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A Review on Moving Object Detection and Tracking Methods

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Abstract:

Real time motion detection has very wide application in human motion recognition or vehicle motion recognition. Patient monitoring, human–computer interaction are the recent applications of the human motion recognition, and is recent application of vehicle motion recognition are vehicle counting and very helpful in traffic control by detecting vehicle as per size, color, speed. In video surveillance real time motion recognition is very difficult so I want to work on real time motion recognition. Based on above discussion in my research work I have decided to develop intelligent framework for Real time motion detection or recognition for appropriate thing or object. Still real time image based or video based motion detection are hidden area so I want to carry out my work on real time video based detect behavior of human as per movement of object or vehicle detection in sense of hybrid. It will prove very helpful for public safety. This paper combines the GMM and Optical Flow object detection and tracking. In this paper we combine GMM and Optical Flow method. GMM can be used in the context of a complex environment while Optical Flow can be used for quick calculation with simple background. GMM is not a complete object tracking while Object Flow provides complete computation tracking.

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

I. INTRODUCTION

Motion detection and object tracking algorithms are an important research area of computer vision and comprise building blocks of various high-level techniques in video analysis that include tracking and classification of trajectories. In the domain of computer vision, object tracking plays a very important role. With the advent of powerful computers, the proliferation of high definition and economical video cameras, and the applications that require automated analysis of a video, a great increase in the interest in object tracking algorithms has come in picture.

For object recognition, navigation systems and surveillance systems, object tracking is an indispensable first step. Object tracking has significance in real time environment because it enables several important applications such as Security and surveillance [1] to recognize people, to provide better sense of security using visual information, In Medical therapy to improve the quality of life for physical therapy patients and disabled people, In Retail space instrumentation to analyses shopping behavior of customers to enhance building and environment design, Video abstraction to obtain automatic annotation of videos, to generate object based summaries, Traffic management to analyses flow, to detect accidents, Video editing to eliminate cumbersome human operator interaction, to design futuristic video effects. Detecting the moving objects relative to the whole image is the major task of it. Detecting moving objects is the foundation of other advanced applications, such as target tracking, targets classification and target behavior understanding [2].

II. RELETED WORK

In this paper [1] optical flow method is used for tracking along with the Gaussian for foreground detection. There are three phases of the algorithm. First phase is choice of different video size. Noise removal from the frames and implementation of optical flow technique. Using optical flow as compared to other methods has the advantage that less data storage is required, complexity is reduced as the feature vectors generated by using optical flow are enough to define the motion and objects of interest, cost of processing is reduced as it requires least bandwidth to transmit only the flow vectors as compared to the whole video that is being monitored In this paper [2] In this paper, Gaussian mixture model is used to establish the background model, the background difference method is used to detect target; target location features, and color features, shape features and modified Hough transform are combined to track the target [2]. In this proposed algorithm, first video is converted into frames and by using Gaussian Mixture Modeling, the background modeling is done. The background is continuously updated. Then the foreground is detected by getting difference between current frame and background frame with removal of shadow. In this paper [3] The advantages of the proposed algorithm are that it is a recursive algorithm that estimates the parameters of the mixture and simultaneously selects the number of components for each pixel, and hence is suitable for real-time operation [3]. The proposed algorithm is applied on many videos like cloudy, sunshine, night, windy, foggy, rainy, etc. the comparison is done with other methods and result shows that proposed algorithm is not best for all condition. This algorithm is basically application based algorithm. Also background modelling and subtraction in itself is application-oriented. There are some changes requires for better output in real time video especially in traffic video surveillance system. In this paper [4] to avoid the disadvantages of single method, a motion detection method is given based on optical flow and self-adaptive threshold segmentation is used. Window image is got by optical flow. Then, moving object area is obtained in the In this paper [8] The emphasis of this paper is based on the background modeling method of Gaussian mixture model; its modeling object is every pixel point's pixel value. In the model, every pixel point's grey value in the image is regards as a statistics and stochastic process, the pixel value of pixel point can be regarded as a vector sequence, arbitrarily pixel point. The improved algorithm unifies the two updating method, which not only considers the speedily convergence of system parameter in initialization phrase, but also researches the system parameter updating calculation after stable, makes it can quickly get expectation background parameter when the background has big changes [8].

III. OBJECT DETECTION METHODS:

Object detection and tracking are playing an important role in many computer vision and pattern recognition applications such as surveillance, vehicle navigation and autonomous robot navigation. Object detection includes detecting objects and recognizing patterns in the frame of a video sequence. An object detection mechanism is needed in any tracking method either in every frame or when the object first appears in the video. Using information in single frame is the most common method for object detection. Although some object detection methods use the temporal information computed from analyzing a sequence of frames in order to reduce the number of false detections and increase accuracy rate [1] Few methods of object detection are described as follows:

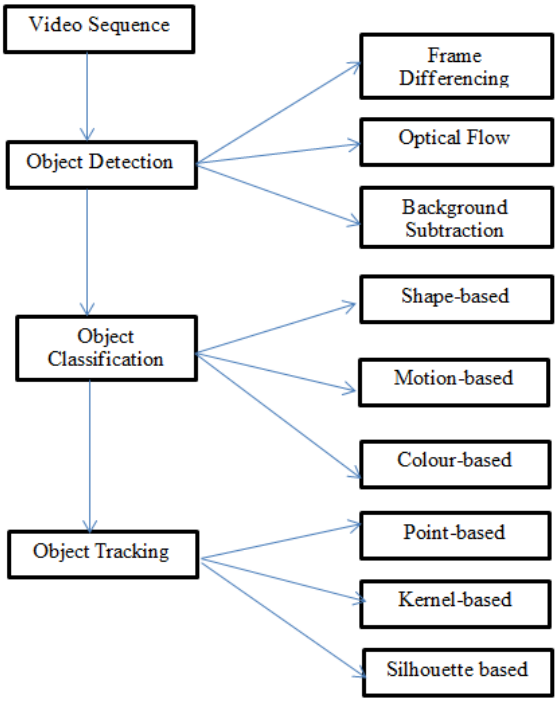

Fig 1: Basic steps for detection and tracking and object

First step in the process of object tracking is to identify objects of interest in the video sequence and to cluster pixels of these objects. Since moving objects are typically the primary source of information, most methods focus on the detection of such objects. Detailed explanation for various methods is given below

A. Frame differencing

The presence of moving objects is determined by calculating the difference between two consecutive images. Its calculation is simple and easy to implement. For a variety of dynamic environments, it has a strong adaptability, but it is generally difficult to obtain complete outline of moving object, responsible to appear the empty phenomenon, as a result the detection of moving object is not accurate [4].

B. Optical Flow

Optical flow method [4] is to calculate the image optical flow field, and do clustering processing according to the optical flow distribution characteristics of image. This method can get the complete movement information and detect the moving object from the background better, however, a large quantity of calculation, sensitivity to noise, poor anti-noise performance, make it not suitable for real-time demanding occasions.

C. Background subtraction

First step for background subtraction is background modeling. It is the core of background subtraction algorithm. Background Modeling must sensitive enough to recognize moving objects [3]. Background Modeling is to yield reference model. This reference model is used in background subtraction in which each video sequence is compared against the reference model to determine possible Variation. The variations between current video frames to that of the reference frame in terms of pixels signify existence of moving objects [8]. Currently, mean filter and median filter [2] are widely used to realize background modeling. The background subtraction method is to use the difference method of the current image and background image to detect moving objects, with simple algorithm, but very sensitive to the changes in the external environment and has poor anti-interference ability. However, it can provide the most complete object information in the case background is known. As describe in [3], background subtraction has mainly two approaches:

1. Recursive Algorithm

Recursive techniques [3] do not maintain a buffer for background estimation. Instead, they recursively update a single background model based on each input frame. As a result, input frames from distant past could have an effect on the current background model. Compared with non-recursive techniques, recursive techniques require less storage, but any error in the background model can linger for a much longer period of time. This technique includes various methods such as approximate median, adaptive background, Gaussian of mixture

2. Non-Recursive Algorithm

A non-recursive technique [6] uses a sliding-window approach for background estimation. It stores a buffer of the previous L video frames, and estimates the background image based on the temporal variation of each pixel within

the buffer. Non-recursive techniques are highly adaptive as they do not depend on the history beyond those frames stored in the buffer. On the other hand, the storage requirement can be significant if a large buffer is needed to cope with slow-moving traffic.

IV. OBJECT TRACKING METHODS

Tracking can be defined as the problem of approximating the path of an object in the image plane as it moves around a scene. The purpose of an object tracking is to generate the route for an object above time by finding its position in every single frame of the video [2]. Object is tracked for object extraction, object recognition and tracking, and decisions about activities. According to paper [1], Object tracking can be classified as point tracking, kernel based tracking and silhouette based tracking. For illustration, the point trackers involve detection in every frame; while geometric area or kernel based tracking or contours-based tracking require detection only when the object first appears in the scene. As described tracking methods can be divided into following categories:

A. Point Tracking

In an image structure, moving objects are represented by their feature points during tracking. Point tracking [6] is a complex problem particularly in the incidence of occlusions, false detections of object. Recognition can be done relatively simple, by threshold, at of identification of these points.

1. Kalman Filter

They are based on Optimal Recursive Data Processing Algorithm. The Kalman Filter performs the restrictive probability density propagation. Kalman filter [1] is a set of mathematical equations that provides an efficient computational (recursive) means to estimate the state of a process in several aspects: it supports estimations of past, present, and even future states, and it can do the same even when the precise nature of the modeled system is unknown. The Kalman filter estimates a process by using a form of feedback control. The filter estimates the process state at some time and then obtains feedback in the form of noisy measurements. The equations for Kalman filters fall in two groups: time update equations and measurement update equations. The time update equations are responsible for projecting forward (in time) the current state and error covariance estimates to obtain the priori estimate for the next time step. The measurement update equations are responsible for the feedback. Kalman filters always give optimal solutions.

2. Particle Filtering

The particle filtering [7] generates all the models for one variable before moving to the next variable. Algorithm has an advantage when variables are generated dynamically and there can be unboundedly numerous variables. It also allows for new operation of resampling. One restriction of the Kalman filter is the assumption of state variables are normally distributed (Gaussian). Thus, the Kalman filter is poor approximations of state variables which do not Gaussian distribution. This restriction can be overwhelmed by using particle filtering.

3. Multiple Hypothesis Tracking (MHT):

In MHT algorithm [10], several frames have been observed for better tracking outcomes MHT is an iterative algorithm. Iteration begins with a set of existing track hypotheses. Each hypothesis is a crew of disconnect tracks. For each hypothesis, a prediction of object's position in the succeeding frame is made. The predictions are then compared by calculating a distance measure. MHT is capable of tracking multiple object, handles occlusions and Calculating of Optimal solutions.

B. Kernel Based Tracking

Kernel tracking [3] is usually performed by computing the moving object, which is represented by 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 presence representation used, the number of objects tracked, and the method used for approximation the object motion. In real-time, illustration of object using geometric shape is common. But one of the restrictions is that parts of the objects may be left outside of the defined shape while portions of the background may exist inside. This can be detected in rigid and non-rigid objects .They are large tracking techniques based on representation of object, object features ,appearance and shape of the object.

1. Simple Template Matching

Template matching [9] is a brute force method of examining the Region of Interest in the video. In template matching, a reference image is verified with 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 [9]. Template Matching is a technique for processing digital images to find small parts of an image that matches, or equivalent model with an image (template) in each frame. The matching procedure contains the image template for all possible positions in the source image and calculates a numerical index that specifies how well the model fits the picture that position. It can capable of dealing with tracking single image and partial occlusion of object.

2. Mean Shift Method

Mean-shift tracking tries to find the area of a video frame that is locally most similar to a previously initialized model. The image region to be tracked is represented by a histogram. A gradient ascent procedure is used to move the tracker to the location that maximizes a similarity score between the model and the current image region. In object tracking algorithms target representation is mainly rectangular or elliptical region. It contain target model and target candidate [2]. To characterize the target color histogram is chosen. Target model is generally represented by its 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 gives a set of positive and negative training values. For SVM, the positive samples contain tracked image object, and the negative samples consist of all remaining things that are not tracked. It can handle single image, partial occlusion of object but necessity of a physical initialization and necessity of training.

C. Silhouette Based Tracking Approach

Some object will have complex shape such as hand, fingers, shoulders that cannot be well defined by simple geometric shapes. Silhouette based methods [14] afford an accurate shape description for the objects. The aim of a silhouette-based object tracking is to find the object region in every frame by means of an object model generated by the previous frames. Capable of dealing with variety of object shapes, Occlusion and object split and merge.

1. Contour Tracking

Contour tracking methods [9], iteratively progress a primary contour in the previous frame to its new position in the current frame. This contour progress requires that certain amount of the object in the current frame overlay with the object region in the previous frame. Contour Tracking can be performed using two different approaches. The first approach uses state space models to model the contour shape and motion. The second approach directly evolves the contour by minimizing the contour energy using direct minimization techniques such as gradient descent. The most significant advantage of silhouettes tracking is their flexibility to handle a large variety of object shapes [14].

2. Shape Matching

These approaches examine for the object model in the

existing frame. Shape matching performance is similar to the template based tracking in kernel approach.

Another approach to Shape matching [10] is to find matching silhouettes detected in two successive frames. Silhouette matching, can be considered similar to point matching. Detection based on Silhouette is carried out by background subtraction. Models object are in the form of density functions, silhouette boundary, object edges. Capable of dealing with single object and Occlusion handling will be performed in with Hough transform techniques [14].

V. CONCLUSION

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 Modeling 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 to decrease the time required for detecting the object for variety of videos containing diversified characteristics and increase accuracy rate with using GMM and Optical flow.

COMPARITION OF METHODS

Method	Advantages	Disadvantages
Foreground detection with Gaussian mixture, Lucas-Kanade, Optical Flow	Less data storage is required, complexity is reduced as the feature vectors generated by	Here only for neural network and It is not real time.
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, and	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 reason 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.	(1)The detected object may be larger than its real size. (2) There may be holes in detection results (3) When an object is moving slowly, its motion is unreliable
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 tracking system

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