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A Review of RealTime Object Detection and Tracking

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ABSTRACT

Object detection and tracking is one of the critical areas of research due to routine change in motion of object and variation in scene size, occlusions, appearance variations, and ego-motion and illumination changes. Specifically, feature selection is the vital role in object tracking. It is related to many real time applications like vehicle perception, video surveillance and so on. In order to overcome the issue of detection, tracking related to object movement and appearance. Most of the algorithm focuses on the tracking algorithm to smoothen the video sequence. On the other hand, few methods use the prior available information about object shape, color, texture and so on. Tracking algorithm which combines above stated parameters of objects is discussed and analyzed in this research. The goal of this paper is to analyze and review the previous approach towards object tracking and detection using video sequences through different phases. Also, identify the gap and suggest a new approach to improve the tracking of object over video frame.

Keywords : Object Tracking, Object Recognition, Statistical Analysis, Object Detection, Background Subtraction, Performance Analysis, Optical Flow

I. INTRODUCTION

Recently, there is an advance of miniaturization and lower the cost of cameras have preferred the implementation of large-scale networks of the camera. This increasing number of cameras could permit novel signal processing applications which employ multiple sensors in extensive areas. Object tracking is the novel procedure for discovering moving objects beyond time by utilizing the camera in video sequences. (Kothiya and Mistree, 2015). Their main aim is to relate the target objects as well as the shape or features, location of the objects in successive video sequences. Subsequently, the object classification and detection are essential for object tracking in computer vision application. Additionally, the tracking is the first step towards locating or detects the moving object in the frame. Followed by this, detected object could be divided as swaying tree, birds, human, and vehicles and so on. Though, in image processing approach object tracking using video sequences, is a challenging task. Furthermore, several issues appear ascribed to occlusion of the object to scene, object to object, complex object motion, real-time processing requirements as well as the improper shape of the object.

Subsequently, this tracking can be explained as the procedure of determining the orientation of object across the time as the object moves throughout a scene. This is posting importance in the arena of computer vision because of expansion of high- powered computers and the growing need for automated surveillance systems, and it is broadly applied for applications namely automated surveillance, robotics monitoring, human-machine interface, motion-based recognition, vehicle navigation, traffic monitoring and video indexing. A substantial number of such applications require reliable tracking methods which meet real-time restrictions and are challenging and complex with respect to changes of object movement, scale and appearance, illumination of scene and occlusion. The results of tracking could be impacted by the disparity of one among the parameters. In addition, moving objects tracking is one of the major tasks in computer vision and broadly applied in industrial vision, intelligent transport systems and visual surveillance. In the recent years, Video surveillance has widely adopted to monitor the security sensitive areas include highways, borders, department stores, banks and crowded public places. The development in computing power, the infrastructure of high-speed network and accessibility of

large-capacity storage devices cover the way for inexpensive, multi-sensor video surveillance systems. Keeping a track on the moving object is a critical task.

In this paper, to study as well as analyze the previous approach towards object tracking using video sequences through different phases.

Two key steps in video analysis are discussed as follows:Identification of targeted object in moving sequence and Object tracking based on one frame to another frame.

II. LITERATURE REVIEW

In the previous study most of them have concentrated towards Object detection (Najva and Bijoy, 2016; Ramya and Rajeswari, 2016; Risha and Kumar, 2016; Soundrapandiyan and Mouli, 2015; Viswanath et al., 2015) ,Object tracking (Weng et al., 2013; Zhang et al., 2016) and Object recognition (Chakravarthy et al., 2015; Nair et al., 2011) for tracking the object using video sequences. These are discussed as follows. The basic flow diagram of an object tracking shown in figure 1.

Figure 1. Basic flow diagram of object tracking

A. Studies related to object detection

The detection of an object in video sequence plays a significant role in many applications. Specifically as video surveillance applications (Amandeep and Goyal, 2015). The different types of object detection are shown in figure 2.

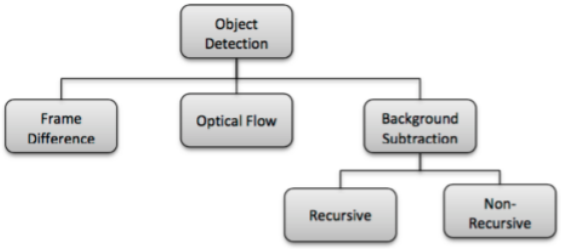

Figure 2. Types of Object detection method

The previous studies related to object detection is discussed as follows:

Viswanath et al. (2015) suggested and modeled the approach using non-panoramic background modeling. By the use of this approach, they modeled the entire picture element with one Spatio-temporal Gaussian. The simulations result shows this method able to identify the moving substances with fewer false alarms. However, this method fails once the adequate features are not obtainable from the section.

Soundrapandiyan and Mouli (2015) suggested a novel and adaptive method for pedestrian detection. Further, they separated the foreground objects from the background by image pixel intensities. Subsequently, they used high boost filter for enhancing the foreground edges. The efficacy of the proposed method is evident from the subject evaluation results as well as objective evaluation with around 90% of pedestrian's detection rate compared to the other single image existing methods. In future, they planned to improve the performance of the method with higher detection rate and low false positives on par with sequence image methods.

Ramya and Rajeswari (2016) suggested a modified frame difference method which uses the correlation between blocks of current image and background image to categorize the pixels as foreground and background. The blocks in the current image which are highly correlated with the background image are considered as background. For the other block, the pixel-wise comparison is made to categorize it as foreground or background. The experiments conducted proved this approach improves the frame difference method particularly as finding accuracy with speed. However, this study needs to focus towards other information available in the blocks such as shape and edge can be used to improve the detection accuracy.

Risha and Kumar (2016) suggested an optic flow with the morphological operation for object detection in video. Further applied morphological operation towardsobtaining clear moving target image. This study only concentrated on static camera. So need to focus on moving the camera as well as identify multiple objects in video frames.

TABLE I. COMPARATIVE STUDY OF OBJECT DETECTION TECHNIQUE

Object Detection Method	Basic Principle	Computational Time	Accuracy
Temporal Differencing	Pixel-wise Subtraction of Current & Background frame	Low	High
Background Subtraction	Current frame is subtracted from background frame	Low to Moderate	Moderate to High
Mixture of Gaussian	Based on multimodal distribution	Moderate to high	Moderate to high
Optical Flow	Uses optical flow distribution characteristics of pixels of object	Moderateto high	High

Najva and Bijoy (2016) proposed a model for detection and classification of objects in videos by combining Tensor features with SIFT approach towards classifying the detected objects using Deep Neural Network(DNN). The DNN capable of handling large higher dimensional data with billions of parameters as like human brain. Simulation results obtained illustrate that the proposed classifier model produces more accurate results than the existing methods, which combines both SIFT and tensor features for feature extraction and DNN for classification.

B. Studies related to object tracking

The object tracking is the term which used to identify the moving object position as well as tracking them from video sequences (Balasubramanian et al., 2014). The tracking method is classified into three types such as kernel, point and silhouette based tracking. Compared to silhouette method, existing most of them have focused on kernel-based method due to high accuracy with less computational cost. However, the point tracking method has less computational cost with reduce in accuracy (Weng et al., 2013). The various types of object tracking techniques are shown in figure 3.

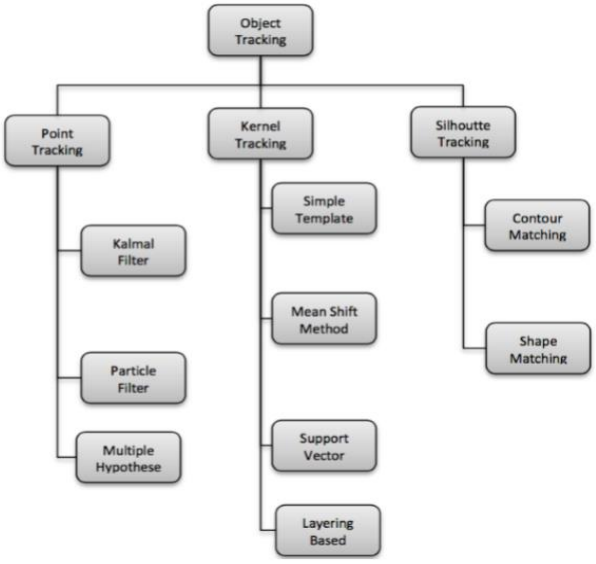

Figure 3. Types of Object Tracking approach

Weng et al. (2013) proposed an algorithm for improving the performance of natural feature selection in the real world. Further, they used to speed up robust features (SURF) for features extraction from live mobile camera image and recognition. These extracted features are calculated using pose matrix through Homography approach. The simulation result shows this algorithm tracked and recognized the object from natural features in easy, speedy with suitable way. However, its speed and accuracy need to be improved.

Zhang et al. (2016) proposed an approach by combining frame difference and non- parametric method for video analysis traceability. The simulation result proved

TABLE II. COMPARATIVE STUDY OF OBJECT TRACKING TECHNIQUE

Object tracking method		Algorithm used	Computational time	Accuracy
Point Tracking	Kalman Filter	Kalman filtering algorithm	Low to Moderate	Moderate
	Particle Filter	Recursive Bayes filtering	Moderate to High	High
	Multiple Hypothesis tracking	MHT algorithm	Low	Low to Moderate
Kernel Tracking	Simple template matching	Matching region of interest in video	Low to Moderate	Low
	Mean shift method	Expression &,location object; optimal gradient decline	Low	Moderate
	Support vector Machine	Positive & negative training values	Moderate	Moderate
	Layering based tracking	Shape representation using intensity	Moderate	Moderate to High
Silhouette tracking	Contour matching	Gradient Descent Algorithm	Moderate	Moderate to High
	Shape matching	Hough Transform	High	High

this approach performance was better than the traditional frame difference and GMM. Further, it can able to remove the noise from a background which gives us the ability to detect the moving object more precisely in the applications such as food and agriculture related product traceability analysis. However, this study needs to enhance the capability of traceability system and supply the visual supply chain for the common user to ensure the safety.

Oiwa et al. (2016) suggested probabilistic background model towards tracking the object from video sequences. The simulation results show the accuracy and effectiveness of this method high compared to previous technique. However, this study needs to concentrate on higher speed as well as improve the accuracy of object tracking.

Aggarwal et al. (2006) suggested a novel technique which was the combination of motion estimation and background subtraction for object tracking using video sequences. The system mainly focused on four scenarios such as interpolation, identify the object, subtract the background and object selection. However, this study needs to focus more towards full occlusions of video sequences, multiple object tracking, fast camera motion and unsupervised object tracking.

C. Studies related to object recognition

Zhang and Jiang (2014) suggested regression based kernel technique on behalf of identifying multiview objects as well as approximating their poses. The simulation results proved obtained results are improved recognition, while comparative analyses with state-of-the-arts. Further, they authenticated the robustness and efficiency of this approach. However, the existing research needs to focus more attention on resolving issues of object space recognition

TABLE III. COMPARATIVE STUDY OF OBJECT CLASSIFICATION TECHNIQUE

Object Classification Method	Computational time	Accuracy
Shape Based	Low	Moderate to High
Motion Based	High	Moderate
Color based	High	High
Texture Based	High	High

Chakravarthy et al. (2015) suggested and estimated a technique for video sequence stream processing. Further, they demonstrated the various types of situations which were based on arable and relational illustrations. However, this study fails to express complex situations. So, needs to focus towards accepting feature vectors as well as bounding boxes towards identifying the temporal and spatial computations.

III. RESULTS AND DISCUSSION

Soundrapandiyan and Mouli (2015) suggested a method for improving the performance with higher detection rate and low false positives on par with sequence image methods. Ramya and Rajeswari (2016) suggested a modified frame difference method which uses the correlation between blocks of current image and background image to categorize the pixels as foreground and background. However, this study needs to focus towards other information available in the blocks such as shape and edge can be used to improve the detection accuracy.

Weng et al. (2013) enhanced the performance of tracking for real-world objects using naturally formulated approach. However, its speed and accuracy need to be improved through replacing SURF algorithm with the different computationally efficient algorithm. Zhang et al. (2016) developed a novel algorithm for improving video analysis traceability by combining frame difference and non-parametric techniques.

Many researchers have concentrated namely on Particle filter, Mean shift, and Kalman filter. Several works have been proposed to combine the prospects of these trackers in order to achieve better results of tracking. One of the most explored objects tracking issues in computer vision is the handling of occlusion. Existing literature works have argued that occlusion handling is achieved through Particle filter, Kalman filter and Mean Shift tracking methods. Though the fusion of these methods is accurate, they are tested only on particular videos .

Visual tracking is facilitated by the least squares (LSs) criterion which is the use of Euclidean distance to calculate approximately tracking of sparse representation (Xue Mei and Haibin Ling, 2011). It is deemed that if Gaussian data distribution is involved,

then the performance of LS criterion is efficient. On the contrary, tracking issues imply different data representations which are categorized based on intensity, color (Collins et al., 2005), edge, and texture. Tracking performance could be improved significantly if different sources of information are considered since with these characteristics, tracking could be facilitated (Weifeng Liu and Dacheng Tao, 2013). Though multiple views are to be considered, another issue is the ways of integrating data representations and a model to examine independence and mutual dependence. Furthermore, outlier tasks also exist very often. Outlier tasks do not share the features that are common with the majority of tasks. Similarly, Xue Mei and Haibin Ling (2011) utilized the feature of intensity to model target's appearance change. The intensity appearance model with L1 minimization shares robustness towards partial OCC and other tracking issues (Xue Mei and Haibin Ling, 2011). Even though this developed model is sensitive to track non-rigid objects since shape deformation is more evident with these objects.

IV. CONCLUSION

In this paper, review on different object detection, tracking, recognition techniques, feature descriptors and segmentation method which is based on the video frame and various tracking technologies. This approach used towards increase the object detection with new ideas. Furthermore, tracking the object from the video frames with theoretical explanation is provided in bibliography content. The bibliography content is the most significant contribution of research since it will lead to a new area of research. We have identified and discussed the limitation/future scope of various methods. Also, we have noted some methods which give accuracy but have high computational complexity. Specifically, the statistical methods, background subtraction, temporal differencing with the optical flow was discussed. However, these technique needs to concentrate towards handling sudden illumination changes, darker shadows and object occlusions.

V. FUTURE SCOPE

Design and simulation of complex video sequence and test them using same tracking algorithm. In the potential scenario, occlusion is used for an object with the same color for the moving objects or else using bigger occlusion with longer occlusion time. Increasing the number of the object help to identify the efficiency and functionality of the tracking algorithm. Weight parameters are needed to be added for individual intensity levels of each pixel. In an image, if an intensity value is assigned as foreground based on the current frame then it has less probability that foreground also has similar pixel coordinate so that BG weightage for the pixel is set to the minimum than the initial value. Through adding weightage lower than the initial value provides the advantage of removing the old pixel value with least probability rather than the evolved scene. Need to focus towards enhancing the variance data of each channel based on the Mahalanobis distance calculation. By this, can able to adopt a change in the rapid scene through Euclidean distance algorithm.

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