A REVIEW ON PROBABILITY BASED TECHNIQUES FOR EFFICIENT OBJECT TRACKING FROM VIDEOS

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Abstract:

The object tracking is a technique which is used to track object from the image or from the video, The video consist of multiple frames and in each frame location of that object had been predicted 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. In this paper, methods for object detection, classification and tracking are discussed. In this paper, an overview of techniques to track single as well as multiple objects are discussed.

Keywords - Multiple object tracking ,Object classification, Object detection, Single object tracking

I. INTRODUCTION

Object tracking refers to the tracking of path of an object or multiple objects in the image plane as it moves around a scene. After object detection the detected object is tracked by using approaches like point tracking, kernel tracking or silhouette tracking**.** 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 main steps in object tracking are detection and classification of object. From number of images object detection detects real world objects and then track their exact location with precision [1]. Then classification of an object is done and put them in different categories by classifying them. Time and space variations in images helps in tracking of object like Red light violations on roads considers timely changes. Large number of views of multiple objects makes tracking of multiple objects bit difficult and complex. In algorithms for analysis of high level scenes, tracking of object is preceding step for these analysis.

II. OBJECT DETECTION

Tracking methods requires detection mechanism for identifying and Clustering of pixels of object of interest in video is done during detection of an object. Many techniques are used for object detection and some object detection techniques are:

Fig.1.1. Object detection [1]

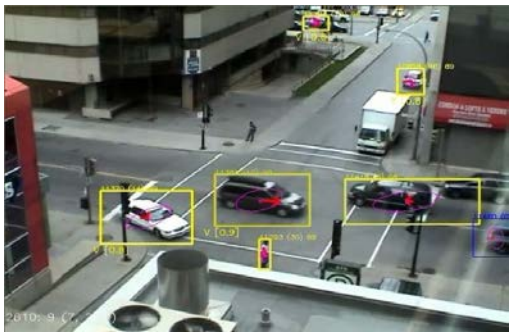

Fig.1.2. Object detection [1]

Frame differencing: Frame differencing method gives difference between two consecutive images which tells us the existence of moving object. Frame differencing method gives approximation of location of an object. The calculations used in this method are uncomplicated and its implementation is effortless. This method is robust and adaptable but demanding for complete detailed outline of moving object. So the detection of moving object is not so accurate in results [2].

Optical Flow: Optical flow method obtains the pattern of apparent motion of an object and its surfaces between an observer and the image scene. This method calculates the image optical flow field and performs clustering process according to optical flow distribution characteristics of image. It gives complete information about movements of object and detection of moving object is done from background and with more accuracy. Includes large number of calculations, sensitive to noise, poor anti noise performance and is not suitable for real-time applications [2].

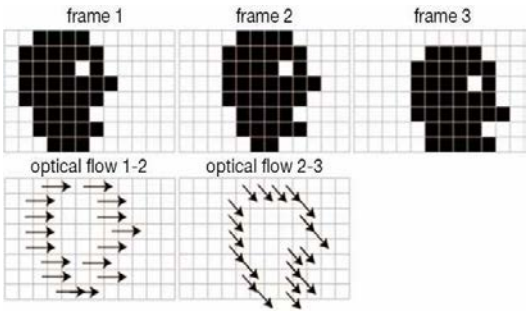

Fig.1.3. Optical flow [3]

Background subtraction: Background subtraction or foreground detection method extracts foreground objects in a particular scene like if an animal is walking in front of some moving object, the animal forms the foreground object while moving object having motion are considered as background. Sometimes distance of the moving object forms a basis to make it as a background.

Fig.1.4. Background subtraction [3]

III. OBJECT CLASSIFICATION

Object can be classified as vehicles, birds and many other objects. Classification of an object is mainly done on the basis of colour, motion, shape and texture. Some of the object classification methods are:

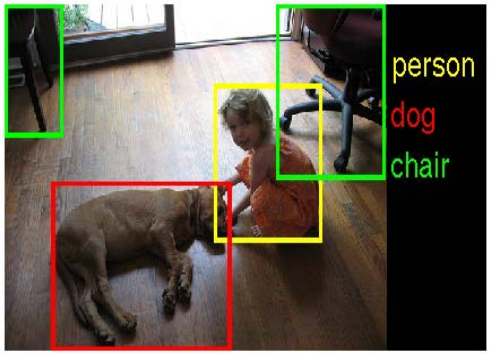

Fig.1.5. Object classification [3]

Shape-based classification [3]: Information of motion regions was given by different descriptions of shape and many shapes are available for classifying moving objects. Input features to shape based method is a mixture of image and scene features like image blob area and apparent aspect ratio of blob bounding box. Histograms are used for representing results.

Motion-based classification [3]: Non rigid objects have periodic motion, so this has been used as a strong cue for moving object classification. Residual flow is less in rigid objects as compared to non rigid objects.

Colour-based classification [3]: Under viewpoint changes, the thing that remains always constant is colour. Colour is not at all good feature for classification and detection of an object but due to its low expenses colour is also considered for classification and detection. Coloured histograms are used in this method.

Texture-based classification [3]: Texture based classification contains the information about the structural arrangement. This type of classification provides a very useful information as discriminating features are considered when calculating for texture.

IV. OBJECT TRACKING

Tracks the path of an object or multiple objects in the image plane according to its movements around a scene .After object detection the detected object is tracked by using approaches like point tracking, kernel tracking or silhouette tracking**.** 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.

a) POINT TRACKING [4]

During tracking of an object, Feature points are used for representation of moving objects. Identification of feature points is done and then by using threshold, object is tracked. As the time of point tracker algorithm increases, lighting variation also get increased. Points can be lost due to high lighting variation. For tracking of object for longer time, it is necessary to reacquire points periodically. Some of the methods of point tracking are given below:

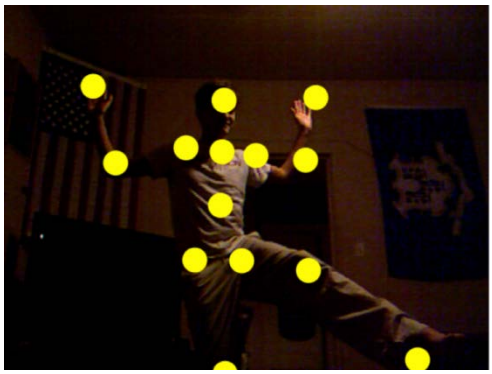

Fig.1.6. Point tracking [4]

Kalman Filter [4]: Kalman filter are mathematical equations that provides a computational means to estimate the state of an object in several aspects. It supports estimations of past, present and future states and it can perform similar even when the precise nature of the system is unknown. A Kalman filter is also referred as optimal estimator which infers parameters of interest from indirect observations. Feedback control is used for estimation in kalman filter.

Particle Filter [4]: Probability based distributions are used in particle filter. Probability based distribution of weighted samples helps in finding the exact location of particle. Each particle represents a guess of location of an object. Particles with less weight have less chances of representing exact location of an object. Probability distributions for finding location of object are done using equations. Particle with the highest weighted mean is taken for the correct estimation of location of an object.

b) KERNEL BASED TRACKING [4]

In this method, Computing of object region from one frame to next frame is done. Parametric motions like rotation, translation represents the motion of an object. Geometric shapes like cube used for real time illustration. Based on shape and appearance, there are many kernel based techniques. Some methods for kernel tracking are given below.

Template Matching: Template matching refers to finding region of interest considered as template in video. In this method, a reference image is selected and then this reference image is matched with the image frames. Part of image frame that matches with the reference image or

which is similar to that of the reference image is considered as the best match Image template is matched with all the possible positions and the one which is equivalent is considered.

Mean Shift Method: In this method, Confidence map is used which is made from the histogram of the previous image. Determine peak of confidence map with respect to old position of the object. Confidence map is defined as probability density function of image frame in which each pixel has its probability that is pixel color which is similar to object in previous image.

c) LAYERING BASED TRACKING

In this method, multiple object tracking is done by layering based technique. Layers are represented by the shapes. Layering based technique is based on kernel based tracking in which computing of object region from one frame to next frame is done. Parametric motions like rotation, translation represents the motion of an object. Geometric shapes like cube, rectangle are used for real time illustration.

d) SILHOUETTE BASED TRACKING [4]

Complex shapes of objects that are not being able to be represented by geometric shapes are very easily described with the help of this method. This method gives correct description of shapes of object. It deals with division of image into uniform regions and also handles occlusions. Some methods of silhouette tracking are given below:

Contour Tracking: This method iteratively progress a primary contour in the previous frame to its new position in the current frame. Contour progress requires the certain amount of object in the current frame. The approach directly evolves the contour by minimizing gradient descent.

Shape Matching: Shape matching is just another name for template based tracking .This method finds region of interest considered as template in video. Reference image is selected and then this reference image is matched with the image frames. Part of image frame that matches with the reference image or which is similar to that of the reference image is considered as the best match .Image template is matched with all the possible positions and the one which is equivalent is considered. Numerical index helps in finding the exact position. Working of shape matching is similar to that of template based tracking.

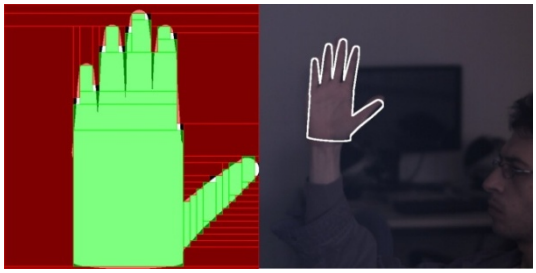

Fig.1.7. Shape matching [4]

SOME STUDIES ON OBJECT TRACKING FROM VIDEOS

Parekh *et al.*, 2014 presented a brief survey of algorithms for detection, classification and tracking of an object available in the literature including analysis and comparative study of methods which are mainly used for tracking of an object. Many limitations were highlighted in each and every technique. Some methods for 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.

Khandar and kharsan, 2014 proposed an algorithm to track an object, moving with an unknown trajectory within the camera's field of view. To achieve this Kalman Filter (KF) was used for tracking and estimation because of its simplicity, optimality, tractability and robustness.

Catak, 2014 proposed object tracking method which is probabilistic and uses condensation algorithm. Particle filter based algorithm which is used to track natural as well as synthetic frames. Firstly, the efficiency of the developed method has been checked against synthetic video frames. Thereafter, single and multi objects scenarios have been examined on natural video frames. The colour 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.

Ramirez and Chouikha, 2013 proposed a novel algorithm for object tracking of videos in which successive frames are subtracted and direction of object which is being tracked is predicted. Analysis of changing areas generated as result of the object's motion helps in object tracking mainly in regions of interest for current as well as for next frame. This moving region was displaced in the direction of the motion of object predicted during subtraction of successive frames.

Yilmaz *et al.*, 2016 analyzed the state of the art tracking methods, classified them into different categories and identified new trends .This method is preferred for high level applications. Appearance changes, Occlusions and many other problems exist in high level applications. Tracking is mainly preferred in high level applications that require location and shape of object in every frame. In this research, they categorized the tracking methods on the basis of object and motion representations which gives details about the methods and examined their advantages and disadvantages.

Lipton and Patil, 1998 proposed the algorithm in which both temporal differencing and template matching is possible. By combining these two, this algorithm works. Motion detection detects the regions of motion under the template differencing which is difference between the

current and previous frame and higher than a specified threshold. Each region of motion is cluttered into the object. Motion regions were recognized by motion detection using temporal differencing. Each object is classified and which becomes the template and tracks the object in next frame.

CONCLUDING REMARKS

The object tracking is the technique which is used to track object from the image or from the video. Various techniques and parameters for object classification, detection and tracking are discussed in this paper. Some studies done on object tracking from videos by various researchers is also discussed. Some investigation will be carried out by applying probability based techniques for efficient object tracking from videos in future.

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