Review on Moving Object Tracking System Based On Camshift and Kalman Filter

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***Abstract*— This paper presents a object tracking system for tracking a moving object within a video sequence and to overcome all the difficulties in the process of tracking a moving object .The proposed system uses a combination of camshift and kalman filter algorithms for better tracking in the case of occlusion.**

***Keywords*— Camshift, Kalman filter, Tracking system, Occlusion**

I. INTRODUCTION

Object tracking is a very important topic in today's world. We require object tracking in number of applications such as in navigation system, video games, industrial automation system and so on. By using a object tracking system we can track any particular thing within a video that we want for our analysis. Object is nothing but anything like person walking on the road, vehicle running on a road, ball in a cricket match or bat in a cricket match and so on. Most of the current researches use tracking methods such as meanshift algorithm, camshift algorithm, kalman filtering and partical filtering. Meanshift algorithm is an efficient pattern matching algorithm with no parameter estimation. Also it is having advantage that we can use this algorithm in combination with other algoritms. when we apply meanshift algorithm continuously to any video sequence a camshift algorithm is formed. Kalman filter is a recursive type of filter. It is also called as a predictive filter. Depending upon the past and present state estimation it can estimate the future state of the object. In this paper we combine the camshift and kalman filter algorithms to form a hybrid system which will give better performance in the case of occlusion.

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.

II. .CAMSHIFT ALGORITHM

A.Meansift Algorithm

The meanshift algorithm is a non-parametric method. It provides efficient matching without expensive 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.

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

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

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;

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

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

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

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 $\hat{p}(y)$.

B.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

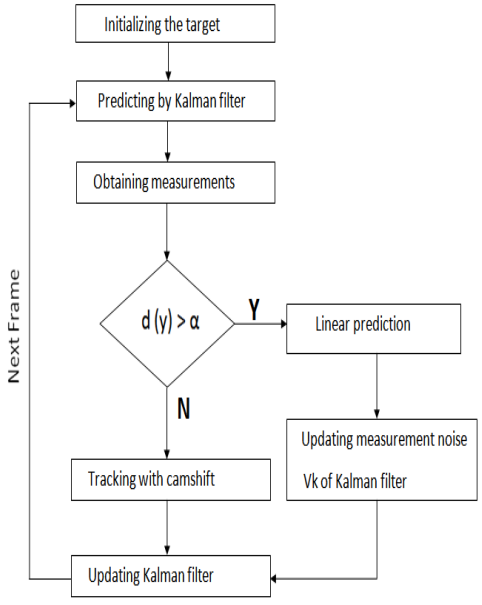

Figure: Flowchart of tracking algorithm

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.CONCLUSION

For tracking a moving object within a video sequence main problem is occlusion.The proposed tracking system is a hybrid syatem which uses a combination of camshift and kalman filter algorithms is bette for tracking a moving object even when occlusion occured. In the case of occlusion, system uses linear prediction for tracking the object.

REFERENCES

[1] Shengluan Huang, Jingxin Hong "Moving Object Tracking System Based On Camshift And Kalman Filter" IEEE 2011.

[2] Dorin Comaniciu, Visvanathan Ramesh, Peter Meer, "Kernel-based object tracking". IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol, 25(5), 2003, pp: 564-577

[3] Zhiwei Wang, Fuping Yang "Object Tracking Algorithm Based on Camshift and Grey Prediction Model in Occlusions" The 2nd International Conference on Computer Application and System Modeling (2012).

[4] HYEON KYU LEE, JIN H KIM. "An HMM-based threshold model approach for gesture recognition," IEEE, Pattern Analysis and Machine Intelligence, Vol 21(10), 1999 pp: 961-973

[5] AFEF SALHI, AMENI YENGUI JAMMOUSSI "Object tracking system using Camshift, Meanshift and Kalman filter" World Academy of Science, Engineering and Technology 64 2012.

[6] P. Hidayatullah, H. Konik "CAMSHIFT Improvement on Multi-Hue and Multi-Object Tracking" 2011 International Conference on Electrical Engineering and Informatics 17-19 July 2011, Bandung, Indonesia.

[7] Huiyu Zhou, Yuan Yuan, Chunmei Shi "Object tracking using SIFT features and mean shift" Computer Vision and Image Understanding 113 (2009) 345–352.

[8] John G. Allen, Richard Y. D. Xu, Jesse S. Jin " Object Tracking Using CamShift Algorithm and Multiple Quantized Feature Spaces" School of Information Technologies University of Sydney Madsen Building F09, University of Sydney, NSW 2006.

[9] Alper Yilmaz, Omar Javed "Object Tracking: A Survey" *ACM Comput. Surv. 38*, 4, Article 13 (Dec. 2006), 45 pages.

[10] R.J. Francois "CAMSHIFT Tracker Design Experiments with Intel OpenCV and SAI" *IMSC-04-423* °c *2004 ARJF* Alexandre Institute for Robotics and Intelligent Systems University of Southern California July 2004.

[11] FUKUNAGA K; HOSTETLER L D. The estimation of the gradient of a density function, with applications in pattern recognition, IEEE Transaction on Information Theory [J], 1975, PP: 32–40

[12] Comaniciu D; Meer P. Mean shift analysis and applications. IEEE Int. Conf. on Computer Vision[C], 1999, PP: 1197-1203.

[13] BRADSKI R. Computer vision face tracking as a component of a perceptual user interface. Proceedings of IEEE Workshop Applications of Computer Vision[J]. 1998, PP:214-219.

[14] Wang Jiangtao, Yang Jingyu. "Object Tracking Based on Kalman-Mean Shift in Occlusions, "Journal of System Simulation, Vol 19(18), 2007,pp: 4216-4220

[15] Wu Huimin, Zheng Xiaoshi, "Improved and efficient object tracking algorithm based on Camshift," Computer Engineering and Applications, Vol 45(27), 2009,

[16] A. Yilmaz, X. Li, and M. Shah, "Contour-based object tracking with occlusion handling in video acquired using mobile cameras," *IEEE Trans. Pattern Anal. Mach. Intell., vol. 26, no. 11, pp. 1531–1536, Nov.* 2004.

