A Review on Object Detection and Tracking Methods

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ABSTRACT

Tracking and detecting of object is most popular now days and is use for motion detection of various objects on a given video or an image. The applications of object detection and tracking is farming, military, transportation, civil, security and for commercial use. Some methods commonly use in it are background subtraction, Frame difference, template matching and shape based methods. We are going to discuss issues about detection and tracking.

Keywords — Object detection, object tracking, motion detection, Digital Image processing, Human detection.

1. INTRODUCTION

Image processing is a term which indicates the processing on image or video frame which is taken as an input and the result set of processing is may be a set of related parameters of an image. The purpose of image processing is visualization which is to observe the objects that are not visible.

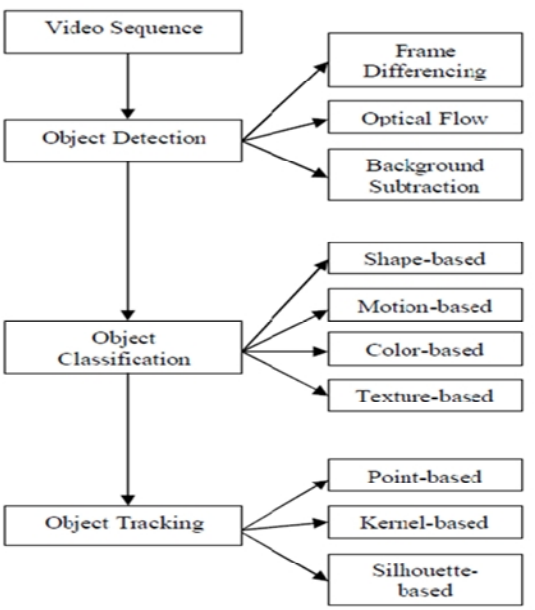

Fig 1: Basic steps for tracking an object [2]

Analysis of human motion is one of the most recent and popular research topics in digital image processing. In which the movement of human is the important part of human detection and motion analysis, the aim is to detect the motions of human from the background image in a video sequence. It also includes detection, tracking and recognition of human behavior along with some objects which are in motion from video frame.

Object detection is performed to check existence of objects in video frame and to detect that object. Then detected object can be classified in various categories such as humans, vehicles and other moving objects [2]. The process of object tracking is segmenting a region of interest from a video frames and keeping track of its motion and position.

This paper is structured in the following way: Section 1 gives introduction to object detection and tracking. Section 2 provides the related work. Section 3 deals with brief explanation on several object detection methods, comparison of those methods and Section 4 provides conclusion.

2. RELATED WORK

2.1. Literature Review

The techniques stated in [3] ranges from very basic algorithm to state of the art published techniques categorized based on speed, memory requirements and accuracy. They used methods such as frame difference technique, Real time background subtraction and shadow detection technique, adaptive background mixture model for real time tracking technique. They used algorithms ranges from varying levels of accuracy and computational complexity. Some of them can also deal with real time challenges like snow, rain, moving branches, objects overlapping, light intensity or slow moving objects.

The problems of achieving high detection rate with low false alarm rate for human detection and tracking in video sequence is to maximize performance and improve response time. The stated causes are the effect of scene complexity, scale changes and scene background-human interactions. A two-step processing solution which is, human detection, and human tracking with two novel pattern classifiers presented in [4].

There are three basic phases in video examination: detection of interesting objects in video scene, tracking of such objects from frame to frame, and analysis of object tracks to recognize their activities. Detecting humans from video is a challenging problem owing to the motion of the subjects. In [6] they developed a detector for moving people in videos with possibly moving cameras and backgrounds, testing several different coding schemes of moving object and showing that orientated histograms of differential optical flow give the maximum performance. Motion-based descriptors are combined with Histogram of Oriented Gradient appearance descriptors. Achieved detector is tested on several databases includes a challenging test set taken from video and containing wide ranges of position, motion and background imbalance, including rotating cameras and backgrounds. [14]

In [7], they have analyzed moving object detection techniques, frame difference and the approximate median method. The frame differentiating has been adopted for the reference frame and the step length. They have suggested the moving object detection and object tracking by using the modified frame difference method. In the surveillance system for video captured by single camera is considered for the space under the observation. This method is experiment on almost ten videos and the results are quite satisfactory.

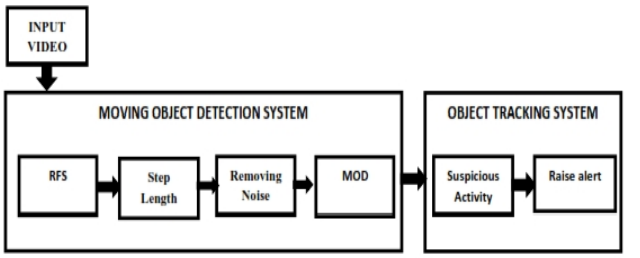

Fig 2: Block diagram of object detection & tracking [7]

The background subtraction method which is used for framing the moving object from its background which requires a following steps:

a) *Reference frame selection (RFS):* In it the initial frame is selected as the reference frame.

b) *Step Length:* Appropriate step length has been selected on the basis of experimental results.

c) *Removing Noise:* Noise is affecting the accuracy and performance of system so it has to be removed.

d) *Moving object detection (MOD):* to detect the moving object from the frame difference with the help of background subtraction methods like Frame difference, approximate median and Modified frame difference methods.

e) *Suspicious Activity:* The bounding box is constructed in the isolated area of interest from video sequence and the object is tracked according to its movement.

f) *Rise alert:* After tracking object the recorded sound will be generate for alert.

Below image is the example of these above steps.

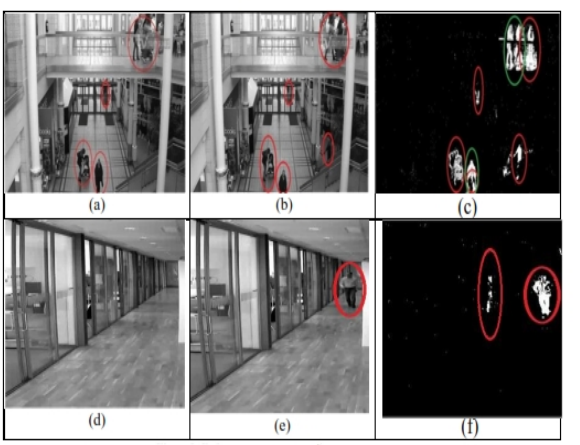

Fig 3: Reference Frame Selection [7]

In [5] cascade-of-rejectors approach with the Histograms of Oriented Gradients features to achieve a fast and accurate human detection system. The features used are Histograms of Oriented Gradients of variable-size blocks that capture salient features of humans automatically. Using algorithm for feature selection, it identifies the appropriate set of blocks, from a large set of possible blocks. It uses the integral image representation and a rejection cascade which significantly speed up the computation. For an image, the system can process 5 to 30 frames per second depending on the density in which it scans the image, while maintaining an accuracy level similar to existing methods.

In [1], author specified new algorithm for detecting moving objects from a static background scene to detect moving object based on background subtraction.

3. DETAILED ANALYSIS OF METHODS

3.1. Methods

During Our literature review we study the basic method for the Object Detection and tracking, all that methodologies are describe bellow:

3.1.1. Background Subtraction Method

A very widely used method which is simple to implement by just subtracting the current frame from previous frame and obtaining threshold value of difference between given pixel value and obtained pixel value. If threshold value is greater than the given the pixel it is considered as foreground. This method is not as appropriate as it is highly inaccurate and gives false rate detection.

3.1.2. Real Time Background Subtraction and Shadow Detection Technique Theory

This method is published in [2] by Mr. Deepjoy Das and Dr. Sarat Saharia, it describes two type of distortion namely brightness distortion and chromaticity distortion based on RGB values of pixels in given image. This method is accurate up to some extends as it also detect the shadow part of object.

3.1.3. Template Matching

Template Matching is probably the best method for some specific environment. It's the most accurate although sometimes there is lack of originality in object detected. Object can be detected for one specific video using a template cropped from the video. However, there is no guaranteed accuracy because all that is known is the best match for each frame; no scanning is done on the percentage template matches the frame. It only works if the object is always in the video, otherwise it will create a false detects.

3.1.4. Shape Based

Shape based method is used to detect objects in real-world images. The shape features are more striking as compared to local features like SIFT because most object categories are better described by their shape then texture, such as cows, horses and cups and also for wiry objects like bikes, chair or ladders, local features contain large amount of background noise. Thus shape features are often used as a replacement to local features.

3.2. Difficulties in Object Recognition under Varied Circumstances

All these methods have some feature and limitation in certain circumstances which are defined as follows:

Lightning: Light differs in many circumstances low light adds darkness in image while more light adds shadow of object. [8]

Positioning: As stated above in 3.1.3 template matching needs uniform position or else it is unable to detect object even if it is present in image. [8]

Rotation: Image can be rotated in any direction. In this case some shapes are unable to be identified if shape matching method is used. [8]

Occlusion: Object behind the object is sometimes not completely visible so it cannot be detected and useful part can be ignored. [8]

3.3. Method Comparison

All the methods described for object detection and tracking have some pros and cons, which are as below:

Table 1 – Method Comparison

Method	Pros	Cons
1. Background Subtraction Method	• A very widely used method which is simple to implement • Objects are allowed to become a part of the background without destroying the existing background. • It learns itself and does not need to be reprogrammed. • Can be implemented in any applications. • Provide fast recovery. • Low memory requirement.	• Highly inaccurate. • Cannot deal with quick changes. • Initializing the Gaussians is important. • Not a good subtraction when shadow, any other obstacles, are there. • Gives false positives • It does not survive with multimodal background.
2. Real Time Background Subtraction and Shadow Detection Technique Theory	• The accuracy of this method is higher than frame difference • It detects shadow as well.	• The algorithm based on this method is quite complex.
3. Template Matching	• Best method for specific environment.	• Only occurs when there's a one-to-one match. • Slow process for recognize new variation of a pattern. • No scanning process is done on the percentage so there is no guaranteed accuracy. • It only works if the object is always in the video, otherwise it will create a false detects
4. Image Differencing	• Simple and straight forward. • Easy to interpret the result.	• Different value is absolute so value may have different meaning. • Require atmospheric calibration. • Requires selection of thresholds.
5. Shape Based	• Simple pattern-matching approach. • Having unable to moderate accuracy.	• More striking technique. • Often used as a replacement to local features. • Does not work well in dynamic situations. • Unable to determine internal movements well. • Computational Time is low.
6. Optical Flow	• It can produce the complete • Object moving information. • Contain enough accuracy.	• Require large amount of calculation.
7. Frame Differencing	• Perform well for static background. • High accuracy. • Easiest method.	• It must require a background without moving objects. • Method having Computational time low to moderate.
8. Motion-based	• Does not require predefined pattern motion detection.	• Struggles to identify a non-moving human object.
9. Texture-based	• Provides improved quality with the expense of additional time.	• High computational time.

Table 1: Method Comparison of Object Detection and Tracking [2], [3], [15]

4. CONCLUSIONS

It is not possible to consider a single method for all type of images, nor can all methods perform well for particular types of image. The background subtraction method detects object with noise and output is not accurate. Object behind object is not detected. Problem occurs during identification of object when any obstacles come before the object. If the position of camera is not proper and object in image is not captured properly then it cannot be identified. To solve above problems and bring some accuracy and richness by combining multiple methods and make use of it together according to the application.

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