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An Abnormal Activity Detection Using Harris corner, Optical Flow and Dynamic Thresholding

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Abstract

In this paper, new method has been introduced for identifying abnormal activity from videos. This method is totally based on motion which can be calculated by applying optical flow method. In this method key points are also detected for calculating method. Key points are detected by Harris corners. For identifying abnormal activity dynamic threshold is used. For calculating dynamic threshold energy has been used. This method doesn't used any prior knowledge or training data. It also do not required static threshold for identifying abnormal activity. This method can detect abnormality from UMN, BEHAVE and UCF-Crime dataset. The activity identified robustly. It also doesn't require much computation.

Keywords: Abnormality, Harris corner, Optical Flow, Dynamic Thresholding

1. Introduction

Since last 10-15 years, it has been noted that video analysis has gain extraordinary improvement and interest from the researchers. Rapid growth has been observed in this field. The goal of this is to detect the abnormal as well as unwanted event from video where there is less need of human interaction. Video surveillance is major interested area found by researcher for identifying and classifying activities of human. They have identified activities in normal and abnormal events. Previously manual surveillance system is totally dependent on human. It needed manual labor to analyze behavior and classify them to abnormal and normal behavior [1].

The general method to identify abnormal activity is to know about the normal activity patterns. First the pattern should be designed during the learning phase from the normal activities. Then it should be classify based on that pattern. At the end decision has to be taken whether activity is normal or abnormal [2]. Activity detection procedure is mainly divided into three part. In this first part is object segmentation. In this step, background and foreground objects are identified. This step is very important because feature extraction has to be perform on this step only. Feature extraction is second step of activity detection. In this step, features has to be identified by various methods and algorithms. The features can be shape, color, motion, poses, silhouette etc. The rich information can be received only from appropriate feature extraction. So it is very crucial step. After this classification has to be performed. Classification can be done by two ways, either supervised or unsupervised. In supervised classification training data should require to classify the activity, while in unsupervised there will be no need of training data. Unsupervised learning methods are generally clustering methods. . These methods are a form of online learning methods and adaptable with context changes over time [3, 4].

2. Proposed flow of algorithm

In this paper, proposed algorithm has been divided into three parts. First part is image preprocessing and background subtraction. Background subtraction has been done using averaging method. Second part is feature extraction. First key points are identified by using Harris corner then optical flow has been applied. Harris

corner will be captured as feature points to represent moving objects and will be tracked by optical flow technique to estimate the motion intensity.

At last, dynamic thresholding has been calculated and activity has been classified in to two class: Normal activity and abnormal activity.

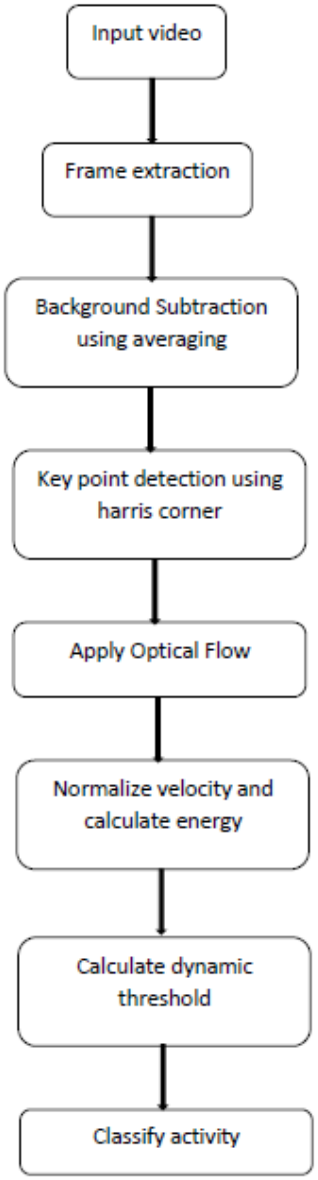

Figure 1: Proposed Algorithm

A. Preprocessing and background subtraction

A background model contains the static image or scene, which does not contain any foreground object. Hence the foreground image can be obtain by subtracting background model to video frames. Fig. 2 shows the procedure for obtaining foreground object using background subtraction method. This technique so most popular because of its effectiveness and straightforwardness [3, 5, 6].

Background modelling can be classified in two categories: (i) Recursive (ii) Non-Recursive. In recursive background modelling, recursive concept is used. Here the model is calculated recursively. Updating is based on input. So the current frame is majorly affected from the too distant past frame. Running average, running Gaussian average etc. are the example of recursive background modelling.

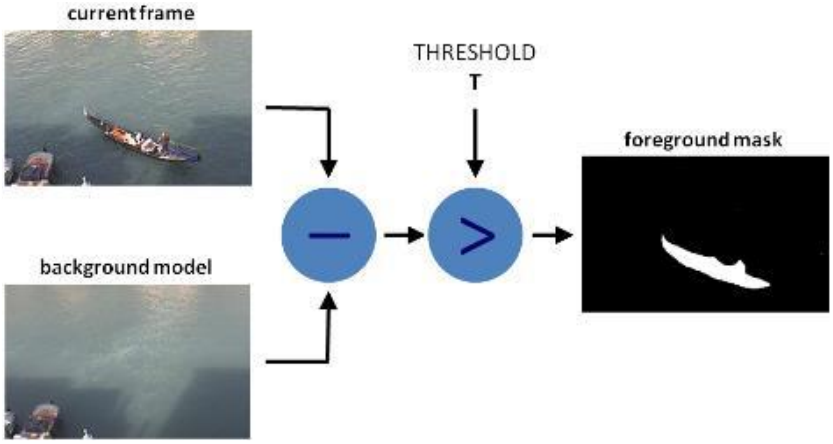

Figure 2: Basic idea of background subtraction technique [7]

Non-Recursive method includes the use of previous frames. It will store previous L frames and the approximation of background is calculated with temporal disparity of each pixel. Frame differencing, median and averaging are few example of non-recursive background modelling methods [8]

In this paper, non-recursive background modelling method is used. The averaging method takes the average of all the frames to construct the background. The advantage of this method is, it provides very fast computing. But the usage of threshold may limit the accuracy [9, 10].

B. Feature Extraction

Features can be extracted using optical flow method. But before applying optical flow key point has been identified using Harris corner method.

Corners are very important in feature extraction. Because they are local features and that points having higher values than the others. Corners are rotation invariant as well as they are not affected by illumination. So observing corners can minimize the amount of processing data. Hence corner detection plays an important role in object detection applications [11].

Harris corner detection has to be performed because the directions are more likely to change at corner points. In this method gradient of the pixel has been calculated and if the value of gradient is greater in x as well as y direction then that pixel has to be consider as a corner. This method improves the efficiency of detection and the reliability of results [11, 12].

Features has to be extracted on this points by using optical flow method. Optical flow [13, 14] is a method which gives the estimation of movement from a sequence of a frames. It is an ironic source of data which gives a wide variety of visual information. It calculates the flow vector which has both magnitude and direction.

Inter-frame difference method is used in optical flow to measure the flow i. e. one frame is taken at time t and another frame which is at t +δt. The goal of this method is to compute motion vector to detect motion. In order to design this motion vector, find out the position of a point in frame I2 such that its intensity matches with the intensity of I1 at particular point position (x, y) [15].

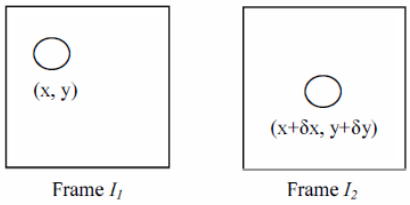

Fig. 3: Example of motion flow [15]

After applying this method, at last two unknown components Vx and Vy are achieved. On this component partial derivation should be applied to get flow estimation. There are various way to obtain this but most popular techniques are Horn - Schunck optical flow method and Lucas - Kanade optical flow method.

This method provides robustness and better performance. But it cannot work with occlusion.

Here in this paper, normalization of velocity is also applied. This step has to perform because pinhole perspective projection effect in scene which is serious. So a weight related to the coordinate of the point has been introduced or use other geometric methods have to be introduce to do modification [16].

C. Dynamic thresholding

To recognize abnormal event dynamic thresholding technique has been introduced in this paper. It uses energy from the all consequence frames. To find dynamic threshold following steps has to be performed.

Step 1: Find energy of each frame

Step 2. Select maximum energy from frames

Step 3. Calculate threshold by subtracting maximum energy from minimum energy. Now select threshold by dividing it by 4

Step 4. Find first and last point of a video, which satisfy threshold

Step 5. Insert text to a frame for abnormality

3. Implementation results and discussion

This algorithm has to be implemented on UMN, BEHAVE and UCF-Crime data set. UMN (University of Minnessota) dataset has been used for finding abnormality, where in each video represents crowd escape panic. The BEHAVE dataset has been taken from [17]. The dataset comprises of two views of various scenario's of people acting out various interactions. UCF-Crime (university of central florida) dataset is a new large-scale first of its kind dataset of 128 hours of videos. It consists of 1900 long and untrimmed real-world surveillance videos, with 13 realistic anomalies [18].

Here results has been taken from UMN dataset after applying our algorithm. Fig. 4 shows the foreground extraction from video.

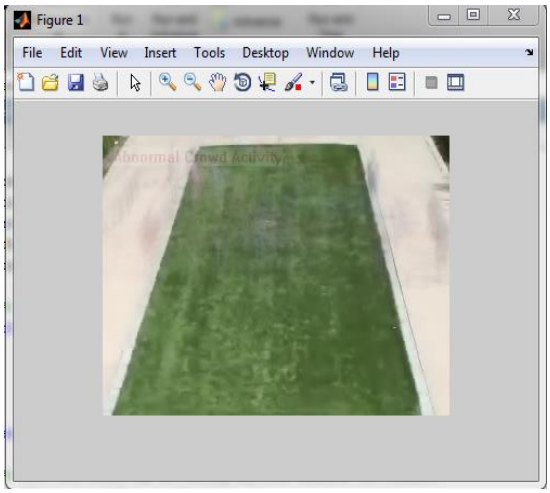

Figure 4: Foreground Extraction

After performing foreground extraction harris corners technique has been applied on each frames and gives output as shown in Fig. 5.

Figure 5: Harris corner extraction

Optical flow has been applied on this key points and it gives motion vectors. Fig. 6 describes the motion of frame.

Figure 6: Optical flow motion vector

Now dynamic thresholding has been applied and accuracy has been calculated. Accuracy has been calculated by taking ration of correctly identified number of video to total number of videos.

Figure 7(a): Starting frame of video where abnormality has been detected

Figure 7(b): Ending frame of video where abnormality has been detected

Fig. 7 shows the frames from where abnormality has been found. Fig. 7(a) shows the starting frame and 7(b) shows the ending frame of video where abnormality has been detected.

TABLE I. ACCURACY ARCHIVED IN UMN, BEHAVE AND UCF-CRIME DATASET

Sr. No	Dataset	Accuracy (%)
1	UMN	67
2	BEHAVE	50
3	UCF-Crime	85

Table I shows the result of abnormality detection in UMN, BEHAVE and UCF-Crime Dataset.

4. Conclusion

Due to heavy growth rate of crime, currently abnormality detection becomes important research area. Surveillance system has been kept in all public places like mall, theater, school, airport etc. Manual monitoring at this places is very crucial and difficult task. So there will be huge necessity of abnormality detection. In this algorithms suddenly running and fighting activity has been considering as abnormal activities. Our algorithm is able to archive quite good accuracy. Before applying optical flow, Harris corner has been calculated which increase the accuracy of motion and avoid unnecessary motion calculation. Here dynamic thresholding has been applied so same method can work for more than one dataset with same abnormality activities.

5. Future work

Accuracy can be increased by introducing more and suitable features. The feature vector can be combined and then dynamic thresholding has been performed. This may results in higher accuracy abnormality video detection system.

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