors due to the overwhelming amount of information to process. This system mainly uses machine learning techniques for automated detection of criminal activities through camera feeds, generating real-time alert messages for security systems. Machine learning algorithms, especially those within computer vision, have shown great progress in analyzing data and identifying patterns and suspicious behaviors. By training machine learning models on large datasets of footage, these algorithms can learn to recognize a wide range of criminal activities.Machine learning algorithms help in classifying detected objects and activities based on their features, movement, and interaction patterns. For example, sudden aggressive movements, unusual crowd behavior, or the presence of weapons can be identified as suspicious. As the model is

exposed to more data, its accuracy improves, making the system more reliable in real-world environments.One of the main advantages of using machine learning is adaptability. The system can continuously learn from new data and adjust to different environments such as streets, malls, banks, or public transport areas.When a potential crime is detected, the system can generate real-time alerts, helping authorities respond quickly and prevent further harm. Overall machine learning enables faster, and more efficient crime detection by reducing human effort,minimize errors.

II. LITERATURE REVIEW

Real-time crime detection has many applications. It has gained many significant attention from recent years.. YOU ONLY LOOK ONCE is a popular object detection algorithm known for its accuracy, making it suitable for real time applications. Crime detection systems mainly based on object detection and activity recognition.Most research focuses on weapon detection and violence monitoring in CCTV. Many YOLO models like YOLOv3,YOLOv5, YOLOv6 are widely used due to better performance.A study used YOLOv8 for real-time crime detection achieve a real time application by email alerts for timely notifications.YOLO has ability to process images in real-time and makes it an ideal choice for detecting crimes such as violence and weapons.It is used in surveilliance systems for object detection.YOLO uses a single convolutional neural network and gives output very fast.

Real time weapon detection using YOLO for smart surveilliance focuses on detecting weapons like guns, knives from CCTV footage using the YOLO object detection .The model trained on weapon images collected from real sources. The system takes video frames as input and identify weapons with bounding boxes. If a weapon is detected then an alert is generated.Reserchers presented the use of YOLOv3 to find firearms in live video streams. They collected a custom dataset of guns and pistols in different environments. They achieved with high detection speed, and reaching about the 85% accuracy in normal lighting conditions **[1]**.

Weapon Detection in CCTV Surveillance using YOLOv4 shows better performance rather than YOLOv3. By applying YOLOv4 detects knives and guns in live CCTV footage. The model used transfer learning with a pre-trained COCO model and trained further using a weapon dataset.It decreases the lower false alarms compared to YOLOv3. This model required GPU acceleration for real time performance to detect. **[2]**. Additionally to improve accuracy it provides Real time Violence Detectio in surveilliance videos using YOLO and LSTM. This model used YOLOv5 for object detection and LSTM that analze motion patterns overtime to detect violence(e.g., fights). By combined object detection and temoporal analysis improve the crime classification accuracy in real-time surveillance.Here complexity is increses due to the LSTM integration.The main objective of this system is to detect humans in surveillance videos using YOLO.Violence detection is not possible by object detection alone because violence is an action that happens overtime.LSTM(Long Short Term Memory) helps to understand motion and sequence patterns.This LSTM learms temporal actions like punching,kicking and pushing. It also identifies sudden aggressive movement.This system classifies the activity as violence or non-violence.Generates alerts in real time when violence is detected.YOLO ensures fast detection and LSTM ensures accurate action recognition.This combination of YOLO and LSTM improves detection accuracy and supports real time security monitoring.It requires good dataset for training and lowlight conditions reduces detection performance. Its accuracy decreases in low light conditions. However, it had the limitation that complexity increased due to LSTM integration, necessitating fine-tuning to minimize false positives when crime is not detected. **[3]**.

Using YOLOv5 based Real-Time Crime Detection and Alert System mainly focused on integrating YOLOv5 with a real-time alert system using Python.It is a smart and modern security solution that uses deep learning to detect crimes.Instead of depending only on people to watch CCTV cameras, this system can automatically monitior live video and identify suspicious activities like weapons,fighting or unusual behaviour in real time. The model detects weapons in public areas and sends an SMS or email alert to higher authorities when a threat identified.It provides efficient and responsive system with faster processing time and real time applications for public safety.YOLOv5 is a fast deep learning model that checks every frame and finds important objects such as person,gun, knife,suspicious behaviour. If detected it shows a box aroubd the object and confidence score.The system decides crime based on detection as if a gun or knife is detected near a person, it may a threat.If many people are detected with aggressive movements then it is fight.When the system detects a crime, it gives alerts like alarm sound, SMS/Email alert to security or police.It reduces human monitoring work and helps in early crime prevention.This system reduces accuracy at low light

and night time cameras and hard to detect hidden or small weapons.This system needs good training data and hardware support.But with proper training and improvement, it can greatly helps in reducing crime and public safety.It mainly useful in public safety and smart cities.By sending alert immediately helps the higher authorities or security to take action quickly **[4]**.

Further for crime reporting of weapon detection using YOLO and RNN introduces a modern security system that helps to detect crimes and report them quickly without depending only on humans. This system works by combing two AI technologies YOLO (You Only Look Once) and RNN(Recurrent Neural Network). First the system watches live CCTV footage and video recordings. YOLO checks every frames in the video and it detects objects like weapons. If a weapon is detected, YOLO highlights it using a box and gives a confidence score. The system can also captures that frame as proof for later investigation. At the same time, the system uses has a chatbot where people can report crimes easily.Now the RNN model processes the text and extracts important information like type of crime. The bot formats the complaint in a structured way. Then it sends its to the higher authorities. The system stores it in a database.It resuces delay in reporting crimes .It is a quick and easy crime reporting through chatbot. Recurrent Neural Networks process the temporal sequence of these features to understand actions over time. Apart from video, RNN-based models(specifically GRUs) can be used for predicting crime by analysing temporal patterns in historical crime data,inflation in various levels. Real time crime detection using RNNs, often in combination with CNNs (Convolutional Neural Networks), analyses live video feeds to identify ,classify and alert higher authorities to suspicious activities like violence or theft. By processing spatial temporal data provides high accuracy,

Proactive surveillance and reduces need for manual monitoring. This smart crime reporting bot is a very helpful system for public safety. YOLO helps to detect weapons from CCTV footage, and RNN helps to understand crime reports sent by people. Together, they make crime detection and reporting faster, smarter, and more reliable **[5]**.

III. SYSTEM ARCHITECTURE AND METHODOLOGY

The system architecture comprises several integrated components that manage everything from input to alert generation. It includes the Input layer, Processing layer, Activity classification using Machine learning, Decision and Alert layer, and Output layer.

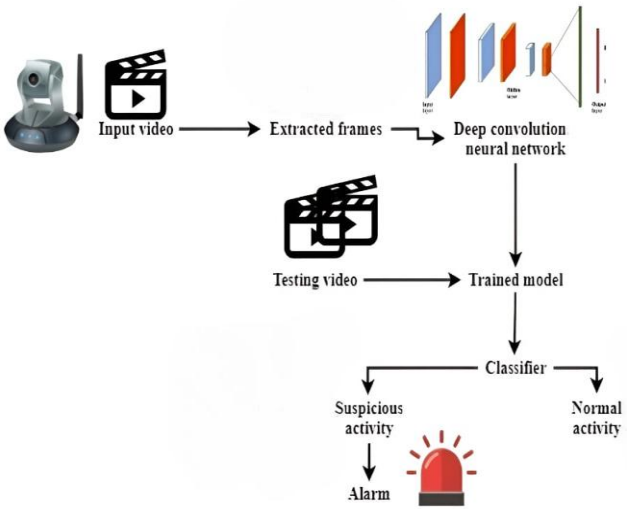

Fig 1: System Architecture

3.1. INPUT LAYER

This layer is responsible for gathering raw data from input sources such as CCTV cameras, IP cameras, and live video feeds. It can also collect audio to help detect specific sounds. It captures real-time video streams and sends frames to the preprocessing module.

3.2. PROCESSING LAYER

This layer handles the main computer vision tasks and data preparation. The continuous video stream is divided into individual frames. Each frame is preprocessed by resizing it to 640x640 pixels, normalizing it, and adjusting the contrast. These frames are analyzed by the YOLO model for object detection. It is the main component of the system, processing the entire image in one pass to predict the bounding boxes and class probabilities continuously. The model we use is YOLOv8, which quickly detects weapons, suspicious human actions, fighting, or assault activities. Before giving the frame to YOLOv8, basic prepocessing steps like resizing and normalization are done to improve speed and accuracy. After preprocessing, the frame is sent to the YOLOv8 model, which detects crime related objects. YOLOv8 gives the output in the form of bounding boxes.

3.3. ACTIVITY CLASSIFICATION USING MACHINE LEARNING

The pre-trained YOLO model is fine-tuned on crime-related datasets. Machine learning models classify the activity using a convolutional neural network for feature extraction. These models determine if the detected activity is suspicious or

normal. It helps in understanding suspicious activities automatically without manual monitoring. It supports real-time monitioring to prevent crimes.

3.4. DECISION AND ALERT LAYER

In this layer, the system checks the detection results from YOLOv8 and activity classification, and then decides whether the situation is normal or suspicious. If a crime is identified, it triggers the alert generation. This layer helps in taking quick action and improves safety by responding to crime situations in real time. This layer is responsible for making final decision and sends alerts immediately. This reduces response time and improves public safety. It supports quick response by showing live alert on screen and highlighting the detected person or object in CCTV footage.

3.5. OUTPUT LATER

This layer manages communication and user interaction and sends output by

1. Alerts and Notifications: The system sends real-time alerts via email and SMS to security personnel and higher authorities.
2. On-site Alarms: A physical buzzer or sound alarm may be triggered locally to alert nearby individuals.
3. Monitoring Dashboard (User Interface): A web-based or standalone interface, often built with frameworks like Streamlit or Django, displays live video feeds with bounding box annotations, reviews incidents, and manages system settings.
4. Evidence Collection: The system automatically records audio and video of incidents for use as evidence. This collection can support further investigations to detect crime through video footage and audio datasets.

This is the final stage where the system displays the final results to the user after detecting and confirming a crime. In this layer, system displays the live video with clear markings, such as bounding boxes around weapons or suspicious people, and labels like knife detected, gun detected or violence detected. It shows details like confidence score, time, camera, location , and type of activity. The system provides results clearly, saving evidence, and deliver alerts to the correct person, higher authorities or police . It is the reporting unit of the entire system.This layer helps the authorities take immediate action by providing clear and real time crime detection results.

IV. YOLOv8 MODEL

YOLOv8 is the eighth version of the "YOU ONLY LOOK ONCE" (YOLO) object detection models, developed by Ultralytics. It is a deep learning model designed for fast, accurate, and efficient real-time object detection. It builds on the strengths of its predecessors (YOLOv3, YOLOv4, YOLOv5, YOLOv6, YOLOv7) and introduces significant improvements in real-time capabilities. It can be used in low-light conditions through image enhancement techniques. By using infrared (IR) cameras, it improves visibility at night.

ARCHITECTURE OF YOLOv8 ALGORITHM

1. BACKBONE: Uses a CSP (Cross-Stage Partial Connections) based architecture, making feature extraction more efficient.
2. NECK: Enhanced with PAN (Path Aggregation Network) to improve feature extraction, helping to detect objects at multiple scales.
3. HEAD: A decoupled detection head separates classification and bounding box prediction tasks, improving accuracy.
4. ANCHOR-FREE: Unlike earlier YOLO versions, v8 is anchor-free and predicts object centers directly. This simplifies training and speeds up the process.

The YOLOv8 model operates at a speed of 30 to 40 FPS on a decent GPU, making it suitable for live CCTV. It is pre-trained on COCO, a large dataset containing 80 common objects, and it can also be trained on custom classes. This model is optimized for both speed and MAP, or Mean Average Precision. It works well with high-resolution video streams and on edge devices. YOLOv8 performs instant segmentation, outlining the exact shape of each object. It can detect suspicious human behavior through pose estimation. The model is robust, versatile, and designed for today's needs. YOLOv8 includes different models, such as YOLOv8n, YOLOv8s, and YOLOv8m, which vary in size from nano to small to medium.

4.1.OBJECT DETECTION USING YOLOv8

YOLOv8 object detection is known for its accuracy and speed. It detects objects by using a single efficient neural network that processes the entire image at once to predict bounding boxes and class probabilities in real-time. Developed by Ultralytics, it provides both accuracy and speed, detecting objects like weapons from the input image. The architecture of the model is based on CNN. The process involves training a specialized model on large datasets of annotated objects, such as weapons from surveillance footage. The core YOLOv8 model features a highly optimized CNN backbone that efficiently extracts features from input images or video frames, functioning as a unified architecture model.YOLOv8 identifies suspicious objects by passing the entire image through a single Convolutional Neural Network (CNN). This network predicts bounding boxes and class probabilities simultaneously. The single-pass

approach enables high frame rates, such as 30 FPS or more in some systems, which is necessary for live video monitoring and faster than R-CNN. To detect items like weapons and knives, generic YOLO models are fine-tuned on custom datasets that include thousands of images of various weapons in different real-world situations. The model employs a backbone, likely a variation of the CSP (Cross Stage Partial) architecture, along with an improved Feature Pyramid Network (FPN) and Path Aggregation Network (PAN) for feature extraction. Unlike other models, YOLOv8 processes the entire image at once. It uses an anchor-free detection mechanism, which directly predicts the center of an object instead of depending on a predefined set of anchor boxes. This improves flexibility and efficiency. When a weapon is detected with a high confidence score, the system can automatically trigger an alert, send an email notification with the image and location, or integrate with existing security systems for immediate response.

The image input is divided into a grid. Each grid cell detects objects whose center is within that cell. This grid-based approach allows YOLO to analyze the entire image in one go. The image passes through multiple convolutional layers to extract low-level and high-level features, such as edges, shapes, textures, and object patterns. These features help the model tell weapons apart from non-threatening objects. For each grid cell, the model predicts class probabilities, showing the likelihood that an object, like a weapon, is present in that area. Cells with higher probabilities indicate possible object locations. Grid cells predict bounding boxes and provide a confidence score. The confidence score represents: 1. The probability that an object exists in the box, and 2. The accuracy of the predicted bounding box. YOLO processes the entire image in one pass and predicts these bounding boxes to detect objects. Only bounding boxes with high confidence scores are kept for further processing. The final result displays bounding boxes around the weapons, along with class labels and confidence scores, showing successful weapon detection. This process allows YOLO to perform fast and accurate real-time weapon detection by analyzing the entire image at once. It is a single-stage detection method, making it highly suitable for real-time crime surveillance systems.

4.2 CRIME DETECTION USING MACHINE LEARNING

The motivation for using machine learning in real-time crime detection comes from the limitations of traditional surveillance systems and the need for smarter automation. These issues lead to delayed identification of crimes. Machine learning can analyze video streams automatically with greater accuracy. Machine learning models learn patterns of normal and abnormal behavior from large datasets. They can detect actions like fighting, weapon holding, aggressive movements, or suspicious activities that humans might miss due to distractions. When combined with YOLO object detection, machine learning improves the system's ability to spot objects and classify crime-related activities in real time. The increasing availability of real-time video datasets, powerful GPUs, and efficient deep learning algorithms further support the use of machine learning for automated crime detection. Adopting machine learning solutions ensures faster response times and reduces manpower needs. It also boosts monitoring efficiency and ultimately helps create safer public spaces. Thus, machine learning plays a crucial role in transforming passive surveillance into an intelligent system. By analyzing large volumes of data in real time, machine learning enhances security, aids law enforcement, and contributes to safer communities. This technology doesn't just help in spotting crimes as they happen, but it can also predict where and when crimes are more likely to occur by studying past crime data. By finding high-risk areas and time periods, it helps security teams and police stay prepared in advance, making the whole security system faster, smarter, and more effective. Overall, this technology helps reduce human workload, improves response time, and plays a major role in keeping public places safer.

Machine learning models detect crimes by learning from real examples of CCTV videos and images, just like how humans learn by watching and understanding situations. They are trained using many samples of normal activities and suspicious events such as fighting, robbery, or someone holding a weapon. Once trained, the system can watch live camera footage and quickly spot dangerous objects like guns or knives using models like YOLOv8. It can also understand unusual human actions, like sudden running, chasing, or violence, by tracking movements over time. When the system notices something risky, it instantly sends an alert with the exact time and location so security or police can respond quickly and stop the situation from getting worse. Crime detection using machine learning works in a similar way to how humans learn from experience. Instead of programming the system to detect every possible crime situation, we train it using past crime-related data like CCTV videos, images, and reports. Since it's not always easy to find clear patterns in huge amounts of data, machine learning helps by studying the data and understanding what looks normal and what looks suspicious. In supervised learning, the system is trained with labeled examples such as "gun,"

"knife," "fight," or "robbery," so when it sees similar scenes in live camera footage, it can quickly recognize them and raise an alert. In unsupervised learning, the system is not given labels, but it learns normal behavior on its own and flags anything unusual, like sudden running, aggressive movement, or crowd violence. In this way, machine learning makes crime detection faster and smarter by automatically spotting dangerous objects and abnormal activities in real time.

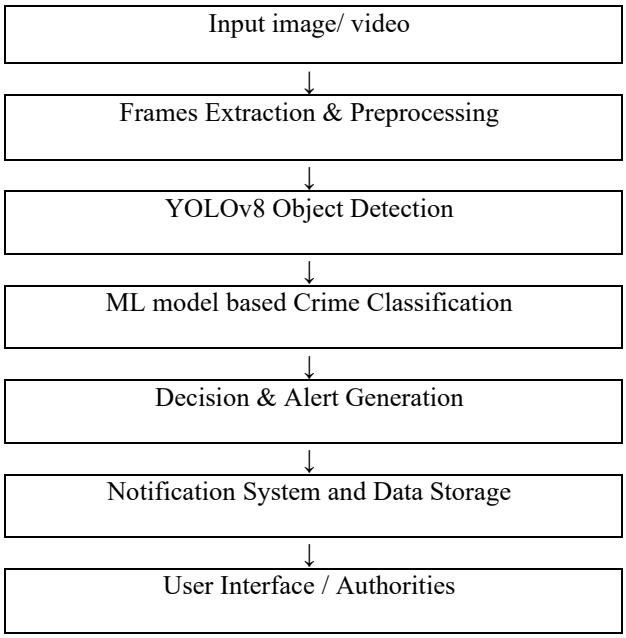

Fig 2: Workflow of Crime Detection using Machine Learning

Machine learning can enhance crime detection by analysing patterns and anomalies in data. Crime detection using machine learning provides an efficient and automated approach to monitoring public spaces. machine learning-based crime detection system works by first collecting video footage from CCTV cameras, dashcams, or drones, along with past crime data for training. The data is then cleaned, organized, and prepared by extracting important features like movements, shapes, and sounds. Advanced models, such as YOLO for object detection and RNNs for recognizing actions, are trained to identify weapons or suspicious behavior. Once the system is set up, it can monitor live video feeds in real time, detect potential crimes, and send alerts to authorities with details like the location, time, and type of incident. All detected events are recorded for reporting and analysis, and the system keeps learning from new data to become more accurate over time.

conclusion, machine learning-based crime detection provides a smart and efficient way to monitor activities, identify suspicious behavior, and alert authorities in real time. By continuously learning from data, the system becomes more accurate over time, helping prevent crimes, improve public safety, and support law enforcement with timely information. Finally, the system performs post-processing and reporting, logging all detected events for further analysis. This allows law enforcement to study crime patterns, identify hotspots, and evaluate the system's performance. Additionally, the system can learn continuously by incorporating new data, improving its over time. detection accuracy Integration with other technologies like facial recognition, license plate detection, and predictive policing algorithms further enhances the system's effectiveness.

V. IMPLEMENTATION

5.1 Environment Setup

Required libraries

pip install ultralytics
pip install opencv-python
pip install matplotlib

5.2 Dataset Preparation

Crime-related datasets come from public sources like Open Images, CCTV footage, and custom-labeled datasets for weapons such as knives and guns, violence, and suspicious actions.

Processing Steps

We extract frames from live video footage and annotate them in YOLO format using bounding boxes. Then, we split the dataset into training, validation, and testing sets.

5.3 Model Training (YOLOv8 with Machine Learning)

We train YOLOv8 with the prepared dataset to detect crime-related objects and activities. You can choose the YOLOv8 variant, either YOLOv8n or YOLOv8s. The training uses GPU acceleration. We integrate machine learning models with YOLOv8 to quickly spot crime activities. The training classifiers include CNN and labeled datasets. The trained model learns patterns linked to criminal behavior.

5.4 Real-time Detection with Webcam/ video

We deploy the trained machine learning model for real-time crime detection using live webcam feeds, CCTV camera streams, and pre-recorded surveillance videos. We continuously analyze video frames for suspicious activities.

5.5 Alert System

We create an alert system to respond to detected crime activities in video frames. The alert mechanisms include:

- Sound Alert: An alarm or buzzer sounds when a crime is detected.
- Email or SMS Notification: Notifications can be sent to authorities via email or SMS.

5.6 Testing and Performance Tuning

We test the system using real-time and recorded data. Testing includes evaluating accuracy and detection rates. We aim to reduce false positives and optimize detection thresholds.

5.7 Documentation and Reporting

We document all stages of implementation, including dataset collection and processing. The final report covers system performance and potential areas for improvement.

VI. RESULTS AND ANALYSIS

The proposed system was tested using live webcam input and recorded survelliance videos. The performance of the model was evaluated based on detection accuracy, speed,and reliability. Performance metrics include accuracy,precision,recall. Inference speed taken as FPS(Frames Per Second). It detects violence,suspicious activity. The model achieved with high accuracy in well lite environment. It performed effectively for both static and moving objects. Automated alerts triggered immediately after detecting a crime.

Crime Classification	Accuracy
Weapon Detection	96.8 %
Violence Detection	95.4 %
Suspicious Detection	93.6 %
Theft Detection	95.0 %

6.1 Analysis of Model

The results show that YOLO is highly suitable for real-time crime detection applications.YOLOV8 demonstrates high detection accuracy due to its advanced backbone and anchor-free detection mechanism. It accurately detects weapons (knife,gun), violence actions, and suspicious behavior. It reduces false alarms compared to older YOLO versions and performs well in crowded environments.Alerts are generated instantly when confidence exceeds threshold. By using infrared (IR) cameras improve the visibility at night. It maintains a high precision and recall,making it reliable for real-time monitoring.It enables quick response by authorities.Automated alerts significantly reduce response time during emergencies.The analysis proved that YOLOv8 combined with machine learning provides an efficient, accurate, and real-time crime detection.The system significantly enhances survelliance capabilities by automating crime detection, reducing human workload, and enable fast response.YOLOv8 maintains good precision and recall making it reliable for real-time monitoring. It can be performed in low lighting by image enhancement (Preprocessing).By using infrared (IR) or thermal cameras improve the visibility at night. Low light with enhancement improve accuracy .With proper dataset preparation and threshold tuning, it offers a reliable solution for detecting crime-related activities in real world environments. Potential Improvements like

1. Multimodel Fusion: Combine video, audio, and sensor data for enhanced detection.
2. Continuous Monitoring: Update models with new data for improve accuracy.
3 Text Analsis: Analyze social media or incident reports for crime pattern classification.
4. Edge Computing: It process data on-device (e.g.,smart cameras) for reduced latency.

YOLOV8 based model provides high accuracy and better performance than manual monitoring. It works on low light conditions by using infrared cameras and improve visibility of light at night.

VII. CONCLUSION

The real-time crime detection system using YOLOv8 and machine learning is an effective solution for modern surveillance systems. By using YOLOv8, the system can spot crime-related objects and suspicious activities from live video streams in real time. This system reduces the need for manual monitoring. It lowers human errors common in traditional surveillance systems. Its ability to process multiple frames per second ensures continuous monitoring. This not only improves situational awareness but also allows authorities to take action before incidents occur. The model is flexible and can work with existing surveillance setups, edge devices, and smart city platforms. However, challenges like low light and complex human behaviors may affect detection accuracy. These issues can be improved with image processing techniques. YOLOv8 is robust, versatili and designed for the modern world. It comes with various models(YOLOv8n, YOLOv8s, YOLOv8m,) that reprents various sizes as nano, small, and medium.YOLOv8 object detection stands for super accuracy and speed.This model make crime detection more accurately.

VIII. FUTURE ENHANCEMENT

The proposed system works well, but there are several ways to enhance its capabilities. Future research can focus on integrating advanced action recognition models like LSTM, GRU, or 3D CNNs with YOLOv8. This will help better understand complex human behaviors like robbery and assault, which are hard to detect with object detection alone. More improvements can come from training the model on larger datasets, including low-light and nighttime images, to increase its reliability in real-world situations. Implementing the system on edge devices, such as Raspberry Pi, can enable real-world usage. This could combine crime detection with facial recognition to identify suspects. Future developments may involve using multiple cameras for monitoring larger areas. Additionally, advanced alert systems, predictive crime analysis, and privacy-preserving methods can ensure ethical and scalable use in smart city surveillance. Running the YOLOv8 model on edge devices and IoT platforms can cut down latency and support faster responses. A significant direction is integrating advanced techniques for recognizing human actions and behaviors, which examine patterns over video frames. This will take the system beyond simple object detection towards a better understanding of human activities.

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