Probability based Technique for Multi-Object Tracking: A Review

Vandana[1] Tarun Sharma[2]
[1,2]Department of Electronics & Communication Engineering
[1,2]Galaxy Global Educational Trust's Group of Institutions, Dinarpur, Ambala, Haryana, India

Abstract— The object tracking is the technique in which object is tracked in a series of frames called video. The object can be tracked by various methods. In this paper, many methods that have been reviewed and studied are discussed. On their basis, the technique that is proposed is enhancement in probability distribution algorithm to track multiple objects from the frames of a video which uses morphological segmentation scan, color and texture features, mean shift and probability based technique considering the issues like computational expenses, occlusion, and moving background rejection. The proposed technique will be implemented in MATLAB. The is proposed that this technique works well in terms of track completeness, correct detections, false alarm track, track fragmentation, closeness of track and provide better accuracy.

Key words: Morphological Segmentation Scan, Occlusion

I. INTRODUCTION

The goal of object tracking is to find the trajectory of an object or multiple objects from a sequence of images called a video. The results of object tracking i.e. trajectory of an object can be either of interest in its own right or can be used as the foundation for higher level analysis.

The input to the object tracking method is a sequence of image frames taken from a video. After it, the objects are detected and classified using any of the methods and then the process of object tracking is applied.

A. Object Detection

Object detection is performed to check existence of real-world objects such as cars, bicycles, buildings in the sequence of images and to precisely locate such objects. The detected object can be classified into various categories such as vehicles, humans, birds, swaying tree, floating clouds and other moving objects.

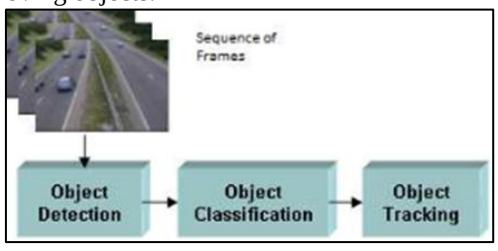

Fig. 1: A Generic Framework

From number of images object detection detects real world objects and then track their exact location with precision.[3] The basic idea for detection of an object is locating an object in to the frame only when it appears first time in video. Although, using some temporal information calculated from series of video images, such detection methods are used to reduce the false detection rate.

1) Object Detection Methods

Object Detection is the task of identify objects of interest in a 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. The commonly used methods of object detection are given below.

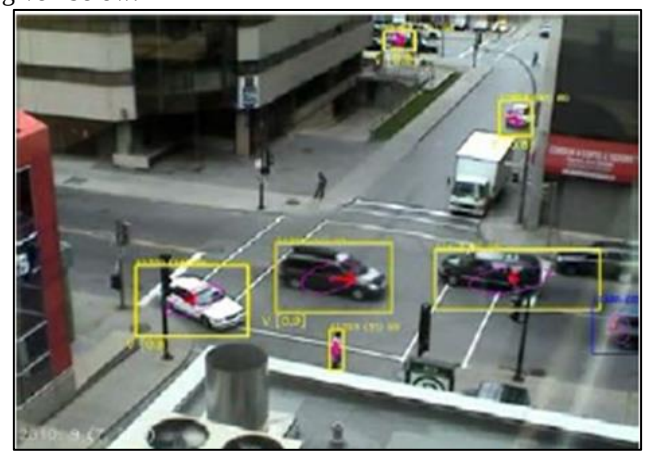

Fig. 2: Object Detection [3]

a) Frame differencing

In this method the presence of moving objects is determined by calculating the difference between two consecutive images. The difference between the two consecutive frames gives information about the location of the object. The calculations involved are simple and it is easy to implement but not that much accurate.

b) Optical Flow

Optical flow method obtains the pattern of apparent motion of an object, its surfaces and edges in a visual scene caused by the relative motion between an observer such as an eye or a camera and the image scene. Optical flow method can give the complete information about the object movements and detect the moving object from the background more accurately however a large number of calculations, sensitivity to noise, poor anti-noise performance, make it non suitable for real-time applications.

c) Background subtraction

Background subtraction is also known as foreground detection. Background subtraction method Extracts foreground objects in a particular scene. A foreground object can be described as an object of attention which helps in reducing the amount of data to be processed as well as provide important information about the task under consideration.

Fig. 3: Background subtraction [2]

B. Object Classification

Object Classification includes a broad range of decision-theoretic approaches to the identification of images. It analyzes the numerical properties of various image features and organizes the data into different categories. Some techniques detect objects which are o similar type and some others will detect object which are of different types.

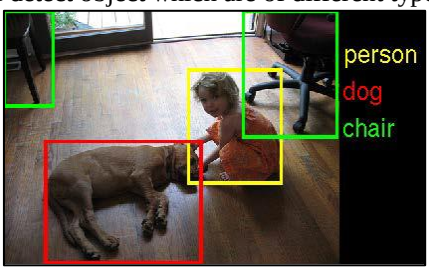

Fig 4: Object Classification [2]

1) Object Classification Methods

The extracted moving region may be different objects such as humans, vehicles, birds, floating clouds, swaying tree and other moving objects. The Various methods of object classification are as follows:

a) Shape-based

Different descriptions of shape information of motion regions such as representations of points, box and blob are available for classifying moving objects. Classification is performed on each blob at every frame and results are kept in histogram [2].

b) Motion-based

Non-rigid articulated object motion shows a periodic property, so this has been used as a strong cue for moving object classification. Optical flow is also very useful for object classification [2].

c) Colour-based classification

Colour is relatively constant under viewpoint changes and it is easy to acquire. Although colour is not always appropriate as the sole means of detecting and tracking objects, but the low computational cost makes colour a desirable feature to exploit when appropriate. To detect and track vehicles or pedestrians in real-time mostly colour histogram based technique is used. A colour histogram is created to describe the colour distribution within the sequence of images and to segment the image into background and objects [2].

d) Texture-based classification

Texture based classification counts the occurrences of gradient orientation in localized portions of an image. It is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization to improve accuracy [2].

C. Object Tracking

Object Tracking is the problem of approximating the path of an object in the image plane as it moves around the scene. The purpose of an object tracking is to generate the route for an object by finding its position in every single frame of the video. We have different methods for tracking the objects, the commonly used methods are given below.

1) Object Tracking Methods

a) Point Tracking

In an image structure, moving objects are represented by their feature points during tracking. Object tracking is done in a simple way by thresholding, after the identification of these points. To track an object over a long period of time, it becomes important to reacquire points periodically [1].

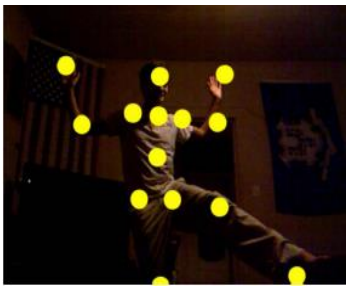

Fig. 5: Point tracking [1]

b) Kernel Based Tracking

Kernel tracking is usually performed by computing 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. There are many kernel based tracking techniques based on representation of object, object features, appearance and shape of the object [1].

c) Silhouette Based Tracking

Some objects have complex shapes such as hand, fingers, shoulders that cannot be well defined by simple geometric shapes. Silhouette based methods provide an accurate shape description for the objects. Silhouette tracking is capable of dealing with variety of object shapes, occlusion and object split and merge. The commonly used methods of silhouette tracking are given below.

- Contour Tracking: Contour tracking methods, iteratively progress a primary contour in the previous frame to its new position in the current 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.
- Shape Matching: Shape matching approach is similar to the template based tracking in kernel Tracking. Tracking based on Silhouette is carried out by background subtraction mostly.

Fig. 6: Shape Matching [1]

II. RELATED WORK

A survey on object tracking on moving objects discussed the feature descriptors that are used in tracking to describe the appearance of objects which are being tracked as well as object detection techniques. They classified the tracking methods into three groups (contour-based, region-based, feature-point based models) and a providing a detailed description of representative methods in each group, and find out their positive and negative aspects [1].

A novel algorithm for automatic video object tracking based on a process of subtraction of successive frames, where the prediction of the direction of movement of the object being tracked was carried out by analyzing the changing areas generated as result of the object's motion,

specifically in regions of interest defined inside the object being tracked in both the current and the next frame. This moving region was displaced in the direction of the object's motion predicted on the process of subtraction of successive frames. Finally, the location of the moving region of interest in the next frame that minimizes the proposed function of dissimilarity corresponds to the predicted location of the object being tracked in the next frame [2].

An Object-tracking algorithm is combination of temporal differencing and template matching. Motion regions were recognized by motion detection using temporal differencing. A motion region is a region that has a difference between the current frame and previous frame more than a specified threshold. Each motion region is then cluttered into the object. Each object is classified and becomes the template. They used that template to track the corresponding object in the next frame. After object being tracked; template was updated by merging the current template with the matched object [3].

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 used for various stages of tracking. Different methods for object detection are frame difference, optical flow and background subtraction. Object tracking can be performed using various methods like kalman filter, particle filter and multiple hypothesis tracking. It can be summarized background subtraction is a simplest method providing complete information about object compared to optical flow and frame difference for detecting objects; in the literature including analysis and comparative study of different techniques used for various stages of tracking [4].

A probabilistic object tracking model based on condensation algorithm. A novel object tracking algorithm based on particle filtering associate with population balances was proposed. The developed algorithm was used to track objects in synthetic frames and natural video frames. The color histogram was used as the main feature of the object, and a probabilistic particle filter method incorporating with a novel population balance approach in imaging was proposed to track an object. Population balance equations (PBEs) were used to define phenomena in particulate processes [5].

III. Conclusion

The object tracking is the technique to track the objects from the sequences of frames called video. Many different techniques and studies done by various researchers are discussed here. To track multiple objects from the video probability distribution algorithm is proposed and is applied to track the objects efficiently and to find out the values of parameters like false alarm rate, track fragmentation, closeness of track, correct detection, track completeness.

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