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A Review Analysis to Detect an Object in Video Surveillance System

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Abstract - *This survey paper presents an approach to define the existence of moving object and various techniques related to video surveillance system to improve security. Generally visual surveillance can be classified into three phases of data processing: moving object recognition, object extraction & tracking and to extract temporal information about such objects. This paper focuses on detection of moving objects in video surveillance system. Moving object detection is first low level important task for any video surveillance application. Detection of moving object is a challenging task. Object detection in video image obtained from single camera with static background that means fixing camera is achieved by background subtraction approach. This literature review presents the techniques available for detection, their fundamental study and comparative analysis of these techniques in visual surveillance which helps for its future research.*

***Key Words*: Object Detection, Background Subtraction, Optical Flow, Frame Differencing.**

1. INTRODUCTION

Object detection technologies are increasingly popular choices which involve verifying the presence of an object in image sequences of videos. Object detection and tracking are important in many computer vision applications including activity recognition, automotive safety and surveillance. However extracting moving objects from a video is a fundamental and critical task since isolating required object from a video is necessary for further process of surveillance as well as differentiating the interested object from other background objects becomes a typical problem, hence it becomes essential to understand video, its constituent and visual surveillance.

Video surveillance is a highly identified research area including applications in traffic monitoring, human activity monitoring, ensuring security at airport, banks, shopping malls etc, autonomous robot navigation and other commercial areas. Videos are basically sequences of images, and each image is called a frame, displayed in fast enough frequency so that human eyes can percept the continuity of its content. The contents of two consecutive frames are usually closely related, so that two adjacent frames can be used to track status of objects in the scene as moving or still.

Figure 1. Detection of One luggage **2.** Detection of one abandoned luggage

3. Detection of two luggages **4.** Detection of one Luggage removed

2. OBJECT DETECTION

Moving object detection from a video is an essential step in video surveillance applications. To identify objects of interest in video sequences and to cluster pixels of these objects, object detection technique is used. The detection of an object in video sequence plays a significant role in many applications specifically as video surveillance applications. The object in a video stream can be detected by processes like preprocessing, segmentation, foreground and background extraction, feature extraction. The different types of object detection are shown in figure.

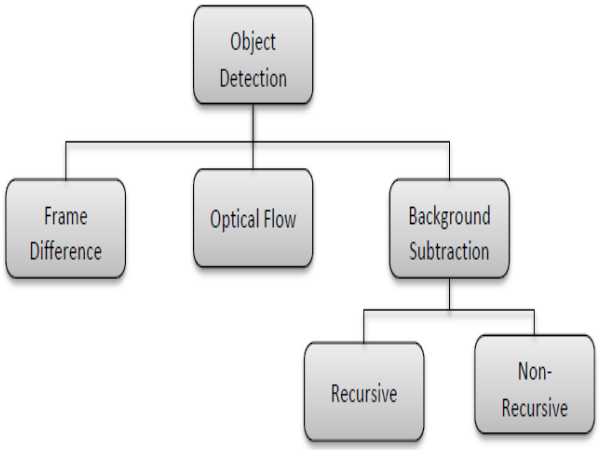

Figure 5. Types of object detection methods

2.1. Frame Differencing

This method uses the pixel-wise difference between two or three adjacent frames in video imagery to extract moving regions. It is highly adaptive approach and very much similar to background subtraction, after the subtraction of image it gives moving target information through threshold value. This method is not applicable for still objects detection, complex scenes computation and cannot be used for real time applications [6][8]. Detecting moving objects from a static background scene based on frame difference occurs by the following steps. Firstly the first frame is captured through the static camera then that sequence of frames is captured at regular intervals, Secondly the absolute difference is calculated between the consecutive frames and the difference image is stored in the system, thirdly the difference image is converted into gray image and then translated into binary image. Finally, morphological filtering is done to remove noise. [10]

Difference of Two Consecutive Frames:

Suppose I_K is the value of the k^{th} frame in image sequences. I_{k+1} is the value of the $(k+1)^{th}$ frame in image sequences. The absolute differential image is defined as

Follows:

$$I_{d(k,\,k+1)} = |I_{k+1} - I_k|$$

After that the differencing value will be compare with threshold value, if the differencing pixel value is greater than the threshold value. So the value is considered to be a part of moving object. Otherwise, it is considered to be the background.

2.2. Optical Flow

Optical flow technique used to describe image motion .This is the method in which motion target of vector characteristics, changed with time to detect motion area in image sequence. Optical flow calculates a velocity for points within the images and provides an estimation of where points could be in the next image sequence. Suppose two image frames which are taken at times t and t+Δt at every pixel position, here optical flow emphasizes the accuracy and density of measurement. Optical flow estimation is used in computer vision to characterize and quantify the motion of objects in a video stream, often for motion-based object detection systems[7]. The application of optical flow includes not only the motion of the observer and objects in the scene, but also the structure of objects and the environment i.e perception of the shape, distance and movement of objects in the world and the control of locomotion. Optical flow information recognized as being useful for controlling micro air vehicles like UAV(Unmanned Aerial Vehicle). Lucas-Kanade method is one of the method of optical flow technique which determines image patches and an affine model for the flow field. Basically it is an algorithm mainly focused on bunch of pixels share similar property.

2.3. Background Subtraction

This method is most commonly used technique for motion segmentation in video images. Background subtraction is the process of separating out foreground objects from the background in a sequence of video frames. It detects moving regions by performing absolute differencing between the current frame pixel-by-pixel and a reference background image that is produced by averaging frames over time in an initialization period[13][15]. The basic idea of background subtraction method is to initialize a background through background modeling and then subtracting current frame with background frame to detect moving objects. The major steps in background subtraction algorithm are preprocessing, background modeling, foreground detection and data validation. Background modeling is the heart of any background subtraction algorithm. Background model is that, which robust against environment changes in the background, but sensitive enough to identify all moving objects of interest. Background modeling technique is categorized in to two parts i.e. recursive and non-recursive. Some of the commonly used non-recursive techniques are frame differencing, median filter, mean filter. Non-recursive techniques are highly adaptive as they don't depend on the history beyond those frames stored in the buffer.

3. LITERATURE REVIEW

Guo et al. (2012) suggested object detection approach for tracking the objects in video frames. The simulation result shows this technique was effective and accurateness, robust for generic object classes' detection with good performance. Further needs to focus towards increase classification accurateness in real-time object recognition.

Soundrapandiyan and Mouli (2015) suggested a novel and adaptive method for pedestrian detection. Further, they separated the foreground objects from the background by image pixel intensities. Subsequently, they used high boost filter for enhancing the foreground edges. The efficacy of the proposed method is evident from the subject evaluation results as well as objective evaluation with around 90% of pedestrian's detection rate compared to the other single image existing methods. In future, they planned to improve the performance of the method with higher detection rate and low false positives on par with sequence image methods.

Risha and Kumar (2016) suggested an optic flow with the morphological operation for object detection in video. Further applied morphological operation towards obtaining clear moving target image. This study only concentrated on static camera. So need to focus on moving the camera as well as identify multiple objects in video frames.

JiuYueHao *et al*. (2013) presents spatio-temporal traffic scene, designed for moving object motion detection. The spatio- temporal model is based on KDE used for dynamic background handling. KDE is used to detect moving foreground object. The Gaussian foreground model is used for the spatial correlation of the foreground pixel. The computation time is also reduced. The algorithm, called frame fusion is used for robust updating stage.

Wang *et al.* (2014) in this paper they described moving object detection technique based on temporal information. It works mainly in three phases. 1. Motion saliency generation: In continuous frames by symmetric difference generates a temporal saliency map. 2. Attention seed selection: By maximum entropy sum method calculates the threshold to get max saliency in candidate area. Using the proposed approach, consecutive objects cannot be recognized.

Liu Gang *et al.* (2013) present moving object detection algorithm with some improvement. The difference of two continuous frames (images) is calculated for detecting the moving object. Similarly, three-frame differential method subtracts frame pairs from three frame images. Detection of the edge of the image is done by Image edge detection. The dilation operation can be used for combining all the points of background into contact with the object in the object. It is not suitable when the environment contains strong light. So it is not suitable for all types of environment.

Dipali Shahare *et al.* (2014) overcome the limitation of fixed cameras. It presents moving object detection with fixed camera as well as the moving camera for automated video analysis. The feature points are extracted from a current frame using the optical flow method. An improved Expectation-Maximization (EM) algorithm is used in consecutive frame subtraction. The algorithm based on the calculation that difference of neighboring frames and then moving region and background are recognized. In background subtraction method the comparison is made between each input image frame and the background model obtained from the previous image frames. That way, foreground frame and background frame can be obtained. However, it is not robust against illumination changes. It cannot detect shadow by a moving object.

DharaTrambadia *et al.*(2015) observe, For object tracking single method cannot give good accuracy for different kind of videos with different situation like poor resolution, change in weather condition. In this paper they combined two methods for the better and accurate detection and tracking of moving object. Gaussian Mixture Modeling is used for foreground extraction and that extracted foreground is used by the Optical flow method for object tracking.

Nishu Singla (2014) This paper presents an algorithm for detecting moving objects from a static background scene based on frame difference. She captured sequence of frame from a static camera and detecting object by frame difference method. The objective of the approach is to detect the moving objects from the difference between the existing frame and reference frame. Frame difference method is the common method of motion detection to adopt pixel based difference to find the moving object. She had done her experiment by evaluating these steps i.e. difference of two consecutive frames, transformation of absolute differential image to gray image and filtering and binarizing transformed gray image.

Table 1. Comparative Study of Object Detection Technique

Serial No	Title	Author	Method	Accuracy	Computational Time	Limitation
1	Video image processing for moving object detection and segmentation using background subtraction	Mohan A.S & Resmi R.	Background Subtraction & Segmentation using Thresholding and Edge Detection	92.6%	low	Cannot be used for real time application
2	Adaptive Pedestrian Detection in Infrared Images Using Background Subtraction and Local Thresholding	Soundrapandiyan, R. et al.	Background subtraction	90%	low	Need to improvance of method in high detection rate and low false positive rate
3	Real-time moving object detection for video monitoring systems	Zhiqiang et al.	Background updating mechanism based on optical flow	88.6%	high	Require algorithm for increasing the robustness of shadow elimination
4	Automatic Detection and Tracking of Moving Objects in Complex Environments for Video Surveillance Applications	Krishna et al.	Background Subtraction and feature-based method	96.4%	high	This approach offers entire moving data however require more calculation
5	W4: Real-Time Surveillance of People and Their Activities	I. Haritaoglu et al.	Frame Differencing	87%	low	Sensitive to dynamic changes
6	Generic Object	Li Guo et al.	Gentleboost Classifier	89.9%	high	Needs to increase

	Detection Using Improved Gentleboost Classifier					classification accurateness in real-time object recognition
7	Novel method of detecting moving object in video	Risha and Kumar	Optical Flow with Morphological Operation	88.3%	High	Unable to identify multiple objects in video frames
8	Moving Object Detection and Tracking Using Hybrid Approach in Real Time to Improve Accuracy	Dhara Trambadia et al.	Gaussian Mixture Modelling	99.4%	High	
9	Motion Detection Based on Frame Difference Method	Nishu Singla	Frame Difference method	90.1%	low	The motion of air should not be captured to affect the object detection process

4. CONCLUSION

This paper is a detailed survey of the object detection methods. In this paper various popular phases are explained which are helpful in object detection for visual surveillance systems. Various approaches of object detection techniques like temporal differentiating, background subtraction, optical flow are briefly described and a comparative study is also presented. Background subtraction technique is easy to implement with less calculation and generally used for real time applications. The bibliography content is the most significant contribution of research since it will lead to a new area of research. We have identified and discussed the limitation/future scope of various methods. Also, we have noted some methods which give accuracy but have high computational complexity. Specifically, background subtraction, temporal differencing with the optical flow was discussed.

5. FUTURE SCOPE

Surveillance system is important to be worthy of situation control, such systems transform video under surveillance from data to information and intelligence acquisition system. Real-time video analysis provides surveillance systems with the ability to react to an activity in real time.

In future, the work can be extended to detect the moving object with non-static background, having multiple cameras which can be used in real time surveillance applications. Need to focus on new features that are not only more powerful, but also more robust and capture more information than the currently popular features.

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