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Techniques and Methods for Detection and Tracking of Moving Object in a Video

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ABSTRACT: The use of video is becoming prevalent in many applications such as monitoring of traffic, detection of pedestrians, identification of anomalous behaviour in a parking lot or near an ATM, etc. While a single image provides a snapshot of a scene, the different frames of a video taken over time registers the dynamics in the scene, making it possible to capture motion in the sequence. Most of the methods include object segmentation using background subtraction. The tracking strategies use different methodologies like Meanshift, Kalman filter, Particle filter etc. Here, classification of the tracking methods is done, and a detailed description is provided of representative methods in each group. Research works on object detection and tracking in videos. The definition and tasks of object detection and tracking are first described, and the important applications are mentioned.

KEYWORDS: Meanshift, Kalman filter, Particle filter.

I. INTRODUCTION

In video processing, a video can be represented with some hierarchical structure units, such as scene, shot and frame. Also, video frame is the lowest level in the hierarchical structure. In video retrieval, generally, video applications must first partition a given video sequence into video shots. A video shot is defined as an image or video frame sequence that presents continuous action. The frames in a video shot are captured from a single operation of one camera. The complete video sequence is generally formed by joining two or more video shots. As we know that videos are made up of subsequent images (frames) which are move fast enough. So that, human eyes realize them continuous. Now, for any processing on video we need to the frame. The video analysis is done by following three steps: 1. Detection of object 2. Analysis of that object 3. Tracking of that object.

II. LITERATURE SURVEY

There are many existing methods of object tracking but all has some drawbacks. Some of the existing models for object tracking are contour-based models, region-based models and feature point-based models.

A. Contour-based object tracking model :

Active contour model is used for finding object outline from an image[1]. In the contour based tracking algorithm, the objects are tracked by considering their outlines as boundary contours. Thereafter these contours are updated dynamically in successive frames. The discrete version of this approach is represented in active contour model. The discrete version of this approach takes the advantage of the point distribution model to limit the shape. However, this algorithm is highly sensitive to the initialization of tracking, making it difficult to start tracking automatically.

B. Region-based object tracking model :

The region based object model bases its tracking of objects on the color distribution of the tracked object[2,3]. It represents the object based on the color. Hence, it is computationally efficient. However, its efficiency is degraded when several objects move together in the image sequences. It is not possible to achieve accurate tracking when multiple objects move due to occlusion. Also, in the absence of any object shape information, the object tracking is largely dependent on the background model used in the extraction of the object outlines.

C. Feature point based tracking algorithm :

In Feature point based model feature points is used to describe the objects[4,5]. There are three basic steps in feature point based tracking algorithm. The first step is to recognize and track the object by extracting elements. The second step is to cluster them into higher level features. The last step is to match these extracted features between images in

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successive frames. Feature extraction and feature correspondence are the important steps of feature based object tracking. The challenging problem in feature point based tracking is feature correspondence because a feature point in one image may have many similar points in another image, and hence results in feature correspondence ambiguity.

III. A SURVEY ON MOVING OBJECT TRACKING

Videos are made up of subsequent images (frames) which are move fast enough. So that, human eyes realize them continuous. Now, for any processing on video we need to the frame. The video analysis is done by following three steps: 1. Detection of object 2. Tracking of that object 3. Analysis of that object

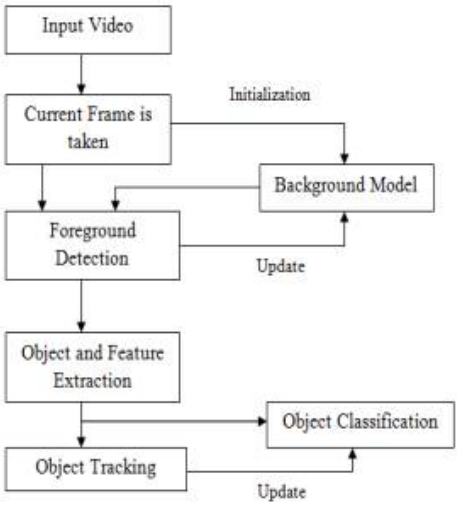

Fig. 1. Basic Flowchart

1. Foreground object detection :
The common 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.

Object detection can be done by following techniques: Frame differencing, Optical flow, Background subtraction, etc.

a) Frame Differencing :
Detection of moving object from a sequence of frames captured from a static camera is widely performed by frame difference method. The objective of the approach is to detect the moving objects from the difference between the existing frame and the reference frame. The frame difference method is the common method of motion detection. This method adopts pixel-based difference to find the moving object.
i)Difference of Two Consecutive Frames:
Ikis supposed to be the value of the kth frame in image sequences. Ik+1is the value of the (k+1) th frame in image sequences. The absolute differential image is defined as follows: Id(k, k+1) = |Ik+1 – Ik|.
ii)Transformation of absolute differential image to Gray Image:
There are holes in moving object area, and contour of moving object is not closed. The absolute differential image is transformed to gray image to facilitate further operations.
iii)Filtering and Binarizing Transformed Gray Image:
In order to remove the holes, the image is passed through the Gauss low pass filter.

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b)Optical Flow :
The optical flow describes the direction and the time rate of pixels in a time sequence of two consequent images. A 2 dimensional velocity vector, carrying information on direction and the velocity of motion is assigned to each pixel in a given place of the picture.
For making computation simpler and quicker we transfer the real world three dimensional (3-D+time) objects to a (2-D+time) case. Then we can describe the image by means of the 2-D dynamic brightness function of location and time I(x, y, t). Provided that in the neighbourhood of a displaced pixel, change of brightness intensity does not happen along the motion field.

2. Background Model :
Background subtraction, also known as Foreground Detection, is a technique in the fields of image processing and computer vision wherein an image's foreground is extracted for further processing (object recognition etc.). Generally an image's regions of interest are objects (humans, cars, text etc.) in its foreground. After the stage of image pre-processing (which may include image denoising, post processing like morphology etc.) object localization is required which may make use of this technique. Background subtraction is a widely used approach for detecting moving objects in videos from static cameras. The rationale in the approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often called “background image”, or “background model”. Some conventional methods used are : Using frame differencing, Mean filter, Running Gaussian average, Background mixture models, etc.

Mean Filter :
In this case the background is the mean of the previous n frames:
$B(x, y,t) = 1\ n\ Pn{-}1\ i{=}0\ I(x, y,t - i)$
$|I(x, y,t) - 1\ n\ Pn{-}1\ i{=}0\ I(x, y,t - i)| > Th$

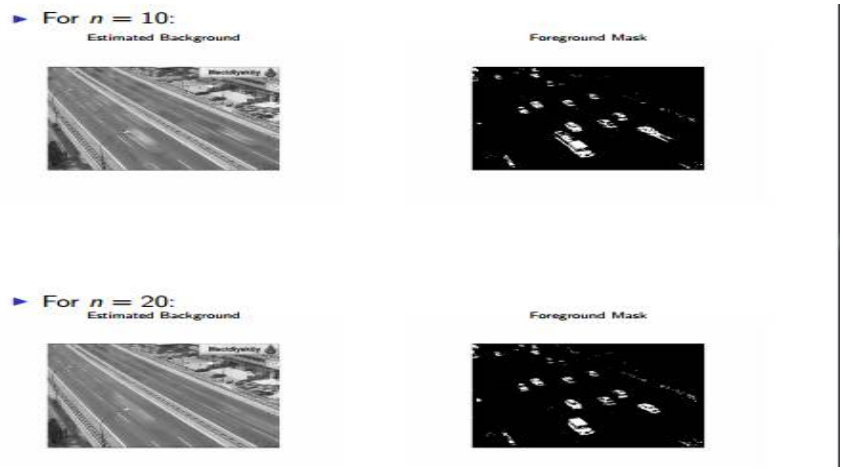

Fig. 2. Mean filtering

3. Feature Descriptor :
Color Features : To increase the discriminative power of intensity based descriptors color feature descriptors are used [8]. Two physical factors primarily influenced the apparent color of an object- 1) the spectral power distribution of the illuminant and 2) objects surface reflectance property. To describe the color information of an object RGB color space is usually used. But RGB color space is not a perceptually uniform color space. Other color space like L*a*b*and L*u*v* are perceptually uniform. However the HSV (Hue, Saturation and Value) is an approximately uniform color space.
Gradient Features : Gradient features are important in human detection in video sequences. To represent objects like human body, shape/contour of the human body is used in gradient based methods.
Edge features : The change in intensities of an image is strongly related to object boundaries because after just after the object boundary the intensity instantly changes. To identify the instant change edge detection techniques are used.

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Compared to color features, edge features illumination changes are less sensitive. Canny Edge detector is mostly used in finding the edges of an object because of it is optimal. Roberts operator, Sobel operator and Prewitt operator are also used for finding the edges.

Texture Features : In Comparison to color features and edge features, a processing step is required to generate the descriptors for the texture features. Local Binary Patterns (LBP) texture feature are known as one of the efficient features. The LBP are gone through an analysis operator is defined as a grayscale invariant texture measure, derived from a general definition of texture in a local neighbor-hood. The most important property of the LBP operator is its tolerance against illumination changes.

Optical Flow : The translation of each pixel in a region can be found out by a dense field of displacement vectors defined as optical flow. Brightness constraint is taken as a measure while computing optical flow, assuming that brightness of corresponding pixels is constant in consecutive frames. Optical flow feature is mostly used in motion-based object segmentation and tracking applications. Furthermore it is also used in video segmentation algorithms.

Spatio-Temporal Features : In recent times local spatio-temporal features are mostly used. These features provide a visual representation for recognition of actions and visual object detection [9]. Salient and motion patterns characteristics in video are captured by local spatio- temporal features. These features provide relative representation of events independently. While presenting events the spatio-temporal shifts and scales of events, background clutter and multiple motions in the scene are considered. To show the low level presentation of an object such as pedestrian space-time contours are used. To covert a one-dimensional contour into three-dimensional space a 3D distance transform is used.

Biological Features : Biological features are important in describing the biological characteristics of human. Attention Regions (ARs) and Biologically Inspired Model (EBIM) features the recent used biological features. Humans biological vision mechanism can be described by these biological and hence to achieve robust recognition.

Multiple features fusion : The multi-feature fusion scheme has achieved high boosting performance or robustness, in the field of computer vision, multimedia and audiovisual speech processing, etc [9].

Object Classification :

The extracted moving region may be different objects such as humans, vehicles, birds, floating clouds, swaying tree and other moving objects. Hence we use the shape features of motion regions.(background best). The approaches to classify the objects are :

a) Shape based classification.
b) Motion based classification.

Object Tracking :

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. Object is tracked for object extraction, object recognition and tracking, and decisions about activities. 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.

Tracking methods can be divided into following categories:

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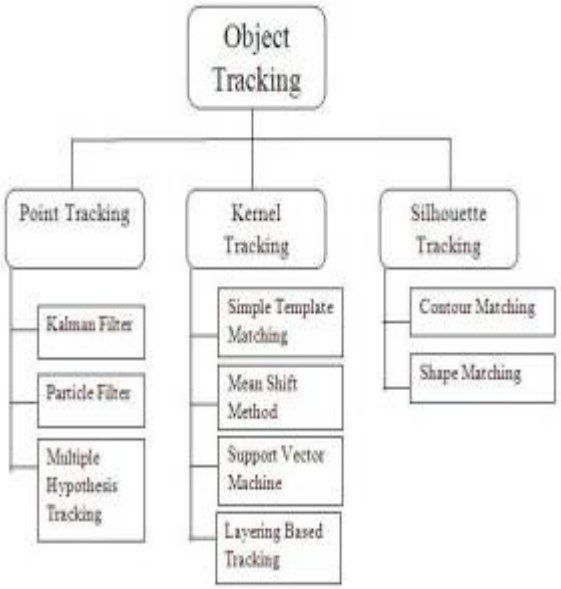

Fig. 2. Types of Object Tracking Method

IV. APPICATIONS

•Surveillance/Monitoring Applications :
1. Security Cameras Traffic Monitoring
2. Traffic Monitoring
3. People Counting

•Control Applications :
1. Object Avoidance
2. Object Avoidance
3. Automatic Guidance
4. Head Tracking for Video Conferencing

V. CONCLUSION AND FUTURE WORK

This paper presents a widespread review of visual surveillance systems describing its phases of object detection, object representations, object tracking and semantic decision. Moving object tracking is a key task in video monitoring applications. Object detecting and tracking has a wide variety of applications in computer vision such as video compression, video surveillance, vision-based control, human-computer interfaces, medical imaging, augmented reality, and robotics. Additionally, it provides input to higher level vision tasks, such as 3D reconstruction and 3D representation. It also plays an important role in video database such as content-based indexing and retrieval.

As per the convention this area of interest has been adopted by many tech giants like Sony Play station, Microsoft Xbox connect, Google car tech, and all the IR/space camera technology. Inspired from this many other technologies have been invented and are being invented. This is also going to serve as a clear backbone to many software technologies that may include security, AI, Augmented Reality, and Game design.

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