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An Empiral Study and Discussions on Multiple Object Tracking: Current State of Art

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Abstract- Multiple Object Tracking (MOT) plays a vital role in image and video processing research area and in computer vision technology. There are several applications like video surveillance; traffic monitoring, robot navigation, security systems and object recognize systems. Multiple object tracking is also utilized to develop modern and successful software applications in video processing. Multiple object tracking can be obtained by recognizing the objects in video sequences (frames) and then linking across frames. Several linear and non-linear methods exist for multiple objects tracking in current state of art. Here some of existing linear and non-linear techniques for multiple object tracking are studied and discussed.

Keywords - *Multiple Object Tracking, Kalman Filter, Optical Flow, Background Subtraction, Gaussian Mixture Model.*

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I. INTRODUCTION

There is a lot of importance in tracking a moving object in computer vision in video frames. Videos are represented as a scene, shot and frame. A video shot can be defined as frames that consist of continuous action. The frames in video shots are captured by a camera in single operation. The complete video sequence is formed by combining two or more video frames which are input to the object tracking. The main goal of multiple object tracking is the process of segmenting the features of an object from video frames and tracks its motion and shape. Object tracking requires location and shape of the objects in video frames. So, object detection and object classification are preceding steps of object tracking.

Multiple object tracking (MOT) finds applications in providing better sense of security using visual information, in security and surveillance to understand humans, in medical therapy to enhance the quality of life of patients and disabled humans, to analyze shopping behaviour of customers in retail space instrumentation to enhance building and environment design, in video abstraction to gain computerized annotation of movies, to generate item primarily based summaries, traffic control to analyze glide, to come across injuries, video editing to remove bulky human operator interplay, to layout futuristic video effects.

In order to track objects, object detection is needed first. Background subtraction is commonly used for detecting moving objects especially when the background has not much changed. The most important issue in background subtraction is maintaining background [1]. In many cases, there are multiple objects to track. The motion-based object tracking can be partition into two fragments i.e., Moving object detection from one frame to another and Analysis of tracked objects and handling the occlusion. Tracking uniform movement was effortlessly done by commonly implemented background modeling, however of non-uniform movement was difficult. Background subtraction or foreground detection is the extraction technique or the detection of moving objects in recordings or static background. The majority of the motion of the image is uniform in nature and it could acquire the on track.

Researchers have an interest in tracking as it is a difficult problem and significant. To obtain a relationship among objects and object parts between consecutive frames of video is important in tracking [2]. It is the most critical task in image and video processing applications because it provides cohesive temporal data about objects that are moving which are used to improve lower level processing such as motion segmentation and to enable higher level data extraction such as behaviour recognition and activity analysis. Tracking had become a tedious task to apply in sophisticated problems when objects are improperly segmented. Some basic problems of erroneous segmentation are Long shadows, full and partial occlusion of objects with each other. At segmentation level and at tracking level dealing with shadows and occlusions is important in robust algorithm [3-15].

This paper is organized as follows: Current state of art is described in section II. Finally, the conclusions are highlighted in section III.

II. CURRENT STATE OF THE ART

A lot of work has been done on the field of multi-object tracking for many years. Here, the study of some of existed multiple object tracking techniques is exhibited and discussed.

Object tracking systems are commonly equipped towards reconnaissance application where it is fancied to screen individuals or vehicles moving around a territory. Object tracking has a great deal of use in this present reality. But it has many technological lacunas still exist in the methods of background subtraction. Horn and Schunck proposed a novel approach of optical flow to detect a single moving object in a video. In this work, correlation, gradient, and frequency information are utilized to detect an object is clarified. To meet the disadvantages of conventional methods, Optical flow based technique is proposed which functions with a minimal degree of person involvement. Factors identified at the outset of a video collection and within a small subset of frames spaced in the course of, can be routinely tracked even when they become occluded or undergo translational, rotational, or deformational motion [3].

The production of optical flow image using Horn & Schunck technique for finding the optimal parameters are done by combining parameters and the different types of displacements. Different types of displacements used are small, medium and large. Optical flow is generally carried out through utilizing a brightness constancy constraint equation (BCCE), which makes use of spatiotemporal derivatives of image intensity. Methods utilizing the BCCE are referred to as differential techniques. There are numerous extraordinary methods to estimate the optical flow, which may be divided into correlation, strength, segment, and differential based approach. The differential based technique of estimating optical flow, based on partial derivatives of the image signal and the sought flow field and higher-order partial derivatives, can be solve using Horn &Schunck method and Locus Kanade method [4].

In many of the previously developed tracking techniques, the first fundamental problem encountered is the object segmentation which extracts the areas (or objects) of interest from the scene. The extracted regions are used as measurements (observations) for tracking algorithms. These foreground segmentation techniques are typically computationally expensive because they operate over the whole image scene [5].

Hitesh A Patel proposed a method which is based on background subtraction and Kalman filter [6]. The particle filter [7] developed in multiple models for the object motion, and comprises an additional discrete state component, denoting which of the motion models are active. The Kalman filter (KF) is useful for tracking different types of moving items. It was initially concocted by Rudolf Kalman at NASA to track the direction of shuttle. The Kalman filter is a technique of combining noisy measurements and predictions of the state of an object to achieve an estimate of its true current state. Kalman filter can be applied to many unique varieties of linear dynamical systems seek advice from any measurable quantity, which includes an object's location, velocity, temperature, voltage [8], or a combination of these.

Kalman Filter recursively appraises the condition of the objective target objects. Kalman filtering is inconceivably utilized as a part of various areas such as object tracking, economics, and navigation systems. Kalman filter is utilized to estimate the state of a linear system where the state is thought to be distributed by a Gaussian. Kalman filter offered an object predicting so as to track the object position from the past data and confirms the anticipated position and verifies the predicted position of the object's presence. Kalman filter is made out of two stages which are the prediction and correction [12-16].

Gaussian Mixture Model (GMM) is a background subtraction procedure that monitors objects in uniform or non-uniform movement. After the extraction of an object from the closer view of an image, object limitation made utilization of this procedure.

In object detection using GMM, a parametric model of probability density function was utilized for object detection. That model is coined as Gaussian Mixture Model (GMM). This model is represented in following way: GMM is equal to the weighted summation of the so-called Gaussian component densities. This GMM can be used as the background model. To get the anticipated outcome pixels of the frame are removed from the necessary video. This background subtraction includes different issues that implicit emerging an algorithm that can use in recognizing the object. Moreover, it could be capable in responding to different alterations like moving and halt of motion objects and illumination. Temporal or spatial smoothing will be applicable at early stages of pre-processing to eradicate noise in the device. This noise could be an issue under the various intensities of light. Smoothing technique involves deleting different elements of an environment such as rain and snow. In real time systems, to minimize the data rates for processing, frame rate and frame size are generally used [14-17].

The combination of Principle Component Analysis and Gaussian Mixture Model (PCA-GMM) is an adaptive mixture of the Gaussian method, in which the pixel processes as time series such that each pixel assumed to be an independent statistical methods, consists of all pixel observations. The GMM does not distinguish components that correspond to background from those associated with foreground objects and record the discovered intensity at each pixel over the preceding N frames. The segmentation of moving objects generated by PCA-GMM performed relatively better than the traditional GMM. This development in overall performance is based on the subsequent: for the reason that GMM portions, the foreground from the background classification for each frame sequence, where the background model can be updated using sufficient statistics and all the estimated parameter can be received proficiently. But, while the foreground is not available or may be changed due to critical situations like illumination changes or it has been removed from the scene, then the GMM needs to consider such situations. The PCA-GMM is an augmentation to GMM which considers these limitations [21].The PCA-GMM which incorporates PCA with GMM produces exact and clear components of the shape in the scenes and gives good categorization of the object. The tracking of moving object is then applying to Kalman filter (KF) on this integrated method.

The PCA-GMM-KF method is a linear system where the state is assumed to be Gaussian disseminated. This filter out no longer best gives an efficient computational method computational solution to sequential systems but also provides an optimal solution for linear filtering problem with discrete data. In this method motion of an object in the video, sequences are observed and allow prediction of an image at any instant based on their previous trajectories because the state of the moving object changes little in the neighboring consecutive frames. If the model of the system is linear Gaussian, Kalman filter provides position of object, speed and dimension of the target respectively [22].

In Extended Kalman Filter (EKF), Kalman filter addresses the general problem of trying to estimate the state of a discrete-time controlled process that is governed by a linear stochastic distinction condition. However, what takes place if the technique to be predicted and or the measurement relationship to the process are non-linear? A number of the most interesting and successful applications of Kalman filtering had been such situations. A Kalman filter that linearizes about the current mean and covariance is referred to as an Extended Kalman Filter (EKF). Taylor series and the partial derivatives of the process used to linearize the estimation around the current estimate and measurement functions to compute estimates even in the face of non-linear relationships [19-22]. EKF utilize past and color information for tracking multiple objects under high occlusion.

III.CONCLUSION

This paper presents a review of multiple object tracking. The existed multiple object tracking methods have been studied and discussed. Among all those methods, Kalman filter and Extended Kalman filters are widely used due to their accuracy and also give optimal solutions under high occlusion in multiple object tracking problems. Along with that, it is also clear that the new dimensions in the usage of multiple object tracking and invention of new mechanisms give a greater scope for research in multiple object tracking. It can also be noticed that large scope with above-cited techniques for development robust, secure and flexible technology. By seeing the growing fame of multiple objects tracking, possibilities of developing methodologies are very high, which would improve the performance in all the aspects in an efficient manner.

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