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Illumination Condition Effect on Object Tracking: A Review

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Abstract

Illumination is an important concept in computer science application. A good tracker should perform well in a large number of videos involving illumination changes, occlusion, clutter, camera motion, low contrast, specularities and at least six more aspects. By using the review approach, our tracker is able to adapt to irregular illumination variations and abrupt changes of brightness. In static environment segmentation of object is not complex. In dynamic environment due to dynamic environmental conditions such as waving tree branches, shadows and illumination changes in the wind object segmentation is a difficult and major problem that needs to be handled well for a robust surveillance system. In this paper, we survey various tracking algorithms under changing lighting condition.

Index terms— object detection, object tracking, point tracking, kernel tracking, and silhouette tracking.

1 Introduction

ariation in the visualation of an object mostly arises due to changes in illumination and pose [2]. However, existing approaches has limitations on illumination conditions and objects [1] [3], or are computationally intense due to iterative optimization procedures used for obtaining the solution [4]. Moving Object detecting and tracking are very important in any vision based surveillance system. There are Various approaches to object detection have been proposed for surveillance, including feature-based object detection, template-based object detection and background subtraction [6] or inter-frame difference-based detection .Most algorithms for object detection and tracking are designed for daytime visual surveillance [5].

Every object tracking method should have an object detection mechanism either in each frame or when the object first time appears in the video. A most of approach for object detection is to use information in a single frame. However, some of object detection methods make use of the temporal information computed from a of frames sequence to reduce the false detections in video frames. This temporal information is usually in the form of frame differencing, which shows information in form of changing regions in consecutive frames. [7] Tracking involves registering the movements of the segmented object from initial frame to the last frame in a video.

The goal of this paper is estimation for improved object tracking and recognition. Object tracking algorithm can be categorized into three steps shown in Fig. 1 [8]. These are point tracking, kernel tracking and silhouette tracking [8]. In point tracking, detected object in consecutive frames are represented by a set of points and kalman filter is widely used in the point based feature tracking [9]. Point tracking is complicated in the presence of occlusion, entries and exists of an object. Kernel tracking is associate with the object shape and appearance. These algorithms differ from the others based on the method used to estimate the object motion and the numbers of the objects tracked [8]. Kernel based object tracking is usually represented with rectangular or elliptical shape of kernel. Silhouette tracking methods provide an accurate shape of the objects [9], where object boundary shows sharp changes in image intensities. Advantages of the silhouettes are their flexibility to recognize and handle a variety of object shapes.

The object tracking also defined as a serial process of object representation, feature selection, object detection and object tracking. [43] [8] The object can be defined as a set of points or single point. Object is represented as primitive geometric shapes like circle, ellipse, rectangle , object contour, object silhouette, skeletal model,

articulated shape models, etc. The combined defined with the appearance representations for tracking purpose. Most of appearance representations are probability densities of object appearance, active appearance model, multiview appearance model and templates. In feature selection is another most important steps in object tracking. Some of the commonly used features are edges, gradient, texture, color, optical flow etc. Every object tracking method requires an object detection mechanism in every frame. Some commonly used object detection methods are: point detectors, segmentation, background subtraction etc. After object detection the tracker's task is to detect and generate the object trajectory over time by locating object position in each frame of the video.

Object tracking can be complex due to the loss of information, complex object motion/shapes, noise in the image, illumination changes into scene and partial occulation object. Kernel tracking is associate with the object shape and appearance. These algorithms differ from the others based on the algorithm used to estimate the object motion and the numbers of the objects tracked [8]. Kernel based object tracking is usually represented with rectangular or elliptical shape of kernel. Silhouette tracking methods provide an accurate shape of the objects [9], where object boundary shows sharp changes in image intensities. Advantages of the silhouettes are their flexibility to handle a variety of object shapes. Object tracking can be complex due to the loss of information, complex object motion/shapes, noise in the image, illumination changes into scene and partial and full occlusion into scene [8]. Illumination is an important concept in visual arts. Illumination problem is defined as the degree of visibility of the object or change in appearance of the object with different lighting condition [10]. The placement of the light sources can make a difference in the type of any object that is being presented. Multiple light source can produces the illumination effect. Another major challenge is the occlusion effect. It is also defined as hidden (occluded) object. In dynamic scenes, the moving objects exhibit many spatial configurations relative to other objects. A relative depth ordering on the objects and the scene background structures is imposed along the lines of sight when observed from a view point. Such a depth ordering leads to the partial or complete viewing obstruction of some of the object of interest by others and the phenomenon is also known as occlusion [11].

II.

2 Relate Work

Illumination effect on object tracking has been the major challenge till date and various researchers have proposed the effective algorithms for the same.

There are several techniques that attempt to pre-compensate for illumination variations between frames caused by changes in the strength or position of light sources in the scene. Some of the earliest attempts to deal with illumination changes used intensity normalization [32][33][34], Most of the algorithms handle luminance intensity, which is one scalar value per each pixel [35][36][37][38][39][40][41].

Few reviews exist for surveying the performance of application independent trackers. The work of 2006 of Yilmaz et al. [8] still provides a good frame of reference for reviewing the literature, describing methodologies on tracking, features and data association for general purposes.

Fuat corun and A. Enis Cetin have proposed method using 2D-Cepstrum characteristics method for object tracking under illumination variations of the target. They also explain object tracking algorithm bsed on the co-difference and covariance matrix based [12].The covariance of feature vectors describing the target is called covariance matrix [13]. Co-difference tracking method describes the co-difference matrix to model the moving objects or target. In these two methods, the aim is to assign this region as the moving target and find the region in a given Image frame having the minimum distance from the target matrix at that frame. The first stage of these algorithms is to find the feature images and vectors and then co-variance matrix and codifference matrix is finding out by using the feature vectors. After first stage, to estimate the distance matrix and target location of the object. This operation is repeated for each frame. Then this algorithm is analyzed by using 2DCepstrum [14] analysis. 2D-Cepstrum is an amplitude invariant feature extraction method. So, cepstrum domain coefficient of a region remains unchanged under the light intensity variations. This property of cestrum provides robustness to illumination variation at the target region.

Co-difference method is applied to video.it is applied to video sequence in which the intensity of the target region varies and experimentally this method provides better result than the ordinary covariance tracking method.

Ashwani Kumar et al., have proposed method to improvement in colour based a moving object tracking for corporate world and employed. The parameter of object consideration are object position, speed, size, object size scale and the appearance effect of the object. The target parameter update based on condition to the perfect tracking of an object [15]. This method is used for non-rigid deformation of targets, partial occlusion and cluttered background. Disadvantage of this method is that it does not consider colour histogram in target regions.

Zhou Dan et al., have proposed method based on surf for higher tolerance of illumination changes, which help in outdoor object tracking [16].this method is robust for difficult and complex environments. Rama Chellappa et al. have proposed a method for object detection and tracking using multiple smart cameras [18]. They use the method of background modelling (background Subtraction) for moving object detection and tracking. In this study, a test image can be subtracted from the template and pixel with large difference can be marked as moving objects. Gaussian distribution functions are used to remove the global changes into the scene such as illumination or camera jitter. Also, the mixer of Gaussian (MOG) model handles periodic background disturbance and can be

used to keep the tack of global changes in the scene. This will reduce the effects of illumination into the Scene. Multiple smart cameras are arranged in the proper direction and the numbers of cameras are connected in the distributed network. In detection and tracking, ground place can be used as a strong constraint for designing efficient and robust estimators for moving objects.

The algorithms are optimized for sensor networks that contain a small number of cameras. The geometric constraints induced by the imaging devices to derive distributed algorithms for target detection, tracking and recognition which are efficiently used.

Object detection and tracking under changing lighting (illumination) conditions studied by Wagas Hassan et al. [19] is based on orientation of the edge. Tracking based on the energy or magnitude of the edges can also suffer from changes in illumination. A change in illumination can causes the magnitude of an edge to change which can result in false tracking outputs. In this paper, author has considered adaptive edge orientation based technique. Adaptive edge orientation method considers the orientation of the edge rather than the intensity and there is no dependency on colour features. Such method will gives the better results where lighting is not consistent.

Under lighting Conditions, edges are more stable than both edge magnitude and colour. This algorithm is also applied to the highly variable lighting video sequence and provides the better results.

Francois Bardet et al., have proposed a method for illumination invariance where multi-objects are jointly tracked through a Markov chain Monte-carlo Particle Filter (MCMC PF) [20]. To allow the object to enter or leave the scene khan et al. [21] extended their Markov chain Monte-Carlo particle Filter (MCMC PF) method to track the variable number of objects. This extended method is reversible Jump Markov Chain Monte-carlo (RJ MCMC) [25] sampler. Reversible Jump Markov chain Monte-Carlo Particle Filter has become a popular algorithm for real-time tracking. RJMCMCPF samplers allow the object classification as well as detect the object shapes. An experiment has been performed by the authors on pedestrian tracking and highway vehicle tracking. In pedestrian tracking, more than ten objects are tracked under variable sunlight condition. Also, highway vehicles are tracked and classify simultaneously with time evolving sunlight.

RJ MCMC PF sampler algorithm overcomes the problem of Isard et al. [24]. They have proposed a method using SIRPF (Sequential Importance Resampling Particle Filter) and a Monocular multi-Object Tracker (MOT) which has the limitation of tracking the maximum three objects.

Online tracking methods under the various outdoor lighting variations with moving cameras are studied by Yanli Liu and Xavier Granier [22]. To design the algorithm, they have assumed a strong correlation in lighting over large spatial and temporal extents. With such an assumption, they combine the information of previous frame with the current frame for estimating the relative variations of sunlight and skylight. Sunlight and skylight are estimated via a sparse set of planar featurepoints extracted from each frame. The most of algorithm achieves nearly real-time processing with an unoptimized Matlab implementation. This approach does not require any prior knowledge of 3D scene and works with moving view point. Also algorithm provides a user with an augmented reality experience with its general purpose camera. Without knowledge of lighting direction, algorithm cannot deal with indoor scenes.

Moving object tracking approach defined by Oksam Chae et al. [45] is based on the parametric edge of the object. Image information lies on the edge of different objects. Edge information is less sensitive to noise and is more consistent than the pixel values in the video sequence. Also edge-based methods show more robustness as compared to pixel intensity based methods and less sensitive to illumination variation than intensity features. Object boundary shows sharp changes in image intensities. Segment based edge pixels representation is fast compare to all the pixels in the image. This representation helps to incorporate a fast, efficient and flexible edge tracking algorithm. Tianzhu Zhang et al. have proposed a robust visual tracking algorithm using multi-task sparse learning [26]. This algorithm handles the particles (target Candidates) [27] independently. First stage of this algorithm given by the authors is to define or formulate the object tracking in particle filter framework as a multitask tracking. They have also uses the particle filter to track the target object. Then the particles are randomly sampled according to Gaussian distribution. These particles are represented as a linear combination of updated dictionary template. As particles are densely sampled around the target stage, their representation will be sparse. This is more robust representation for particles. This convex optimization problem can be solving using accelerated proximal gradient method. This algorithm improves the tracking performance and overall computational complexity.

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4 Evaluation Parameter

Basic types of evaluation parameter used in object tracking for algorithm [7][8] [42][43]:

1. Deviation: the track's location deviated from the ground truth. 2. True positive: tracker identifies a target which is a target. 3. False positive: tracker identifies a target which is not a target 4. True negative: tracker not misses to identify and locate the target. 5. False negative: tracker misses to identify and locate the target.

IV.

5 Conclusions

In this paper, we present a literature survey of object tracking approaches and also give a brief review of related topics. We devides the basic approach in three categories such as point tracking, kernel tracking and silhouette tracking. Moreover, we describe the degree of applicability and qualitative comparison of the tracking algorithms.

After the literature survey, we came to the conclusion that in order to track object under illumination condition, the features extracted from frames must be invariant to illumination. We expect that this survey on moving object tracking in video with rich theoretical details of the tracking methods along with bibliography contents will give valuable contribution to research works on object tracking and encourage new research.

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Figure 1: Figure 1 :

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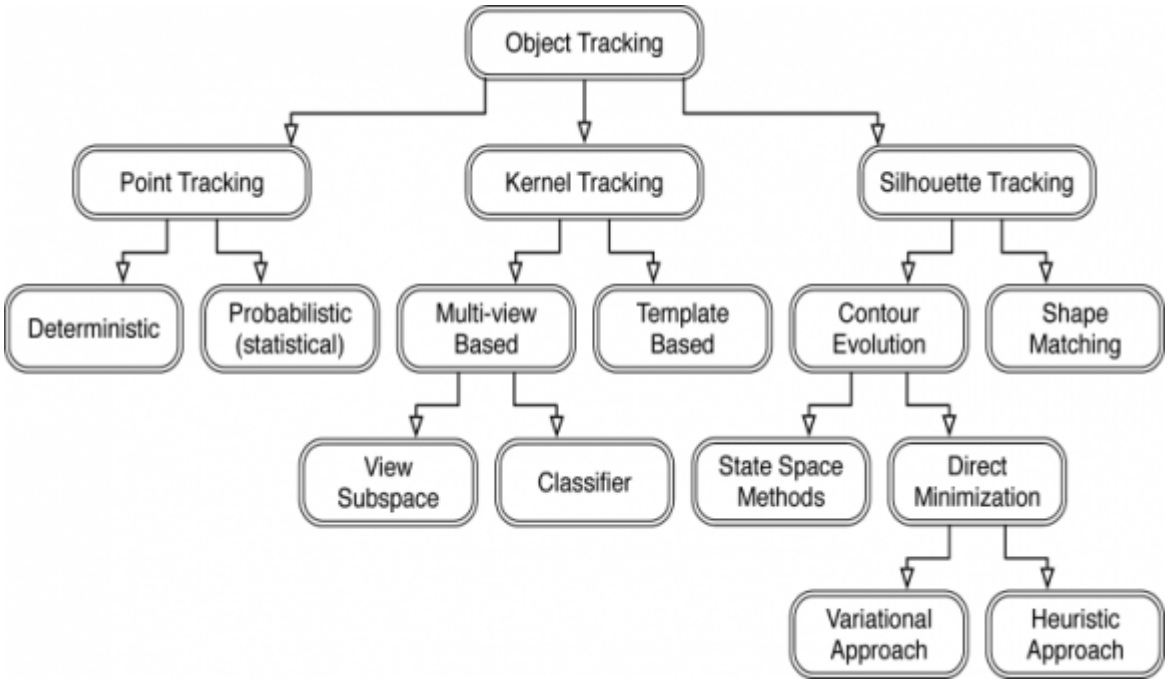
Object Tracking
Point Tracking
Kernel Tracking
Silhouette Tracking
Deterministic
Probabilistic (statistical)
Multi-view Based
Template Based
Contour Evolution
Shape Matching
View Subspace
Classifier
State Space Methods
Direct Minimization
Variational Approach
Heuristic Approach

Figure 2: F

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