Abnormal Event Detection in Video
Using Frame Subtraction and Feature Based Tracking Method

Major Project II
Submitted in Partial Fulfillment of Requirements for the Award of the Degree
Of

Master of Technology
IN
INFORMATION SYSTEM

SUBMITTED BY
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(2016-2018)

CANDIDATE'S DECLARATION

I, **Sapna Sharma** (**2K16/ISY/11)** student of M.Tech **(Information System),** hereby declare that

The project Dissertation titled **"Abnormal Event Detection in Video Using Frame Subtraction and Feature Based Tracking Method"** which is submitted by me to the **Department of Information Technology**, Delhi Technological University, in partial fulfillment of the requirement for the award of the degree of Master of Technology, is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any degree, Diploma Associateship, Fellowship or some other title or recognition.

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CERTIFICATE

This is to certify that Ms. **Sapna Sharma (2K16/ISY/11)** has carried out the major project titled **"Abnormal Event Detection in Video Using Frame Subtraction and Feature Based Tracking Method"** as a partial requirement for the award of **Master of Technology** degree in **Information System** by **Delhi Technological University, Delhi.**

The Major project is a bonafide piece of work carried out and completed under my supervision and guidance during the academic session 2016-2018. The Matter contained in this thesis has not been submitted elsewhere for the award of any other degree.

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ACKNOWLEDGEMENT

I express my gratitude to my major project guide **Ritu Agarwal, Assistant Professor** in **Department of Information technology** at **Delhi Technological University, Delhi** for the valuable support and guidance she provided in making this major project. It is my pleasure to record my sincere thanks to my respected guide for her constructive criticism and insight without which the project would not have shaped as it has.

I humbly extend my word of gratitude to **Dr. Kapil Sharma**, Head of Department and other faculty members of department of Information Technology for providing their valuable help and time whenever it was required.

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ABSTRACT

Nowadays, there is large requirement of video surveillance system in security and intelligent system for the public and finding out motion of real time object is a major task in video surveillance system. A single surveillance camera can record all activity in day and night. In this paper, we used an approach to find out abnormal activity based on features of object which is independent of object size, shape and speed. To detect the suspicious moving object of abnormal behavior, we have used foreground subtraction approach and features based descriptor. In frame subtraction, we will calculate the difference of active pixel of successive frame in motion and find out the region of interest by setting a fixed value of threshold. We will compare the mean of illumination of active pixel of frame in motion by threshold value, and locate the suspicious object if its value is more than the threshold value by setting pixel value 1 and non-interest portion with pixel value 0.

In our approach, we only focus on the frame in motion having active pixel, so for that we find the frame in motion to increase efficiency. For this purpose, calculate the peak values of change in illumination of active pixel of initial 10% frame. If the difference of illumination in successive frame is more than that peak value then we can say that there is a high probability of change in motion and we count it as “frame in motion” otherwise ignore the frame. Advantage of this approach is that we can save time and also increase efficiency. For track and locate the object, we use features based tracking method. The proposed algorithm requires less computation by using efficient approach and also increase accuracy in video surveillance system to detect abnormal activity in real time environment.

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Chapter 1

INTRODUCTION

Nowadays, there is a huge requirement of digital automation system because of increasing demand of digital multimedia. But there is a problem occur because of large size of input data set [1]. So, to overcome this problem, there is a need of video summarization approach. We can summarize the video either based on Key frame or Video skim. To reduce storage, we can also use motion sensitivity based camera [2]. For both moving and static camera, video motion detection is an important work for monitoring and surveillance system. In noisy and cluttered environment, it is very difficult task to detect long range moving suspicious object with poor visibility [3].Video Surveillance system used to provide security by identifying abnormal activity in area like in army, in banking sector, in parking slot etc. For this, we have to detect the object with suspicious activity by using frame subtraction method and then track it by using feature based tracking method. Frame subtraction or temporal differencing method is extremely adaptive for dynamic environment. These method are not able to find out shape of certain type of moving object. For static camera, background subtraction algorithm is generally used. It compares the present image with a reference image [4].If Gaussian mixture model is used for foreground calculation then object tracking is not able to handle temporal object stillness and visual burst. [5]

In my proposed work, we focus only on the frame which have high probability of change of object. So, we calculate the frame in motion by comparing the peak value of change in initial 10% frame. Because of this, there is large increment in performance of calculation. We calculate the difference of illumination and intensity and then set the threshold to find out the region of interest [6] of frame in motion with active pixel [1]. To display the object, set pixel value 1 if respective difference is more than the threshold otherwise set pixel value 0. And then locate the object by using feature based tracking method [7] by finding out the slope changing in gradient of Log-likelihood ratio test [1].After understanding the behavior of object if it is abnormal then display it.

1.1. Detection of object with its methods and Categories

Object Detection approaches and state of art of algorithm are used to find out features for identification of object instance. There are various application where object detection are used for getting the images from different source like security in army, banking intelligence system, vehicle parking system [7].

1.1.1. Categories of Object Detection

There are different categories of object detection which are:

- Model Based System: The System tries to coordinate model that is intended for the object to different part of image.
- Image Invariance Method: This method is utilized for coordinating of an object on a group of an image patterns relationship like brightness level.
- Example based learning Method: This method used to sort object detection system in a decent way. The primary application area of this strategy are computer vision and object recognition [7].

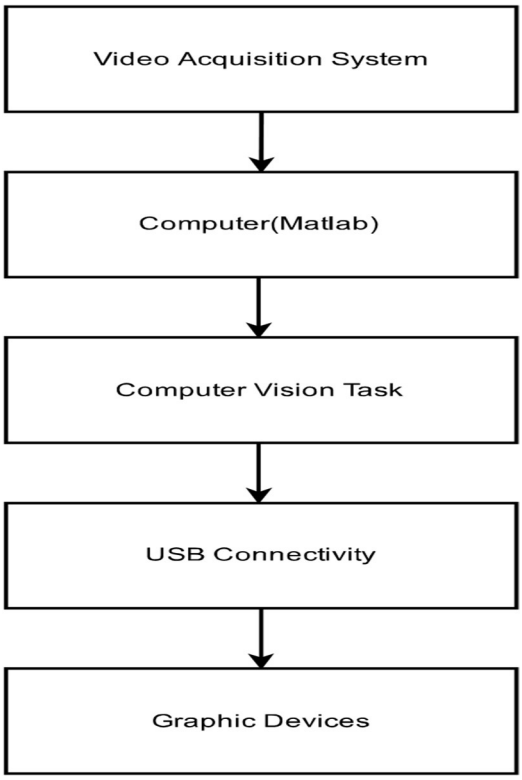

Figure 1.1. Block diagram of requirements to implement algorithm

1.1.2. Object Detection Method

To detect moving object in video there are known methods:

- **Frame Subtraction or Temporal Differencing Method:** In this method, at first input video is converted into frames [6] and motion in object is calculated by finding out the difference between successive frames and difference is stored, which is then compared with the defined threshold and if respective changes are more than the threshold, we locate the object by setting high pixel value.

The implementation of this method is not very much suitable for the video where change in video motion is very slow [7].

- **Optical Flow Method:** This method can represent optical flow field of frame or image .In this method we can find out the movement information from background [7]. We can used this method to find out the abnormal behavior which occur because of abnormal event. For the representation of motion features, we can compute the low level features by using optical flow. Horn and Schunk describe an optical flow method to compute optical flow by global condition on smoothness. By using STV orientation and magnitude of motion of optical flow at every pixel is combined. To find out the motion features in "spatio-temporal volume' optical flow histogram was used [8]. SVM is generally used for classification and it is also regression based method. In Optical flow, if we have used one class classification then there is a problem occur in this approach because it will consider only positive class data. One class SVM can be used to find out the features space region which contains maximum sample from an "unknown probability distribution".

- **Background Subtraction:** This method used for retrieval of foreground object in the activity. We can consider these object as moving object in the video [9]. To detect the object by this method, firstly Background modeling was done. For moving object detection, difference method is used to find out the difference between the background image and present image. Then we compare this difference with a threshold value, if this difference is more than threshold then this pixel is foreground pixel. This algorithm is used where every sequence of video is compare with background. The change between referenced frame and current frame define the presence of motion in object in term of pixel. There are two types of method used in background subtraction:

    - Recursive Algorithm
    - Non – Recursive Algorithm

Recursive Algorithm: This algorithm is used to update an atomic background model which depend on every incoming number of frame. In this, storage requirement is low. Difference technique is used in this method like Gaussian mixture, approximation median etc [7].

Non-Recursive Algorithm: In this method, for background estimation "sliding window" estimation method is used. To calculate the background image it "store a buffer of the previous frame" which depend on changes of every' pixel with in the buffer'.

1.2. Tracking of object with its methods and Methodology

Object tracking is an important task to locate the object and to find out abnormal activity. It is a method or approach which locate the object in successive frame .There are different categories and method of tracking are available for this purpose.

1.2.1. Methodology of Object Tracking [7]

Generally these methodology are used to locate the object and find out the movement of object in between number of consecutive frame. Generally it divides into:

- Region Based Tracking: In this tracking Method, we detect the object in the frame and then find out the movement occur in consecutive frame.
- Contour Based Tracking: In this type, we match the energy of boundary of consecutive frame.

1.2.2. Method of Object Tracking

There are different type of tracking method used to find out foreground object between consecutive number of frame such as color, texture, velocity etc. It is the process of locating object in different frame. [7]

The type of tracking method are:

- Point Tracking: This method is very reliable and generally used for vehicle tracking.
- 3-D Model Based Tracking Method: This type of tracking generally used where require 3-D tracking system for different type of vehicle like Vans, Track, and Bus etc. This method depend on the rule based boundary feature.
- Feature Based Tracking Method: By using this method we can classify the vehicle by using different features of object in video surveillance system.

There are two type of object:

- Single Moving Object Tracking
- Multiple Moving Object Tracking

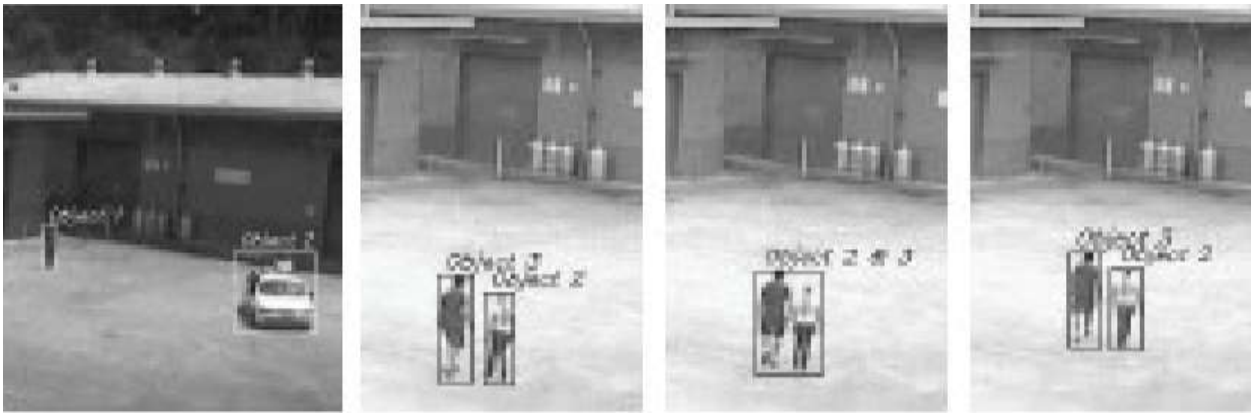

Figure 1.2. Multiple Moving Object Tracking of Activity in Video [7]

1.3. Video Surveillance System

Video Surveillance System are generally used to analyze and describe the behavior of object. In this, we detect either static object or moving object. To find out that which type of object is present in video, we have to detect the object by using any object detection in algorithm for example by using frame subtraction algorithm and then analyze the behavior of object whether it is normal or abnormal object. Video Surveillance system are also used to secure the sensitive area like banking, shops, in army to secure border etc.

There are three type of generation in video Surveillance System: [7]

- 1GSS: This type of surveillance system was introduced for action of recollecting an image and then processing it. But there was some problem occur such as retrieval of activity which occurred in system with high bandwidth.
- 2GSS: This type of generation generally used in digital and analog sub-system. The problem with 1GSS i.e. problem which occur because of high bandwidth was resolved by 2GSS and filter out false activity.
- 3GSS: This type of system used for "end to end" digital system. In 3GSS, a smart system is used which yield real time alarm for event which happen in system. I am work on 3GSS.

`Chapter 2

RELATED WORK

2.1. Abnormal Event

We consider abnormal event as suspicious activity which occur abruptly or unintentionally [2]. So if there is any suspicious event occur, we must have to find these activity and define the exact location and time where and when these activity happened, and then raise the alarm to inform happened activity to the respective person which can take care of that event. For example, there is a sick person in the hospital lying on bed but currently there is no one with the person, so if there is any abnormal thing happen with that person then it should be notified to nurse or doctor such as if respective person fall down from his bed so it should be taken care as fast as possible. For this purpose we have to find out that activity when it happen and send the image to respective person and raise alarm so that he will be taken care by nurse as fast as possible and try to resolve all losses which can me happen. There are many methods used to find out the abnormal event. There are two type of abnormal event occurred generally:

- Global Abnormal Event
- Local Abnormal Event

  There is an enormous request in developing fast and accurate abnormal event detection approach. Video provided as input then it converted into sequence of frames and these frames are used for the detection of object. The commitments for activity observation are proposed. It is challenging task for object tracking and video surveillance and because of illumination changes, quick variations in object appearance, similar non target objects in background and obstacle[10] .The Real time object tracing gives wide application regions in security issues in various other fields. Real time video tracking is important application to find abnormal events for security issues. In the video examination there are three stages: In the first place, we need to identify the moving object under region of interest and second the tracing of object from frame to frame and third understanding the behavior of traced moving object. Motion estimation is a way of determining motion vectors that depict the change from one 2D image to another; usually from adjacent frames in a video sequence. The methods for finding motion vectors can be categorized into pixel based methods (Direct) and feature based methods (Indirect) [2].There are different categories and method of tracking are available for this purpose.

Methodology	Features	Dataset
Lucas-Kanade Method for optical Flow	Region Based	---------
Support Vector Machine for Trajectory based Analysis	Spatial Features	---------
Temporal map for threshold detection	Spatial saliency	UMN
HOG for Object Classification	----	MIT pedestrian dataset
Coupled Hidden Markov Model	Visual Features	Terrascope dataset

Table 2.1. Comparison of method for Unusual Event Detection [2]

2.2. High Order Statistics (HOS)

This methodology generally uses 3rd or higher power, but in my approach, I am using 4th order power for detection of changes occur in frame. Generally lower Order Statistics (LOS) are used to compute zeroth, 1st and 2nd power. In kurtosis and skewness 3rd or higher power are used to calculate the change in distribution from normal distribution. Example of Lower Order Statistics are calculation of variance and arithmetic mean [15]. Higher Order Statistics are generally used for calculation of shape parameter like kurtosis and skewness.

Kurtosis work as a descriptor whereas skewness for the shape of probability distribution. It is used to measure the tailedness of "real value of random variable of probability distribution." High Order Statistics are less robust than LOS because of its high power computation. We can use L-moments instead of HOS because its robustness is higher than HOS.

In my proposed work, after calculation the intensity and illumination difference between successive frames, I used Higher Order Statistics for finding out the peak value of deviation where pixels are under motion. This technique is generally used to find out where abnormal changes occur in shape of illumination and intensity difference [16]. When these changes are find out, locate the changes with time and location and find out the behavior of these change and then raise the alarm to solve the emergency situation and display the respective object.

2.3. Detection of Motion in Video

In video, there are two types of object: Moving Object and static Object. To find out the motion in moving object we have to identify the object[10]. There are different types of approach to identify the object which are Background Subtraction, Foreground Subtraction and optical Flow. I am using foreground subtraction for detection of object.

In this approach we have to calculate the difference between successive frames and compare the difference with threshold to calculate region of interest[10]. After find out region we will display that object by setting pixel value 1 and ignore remaining part. After find out object we have to track and display the object. For locate the object use tracking method [7]. To find out in which frame there is a change in motion we used Likelihood Ratio Approach [1]And to find out peak change in frame High order Statistics are used which calculate the change in slop of difference of illumination of pixel. The approaches for finding motion vectors can be divided into pixel based methods (Direct) and feature based methods (Indirect)[6].

- **Direct methods**:
    - Block Matching Algorithm
    - Pixel Based Method

A Block Matching Algorithm is a way or finding coordinating macro blocks in a succession of digital video frames for the reasons for movement estimation. The underlying supposition behind movement estimation is that the patterns relating to objects and background in a frame of video sequence move within the frame to form corresponding objects on the subsequent frame. A block matching algorithm involves dividing the present frame of a video into macro blocks and comparing each of the macro blocks with a corresponding block and its adjoining neighbors in an adjacent frame of the video (sometimes just the previous one). A vector is created that models the movement of a macro-block starting with one area then onto the next. This movement, calculated for all the macro-blocks comprising a frame, constitutes the motion evaluated in a frame [7].

Pixel Based Method: In this work, I utilized the pixel based method. I took an approach for the detection of pixel where motion occurs in video, and the extraction of the frames when change happen in the video. The pixel where action happen form a binary active mask, which is equal to one in the active pixels and zero otherwise. This mask is extracted by processing the higher order statistics of intensity difference between successive frames. Sequential change Detection techniques are then applied to the intensity variation between video frames, in order to find at which frame abnormal change happen.

- **Indirect methods** utilize features, such as corner Recognition, and match corresponding features between frames, usually with a statistical function applied over a local or global area. The motivation behind the statistical function is to expel matches that do not correspond to the actual motion.

2.4. Application of Video Surveillance System

Nowadays, video surveillance system play an important role in security of different Area. It will play an important role to provide security and safety to the public[2]. A single video camera is able to locate the object in day and night.

Video surveillance camera used in different area like:

- In Border Area
- For Street Monitoring System
- In Intelligence System of army
- In Banking Sector
- Parking Area
- Vehicle tracking etc.

Classifier Methodology	Events	Real Time
Hidden Markov Model	Snatching	N
Fuzzy SOM	Activity in traffic at junction	N
Minimum Description Length	Traffic incident at the crossroad	N
Trajectory Analysis	Changing the path, unexpected stopping	Y

Table 2.2. Application Oriented Technique for Event Detection [2]

Chapter 3

LITERATURE SURVEY

3.1. Statistical Processing of Video for Detection of Event [1]

This paper proposed by Alexia Briassouli Singh and Loannis Kompatsiaris on Statistical Processing of Video for Detection of Event in Space and Time in 2008. This paper first find out the portion where suspicious activity occur at every pixel by using kurtosis as an outlier on illumination changes between frame. To find out the pixel where activity occur, they are using activity mask algorithm and to locate where suspicious activity starts and end in video and to locate that activity "sequential Likelihood change Test Approach" is used here. By using this approach, they increase the efficiency by using the less number of data set. This paper finds out changes in both data set with noise and without noise because during recording of a video, there are chances that noise can also introduced to recorded video [1].

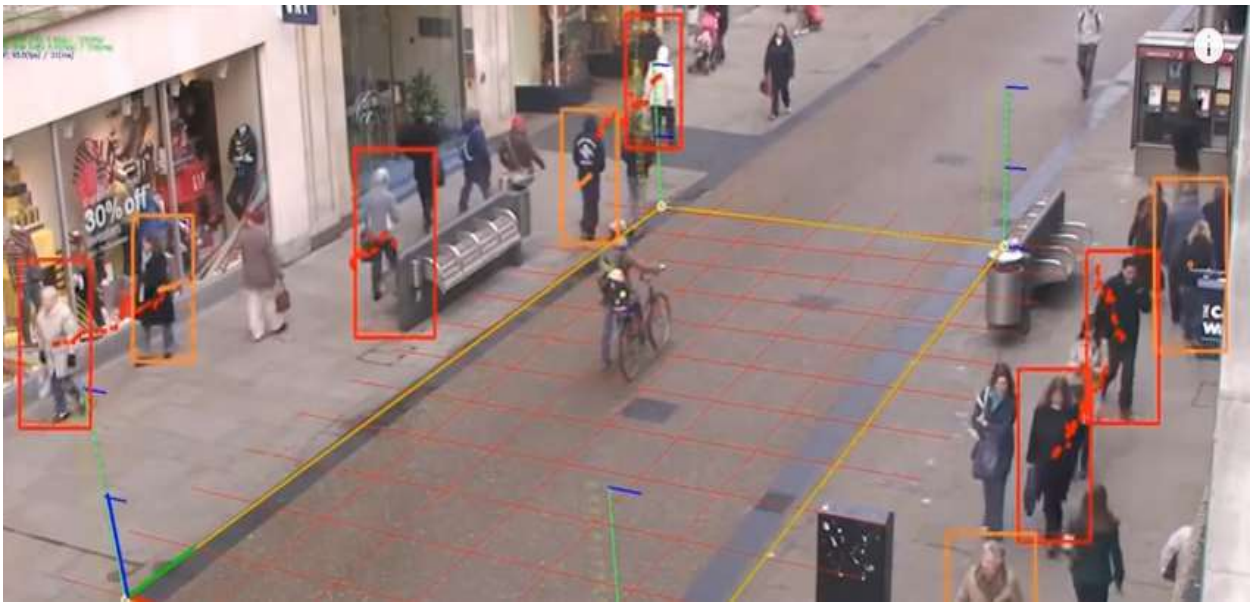

Figure 3.1.Real time people tracking to compute Trajectory

So they find out changes in both data set and compare them after removing the noise by using Gaussian filter. With less number of data set,they check the accuracy of proposed approach.

In this paper, Author used the Spatio-temporal method for localization of activity in frame. The approach used in this paper reduced the complexity cost and also increase the reliability of detect

change in frame. The Ground truth value identified by observing the video and compare the ground truth with the change identified in frame by using "Sequential Likelihood change testing" approach, they find out high probability of increasing reliability.

3.2. Towards Comprehensive Understanding of Event Detection and Video Summarization [2]

This paper proposed by Kalaivani P and Mohamed Mansoor Roomi on event detection and video Summarization Approaches in 2017. This paper suggest to use "motion sensitivity based camera" to store the recorded video for reducing the large amount of space which was used for this purpose but still volume is increasing in crowded scene. But large data set cannot be used for suspicious object detection so there is need for video summarization approaches according to the scene. This paper describe the different approaches of video summarization to detect and compute trajectory. They provide the unsupervised approach to detect abnormal activity. According to work of chen change,"Lucas-Kanade method" used to find out the optical flow of each pixel and then uses "Bayes Classifier" with threshold to find out that activity is suspicious or not. "Nearest neighbor Method" was used to detect nearby Euclidian distance. To calculate the optical flow. " Lucas-Kanade method" was using and this method was focusing on both velocity and direction of activity. Backpropagation method was using for training of neural network and to make decision tree. There was some event which uses SVM method to detect abnormal activity. This method was generally used for the purpose of clustering and classification of object. The region based approaches to find out the abnormal activity firstly divide the activity into number of regions and this approach used 3 "feature descriptor" which uses average optical flow by measure of size, texture and speed.

3.3. Object Size invariant anomaly detection in video surveillance

This paper proposed by Juan C. San Miguel and Jose M. Martinez on Object Size invariant anomaly detection in video surveillance in 2017. This paper describe as finding out the abnormal behavior depending on the characteristic of object size which is not based on the resolution of video and size of the object. To support this, we use variable size of spatial window which depends on object size. Pixel level calculation was used to support the real time video. For finding out anomalies, they build a picture which calculates present activity with associated characteristics.

Generally, a descriptor of characteristics build upon to calculate the motion of "spatio-temporal" which presents in every pixel of activity of scene [4].The descriptor of calculated features contained each and every features such as speed, motion and size of respective object on all the location. In event modelling, pixel of respective frame of motion generally revolving multiple time between the two states described as: moving and static. For description of behavior of motion in normal event, a background image is trained with number of frame of video. So peak value of event activity of sequence of training taken as normal behavior. Detection of anomalies was done by setting the threshold on calculation of difference between calculated behavior of background image and events which are observed.

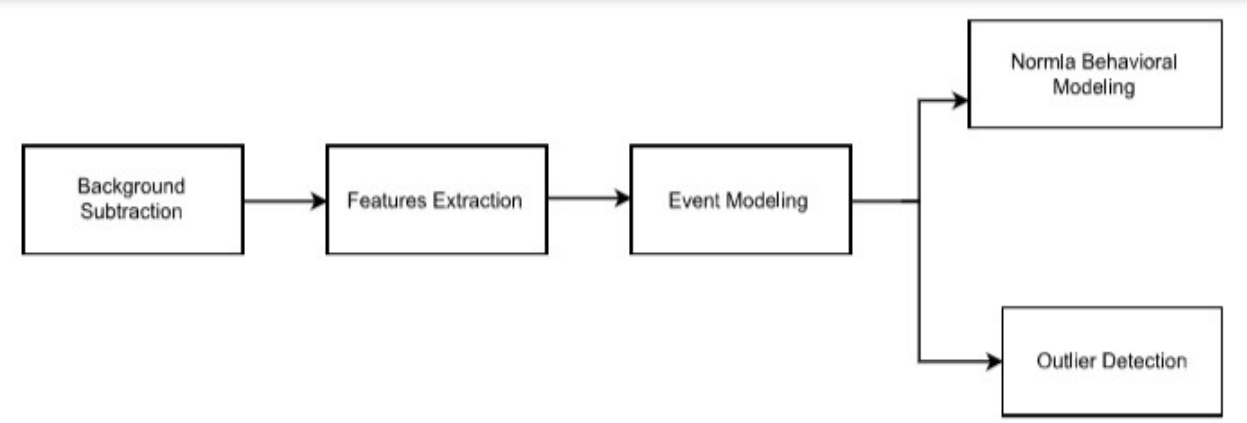

Figure 3.2. Behavior of System [12]

3.4. Motion Estimation for human activity surveillance [6]

This Paper proposed by P.A Dhulekar and S.T. Gandhe on motion estimation in video for human activity surveillance on 3 feb 2017. To find out the activity of object, they uses the optical flow method. The calculation of this method was already completed and it is used for the identification of object in the number of frame in video. The grouping of activity is done by "distribution characteristics" method. To implement the corresponding approach or we can say that to identify the activity in video, convert the respective video into number of frame and fixed the size of frame. DCT method is using to find out the changes in respective position of frame in input video and find out the motion in those frame. When motion detected, to find out suspicious object, template

matching approach was used and display the respective object .Buzzer was used in the frame when the suspicious object in the frame tracked [6].

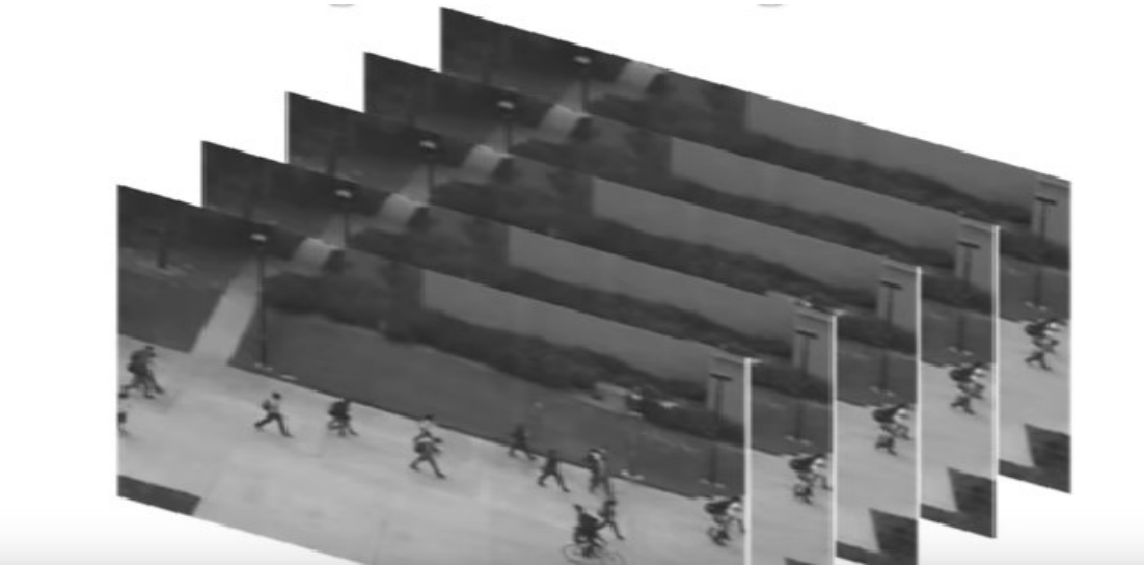

Figure 3.3. Conversion of Video into Number of frame

3.5. Detection of Abnormal Events in Crowed Scenes

This paper proposed by N. Patil and Parbeer Kumar Bishwas on Detection Of abnormal Events in video in 2017.The abnormal events in crowded scenes are two types: Local Abnormal Event and Global Abnormal Event. In this paper input video was described by some "set of overlapping space – time" cube. The "Global feature" of descriptor was describe by using the histogram of "motion magnitude" and "optical flow orientation". There are two type of method used in crowded scene: Object based method or Conventional and holistic method [8].

In object based method crowd or rush was consider as some group of individuals and in this type of cases trajectory, based method are most beneficial. But object based methods are not able to resolve occlusion problem and also this method need high computationally for crowded scene. So to remove this problem second type of method i.e. holistic method was introduced[11].

Holistic method taken the rush as "medium to high density" scene. This method was used to resolve the problem of trajectory based method by describing the low level characteristics from

“Spatio-Temporal “information. In many method “Spatio-Temporal” data was taken in consideration. Optical flow method finds out the abnormal behavior of activity in scene by calculating the difference in variation of changes in motion of behavior from normal activity. To find out the optical flow in video “Horn and Schunk” describe an algorithm which is based on global condition on smoothness of object in activity.

After finding out the optical flow of object, STV are used for addition of orientation or direction and change of magnitude in motion. The change in motion magnitude of activity scene in STV was averaged. For the selection of STV, a fixed value of threshold was used in proposed approach of this paper. To define the optical flow, at first find out the characteristics of magnitude based on some value of threshold. After that we select the STV for training and remaining was discarded. Orientation of optical flow histogram was used as characteristics of descriptor to define motion in video. HOFO was used only for selection of STV. After that one class classifier was used, but it has problem because it took the data from only positive class.

Figure 3.4. Suspicious Event Detection in video Motion

3.6. Motion Detection for Video Surveillance [10]

This paper proposed by Birmohan Singh and Dalwinder Singh on Motion Detection for video Surveillance in video in 2014. In this paper, a novel approach for Motion Detection (MODE) was used which independent on dynamic variation, bootstrapping and changes in illumination. MODE algorithm use pixel based approach which needs one frame for building the new model [10]. From 2nd frame onwards, the detection of foreground behavior starts. In this, new methods are used to track the suspicious object which can be find out and delete the ghost object while saving the abandon object from breakdown into background. In this, take the input video sequence in the mat lab software by connecting the video acquisition system to system i.e PC. Then construct the background model, this model must adapt the changes in illumination because video illumination and other features like intensity are varying during the recording of video.

Illumination changes will generally include the intensity variation in video because of variation in light in day or night. It uses background subtraction approach to find out the suspicious object. The behavior of background is identified and to find out the object activity, subtract the background behavior value of illumination from frame. Object tracking was performed on object, generally object lies on one of the two state i.e. either in moving state or in static state. We track the both type of objects i.e Moving Object and Stationary Object. Stationary object decompose the ghost object and must preserve the Abandon Object. After foreground segmentation, update the respective background model.

3.7. A study on Video Surveillance System For object Detection and tracking

This paper was proposed by Pawan Kumar Mishra and G.P. Saroha on "Study on Video Surveillance System For object Detection and tracking" in 2016 [10].Video Surveillance system generally used to find out the behavior of object in scene. To find out the behavior, we focus on both moving and static object. Objects are present in all the video, so to construct the behavior find out the object by using the different approached of object detection. There are different descriptor to describe the behavior of object with its associated features. We used static object detection in different application like to capture the vehicle which parked in non-parking area. To identified these object matching of static object i.e matching technique was using. In moving Object detection, object is identified when there is a motion in the video. Generally to detect the object in video motion, single frame was used, but it is very difficult to capture the video in motion. There is some possibility that noise will come in video during recording. To remove the noise, there are different filters which we are using nowadays like Gaussian filter. There are different methods

which are used to find out the moving object e.g. optical flow. After this, object tracking is performed and then display the suspicious object with an alarm or buzzer [7].

3.8. Robust and Sensitive video Motion Detection For sleep analysis

This paper was presented by Adrienne Heinrich and Di Geng on "Robust and Sensitive video Motion Detection For sleep analysis" in 2013 [13].They present a camera based device or system which can find out all in one device i.e. which can identify motion means detect and calculate it in machine learning for the purpose of analysis of sleep person. It can estimation the motion in each frame and based on that identify the movement in video and analyses it with different type of classifier. It used an attractive approach to find out the pattern for analysis of sleep in motion by sensing and analysis pattern. But the problem is that illumination in frame keeps on changes. So it can resolve by global light changing and identified it. So they will using the calculation of shadow i.e desired shadow, background and interfering shadow. So we have to use motion detector which is robust in nature and can handle any type of shadow. In given Diagram VP means Variance Plus, TM means Texture Model which characterize the different texture by using sum of squared difference of different surfaces, BPF means Band pass filter which are using to remove the low edge of frequency. TM delete the false positive direction where texture was unchanged, MCTM means Motion compensated Texture model which can remove the false direction detection in which texture was keep on changing with time in an unpredictable manner.

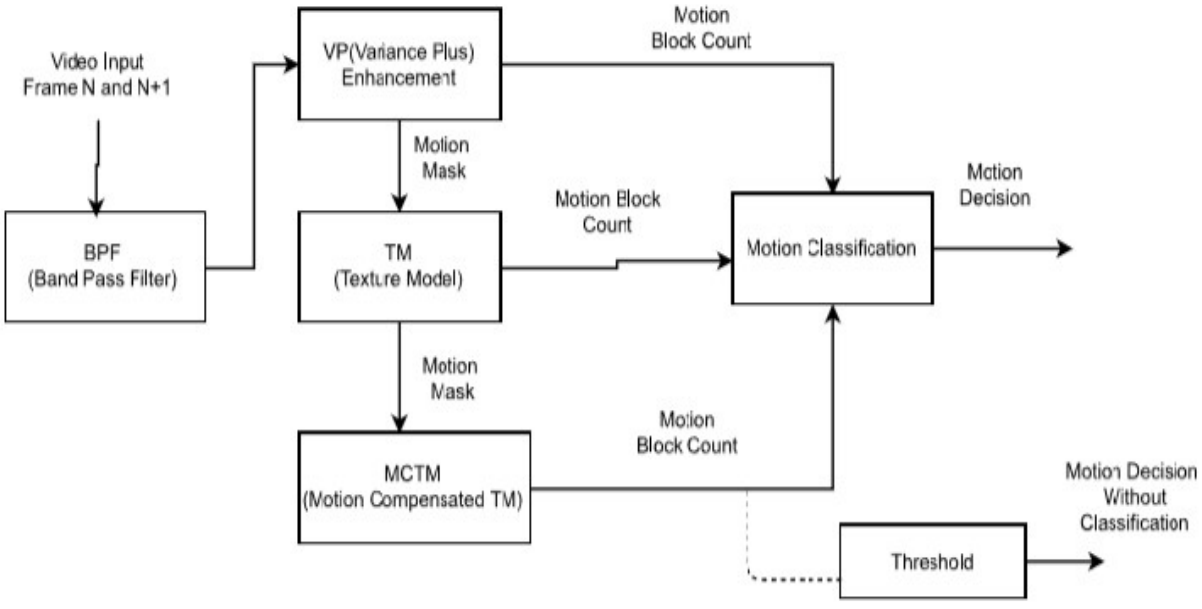

Figure 3.5. Block Diagram of Video Movement Detection [13]

Chapter 4
PROPOSED APPROACH

To find out the abnormal event in video, we propose an approach in which we find out motion in each frame using foreground Subtraction Algorithm. This method uses pixel based approach for calculation of object.

- Temporal or Frame Differencing Detection Method: We use this method for the detection of moving object [14]. To calculate the region of interest, we find out the difference between successive frames which have high probability of change of object. We find out the difference of Image I1(x,y,t) and I2(x,y,t1) at time t and t1 and compare this difference by fixed threshold value. If the respective difference is more than the threshold value, then active the region by setting the value 1 otherwise ignore it by setting value 0.

  Frame Difference (Fi) calculated as:

$$F_i(x, y, t1) = 1 \text{ if } \mathbf{I}(x, y, t1 > \text{Threshold T}) \quad \mathbf{0} \text{ Otherwise} \tag{1}$$

$$\mathbf{And} \text{ Threshold T} = 2 * \text{mean } (I(x, y, t1)) \tag{2}$$

4.1. Steps of Implemented Approach

1. Input to the system is video with normal and abnormal behavior.
2. Next step is to find out that activity is normal or abnormal.
3. For this, we detect the moving object using foreground subtraction algorithm.
4. Find out the difference of illumination and intensity between successive frame and store the difference.
5. Calculate the peak difference of change in pixel of initial 10% frame.
6. Compare the illumination difference of successive frame with peak value and if it is greater than the peak value then to display the object set pixel value 1 otherwise set 0.
7. To display the object, we used features based tracking method.
8. To display the frame in which abnormal change occur, we used sequential likelihood ratio and display the frame number.

4.2. Flow Chart of the Method

The basic sequences of events happening in this project is depicted in this Flow Chart. It is showing the start of the flow of event detection in video with step by step using foreground subtraction algorithm.

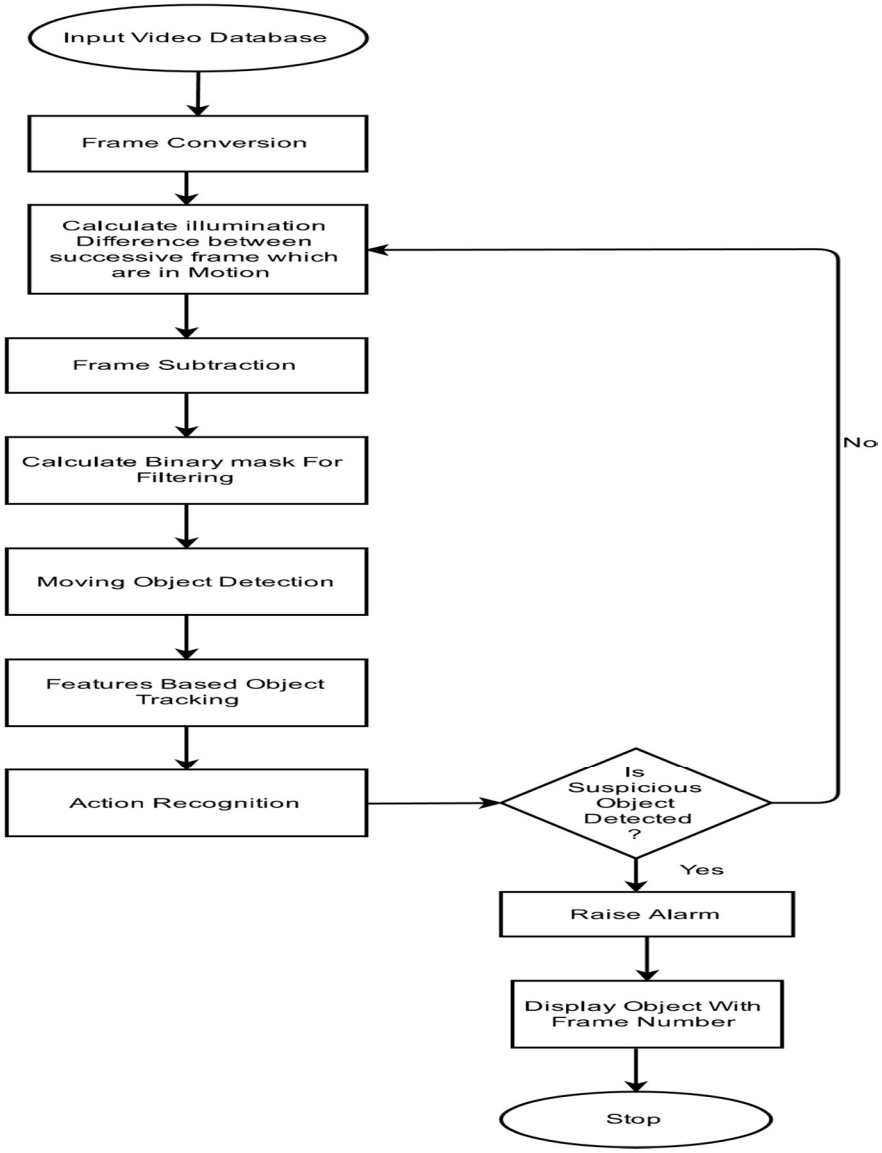

Figure 4.1. Flow Chart of Overview of the Method

4.3. Procedure to calculate abnormal behavior in video

The sequences of events happening in this project is depicted in this block diagram. It is showing the starting of the flow of event detection in video with step by step using foreground subtraction algorithm.

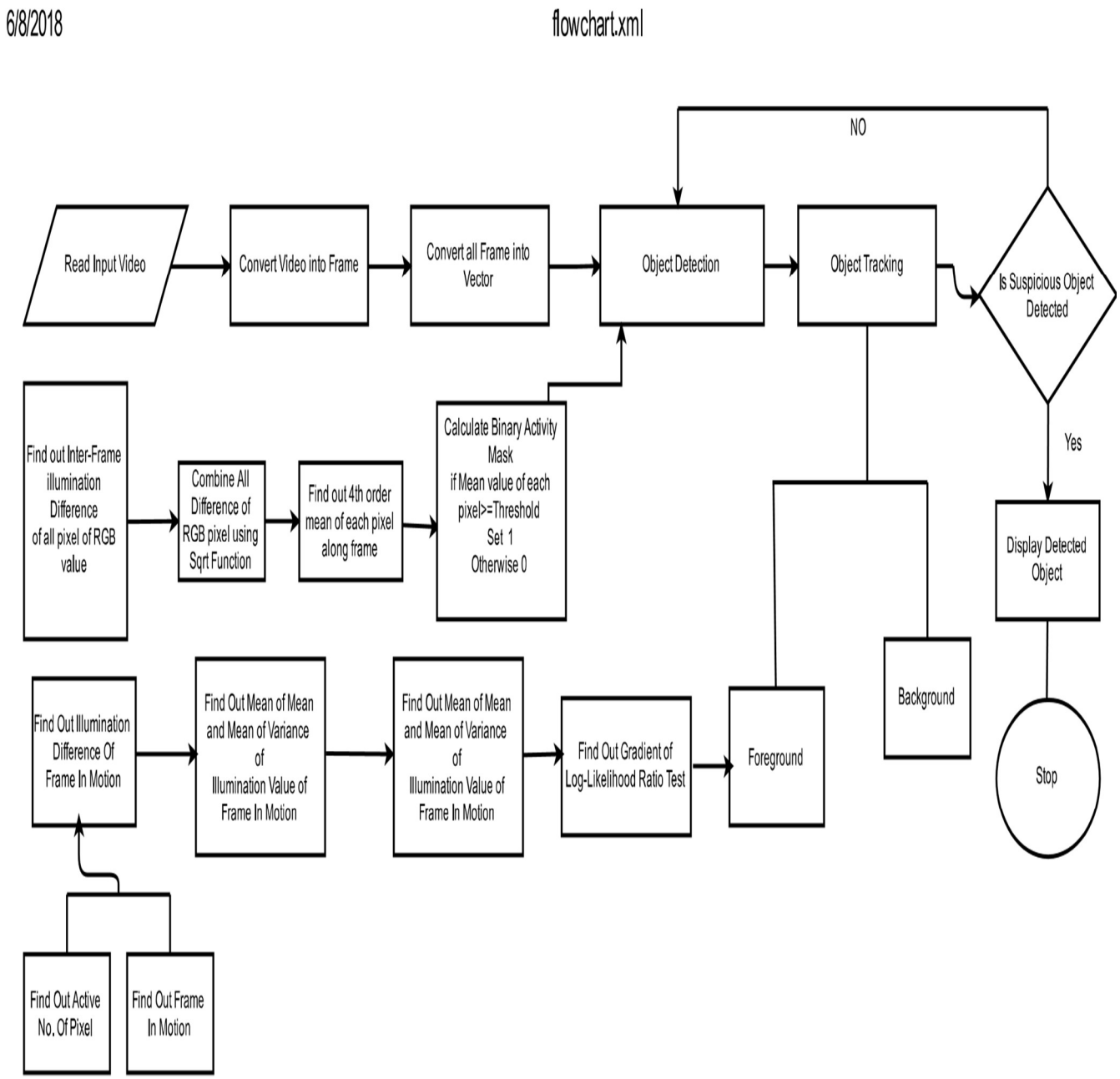

Figure 4.2. Block Diagram showing all the steps to detect abnormal activity in video Motion

4.4. Algorithm to Find Out Abnormal Event in Video

Input: Video having normal and abnormal behavior in moving object.

Output: Display moving object having suspicious behavior with respective frame number.

Steps:

1. Convert input video into number of frames.
2. **For** i = 1 to …..all frames
3. **While** isGood true count number of valid frame
4. **End while**
5. Calculate inter-frame intensity and illumination difference of all pixels.

Object Detection

6. Find out 4^{th} order mean of each pixel along frame.
7. **for** i= 1 to……hight of frame
8. **for** j=1 to……hight of frame
9. Calculate Binary Activity Mask
10. **End for**
11. **End for**
12. **for** i=1 to length of frame in motion

Object Tracking

13. Find illumination difference value of frame in motion along active pixel.
14. Take Log-likelihood Ratio test (LLRT) and gradient of LLRT to track the suspicious object.
15. Display variation of object by using Sequential change Detection Algorithm.
16. For tracked object use features space generation

    $$F(x,y,z)=a$$

    Where a measure the z^{th} frame y^{th} feature for the x^{th} object [9].
17. **End for**
18. **End for**

Chapter 5

EXPERIMENT RESULTS

In this section, we compare the existing method Result with our proposed Approach Result to find out Abnormal Activity and then calculate the performance.

5.1. Data Set

In our Proposed Approach, we did experiment on Different existing Dataset which is publicly available. In UMN dataset, there are three different scene present in video with 320x240 resolution and we divided it into 200 frame with 10frame/sec in which 45 abnormal ab-normal frame 155 normal frame.

Data Set Name	Total Number of Frame	Frame Number		Number of Anomaly
		For Training	For Testing	
UMN Dataset	200	20	80	3
WALK1	618	20	180	1
MEET WALK TOGETHER	707	20	200	1

Table 5.1. Dataset information

http://crcv.ucf.edu/projects/Abnormal_Crowd/#WebDataset

5.2. Ground Truth Preparation

In UMN Data Set, Ground Truth Value in existing paper [8] is provided with Red Color in upper Left Corner. But in existing method ground truth value is not completely correct, so we have to correct the ground truth value and implement it.

NORMAL **ABNORMAL**

Figure 5.1 Example of Normal and Abnormal Event of UMN Dataset

5.3. Evaluation Metrics

ROC (Receive Operating Characteristics) curve used to Plot the True Positive Rate (TPR) with False Positive Rate (FPR) and we will make the curve of both existing and proposed approach and compare it.

	Classified Positive	Classified Negative
Actual Positive	TP	FN
Actual Negative	FP	TN

Table 5.2. Introduction of TPR and FPR

TP: Number Of abnormal Event correctly classified as Abnormal.
TN: Number Of normal Event correctly classified as normal.
TP: Number Of normal Event incorrectly classified as Abnormal.
TP: Number Of abnormal Event incorrectly classified as normal.

$$TPR = \frac{\text{TP}}{\text{TP+F}} \tag{3}$$

$$FPR = \frac{FP}{TN+FP} \tag{4}$$

$$P(precision) = \frac{TP}{TP+FP} \tag{5}$$

$$R(Recall) = \frac{TP}{TP+FN} \tag{6}$$

- Sensitivity is same as TPR and Specificity are also called True Negative Rate (TNR).

$$TNR = \frac{TN}{TN+FP} \tag{7}$$

Then

$$FPR = 1 - Specificity \tag{8}$$

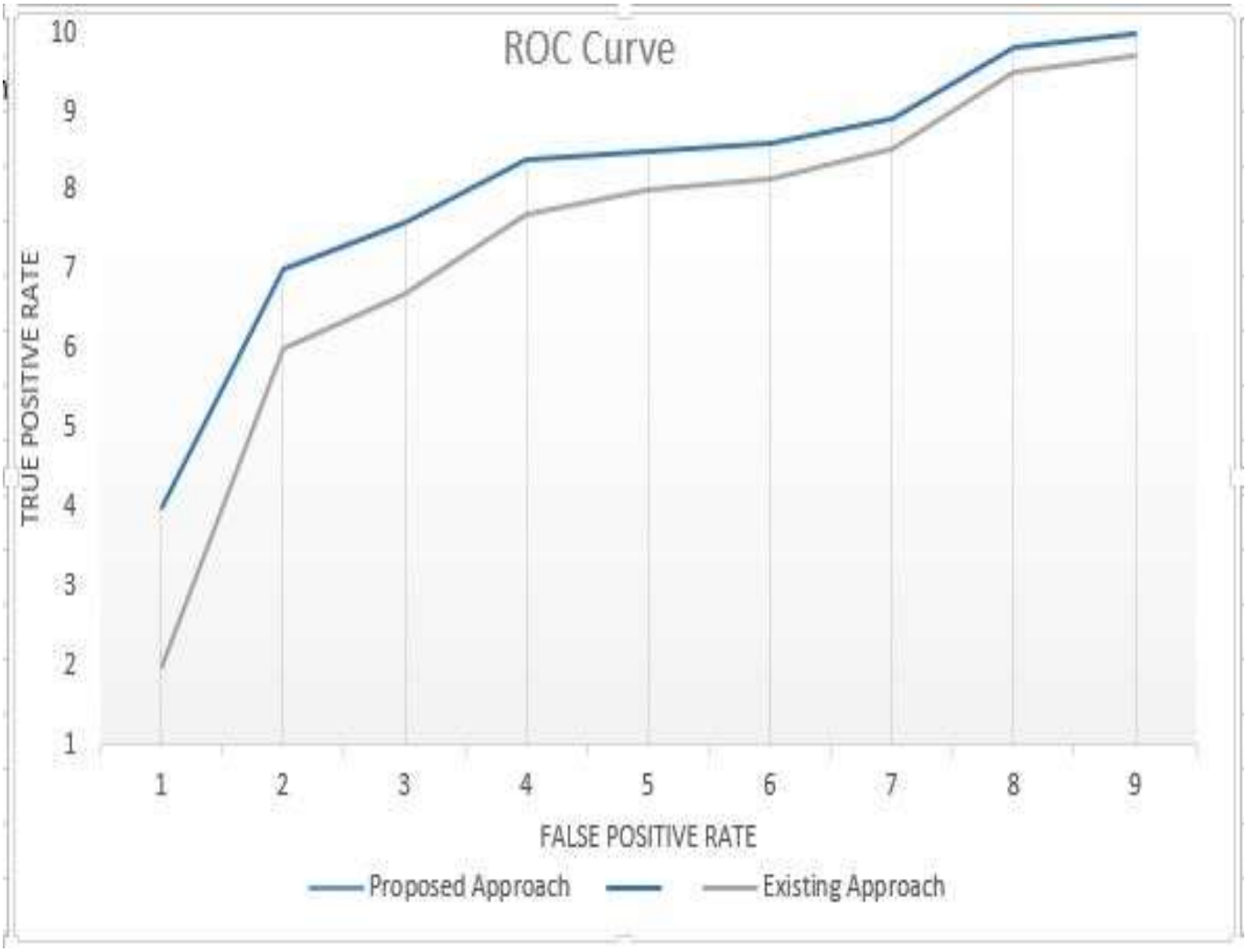

Figure 5.2. ROC curve to compare the existing Approach with Proposed Approach

5.4. Results

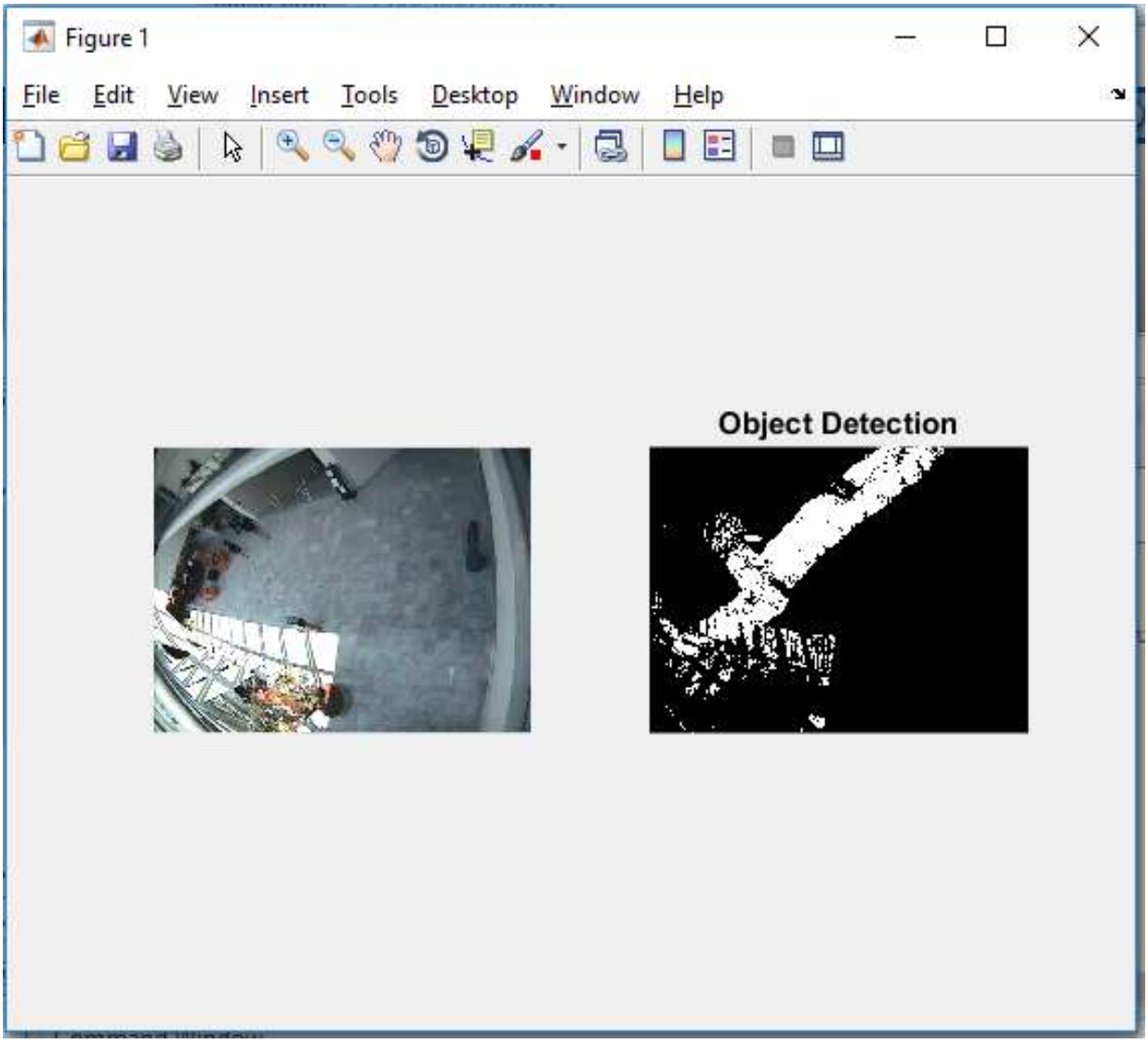

Figure 5.3. Detected Object of Abnormal Behavior

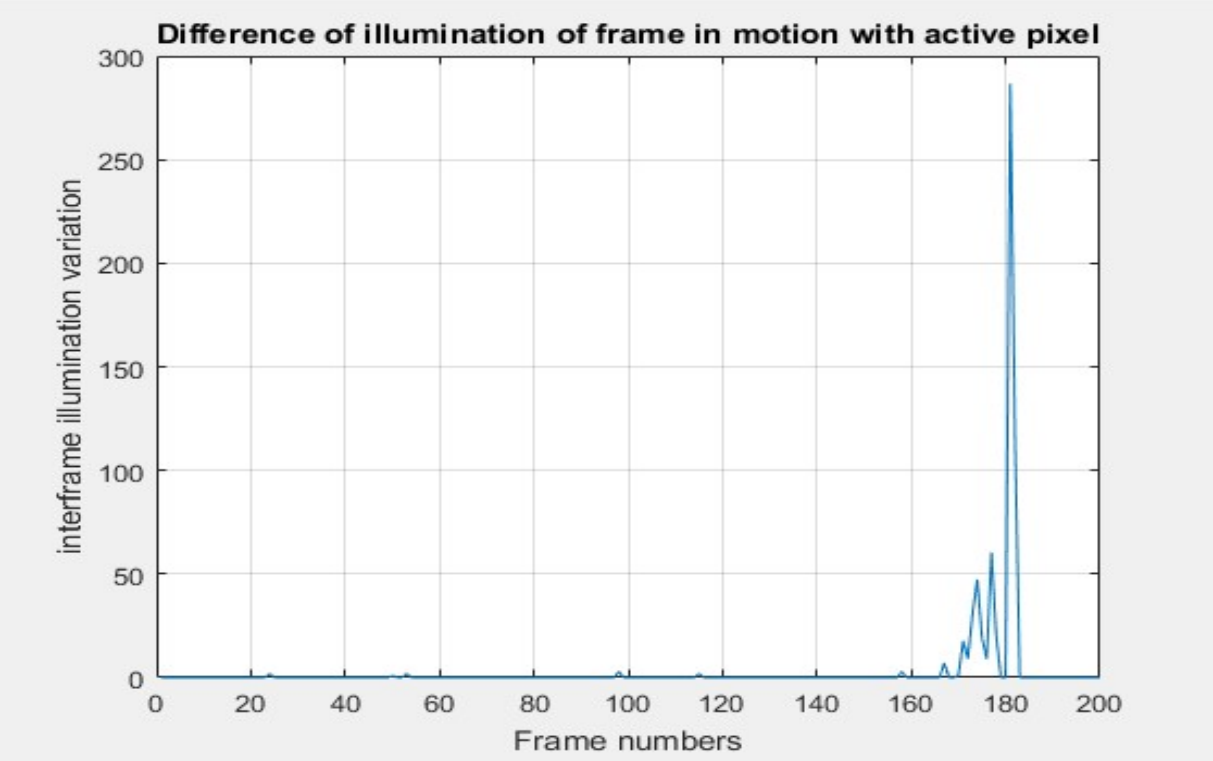

Figure 5.4. Variation in illumination of successive frame having high probability of motion

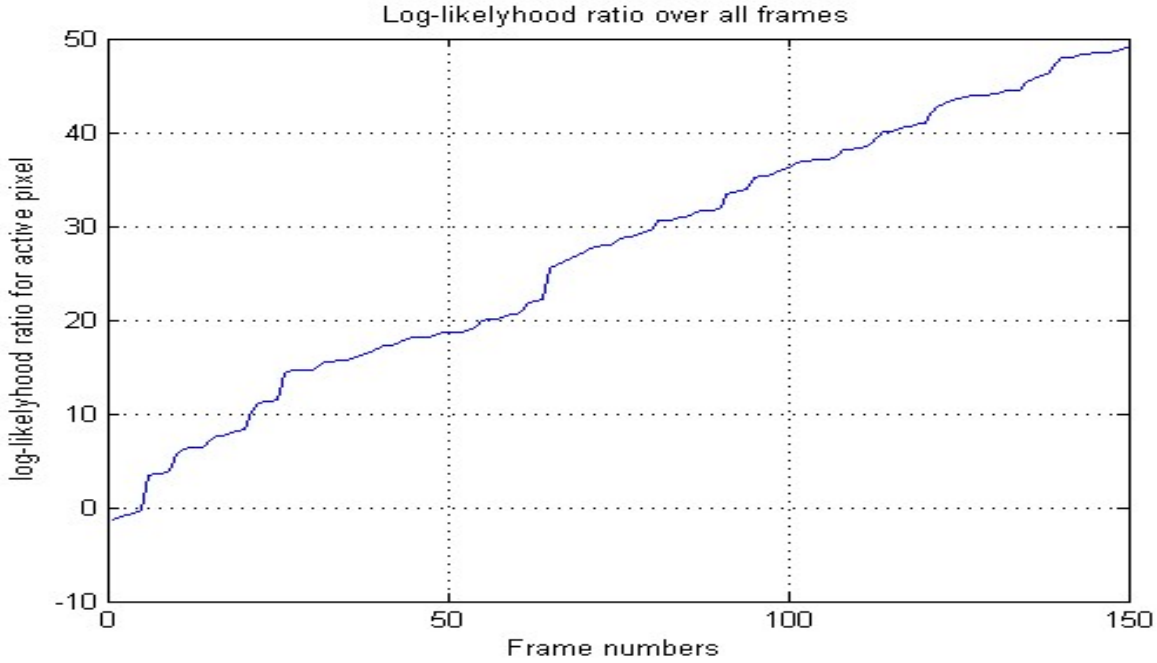

Figure 5.5. Use Likelihood ratio to find out goodness of Ab-normal activity vs Normal Activity

It will find out how many time normally abnormal activity occur in video and generally at what part of video.

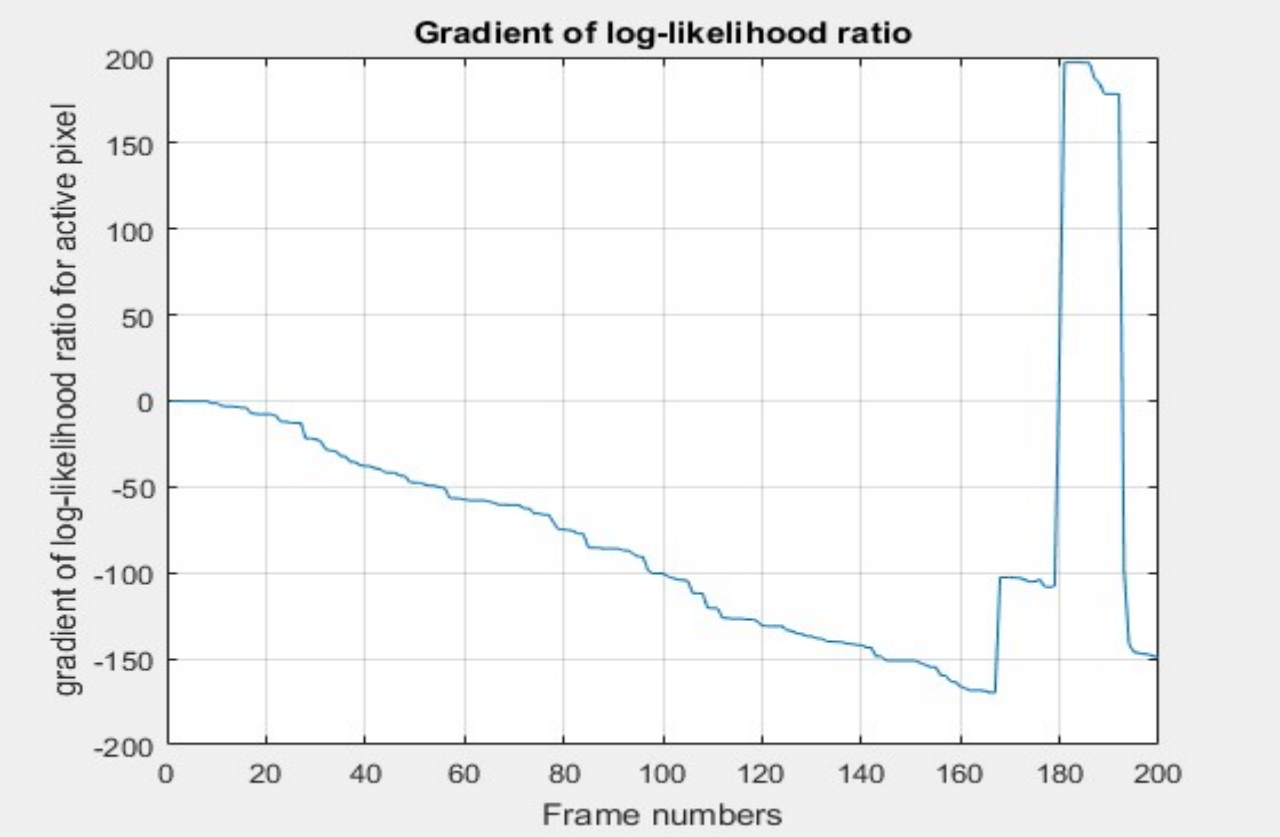

Figure 5.6. Gradient of log-likelihood ratio test to find out slope of change in frame

Chapter 6

CONCLUSION AND FUTURE SCOPE

6.1. Conclusion

We propose an approach for detection of abnormal activity in video surveillance system by detecting the suspicious activity object and display the object with respective frame by raising an alarm. We used frame subtraction algorithm to find out the moving object, for this calculated the difference between successive frames and compare it with threshold value to calculate region of Interest. To track and locate object, Features based tracking method is used which construct the descriptor based on some features like shape, speed, color, velocity, orientation etc. and then compare the behavior with observed event. In our work we apply this algorithm only on the frame which have high probability of change of object along with active pixel. So, it will increase the efficiency with low computational cost. The Proposed Approach was implemented in Matlab by taking input video having number of frame.

6.2. Future Scope

In future work, we will going to work on calculation of suspicious object in multiple direction moving object with dynamic environment. Because in some cases Temporal Difference method not able to find out complete shape of moving object in dynamic environment. To make the detection of activity in multi direction save the all direction background environment and apply approach differently on all of that and then find out which direction have high probability of change in motion of moving object, but this approach still have problem with moving camera in which illumination value keep on changing and also there is high effect of noise in video recording. In algorithm, sometime it will not able to find out very small size object having different shape so in future I am working on variable size window object having dynamic environment. In place of only alarming, alarm with image of suspicious object can be send to tackle problem fast and efficiently.

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