# A Review on Intelligent Surveillance System for Crime Detection

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*Abstract*: **Closed Circuit Television (CCTV) systems are increasing in popularity and are being deployed by many domains of accommodation, offices, and also in the most public places. Now-a-days, CCTV cameras and video surveillance systems plays vital role in improving safety and security. CCTV monitoring systems have been implemented all over the globe and it is helping reduce the crime rate. As many camera views a single CCTV operator can manage is limited by human factors, such monitoring systems constitute an enormous burden on this sector. The primary objective of this review paper is to analyze the existing approaches and methods for the automatic detection of the gestures or signs of aggression and brutality on real time. This paper examines the existing systems that suspect crime activities in run time from the real-world data.**

*Keywords*: **AI, CCTV, CNN, image processing, object detection.**

## 1. Introduction

In the past decade, the capabilities of video surveillance systems are transformed by fundamental shifts in how digital data is gathered, analyzed, shared and stored. Security cameras are already playing a key role within the drive to smarter cities and therefore the burgeoning industrial internet of things. Deep learning and AI is becoming more prevalent, as cameras are ready to more accurately gather data and make predictions supported integrated analytical software manufacturers have developed. Amidst the associated public expenditure and therefore the expansion, also as concerns about their social costs and efficacy, there's an increasing need for an evidence-based approach to tell CCTV practices and policies. Cases of harassment in work places also are becoming very serious. With the ever-growing installation of advanced CCTV infrastructure, almost entire cities can now be monitored, through the main purpose served by an equivalent is only evidential. It might only be natural to expect an alert or warning system for ongoing (or close to happen) mishaps and crimes, where timely action are often the difference between life and death. Such scenarios are expected to be monitored and identified by personnel viewing live footage. But because the number of CCTVs per unit are keeping rising, this approach is becoming increasingly impractical. Therefore, we might require a surveillance unit capable of thriving in these situations with negligible human input.

Main challenge involved in motion tracking algorithm is to estimate object motion as more precisely and efficiently as possible. Moving object detection is an important aspect in any surveillance applications. Usually, video frames contain foreground also as background information, in which the feature points within the region of interest are the foreground information and therefore the remaining feature points are considered to be background information. In general, video CCTV involves two major building blocks like motion detection and motion estimation. Object detection is that the first and foremost step because it is directly influenced by the background information. Since there is considerable irrelevant and redundant information in the video across space and time, the video data got to be compressed at the earliest in video surveillance applications.

## 2. Methodology

In this paper, we have discussed classification method for analyzing the video and to detect anomalies. The subsystems used to fulfill the goal of visual surveillance is to accomplish, as automatically as possible, the surveillance task are as follows:

*1) Video Capture CCTV*

CCTV works by the camera or cameras taking a continuing sequence of images that are then transmitted by cable or wirelessly (depending on the chosen system type) to the recording device then on to the display monitor, which ascertains the sequence of images as video footage.

*2) Frame Capturing*

Frames are considered as combination of images whereas video is a sequence of related images (frames). Generally, one second of a video is comprised of 24 or 30 frames per second also referred to as FPS. Frames are shown once the subsequent frames are reconsidered images. Each frame is captured and processed to check whether there is any human activity in the scene.

*3) Motion Detection*

The growing interest in human motion analysis is strongly motivated by recent improvements in computer vision the supply of low-cost hardware like video cameras and a spread of latest promising applications like personal identification and

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visual surveillances. The goal of motion detection is to acknowledge motion of objects found within the two given images.

Motion within the scene is detected by analyzing the frames captured. This will be achieved by a method called background subtraction wherein still objects within the scenes are eliminated by analyzing the position of every object within the stored frames. If the position of object is modified, the object is marked to be a moving object.

*4) CNN*

A convolutional neural network (CNN) is a type of artificial neural network used in image recognition, classification and processing. The structure of a CNN resembles to the connectivity pattern of Neurons in the Human Brain.

*5) Frame Analysis*

The frame analysis is used to recognize activities in the scene.

Various algorithms are utilized to track multiple moving objects. The behavioral analysis is performed to analyze the behavior of moving objects to check for any act of abuse, bullying or harassment.
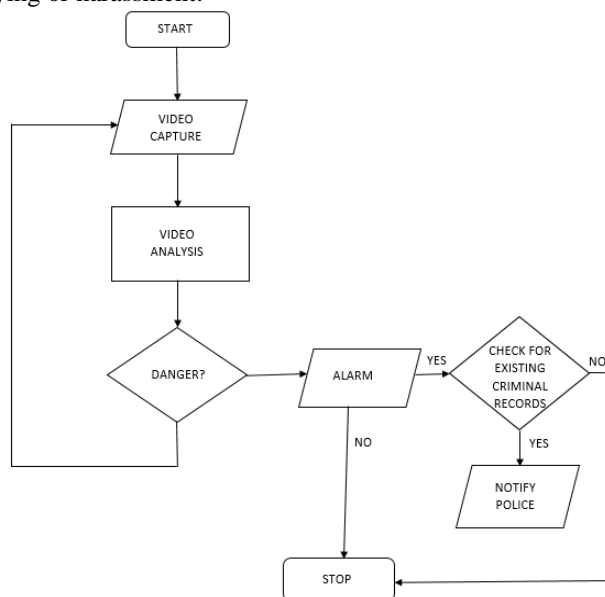


Fig. 1. Flowchart

## 3. Related work

*i-Surveillance Crime Monitoring and Prevention Using Neural Networks*: [1] In this research article, authors have proposed algorithms that are able to alert the human operator when an abandoned luggage, presence of a dangerous act, or an abnormal behavior of a person is detected. They have focused on limiting the number of false alarms in order to make it useful in a real-life application of the system. This proposed system can be used at low scale. A technique called background subtraction is used to detect motion in the scene, wherein still objects in the scene are eliminated by analyzing the position of each object in the stored frames. If the position of object is changed, the object is flagged to be a moving object. The behavioral analysis algorithm also makes it easier for the CCTV operators to monitor the CCTV systems and prevent crimes in

the first phase, where security issues are less or easy to handle.

*Smart Surveillance System for Detecting Interpersonal Crime*: [2] The proposed information processing technique focuses majorly on maintaining confidentiality and privacy of official meetings and discussions in the work environment while ensuring detection of interpersonal crimes. In the proposed system, image and speech processing are used in combination to identify critical conditions such as harassment, assault and bullying, and ensue conditional video recording and saving.

In public places, the interpersonal crime is identified using video and voice processing, which will then raise an alert at the local surveillance station, where numerous CCTV videos from neighboring areas might be available.

They have used background subtraction based on Gaussian Mixture Model and motion tracking is achieved by a Kalman filter. They have achieved high accuracy by using speech processing to detect interpersonal crimes.

*Moving Object Detection for Video Surveillance*: [3] The proposed algorithm consists of various steps including video compression, object detection, and object localization. In video compression, the input video frames are compressed with the help of two-dimensional discrete cosine transform (2D DCT) to achieve less storage requirements. In object detection, key feature points are detected by computing the statistical correlation and the matching feature points are classified into foreground and background based on the Bayesian rule. At the end, the classified foreground feature points are detected in successive image frames by rectangular bounding box. The proposed method effectively handles the challenging environments including target translations and partial or complete occlusions and detects the target when it reappears.

*A Proposed Architecture to Suspect and Trace Criminal Activity Using Surveillance Cameras:* [4] In this paper, they have presented an architecture and workflow that empowers multi-modular information accumulation and computerizes the discovery of crime-related activities. To identify crime at real-time in any organization, first of all, the video data from all buildings of the organization utilizing surveillance cameras are collected. Collected video information is scanned for creating discrete single frames. Frames are processed for generating single images. From a trained and stored dataset, the generated images are compared. Finally, from a centralized computer, a run-time inspection process suspects the criminal activities simultaneously from data captured by different cameras. The system performs a real-time operation automatically which make the process efficient and faster.

*The effect of public surveillance cameras on crime clearance rates*: [5] Using the data of public surveillance cameras and case clearances in Dallas, Texas, along with a pre-post-research design, they have examine the efficacy that public CCTV cameras increase case clearance rates. The most widely studied topic for CCTVs is their deterrent effects on crime. CCTVs are consistently effective in decreasing crime in parking lots and residential areas as well as other locations. The effectiveness of CCTVs in crime clearance. CCTV may help police to detect crimes and arrest offenders in progress by real-time monitoring,

as well as find possible suspects by examining video footage after a crime has occurred.

This research has explored the relationship between CCTV installation and clearance rates in crime. Several findings suggest some promising uses of a CCTV as an investigative tool which enhances crime clearance. Relative to what clearance rates were before cameras were installed, CCTVs appeared to increase clearances of crimes by around 2% in its nearby area.

*CNN based Aerial Image processing model for Women Security and Smart Surveillance*: [6] This project helps in utilizing drone technology in an effective way to solve different issues of society by proposing a CNN based image processing model which is effective for aerial surveillance with various smart autonomous modes. The paper also discusses the requirement for employing such faster, simpler, and effective working methods in aerial surveillance by streamlining, and enhancing its operations by overcoming the various challenges of aerial imaging utilizing pose estimation. In real-time, the model functions in three different modes. Two modes are designed for general crime and one for the gender-based crime which is a women security model. The model is accurate enough for high-quality videos but is not decent in case of low-quality videos with less lightning, and contrast. The model can be modified to function fully as a drone model with the reference of the given requirement, modules, and equipment in the drone section. It can further be interlinked with an app.

*Criminal Activity Monitoring and Prevention Using CCTV Surveillance*: [7] It is very essential to expect an alert or buzzer system for the ongoing/to be happen accidents and criminal activities, where certain actions should be taken on time as it can be question of life and death situation. Here in this article, they have proposed algorithms which are able to make the people attentive about (1) Presence of any hazardous act, the danger is detected when the objectional object appears in the frame with the presence of human. (2) An abnormal activity of human when they be handling the weapons or acts of assaults. They allowed the real time application to completely focus on reducing the number of negative alarms. For Detection system they have used faster R-CNN deep learning algorithm as it implements selective search to extract a bunch of regions in the image rather than the massive number of regions to check if any of these boxes contain any object that we require for our process. The current model consists of 2 detection functions, one for detecting crimes which are done when any threatful movement is detected and other one for detecting crimes that are committed with aggressive movements.

*Face Detection and Recognition System for Enhancing Security Measures Using Artificial Intelligence System*: [8] This research study involves extracting information like pose, expression, gender, age, identity, etc. which helps to maintain security in an organization. During this study, it has been worked on the input camera which takes multiple shots of person. After that, the Cascade Classification algorithm has been used inside the application which creates the multiple human templates. So, the facial features have been detected. After that, it saved in particular database with their unique ID. Furthermore, the verification process has been started by matching the templates inside the database. Through this process, the student attendance has been marked automatically.

This study is centered on face detection with voice and biometric technology. It has been presented that face detection with voice and biometric technology can enhance the security measures.

*Deep Learning based Crime Investigation Framework*: [9] The applications of Deep Neural Networks in a variety of domains have made it an important area of research. The huge volume of crime-related datasets and the various different types of crime and their different characteristics and the complex relationship between them make Deep Neural Networks an ideal choice for this domain. The knowledge gained from this analysis will enable law enforcement officers to process information rapidly and accurately. In the paper, they have proposed a crime framework for India keeping in mind the language and cultural differences across the country. They have proposed automatically creating keywords from the written complaints and tagging the cases using Natural Language Processing. They have also proposed an approach using Deep Neural Network to classify the crimes and match the crimes to offenders using the method of operation. They have also used Deep Neural Networks for prediction of crime rates and hotspots. Evidence related to a police case can be divided into text evidence, photo/videos and digital evidence like documents in the laptop or chats and messages in the smartphone. Indian government sponsored OCR programs such as Sanskrit OCR, e-aksharayan can be used to extract data from text evidences. Photos and videos found during the investigation process can be preprocessed to extract important details from them. If it is a photo of person/persons, the facial features can be extracted and stored in the image database. It can also be matched with already existing images in the image database. In this paper they have discussed use of Deep Neural Networks, Classification, Clustering/Matching and prediction using Deep Neural Networks.

## 4. Conclusion and Future Work

CCTV plays crucial role from the smallest act of danger to the most critical moments where life is at stake. Monitoring a CCTV footage manually is quite challenging and difficult to manage. This is where the smart CCTV surveillance system plays an important role. There are few such existing systems. These systems are capable to alert CCTV operators if any abnormal behavior, presence of dangerous act or assault is detected. In order to make this system more efficient we have proposed a system which will compare the detected individual in the scene with existing criminal records. If any matching criminal record is found then the system will notify the police. Further improvements to the proposed system will include:
 a. Accident detection and ambulance auto-calling system
 b. Traffic rule violation detection

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