International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 08, 2020
ISSN: 1475-7192

MOVING OBJECT DETECTION AND TRACKING TECHNIQUES

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ABSTRACT*—Moving object detection and tracking has become a challenging and rapidly changing task in the field of video tracking. With the greater rise in the number of applications of video surveillance in security, robot vision and monitoring traffic in the coming decade, the need of automated and self- regulated system to identify non-stationary entities has presented itself with the importance like never before. The first step towards the successful tracking is the detection, next is the identification of the position of the changing objects in the subsequent frames in the video. This paper presents a survey of various algorithms used in the process and also discus s its limitations.*

Keywords-- *moving object detection and tracking techniques*

I. INTRODUCTION

Video surveillance is observing the various image sequences and supervising them for analyzing them or tracking various moving object's behavior. There are various types of video surveillance, they are manual, semi-autonomous or fully- autonomous. in manual surveillance a human analysis the video. Various examples are video monitoring in various clubs, institutions, hotels done by the security staff. Semiautonomous operates by human interaction and video processing techniques. Examples are systems which record video only when there is considerable motion in the recorded video and are sent to the human expert for analysis. In the case of fully-autonomous systems, the video is recorded and analyzed by the artificially designed system. It even tracks the various moving entities and even has a high-level decision-making task like suspicious event detection and gesture recognition. Automatic video surveillance for long duration can provide longer undivided attention and better feasibility than a human operator. There are many challenges in front of video monitoring like illumination changes, bad performance and enough training datasets. Video surveillance has two parts, one is identifying background and foreground and the other is tracking the different moving objects in the same. While static environments are easier to administer but dynamic environments pose greater difficulty. Automated visual monitoring is also called intelligent visual surveillance

(IVS) which involves analysis and semantic interpretation of different objects in the video.

II. METHODOLOGIES

Real-time object detection and tracking starts with the Real time detection of foreground and background objects in video frames. The detecting algorithm does this by segmenting the non-stationary object in the video

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Received: 21 Dec 2019 | Revised: 18 Jan 2020 | Accepted: 05 Feb 2020

[17]. Various algorithms for the same are background subtraction, frame differencing, optical flow. Object classification is another major task which is done by shape based, colour-based, texture based, motion- based classification. Non-stationary objects are tracked by various object tracking algorithms. Point based, kernel based and shape-based are various types of object tracking.

III. OBJECT DETECTION

The starting step is object detection. It is the first and very important part of video surveillance, it involves the segregation of background with the foreground moving objects. Various object detection algorithms are[18]:

Background Subtraction

Background subtraction [1][2][3][4] involves the careful modeling the backgrounds that the model is sensitive enough to capture even the slightest moving objects but robust against the changes in the background [5]. Temporal and spatial smoothing, post-processing may also be used as a part of pre- processing the model to balance against then ambiguity in the video due to bad visual input or dynamic environment. Foreground detection [27]is also a very important step of background subtraction as it compares a video frame with the background model [6] and detects the difference in the pixels [7] of both for the foreground object. Some challenges of background subtraction include poor performance means it cannot be used for tasks which include quick responses.

Frame differencing

It involves the difference between the current frame and the previous frame for object detection. It captures the outline of the moving objects and calculates the mean movement if it is more than threshold previously described than the object is considered as moving e.g. edge maps[edge]. This method is very good for dynamic environment nut for objects with deteriorated shapes lots of frames need to be taken for correct tracking of the object[6].

Optical flow

It calculates the optical flow distribution [1] [29] of the different objects in the video and then groups the objects with similar property. This technique is quite accurate in detecting the moving objects in the video. It involves lots of calculations in carries out the process. It is also very susceptible to the noise in the video. So it makes it very hard to use it in case of dynamic background and real-time applications[8].

Double difference

Here three consecutive frames are taken and the first and last is subtracted from the middle frame. The average or mean difference is taken and if this difference is more than some previously set value then the object is considered a moving object.

IV. OBJECT CLASSIFICATIONMETHOD

The object is detected in the video, but it is classified based on a different feature it possesses and it is assigned to a different group based on its features. So the basic characteristics like shape, colour, texture, and motion are considered as the parameters for object classification [6].

Motion based

There are two types of objects. One is of the form which do not deform easily and are called rigid objects, while other form does not have fixed shape at all times of its motion. While, on one hand, optical flow can be used

to cluster moving objects effectively, residual flow can also be used to group objects as the non-rigid or flexible objects have more and lasting average residual flow [30] and even show more periodicity than the rigid objects.

Texture-based **classification**

Here there are plenty of ways to classify objects based on texture like co-occurrence matrix and its formulation. Here various co-occurring values form the matrix and feature extraction is done based on the matrix. This technique is limited for images with large texture

Colour based

Colour is a basic and fundamental characteristic of the object. The colour of moving object remains invariant to the object in motion and is likely to remain the object identification in the image. It is used as a feature of the moving object. A colour histogram is used for object representation and classification.

Shape-based

Shape based classification is one of the most intelligent and widely used method for object classification. [23].Blob analysis is used to select the object based on the blob area and shape of the moving object in the video. Blob area is calculated in every subsequent frame of the video to track the object in the video.

V. OBJECTTRACKING

Object tracking is about finding the route of the object [32] moving along the video and to track it for making meaningful decisions. It is later classified as point tracking, kernel based, shape based, feature based [31].

Point based

In a point-based tracking the object is represented as the sum of the feature points. So the tracking is done by tracking these points in group. And their relative distance from each other in representing the object presents the problem during occlusions [9]. This method works by predicting and correction of the moving object. The movement of the object is tracked and its position in the subsequent frame is predicted and it leads the system to have a rough estimate for the object to boost the performance. Correction is done to correct the prediction model and to identify the object precisely. Some well-known point-based tracking algorithms [5] are Kalman filter, particle filter, Multiple Hypothesis Tracking.

A. Kalman filter

It was originally designed to predict the path of the space- craft in the shape, this algorithm [9] is actively used in predicting the movement of the moving object in the video based on the previous observation. It is constructed on Maximum Periodic Documents Dispensation Algorithm. It has two parts first is predicting the object position and second is the update in which it updates its model based on the input provided in the current frame[1][2][3][4].

B. Particle filter

The particle filter [10] is a hypothesis tracker that sets the weights to find about the filtered distribution and track either one or multiple moving objects in the video during its transition. It also has an update and predict phase just like the Kalman filter [5]. Here variables can be generated dynamically which gives it the advantage over Kalman filter[10].

C. Multiple Hypothesis tracking

Received: 21 Dec 2019 | Revised: 18 Jan 2020 | Accepted: 05 Feb 2020

Multiple hypothesis algorithm [11] considers the multiple frames in the video and tracking moving object in its course. It gives a better idea of the path than using just two frames. Here each hypothesis starts with the set of the existing hypothesis. Each hypothesis is applied together to predict the object position in the current frame and then track it [1].Kernel Tracking

Kernel tracking [12] [19] is done to determine the different moving objects. It can track various rigid and non-rigid objects based on its representation movement of the object is in a parametric form such as transformation, affine etc. There are various ways of kernel tracking are mean shift tracking, simple template matching, layered based training [1].

D. Mean shift tracking

Here the different region of interest can be calculated in the frame using segmentation techniques and then tracking of these regions and moving objects can be done by mean shift tracking algorithm. Using Bhattacharya Co-efficient, the distance between different distribution scan be minimized.

E. Template matching

Template matching [13] [20] is an algorithm which is used to identify certain areas in the image called the region of interest (ROI) [24].It involves making of a model in which the images in every frame are compared with the background image to detect the various small portions that in every frame can match with the template.

F. Layered based training

Here are different layers built of shape features, motion (which consists of translation and rotation) [14], and intensity- based layer appearance [4]. Re numeration of the background motion on each level is done so that the foreground motion of theobjectintherewardedimagecanbedoneby2Dparametric motion. This method is very good in tracking multiple moving objects in the video simultaneously [17].

G. Silhouette tracking

This model detects the moving objects in the frame using the model which is trained from previous frames. This technique basically works with images shapes and their correlation from the previous frame using shape [19] [24], colour as the parameter. Colour, hologram, object edges, contour are used to represent the model. Contour tracking, shape-based are types of silhouette tracking [15]. Remuneration of the background motion is done.

H. Contour tracking

Here contour[13][24][17] in the previous frame is advanced to its new position in the current frame [19]. This is done taking that into account that certain amount of object in the current frame resemble the object in the previous frame. There are two approaches to contour tracking. First one is to use state space models [13] to account for shape and movement. The second approach updates the contour by minimizing using algorithms like gradient descent. It is a good approach in case the video has objects with different shapes[16].

I. Shape matching

Here the moving objects can be tracked in different frames

[21] by finding out by matching their silhouette just like point matching [11][25][26]. Here the model is in the form of density function made in the form of object's, silhouette boundaries and edges. It is better in tracking a single object with greater efficiency.

VI. CONCLUSION

This paper summarizes the different modules which are involved in detecting the moving object in even the dynamic video. Different phases of object detection and tracking include object detection, object classification, and object tracking. Object detection is used to detect the various moving objects in the video or the object of interest. Various algorithms discussed are background subtraction, frame difference, optical flow, double difference where background subtraction suffers from poor performance but is simplest of all. Frame difference is also suitable algorithms for dynamic environments. Objects can be represented using color, texture, shape and motion property. At last object tracking algorithms are discussed which are point based, kernel based, and silhouette based and can be used to track rigid as well as non rigid objects. Kernel and contour algorithms for tracking involves tracking the object when it first appears whereas point tracking involves detection in every frame. Various complex and important concepts related to video surveillance have been presented in the paper. Recently more optimized algorithms are being made gradually which makes video surveillance potential research field. We have discussed various algorithms which are of critical use in object detection and tracking and believe that it may give proper insight into video surveillance

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