

# Analysis of Anomaly Detection Techniques in Video Surveillance

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**Abstract-** Abnormal activity detection plays a decisive role in surveillance applications. To capture abnormal body of human without the intervention of system i.e. automatically captures the video can be implemented. Human fall detection, suddenly jumping down which has an important application in the field of safety and security. Proposed system use for detecting road side human activity or behavior by using Probabilistic Neural Network (PNN) method for classifying activities or behavior between training dataset and testing videos. The partitions between classes of normal activities have also been learned using multi-PNNs. Local Binary Pattern (LBP) to track the object by using blob analysis. The proposed system is used to recognize and detecting outcome that are equivalent to or better than previous methods.

**Keywords-** Anomaly detection, video surveillance, abnormal activity.

## I. INTRODUCTION

Anomaly means something which is unusual, unbalanced or irregular that is abnormal. Now a day's human behavior and activity pattern researches are more important in surveillance [1]. Detection and tracking the object of behavior is important factor in video surveillance system [2]. If anomaly is happening in crowded area based on behaviors of persons then it depends on two types spatial and temporal [3].

### A. Types of anomaly

There are three different groups of anomalies are:

- 1) *Point anomaly*: point anomaly is the individual dataset that can be considered as abnormal with respect to the rest of data. This is very simple type of anomaly. For example Credit card detections.
- 2) *Contextual anomaly*: The data occurrence is anomalous in a definite context is called contextual anomaly.
- 3) *Behavioral anomaly*: The behavioral anomalies are not appropriate characteristics of an instance [4]. In Video surveillance the security helps to reduce the crime and keep the people safe. It is one kind of system which monitor the activities in particular area using television system in which signal are transmitted through television camera to the receivers by link or cable [5]. For the security application increases the need and has motivated the advancement of the research in the research in the area of visual surveillance system [6]. The human fall is one of the

major health issues for elderly people. The detection of a fall is important step to avoid any serious injuries [7]. Cameras attached to monitor screens are generally a traditional video surveillance system. A limited number of operators are responsible to constantly monitor a large area with the help of the cameras installed in various places. While some monitors show a video stream of a single camera, in other instances, a single monitor can show multiple streams simultaneously or sequentially [8]. Video Surveillance is for monitoring the behavior of dataset, activities of person, and other varying information related to the abnormal activities. The movements are observed using CCTV cameras. As a result it is obtained through human intelligence agents. Anomalous behavior in crowd is detected using intelligent video surveillance system [9]. Surveillance can notice by giving human operatives accurate and live situational consciousness [10]. Surveillance can help rebuild an incident through the availability of footage for forensics experts, it again helped by video analytics.

### B. Anomaly detection

Detection of anomaly refers to the problem of discovery the different patterns in data that do not validate to expected behavior of human activity. These unusual patterns are often referred to as anomalies, outliers, discordant observations, exceptions, aberrations, surprises, peculiarity [10]. Anomaly Detection is useful in several of applications and field such as fraud detection in credit cards, insurances, in health care systems, intrusion [11]. Anomaly detections importance is that of because of anomalies in dataset convert into major actionable information in a huge variety of application domains. Anomaly detection methods have been developed in several research communities [12]. Develop a techniques have been specifically for certain application domains, while others are more generic. Anomaly detection is also useful in traffic area for vehicles detection. Traffic surveillance video is active area of a research and also challenging in urban environment [13]. Anomaly detection is also useful in stairs. There are two types of stair actions normal and abnormal. In a normal stair incident the person with correctly placing their feet on the steps without any loss of balance and the abnormal incident in which person misses the step at some point [14]. Anomaly detection is also use in sports video, for example

soccer video. In soccer video event detection is depend on the theory of pattern reorganization. In this detection of anomaly is depends on extracting the feature of soccer video and identifying the soccer event [15]. Anomaly detection is also useful for fall detection which is based on visual monitoring which is include four steps data collections, data segmentation, feature extraction, fall detection [16].

### C. Classifying anomaly detection

A sample of possible themes along which some of these papers can be grouped, however, such categorization may lead to a long ambiguous list since each research paper may have contributions that may be unique to certain aspects but similar to other works when viewed from a different perspective [17]. There is a wide-ranging array of methods proposed to treaty with peculiarities of exact applications. Given that there are several ways to sort out the research, we attempt in this survey to use a “vital decision” perspective. Decide on what methods to use in developing a vigorous detection system for the particular situation [18]. Depending on the quantity of prior knowledge and human participation in the learning process, we may generally categorize the research in abnormal behavior detection as supervised, unsupervised, and semi supervised.

- 1) Supervised: These methods based on normal or/and abnormal behavior based on the labeled data [19]. The challenge although in this is how to include long-term scene version. A complete set of all possible scenarios in the real world is impractical, so, the growing appeal toward dynamic data-driven modeling techniques.
- 2) Unsupervised: These methods based on normal or/and abnormal behavior based on unlabeled class of data [20]. They learn the normal and abnormal patterns from the statistical properties of the observed data. Isolated clusters identified as anomalies.
- 3) Semi supervised: They learn a model of usual/unusual events using partially labeled data [21]. Based on the different classification of object and person Background subtraction method is uses. Background subtraction method useful for motion objects detection. It is very simple and if we select the reference image then it will separate motion objects accurately [22]. Blob analysis methods is used for tracking the region or recognize the people based on their different classification. For example walking, jumping and cycling [23].

## II. RELATED WORK

This paper is much work on abnormal behavior detection took a supervised learning approach based on the assumption that there exist well-defined. Diverse contributions have been made in the development of behavior recognizers for smart building surveillance applications. In automatic roader human surveillance, the vehicle or human activities and behaviors are detected and recognized for monitoring and warning purposes, for detecting human behavior. Below table I shows that analysis of different anomaly detection techniques. There are various

types of anomaly to detect object or behavior some are as follows:

### A. Video-based abnormal human behavior recognition

This technique only focuses on updating anomalous human behavior detection. The main purpose of this survey is to extensively identify existing methods and characterize the literature in a manner that brings key challenges to attention. The Hidden Markov Model (HMM) and Dynamic Bayesian Network Model (DBNM) [1] are using to detect the suspicious behavior as shown in Fig. 1.



Fig. 1 Example of different from walking or jogging

### B. Motion detection, tracking and classification for automated video surveillance

This achieves the complete detection of a moving object which is robust against of changes in brightness, dynamic variation in the surrounding environment and noise from the background. The propose method is pixel dependent [2] and non parameterized approach. The detection of foreground represents object and background which is the surrounding of the environment. Bayesian based methodology, Optical flow method is used. These proposed method focusing on moving detection and tracking results shown in Fig. 2

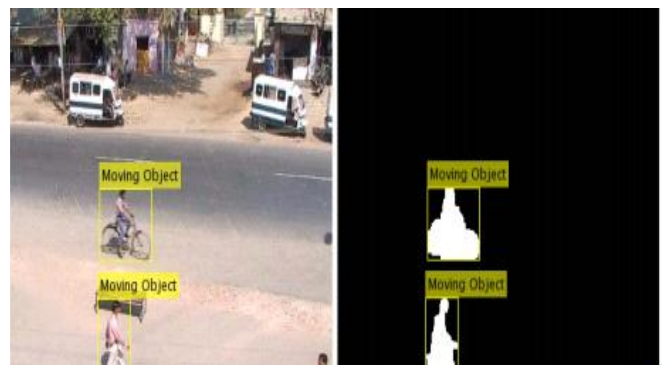


Fig. 2 Tracking of moving object

### C. Anomaly detection in crowded scenes

There are three different properties are identified as detection in scenes such as joint modeling of appearance and active of the scene, sequential and spatial anomalies.

This technique shows various states of the anomaly detection techniques. Examples of abnormal detections as shown following Fig. 3

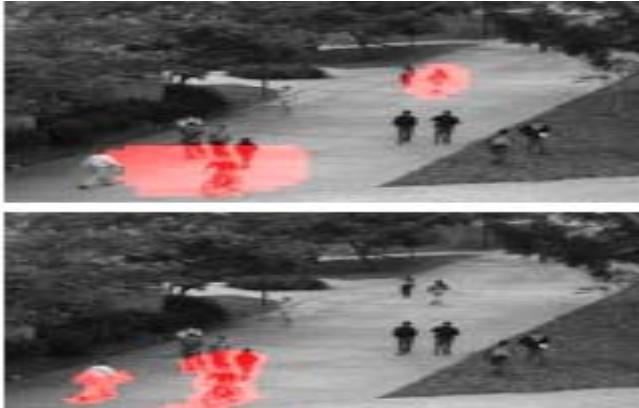


Fig. 3 Person running on road in crowded area

#### E. Automated detection of unusual event on stairs

In stair case event detecting and recognizing unusual incident is done in given input dataset. The motivation is to provide a tool for biomedical researchers [14] to rapidly find and analyze the events of interest within large quantities of video data. System identifies potential sequences containing anomalies, and reduces the amount of data that needs to be searched by a human. This system uses background subtraction method and following Fig. 4 shows that examples of background subtraction method.

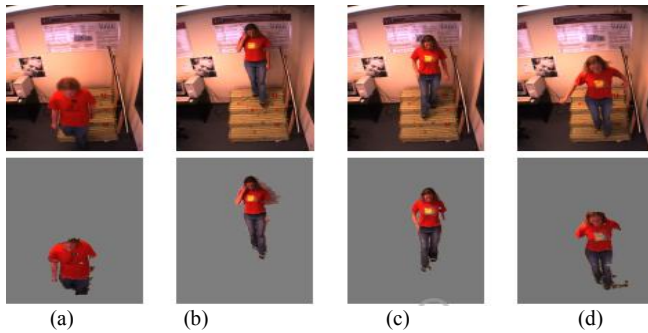


Fig. 4 Examples of background subtraction method

#### F. Vehicle detection, recognition and tracking in traffic surveillance

It provides a full review of the state-of-the-art video processing technique for vehicle detection [13], recognition and tracking with analytical description. Group of vehicle recognition in motion and look based techniques, unequal from simple frame differencing and adaptive median filtering, to more difficult probabilistic modeling and feature extracting. These systems perform three major operations that are vehicle detection, tracking and recognition. Following Fig. 5 shows that traffic surveillance.



Fig. 5 Traffic surveillance

#### D. Anomaly in road side scene

The proposed system detects the motion of human behavior scene to recognize the activity is normal or abnormal. We work in video surveillance on person action that is lying down, falling down and jumping down. To evaluate the performance of the anomaly detection approaches, a one-hour sequence of test data with a number of purposely inserted anomalies was recorded. This dataset was manually labeled. Both simple single object anomalies and more complex ones involving multiple objects were recorded. Examples of single object anomalies recorded in the test data are illustrated and include:

- A person walking on the grass where people normally do not walk.
- A person walking on the grass instead of on the pavement.
- A person running where people usually walk, one instance from left to right and one from right to left.

These anomalies might require the use of more advanced anomaly detectors, which need to handle more attributes. Following Fig. 6 shows that road side scene, in those two persons fighting each other and that anomalous activity or human behavior detected by proposed system.



Fig. 6 Road side scene - persons fighting with each other

### III. METHODOLOGY

In video surveillance system roadside jumping action, falling down human activity is captured in a video that is further analyzed using image processing techniques. The proposed method consists of PNN classifier, LBP, Divide and Conquer to detect the abnormal human behavior. Input video is stored in dataset to process further. Video is converted into small frame to easily show object or motion. Using blob analysis human motion is tracking to extract the feature. feature extraction removes all background data such as if person simply walking on roadside area and suddenly person is falling down the roadside area is subtracted using LBP and it shows only



human body and then it classify the behavior of human using PNN classifier to detect the activity is normal or not.

#### A. PNN (Probabilistic Neural Network)

This method is used for both classification and pattern recognition problems.

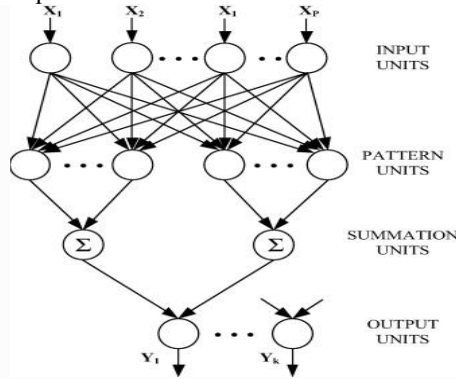


Fig. 7 Layered base architecture of PNN

On the output of the second layer participate transfer function and picks the maximum of these probabilities, and make upbeat classification for that class and negative for non-targeted classes. The proposed technique is built on a probabilistic neural networks strategy. This method can detect moving vehicles more accurately and more absolutely. The background subtraction method successfully adjusts the bit-rate variations in video streams.

#### B. Local Binary Pattern (LBP)

LBP can uses images at the pixel level. These labels integer numbers describe and characterize the original image at a much lower scale. The Local Binary Pattern (LBP) is a useful method in texture analysis, is shown in Fig. 8.

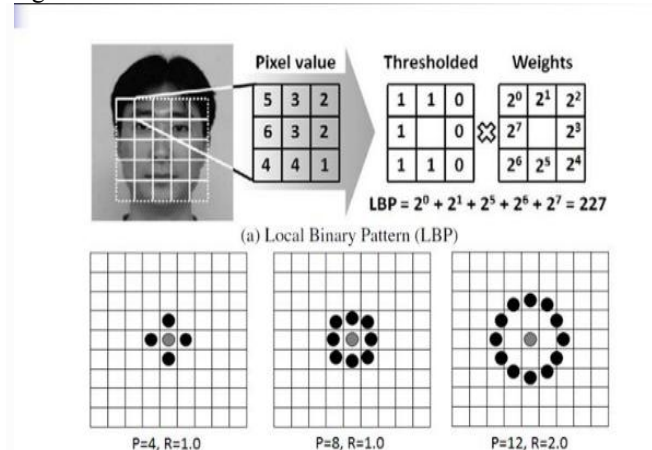


Fig. 8 Local Binary Pattern

#### C. Divide and Conquer

The problem i.e. problem statement P into a number of sub problems ( $p_1, p_2 \dots p_n$ ) that are themselves smaller

instances of the same problem statement P we have defined. Recursively solving those sub problems. After exploiting the above divide and conquer strategies the system found in concurrent functional dependency processing and identified objects such as: i) User: video capture and upload ii) Database: Authentication, User info, User detect iii) System: Features Extraction, video detection, Matching, Result.

### IV. PROPOSED SYSTEM

CCTV Video captures the user body and then verifies the information into database. Proposed work deals with automated system to detect and classify the human body using Probabilistic Neural Network (PNN) algorithm. The comprised of three phases, first body detected from CCTV camera, secondly apply Local Binary Pattern (LBP) algorithm for the purpose of feature extraction, the most useful and unique features of the human body recognized in the feature extraction. The human body is compared with the images from the database. We empirically evaluate human body recognition which considers both shape and texture information to represent human images based on Local Binary. Pattern is for to show the person independent abnormal or not. Proposed system discussed on human behavior on road side. The proposed method consists of the following modules:

Input video, video to frame conversion, preprocessing, motion tracking, feature extraction, classification and behavior identification as shown in below Fig. 9.

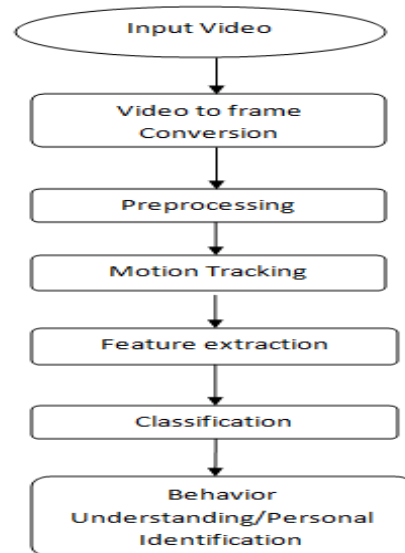


Fig. 9 Architecture of proposed system

#### 1. Input video:

Usually a hardware device even if we can use video surveillance systems on save video files as well. The camera provides a flow of images which is the input. To work on motion activity is to take a first input as a video for further processing. It is important to note that although we can learn a lot of important features from a single image, it is not enough. CCTV video captures the activity of human behavior to detect the motion tracking.

## 2. Video to frame conversion:

In these step after taking the input video, these input video has to be converted into frame. Framing divides the multiple human behaviors into small frame. It easily find out how many motion are there.

## 3. Preprocessing:

Preprocessing removes all noise from input dataset. It extracts the all noisy data from environment background. The background means that for example, in a scene where two people are walking in front of a tree, the tree is considered to be background. In extracting the background, the calculations can be much more accurate.

## 4. Motion tracking:

It is important to understand that tracking is not motion detection (motion segmentation). It is identifying the same object in different frames. For instance a person who walks in front of the camera in frame 1 will be identified as the same person in consecutive frames. This provides the trajectory that this person took during his entire trip.

## 5. Feature extraction:

Feature extraction is a text-based feature. In the feature extraction according to the video given as an input is check. Any kind of noise or sound can be identified and then removal of that sound is done. For tracking the object it is necessary to remove the unwanted sound from the video and then detection of actual image is done. The video is divided into multiple frames. On each frame feature extraction is applied and then tracking the object is done.

## 6. Classification:

When a feature extraction is done then next step is classification of the detected object. In the classification process various region and the edges of tracking images is done. Efficient result can be extracted from the database. By using PNN classification can be done.

## 7. Behavior Understanding/Personal Identification:

Here we put various learning algorithms or any kind of algorithms that manipulate the data that was gathered. After carrying out all above process last stage is to show that motion is normal or abnormal.

## V. CONCLUSION

Human behaviors are complex and have much variety in an unconstrained environment. In this paper we did the analysis of anomaly detection techniques such as abnormal human behavior, motion detection, crowded scenes, stairs and road side scenes. After the analysis we found that in road side scenes for detecting human behavior PNN method is gives superior results. The proposed system describes an advanced algorithm, PNN for classification and the classifier is trained on instances of each class. The detected body is matched against the reference body in the dataset and detects the human body in CCTV Video camera. Result shows that the user is abnormal or not. We achieve real-time video processing of the actual application requirements; therefore it can be used in practical applications, especially in the process of social public security.

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TABLE I. Analysis of anomaly detection techniques in video surveillance

Sr. No.	Title of the paper	Authors	Publication	Year	Methods/ Techniques/ Algorithms	Finding /Limitation	Scope of Research
[1]	Video-Based Abnormal Human Behavior Recognition	Oluwatoyin P. Popoola and Kejun Wang	IEEE	2011	Hidden Markov Model (HMM) and Dynamic Bayesian Network Model (DBNM)	Modeling Human Behavior and activity pattern for recognition	Need to test the performance of these approach in unstructured situation
[2]	Motion Detection, Tracking and Classification for Automated Video Surveillance	Neha Gaba , Neelam Barak and Shipra Aggarwal	IEEE	2016	Bayesian and Optical flow method	Detect the moving object tracks and classifies it according to the aspect ratio of object	Increase in terrorist threats and safety in traffic using CCTV based surveillance
[3]	Anomaly Detection in Crowded Scenes	Vijay Mahadevan, Weixin Li, Viral Bhalodia and Nuno Vasconcelos	IEEE	2010	Latent dirichlet allocation model, coupled HMM model and background subtraction method	Underlying visual representation and existing algorithm are not applicable to crowded scene	Saliency detection are extensively studied topic
[4]	Automated Detection of Unusual Events on Stairs	Jasper Snoek, Jesse Hoey, Liam Stewart and Richard S. Zemel	IEEE	2016	Hidden markov model, temporal segmentation method using conditional field, adaptive background subtraction technique	Overcome with multiple tracket tracking	Research the causes and types of accidents, how to prevent that
[5]	Vehicle detection recognition and tracking in traffic surveillance	Ma'moun Al-Smadi, Khairi Abdulrahim, and Rosalina Abdul Salam	IEEE	2016	Motion and look based technique	Vehicle recognition and classification utilizing vehicle attributes like color, license plate, logo and type, provide a detailed description of the advances in the field	Sophisticated probabilistic modeling and feature extracting
[6]	Anomaly in road side scene	Ramin Mehran and Alexis Oyama	IEEE	2017	KNN classifier, LBP pattern and BLOB analysis	Anomalies might require the use of more advanced anomaly detectors which need to handle more attributes.	Detect the motion of human behavior scene to recognize the activity is normal or abnormal.