HYBRID METHOD FOR MOVING OBJECT TRACKING WITHIN A VIDEO SEQUENCE & OCCLUSION HANDLING

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ABSTRACT

This paper presents a implementation of an object tracking system in a video sequence. The tracking system uses a combination of camshift and kalman filter algorithm. The main steps in video analysis are two: detection interesting moving objects and tracking of such objects from frame to frame. Most of the tracking algorithms use pre-specified methods for processing .The main problem in tracking a moving object is occlusion. Proposed method gives better performance in case of occlusion, by using a combination of camshift and kalman filter algorithm. When the moving object is a large area blocked, the velocity of moving object is applied linear prediction to kalman filter tracking. Also in the case where the camera is moving, we can quickly find the target by using this tracking system.

Keywords: Camshift, Kalman Filter, Tracking System, Occlusion

I. INTRODUCTION

Object tracking is an important task within the field of computer vision. The proliferation of high-powered computers, the availability of high quality and inexpensive video cameras, and the increasing need for automated video analysis has generated a great deal of interest in object tracking algorithms [1].The object tracking (person, face, hand, glass, and car) is widely used in the tasks of automobile driver assistance, vehicle navigation, robotics, human-computer interaction, video surveillance, biometric, video games and industrial automation and security. Most of these applications require reliable object tracking techniques. In a tracking scenario, an object can be defined as anything that is of interest for further analysis. For instance, boats on the sea, fish inside an aquarium, vehicles on a road, planes in the air, people walking on a road, or bubbles in the water are a set of objects that may be important to track in a specific domain [5]. In its simplest form, tracking can be defined as "the problem of estimating the trajectory of an object in the image plane as it moves around a scene". In other words, a tracker assigns consistent labels to the tracked objects in different frames of a video. Additionally, depending on the tracking domain, a tracker can also provide object-centric information, such as orientation, area, or shape of an object.

One can simplify tracking by imposing constraints on the motion or appearance of objects. For example, almost all tracking algorithms assume that the object motion is smooth with no abrupt changes [9]. One can further constrain the object motion to be of constant velocity or constant acceleration based on a priori information. Prior knowledge about the number and the size of objects, or the object appearance and shape, can also be used to simplify the problem.

There are a lot of object tracking methods available which has advantages along with their disadvantages. Depending upon our application requirements we can use them for object tracking. "Meanshift algorithm" with quickly matching mode is widely used in object tracking on the basis of the estimation theory of nonparametric kernel probability density. Fukunaga et al proposed the mean shift algorithm [11] and applied to pattern recognition. "Meanshift" is an efficient pattern matching algorithm with no parameter estimation, and can be combined with other algorithms. It uses the kernel function histogram model of the target object. Comaniciu applied the mean shift algorithm [12] to object tracking. But the mean shift algorithm is not able to update the object model in the process of tracking, which will result in inaccurate scale locating and even object losing while object's scale varies obviously. Camshift (continuous adaptive of mean shift) algorithm is proposed by Bradski [13] in order to solve such problems. Richard, John and Jesse [16] Track a Robust Real Time non-rigid objects based on color thresholding, user selected region of the initial frames using K-means Algorithm. But they were not combining other features of the video such as edges and texture together with color information. Wang Jiangtao, Yang Jingyu proposed "Object Tracking Based on Kalman-MeanShift in Occlusions" [14] to solve the problem of occlusion"Mean-Shift" itself is a robust nonparametric technique for finding the mode (peak) in a probability distribution. In Camshift, Mean-Shift algorithm is modified so that it can deal with dynamically changing color probability distribution which is taken from the video frames. This algorithm can automatically adjust the window size to fit the size of object changes in the image. It is effective to resolve the problem of inaccurate object tracking due to the deformation of moving object.In view of the above it will be apparent that, there exists a need of "object tracking system" that will overcomes the drawbacks of all above methods and provides a better performance with occlusion handling. Proposed method is a hybrid method which uses combination of Camshift and Kalman filtering for tracking a moving object within a video sequence.

II. CAMSHIFT ALGORITHM

2.1 Meansift Algorithm

The meanshift algorithm is a non-parametric method. It provides accurate localization and efficient matching without expensive exhaustive search.The size of the window of search is fixed. It is an iterative process, that is it firstly computes the meanshift value for the current point position, then move the point to its meanshift value as the new position, then compute the meanshift until it fulfill certain condition. As the HSV colour space are better in expressing the colour information, the RGB colour space of target area is converted to HSV space firstly. Secondly we extract the component H and divided into m shares with each corresponding to a sub-characteristic value. Lastly the whole target region can be characterized by these values. For each sub-feature, kernal-based density distribution function is exploited for calculating the probability distribution.

To characterize the target, first a feature space is chosen [2]. The reference target model is represented by its pdf "q" in the feature space. For example, the reference model can be chosen to be the color pdf of the target. Without loss of generality, the target model can be considered as centered at the spatial location 0. In the subsequent frame, a target candidate is defined at location y, and is characterized by the pdf p(y). Both pdfs are to be estimated from the data.

$$\hat{q} = \{\hat{q}_u\}_{u=1 \dots m} \qquad \sum_{u=1}^{m} \hat{q}_u = 1$$

$$\hat{p}(y) = \{\hat{p}_u(y)\}_{u=1 \dots m} \quad \sum_{u=1}^{m} \hat{p}_u = 1$$

Here similarity function is calculated which characterizes the similarity between the initial target model and target candidates, Similarity measure methods commonly used include "Bhattacharyya coefficient", "Fisher measure of information", and "histogram intersection technique"[1]. Here proposed method uses "Bhattacharyya coefficient method" [2]. The sample estimate is given by;

$$\hat{\rho}(y) \equiv [\hat{p}(y), \hat{q}] = \sum_{u=1}^{m} \sqrt{\hat{p}_u(y)\hat{q}_u}$$

Using (3) the distance between two distributions can be defined as;

$$d(y) = \sqrt{1 - \hat{\rho}(y)}$$

The statistical measure d(y) is well suited for the task of target localization. If *d(y)* was smaller, the similarity between the two color distribution histogram would be higher. In the search process we employ mean-shift iterations to achieve the maximization of $\hat{\rho}(y)$.

2.2 Camshift Algorithm

If we extended meanshift to a continuous image sequence, thus CamShift algorithm is formed. The basic idea of camshift is to make all the video frames MeanShift operations. And the result of the previous frame is taken as the initial value of the Search Window of the next frame's MeanShift algorithm. If this iteration continues, target tracking can be achieved. The iteration steps list below [1]:

1: Set the image as the search area.

2: Initialize the size and location of the search window.

3: calculating the probability distribution of color in the search window.

4: Run Meanshift to obtain a new location and size of search window.

5: In the next frame of video images, initialize location and size of search window by (4) and Jump to (3) continue to run.

III.KALMAN FIRTER

The Kalman filter estimates the position of the object in each frame of the sequence. The input parameters of the Kalman filter, respectively, the position of the object in the image at time *k*, the size of the object and the width and length of the search window of the object which varies due to the mobility of the object during the sequence. These parameters represent the state vector and measurement vector of the Kalman filter. The variable parameters of the Kalman filter are the state vector and measurement vector [5]. The state vector is composed of the initial position, width and length of the search window and the center of mass of the object at time *tk* the measurement vector of the Kalman filter is composed of the initial position, length and width of the search window of the object at time tk.
Kalman filtering algorithm is that predict the most probable object location in the current frame according to the results of targets tracking in the previous frame, then search target location in the neighbor area of the location. If there is a target existing in the search area, continue to process the next frame [1]. The key of kalman filter is prediction and update.

IV.SYSTEM OVERVIEW

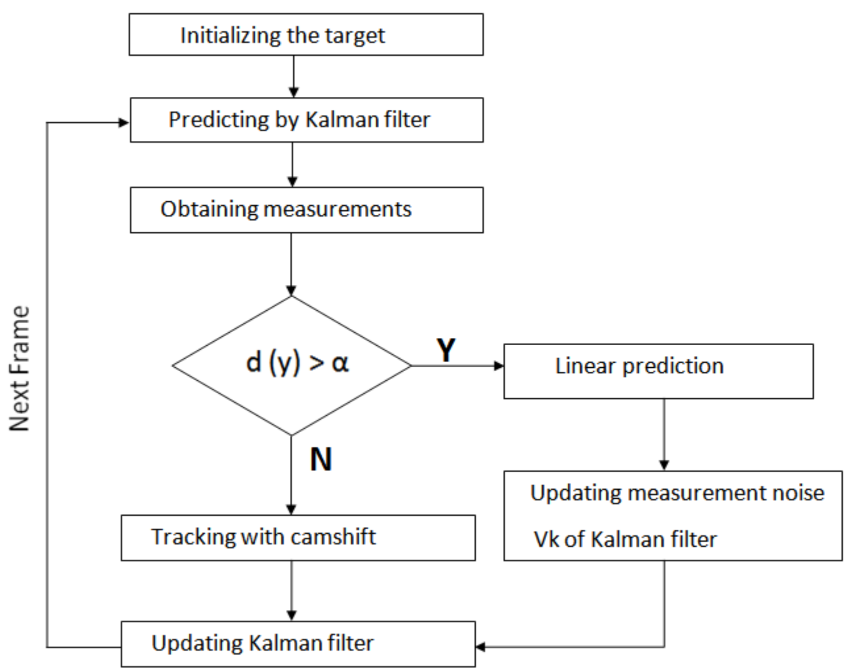

Figure 1: Flowchart of tracking algorithm

The tracking system uses a combination of Camshift and Kalman Filter. In experiment, the proposed method assumes a threshold (α). Firstly Here similarity function is calculated which characterizes the similarity between the pdf of initial target model and target candidate using "Bhattacharyya coefficient method" [2]. Then from similarity function the distance between these two distributions is calculated. If Bhattacharyya distance [$d(y) > \alpha$], it is inferred that the object has been occluded [1]. If the target appears occlusion, system track object by using the method of linear prediction .Otherwise, system track object by using camshift. Linear Prediction is be utilized to search the target location. Moving target can be divided into horizontal and vertical velocity components. Horizontal and Vertical velocity components, these components are predicted using linear prediction technique [1].

V.NUMERICAL RESULTS & DISCUSSION

Figure 2: Object Tracking by Using Hybrid Method

In our hybrid method of tracking an object we assign a threshold value α = 76797.114, when d(y) value exceeds than α object is said to be occuled & it can not be tracked perfectly by Camshift method so in this case linear prediction method is employed to track the object .In linear prediction method it calculates the horizontal & vertical velocity component & based on that track the object .The different values of similarity function d(y) i.e nothing but the bhattacharya distance is calculated for every frame as shown in the figure below,

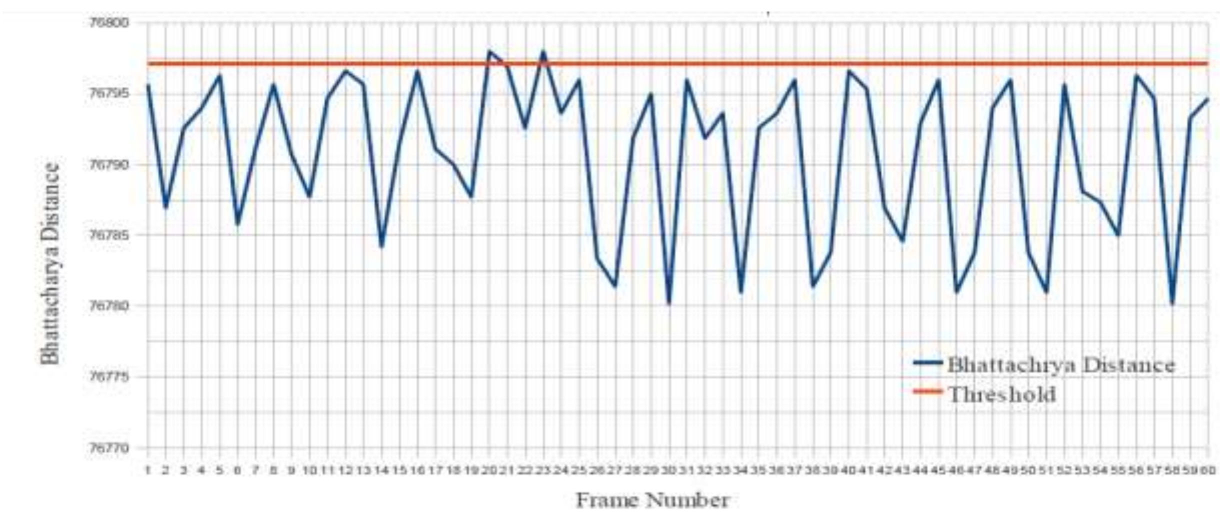

Figure 3: Bhattacharya Distance Graph

VI. CONCLUSION

Here we have made a hybrid method for tracking a moving object within a video sequence which is giving the better performance than kalman filter or Camshift method alone .Also it handle the occlusion condition very well.

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