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SMART SURVEILLANCE USING DEEP LEARNING

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Abstract—In the context of pattern recognition,abnormal event detection plays an important role. Anomaly detection is an active area of research on its own. Previously known anomaly detection techniques are usually not object based, where objects are not recognized prominently. In this system we find optimized object aware anomaly detection technique, based on certain object categories focusing on mobile objects. Algorithm used performs block based foreground segmentation to restrict our analysis to moving objects and unrelated background dynamics. Object detector is used to discard unrelated objects on connected blocks. Histograms of block-motion trajectories are extractedand cluster them to represent normal events. This framework gives a relatively low computational complexity and high detection accuracy.

Keywords—anomaly detection; block based foreground segmentation; object aware;

Introduction

Recently, thereisan increasing demand for analyzing digital video to gain and generate security alarms when an abnormal activity occurs. Many algorithms are available which support proper abnormal activity detection where multiple videos and cameras can be operated by single or by very few number of operatorseffectively.

Abnormal event detection is an active area of research on its own. Abnormal activity is a pattern in the data that does not match to the expected normal activity. In every scenario there are some predefined rules to define activity. If any activity happens which does not follows the defined rules then it is termed as Abnormal Activity. Also referred to as outliers, exceptions , suspicion , surprise etc.

In abnormal activity detection we have to keep track of every entity or object in the scenario and define modelsto detect abnormal objects when and where encountered.

Abnormal event detection plays an vital role in digital video surveillance and camera systems. Many abnormal activities have been examined, including restricted area access detection, car counting,detectionof people carrying cases [5], abandoned objects , group activity detection , social network modeling, monitoring vehicles , scene analysis and so on. Here, focus is on detecting abnormal events in crowded scenes.

Fig: 1 Example of Abnormal Event Detection

In this model, both psychological and physical effects are considered in formulating the behavior of the crowd.

Related Work

Sr. No	Paper Title	Description	Pros	Cons
1	A framework for an event driven video surveillance system	Tenable optimization of event driven surveillance	Scalability	Works on tested interface only, Not compatible with current technology.
2	Automated Unusual Event detection in video surveillance	Automated approach for detecting falls of elderly people	More accuracy for fall detection using single static camera.	Failures may leads to unnecessary alarms.
3	Real Time Unusual Event detection using video surveillance for enhancing security	To detect an unusual events within the different bank.	Can detect overcrowding areas,Low Cost .	Low resolution, Not trained with dataset.
4	Abnormal detection using interaction energy potentials .	To detect abnormal behaviors in human group activities	Does not relied on individual human so it is more robust to errors	Cannot detect static object efficiently.
5	Action Recognition by dense trajectories	To model videos by combining dense sampling with feature tracking	More Robust, Improve performance and efficiency	More Complex model, Inconsistency

A framework for an event driven video surveillance system.

As analysis of huge volume of daily archived surveillance media is impossible to handle manually and some interested events may get missed. This paper uses an approach which helps in management of large store of surveillance media and optimizes the event detection. Here, Finite State Machine (FSM) is used to represent events considering it as state and change as state transition. This system provides improved Scalability due to client-server architecture. But, Not Compatible with current technology due to use of FSM. [8]

Automated unusual event detection in video surveillance.
Fall is an unusual activity and serious problem among elderly people causing high risk to life. This paper presents an automatic approach for detecting and recognizing falls of elderly people in the home environment and report to family members. Here, Object detection followed by feature extraction is done and then decision tree is used for classification. Even though single static camera is used, accuracy is more. Failure may leads to unnecessary alarms. [9]

Real time unusual event detection using video surveillance for enhancing security.
There is increasing in number of suspicious actions at ATM booths. This uses low resolution videos for analysis. This is used to detect unusual events such as overcrowding situations and fights in banks or at ATM booths. Here, background subtraction is followed by connected component labeling algorithm and detected events are extracted. There is no need to use classifier and high computational scheme to convert low resolution to high resolution videos. But,therefore not trained with datasets [10].

Abnormal detection using interaction energy potential.
This paper is used to detect abnormal behavior in human group activities.The relationship between current state of subject and corresponding actions is used to distinguish between normal and abnormal patterns. The interaction energy potential is used to model the relationship among group

of people; this is calculated using position and velocity of people. This technique is more robust to detecting errors.But, cannot detect static object efficiently due to no interaction.[5]

Action recognition by dense trajectories.
Feature trajectories have shown to be efficient for representingVideos.This paper uses an approach to describe videos by dense trajectories. Here, sampling of dense points from each frame is doneand tracking them based ondisplacement information from a dense optical flow field.This technique provides efficient solution to remove camera motion by computing motion boundaries descriptors. Dense Trajectories are more robust and calculate motion information efficiently and thus improves performance. But, More Complex model and some Inconsistencies are there. [7]

Proposed Methodology:

[A]Image processing:

- Image processing the analysis and manipulation of a digitized image, especially in order to improve its quality.
- Input video is taken from the database which will be converted into continuous frames.
- Continuous frames are used for further processing.

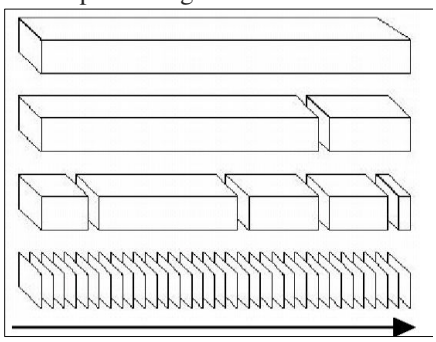

Fig:3 Image Processing

[B]Foreground Detection:

- Input frames from the image processing step are converted into grey frame.
- Consider grey frame size P*Q, now frames are converted into blocks, where each block size p*q.
- Number of Blocks in frame can be represented as m*n, where m=P/p, n=Q/q.
- Calculate feature value for each block where it is summation of pixel values in each block.
- Obtain foreground block by measuring difference between the adjacent frames.
- Reduce the average of pixel values from original grey frame
- Form the sparse matrix which represents the foreground.

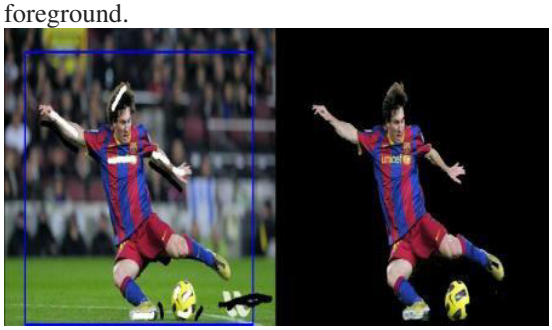

Fig: 4 Foreground Detection

[C]Extract Interested Objects:

- Remove the uninterested blocks from the sparse matrix.
- Traversing row wise in matrix, create groups of sequencing blocks based on the movement done.
- Allocate blocks to the groups if group is already created else create new group.
- Generate rectangles as per groups.
- Apply Deformable Part Model (DPM) to detect objects.
- By applying this, we get fine foreground matrix.

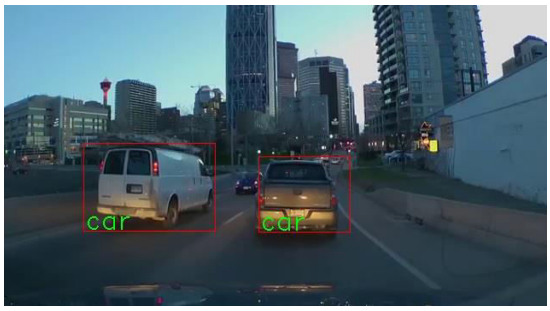

Fig: 5 –Detecting interested object

[D]Track Foreground Block of Interested Objects:

foreground_objects = current_frame-background_layer

Here some number of frames will be saved and try to figure out which of the pixels are the same for most of them, then this pixels becoming part of background_layer. Difference generally in how we get this background_layer and additional filtering that we use to make selection more accurate.

[E]Abnormal Event Detection:

- If any motion happens in the learned path and speed of object is similar to the learned speed then it is a normalevent.
- If any motion happens in the learned path and speed of object has large difference from the learned speed then itis an abnormal event.
- If any motion happens in an area other than the learned path then that it is detected as abnormal event.
- If there is motion after the allowed time for that event then it is detected as abnormal event.

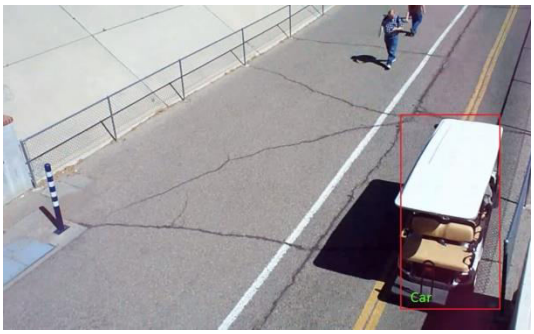

Fig: 7Detecting abnormal object

[F]Reporting to Authorities:

- After detecting abnormal activity, we report to the respective authority to take proper actions regarding the activity.

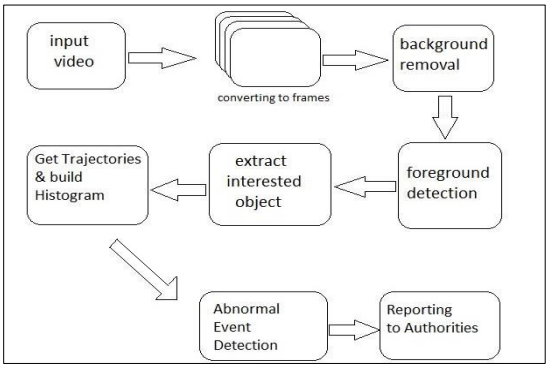

Fig:8System architecture

Video containing abnormal activities is taken as input by system, which may be captured using common cameras or already stored in datasets. This video is then converted into frames by image processing which improves the quality. Then frame is analyzed to identify foreground and thus remove irrelevant background. From that foreground object of our interest is extracted. These objects are then represented using trajectories and then histogram is build. Thus doing comparative analysis, abnormal events are detected and finally reporting it to respective authorities.

EXPERIMENT & RESULTS

An abnormal activity is identified as video is given as input to the system. The result is calculated after applying image processingFor foreground detection on input video.The evaluated result is compared with actual labels of objects stored in pre-trained labels.The videos of the samples are those whose results are close enough with the our propaganda.

The system is implemented using java and OpenCV 2.4 on a windows 10 computer having Intel core i5, 2.5 GHz processor with 8 GB RAM. The algorithm is analyzed using videos from random sources on the internet with random resolution.

Example:

We have considered a scenario of pedestrian road, where pedestrians are walking on the road but whenever a car or bike is going from that road then that will be anomalous activity and should be detected and reported to the authorities.

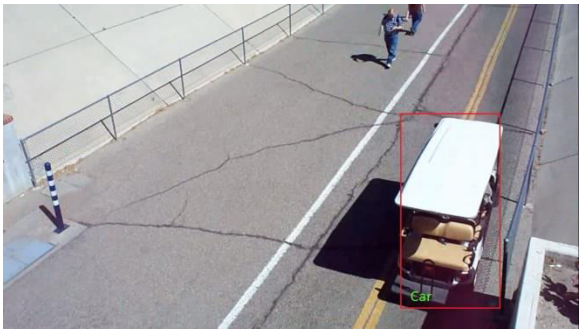

Fig: Detecting car on pedestrian road

Result

n=10	Detected **Yes**	Detected **No**	
Actual **Yes**	**6**	**2**	**8**
Actual **No**	**1**	**1**	**2**
	7	**3**	

By referring above confusion matrix, we can calculate model accuracy as:

Accuracy(%)=Actual detected/total samples

Accuracy(%)=6/10*100

=60%

Error rate (%) = 1-(Actual detected/total samples)

Error rate (%) = 1-(6/10)

=40%

$$precision = \frac{TP}{TP+FP}$$

=6/(6+1)*100=75%

$$recall = \frac{TP}{TP+FN}$$

=6/(6+1)*100=85%

Conclusion

In this paper, uniform framework for object aware abnormal activity detection is used. Here, we used, blockbased foreground segmentation and method to represent spatio-temporal features of human behavior using histogram. As this system is object-based, more uninterested objects are eliminated before abnormal activity detection. As a result, this system gives a low calculus complexity and high detection accuracy.After detecting abnormal activity, we report to the respective authority to take proper actions regarding the activity.

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