A SURVEY ON OBJECT DETECTION, CLASSIFICATION AND TRACKING IN VIDEO

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Abstract

Object tracking is one of the most important components in numerous applications of computer vision such as video surveillances, robot vision, traffic monitoring, video impaintng and animation. The goal of object tracking is to segment a region of interest from a video scene and keep track of its motion, position and occlusion. This paper presents a brief survey on different techniques of object detection, classification and tracking, including analyzing and comparative study of different methods used for tracking.

Index Terms: Object detection, Classification, Tracking, Trajectory, Multimodality, Background modeling.

I.INTRODUCTION

Object tracking is one of the core problems of computer vision. Computer visions have a wide range of applications that include human computer interaction, surveillances and augmented reality. Tracking video is much more challenging in video sequence to improve recognition and tracking performance. In a video there are primarily two source of information that can be used for detection and tracking of objects: first source is a visual feature e.g. color, texture and shape and second source is motion information. By combining the statistical analysis of visual features and temporal analysis of motion information robust approaches have been suggested.

Videos are the sequences of images and each of which are called frames. These frames are displayed in fast frequency so that the human eyes can percept the continuity of its content. All the images processing techniques are applied to individual frame. Object recognition is followed by object detection, classification and tracking in video as described in many literature.

Object detection: It is the task of finding and identifying objects in an image or video sequences. It is commonly used in applications such as image retrieval security automated vehicle parking system and surveillance. Object detection can be done various techniques such as frame differencing, optical flow and background subtraction.

Object classification: object can be classified as vehicle, animals, birds, swaying tree, floating clouds and other moving objects. The approaches that are used to classify the objects are shaped based classification, motion based classification and texture based classification.

Object tracking: It is the process of locating a moving object over time using a camera. It also used in estimating the trajectory of an image plane as it moves around a scene. The approaches used to track the objects are point kernel, kernel tracking and silhouette.
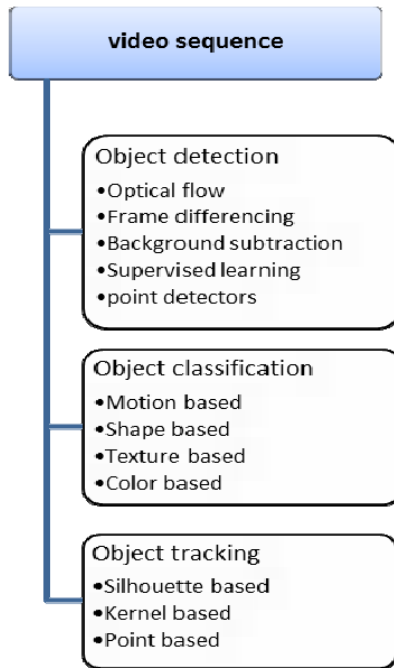
Fig.1. Basic steps for tracking an object.

II. RELATED WORK

Object tracking in video has a wide range of applications in the field of transport, physical security, environmental monitoring, smart space and ambient intelligence etc. wide range of algorithm using various types of data sets is been used by various authors.

Bing-Fei Wu, Jhy-Hong Juang[2] used an adaptive method for detecting and tracking in sunny light, shadow region and during night. The background subtraction algorithm is used for the separation of background and foreground. The foreground scenes are dynamically segmented by using GDVM segmentation method.

Jingchang Huang, Xin Zhang, Qianwei Zhou, Enliang Song, and Baoqing Li[3] In this paper a method is proposed for thr extraction of moving targets fundamental frequency(MTFF) from its acoustic signals. This method is useful for pitch extraction of moving targets. Parameters estimation has been presented.

Roger Schimidt feris et.al [1] used a novel approach for detection and tracking. They used an indexing based method to search a tracked vehicle. Their algorithm supports detection and tracking vehicles under partial occlusions, multiple tracking. They have retrieved the vehicle using fined grained attributes. A comprehensive quantitative analysis was performed using real surveillance data.

Dan Tu, Jun Lei, yazhou Yang[4] In this paper, a robust approach is proposed to track congested vehicles. Proposed algorithm is an improved TMD method and utilizes its character of adaptive tracking. According to algorithm, firstly, we exploit the texture information of the points and the good feature points, using the basic principle of Lucas-Kanade algorithm. Secondly, to track the vehicle in the case of occlusion, rectangle region choosing strategy is proposed. By using those new rectangle regions the tracker and detector of each vehicle are updated.

Qian zhang, student member and King Ngi Nang[11], provide a multi view approach, which segment a group of people into individual human object and then track them across the video sequence with high accuracy. To track each object region an appearance based approach is employed by the motion uncertainty refinement and compensation. The motion occlusions is handled as layer transitions

III. OBJECT DETECTION METHODS

First step in the process of object tracking is to detect or identify the object of interest in the video sequence and then to make cluster pixel of these objects. A common approach for the detection of object is to use single frame and its information. Detailed explanation for various methods is given below.

A. Optical Flow

Optical flow [12] is the pattern of apparent motion of objects, surfaces and edges in a visual scene caused by the relative motion between an

observer and a scene. According to the optical flow distribution characteristic of image, clustering process is being done. This method helps to get the complete information of movement and detect the moving object from background better [13]. However an exaggerated calculation, poor antinoise performance, sensitivity to noise makes it unsuitable for real time demanding work.

B. Point detectors

Point detectors are used to find the region of interest in the images which have a representative texture in their respective localities. It has well defined position in image space. Interested points have been long used in the field of motion, stereo and tracking problems. The local image structure around the interested point is rich in terms of local information contents.

C. Background subtraction

First step for background subtraction is background modelling, and then finding deviations from the model for each incoming frame. Any noticeable change in an image region from the background model signifies a moving object [5]. For realizing background modelling the most widely used filters are mean filter and median filter. It was different method of analysing current image and background image to detect moving object, but are very sensitive to the changes in external environment and has poor anti-interference ability [6]. Background subtraction mainly follows two approaches:

i. Recursive algorithm

Recursive algorithm [6] recursively update a single background model based on each input frame, they do not maintain a buffer for background estimation. As a consequences, the input frame from distant past have an effect on the current background model. Recursive techniques require less storage as compared with non-recursive techniques. This technique includes adaptive background, Gaussian of mixture approximate median.

ii. Non recursive algorithm

Non recursive algorithm uses sliding window approach. It stores a buffer of the previous video frames and using the temporal variation of each pixel within the buffer it estimates the background image. Non recursive algorithms are highly adaptive.

D. Frame differencing

In frame differencing by calculating the differences between two consecutive images, we can determine the presence of moving objects. The calculation is simple and easy to implement. This technique is very adaptive for a variety of dynamic environments. But sometimes the results are more accurate as it is generally difficult to obtain complete outline of moving objects.

E. Supervised learning

By a means of supervised learning mechanism we can perform object detection. By learning different object views, supervised learning method generates a function that maps inputs to desired outputs. A standard formulation of supervised learning is the classification and regression. For object detection, the learning examples are mode of pairs of object features and associated object class where both classification and regression are manually defined. Adaptive boosting and support vector machine are some of the supervised learning mechanism and are applicability to object tracking.

IV. OBJECT CLASSIFICATION METHODS

A classifier is an algorithm that takes a set of features that characterize objects and uses these characterizes to determine the class of each object. There are two types of classification supervised and unsupervised. There are four basic steps to develop classifiers as shown in Fig.2.
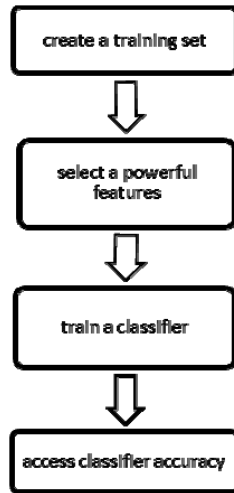
Fig.2. Four steps to develop classifier.

The extracted moving region of different objects may be different such as humans, vehicle, birds, floating clouds, sawaying tree and other moving objects. As per the literatures, approaches to classify the objects are as follows:

A. Motion based classification

Non rigid articulated objects motion shows a property, so for the object classification this has been used as a cue. Optical flow is also very useful for object classification. For analyzing rigidity and periodicity of moving residual flow can be used. Non rigid object such as human being had higher average residual flow as compared to the rigid objects and even displayed a periodic component [7].

B. Shape based classification

For classification of moving objects different descriptions of shape information of motion regions are available such as representatives of points, box and bolob. Input feature to the network is a mixture of scene based and image based object parameters. Classification is performed on each blob as each frame and the results are kept in histogram[7].

C. Texture based classifications

Texture based classification technique, in localized portions of an image counts the occurrences of gradient orientation. To improve

accuracy it computed on a dense grid space cell distributed uniformly[8].

D. Color based classification

Color based classification is constant under view point changes and easy to acquired. Computation cost od algorithms using single color classification is low, but is not always appropriate as the single means of detecting and tracking objects. Color histogram based technique is used to detect and track vehicle pedestrains in real time. In gaussian mixture model[14] is created within the sequence of images to describe the color distribution.then segment the image into background and objects. Occlusion buffer is used to handle object occlusions.

V. OBJECT TRACKING METHODS

Tracking is the problem of approximating the path of object in a image plane as it moves around a scene. The aim of an object tracker is to the object trajectory over time by locating its position in every frame. As described in [5], tracking methods can be divided into following categories:

A. Point tracking

Moving objects are detected in consecutive frames are represented by feature points. The associations of points are based on previous object. Point tracking is complex problem particularly in the false detection of object and occlusion. Point tracking techniques include kalman filter,particle filter and multiple hypothesis tracking. Kalman filter[9] are based on optimal recursive data processing algorithm and also known as linear quadratic estimation. Particle filter based trackers maintains a probability distribution over the state of object being tracked[5]. It usually uses contours,color features or texture mapping. Multiple hypothesis tracking is an iterative algorithm capable of tracking multiple objects, handles occlusion and calculating of optimal solutions.

B. Kernel based tracking

Kernel tracking is typically[10] performed y computing the motion of object, which is represented by a primitive object region, frame one to next frame. The motion of object is usually in the form of parametric motion such as translation, conformal, affine etc. kernel based tracking techniques are largely used based on representation of objects, objects features, appearance and shape of object. But one of the restriction is that sometimes the part of object left outside of the defined object while some of the portion of background left inside. Kernel based tracking is divided into simple template matching, mean shift method, support vector machine, layering based tracking.

C. Silhouette based taracking

Any objects have complex shapes like hands, head and shoulders that cannot be well described by geomrtric shapes. Silhouette based methods provide in accurate shape for these objects. This method [10] aimed at finding the object region in every frameby means of object model generated by the previous frames. This model can be in the form of color histogram, object contour or object edges. It can be divided into two categories namely shape matcching and contour tracking.

VI. CONCLUSION

This paper presents an extensive survey on various phases of object tracking system i.e. object detection, classification and tracking. Different methods of object tracking like point based, silhouette based and kernel based tracking methods has been discussed. These techniques are able to detect an object in shadow regions, occlusions, abrupt changesin tha trajectories, multimodality background etc. advace study can be carried out by researchers to ffind efficient algorithm to reduce complexity, computational cost and to decrease the time required for object tracking through videos containing diversified characteristics.

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