

A Survey on Moving Object Detection and Tracking Methods

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Abstract--The researchers has attracted on object tracking research. There are many tracking algorithm, The purpose of object tracking algorithm is segmenting a region of interest from a video scene and keeping track of its motion, positioning and occlusion. Preceding steps for tracking an object in sequence of images are the object detection and object classification. To check existence and to locate that objects in video, Object detection is performed. The detected object can be classified among the various categories such as humans, vehicles, birds, floating clouds, swaying tree and other moving objects. Object tracking is performed by monitoring objects' spatial and temporal changes like its presence, position, size, shape, etc. during a video sequence. This paper presents a brief survey of different object detection, object classification and object tracking algorithms available in the literature including analysis and comparative study of different techniques which one used for various stages of tracking.

Keywords--Object Detection, Object Tracking, Background Subtraction, Gaussian Mixture Model, Optical Flow

I. INTRODUCTION

Many researchers are attracted to research on moving Object detection and tracking. In the domain of computer vision, object tracking plays a very important role. Actually sequences of images are called videos, each of which called a frame. Frame can be displayed in fast enough frequency so that human eyes can percept the continuity of its content. All image processing techniques applied on each frame and also content of two consecutive frames are closely related [3].

From a video sequence, an image is divided into two complimentary sets of pixels, in which he first set contains the pixels which correspond to foreground objects which is usually moving objects like people, boats and cars and everything else is background while the second complimentary set contains the background pixels. This result is often represented as a binary image or as a mask [4]. Many a time's shadow is represented as foreground object which gives improper output. Object tracking has significance in the real time environment because it enables several important applications such as Security & Surveillance to recognize people as well to provide better sense of security using visual information, In Medical therapy it improves the quality of life for physical therapy patients and disabled, In Retail space instrumentation to analyses shopping behavior of customers to enhance building and environment design, Video abstraction which used to obtain automatic annotation of videos which

generate object based summaries, Traffic management to analyses flow and detect accidents, Video editing for eliminate cumbersome human operator interaction, to design futuristic video effects. The detection of moving objects is the foundation of other advanced applications, such as target tracking, targets classification and target behavior understanding [2]. The basic steps for tracking an object are described below:

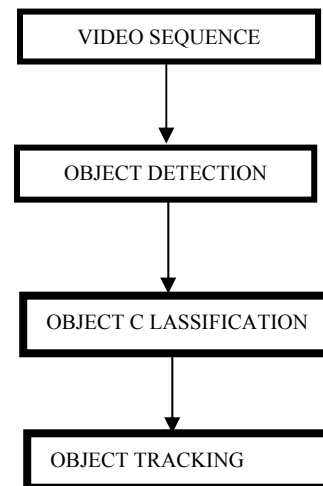


Fig 1: Basic steps for detection and tracking of an object

II. OBJECT DETECTION METHODS:

The Object detection and tracking are playing an important role in many pattern recognition and computer vision pattern recognition applications like autonomous robot navigation, surveillance and vehicle navigation. An object detection mechanism used in when the object first appears or in every frame in the video. In order to reduce the number of false detection and increase accuracy rate [1], some object detection methods use the temporal information computed from analyzing a sequence of frames. Object detection can be done by various techniques such as temporal differencing [9], frame differencing [7], Optical flow [4] and Background subtraction [6, 8].

A. Frame differencing:

The existence of moving objects is determined by calculating the difference between two consecutive images. Frame differencing technique is very simple and also easy to define but it is generally difficult to achieve complete summary of moving object as a result of the detection of moving object is not accurate [7].

B. Optical Flow:

Optical flow method is to calculate the motion between two image frames which are taken at times t and $t + dt$ at every position [4]. This method can get the complete movement information and detect the moving object from the background but a large quantity of calculation, sensitivity to noise, poor anti noise performance, make it not suitable for real-time demanding occasions [4].

C. Background Subtraction:

The main step and core of the background subtraction is Background Modelling This technique segmenting a foreground object from its background. Background Modelling must be sensitive enough to recognize moving objects and also it is reference model [1]. In this technique each video sequence is compared against the reference model to determine possible Variation which is in terms of pixels signify existence of moving objects. Currently, mean filter and median filter are widely used to realize background modelling [6]. The background subtraction method is use to detect moving objects using simple algorithm but very sensitive to the changes in the external environment and has poor anti-interference ability. However it can provide the complete object information in the case background is known. Background subtraction has mainly two approaches [4]:

1) *Recursive Techniques*: In this technique recursively update a single background model based on each input frame and also do not maintain a buffer for background estimation. As a result, an effect on the current background model because of input frames from distant past. The recursive techniques requires less storage but any error in the background model can be linger for a much longer period of time. This technique includes various methods like approximate median, adaptive background, Gaussian mixture [6, 8].

2) *Non-Recursive Techniques*: In this technique sliding-window approach used to the background image based on the temporal variation of each pixel within the buffer that stored the previous L video frames. It is highly adaptive because it depend on those frame that stored in the buffer, but the storage requirement can be significant if a large buffer is needed to cope with slow-moving traffic [8,6].

III. OBJECT TRACKING METHODS

Tracking can be used to defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. Various method like Point tracking, kernel tracking and silhouette tracking are the approaches to track the object. The tracking methods can be divided into following categories:

A. Point based Tracking:

In an image structure, moving objects can be represented by their feature points during tracking. Point tracking is a complex problem particularly for the incidence of occlusions and false object detections. Recognition can be done relatively simple, by thresholding for the identification of these points. Point based tracking approaches [1] are described below:

1) *Kalman Filter*: Optimal Recursive Data Processing Algorithm based technique. Kalman filter [15], which consist of set of mathematical equations used provides an efficient computational (recursive) for estimation of the state of a process in several aspects: it can supports estimations of past state, present state, even future states and it can estimate even when unknown nature of the modelled system. The Kalman filter is also estimates a process by using a form of feedback control. The filter is used for estimation of the process state at some time and after that obtains feedback in the form of noisy measurements. The equations for Kalman filters [15] fall in two groups: time update equations and measurement update equations. The time update equations for projecting forward (in time) the current state and error covariance estimates to obtain the priori estimation of the next time step. The measurement update equations are responsible for the feedback. Kalman filters always give optimal solutions.

2) *Particle Filter*: The particle filter [16] generates all the models for one variable before moving to the next variable. Algorithm has an advantage when dynamic generation of variables and also can be unboundedly numerous variables. It allows for re-sampling of new operation. A restriction of the Kalman filter is the assumption of state variables are distributed (Gaussian). Thus, an approximations of state variables is poor in Kalman filter technique. Which are not Gaussian distribution. This restriction can be overcome by using particle filtering. The particle filter [1] is a Bayesian sequential sample technique which is recursively approaches for distribution using a finite set of weighted trials. It also consists of two phases: prediction and update as same as Kalman Filtering. It is applied in developing area such as computer vision communal and applied to tracking problematic.

3) *Multiple Hypothesis Tracking (MHT)*: In MHT algorithm [17], several frames have been observed for better tracking outcomes MHT is an iterative algorithm. Each Iteration begins with a set of existing track hypotheses. Each hypothesis is a crew of disconnect tracks. For each hypothesis used for prediction of object's position in the succeeding frame is made. The predictions are then compared by calculating a distance measure. The MHT is capable of tracking multiple object, handles occlusions and Calculating of Optimal solutions.

B. Kernel Based Tracking

Kernel tracking [18] is usually performed by the moving object, which is represented by a embryonic object region, from one frame to the next. The object motion is usually in the form of parametric motion such as translation, conformal, affine etc. These algorithms diverge in terms of the representation used, the number of objects tracked, and the method used for approximating the object motion. In real-time, illustration of object using geometric shape is common but the restrictions are the parts of the objects may be left outside of the defined shape while portions of the background exist inside. They are number of tracking techniques based on representation of

object, object features, appearance and shape of the object. Kernel based approaches are described below:

1) *Template Matching*: Template matching [19] is a brute force method of examining the Region of Interest in the video. In template matching, a reference image is verified with use of the frame that is separated from the video. Tracking can be done for single object in the video and overlapping of object is done partially [19]. Template Matching is a technique for processing digital images to find small parts in an image that matches or equivalent model with an image (template) in each frame. The matching procedure which contains the image template for all possible positions in the source image and calculates a numerical index that specifies how well the model fits to the picture at that position. This method is capable of dealing with tracking single image and partially occluded object.

2) *Mean Shift Method*: The Mean-shift tracking tries to find out the area of a video frame that is locally most similar to a previously initialized model. The tracked image region is to be represented by a histogram. A gradient ascent procedure used to move the tracker at the location that maximizes a similarity score between the model and the current image region. The target representation is mostly rectangular or elliptical region in object tracking algorithms. It contain target model and target candidate [2]. To characterize the target color histogram is chosen. Target model is usually represented by probability density function (pdf). Target model is regularized by spatial masking with an asymmetric kernel [2].

3) *Support Vector Machine (SVM)*: SVM [1] is a broad classification method which is termed by a set of positive and negative sample values. For SVM, the positive samples which contain tracked image object and the negative samples consist of all remaining things that are not tracked. It can handle single image and partial occlusion of object but necessity of physical initialization and training is must [20].

4) *Layering based tracking*: In this method of kernel based tracking where multiple objects can be tracked. Each layer consists of shape representation (ellipse), motion (like translation and rotation) and layer appearance (based on intensity). Layering is achieved by first compensating the background motion that the object's motion can be estimated from the rewarded image by means of 2D parametric motion. Every pixel's probability is to be calculated based on the object's foregoing motion and shape features [20]. It can be capable of tracking multiple images and full occlusion of object.

C. Silhouette Based Tracking

Some object have complex shape such as hand, fingers, shoulders that cannot be well defined by simple geometric shapes. Silhouette based methods gives an accurate shape description for the objects. The aim of a silhouette-based object tracking [21] is to find the object region in every frame by means of an object model generated by the previous frames. This method is capable of dealing with

variety of object shapes, Occlusion and object split and merges. Silhouette based tracking approaches are described below:

1) *Contour Tracking*: Contour tracking methods [19], iteratively progress a primary contour in the previous frame to its new position in the current frame. This contour progress needs certain amount of the object in the current frame overlay with the object region in the previous frame. Contour Tracking performed using two different approaches. The first approach uses state space models which used to model the contour shape and motion. The second approach directly evolves the contour by minimizing the contour energy by use of direct minimization techniques such as gradient descent. The most significant advantage of silhouettes tracking is to provide flexibility to handle a large variety of object shapes [22].

2) *Shape Matching*: Shape matching performance is same as the template based tracking in kernel approach. Another approach to Shape matching [17] is to find matching silhouettes detected in two consecutive frames. Silhouette matching, can be considered similar to point matching. Detection based on Silhouette is performed by background subtraction. The Models object is in the form of density functions, silhouette boundary and object edges. Capable of dealing with single object and Occlusion handling will be performed with Hough transform techniques [22].

IV. COMPARITION OF MET HODS

Method	Advantages	Disadvantages
Centroid matching, HSV color matching	This algorithm has better results when we use it in detecting and tracking targets This algorithm is suitable for the real-time target tracking.	It cannot track the targets well when the number of the targets is large. For real time implementation. It requires some modification for real-time.
Gaussian mixture model, morphological operation	It is a recursive algorithm that estimates parameters of the mixture and simultaneously selects the number of components for each pixel	There are some changes requires for better output in real time video especially in traffic video surveillance system.(like cloudy, sunshine, night, windy)
Optical Flow, Otsu method, Horn and Schunck	Algorithm is applied in different image sequences and it gives better efficiency	Algorithm the main condition is that the camera must be stationary. If the camera is moved by any areas on the result is not accurate.
Temporal, spatial saliency, Pixel Saliency and Region Saliency	By fusing both pixel saliency and region saliency, the moving object can be detected from the aerial video. The accuracy and efficiency of proposed algorithm is high.	The detected object may be larger than its real size. There may be holes in detection results When an object is moving s lowly, its motion is unreliable

Method	Advantages	Disadvantages
Block-wise mixture model, Pixel-wise mixture model	In this paper, strategy to detect motion in a region directly. A region is defined as an object block.	Large blocks may fail to match the actual motion in a sequence.
Background Subtraction, blob tracker, morphological operation	Blob identified as new object to be tracked good for real time	We would like to investigate multi-cameras object tracking in order to overcome the limitations of current object trackings.

V. CONCLUSION AND FUTURE WORK

Now a day, moving object detection and tracking becomes attractive and crucial research topic for researchers. There are many methods for the object detection and tracking. All the methods have their own advantages and disadvantages. For object tracking single method cannot give good accuracy for different kind of videos with different situation like poor resolution, change in weather condition. Here two methods are combined for the better and accurate detection and tracking of moving object. Gaussian Mixture Modelling is used for foreground extraction and that extracted foreground is used by the Optical flow method for object tracking. Advance study may open the door to find efficient algorithms to reduce computational cost and also to decrease the time required for detecting the object for variety of videos containing diversified characteristics and improved accuracy rate with using GMM and Optical flow.

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