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An implementation of Object Tracking using Modified Mean Shift Algorithm

Piyali Deb[1], Shubhangini Ugale[2]
Department of Electronics and Comm. Engg / G. H. R.A.E.T., Nagpur, India

ABSTRACT

Visual object tracking is a challenging problem in computer vision. To achieve the goal of object tracking we need to obtain a feature vector which is capable of identifying the object to be tracked despite of presence of translation in the view field, at the minimum.The change in scale of the object due to motion along the perpendicular to the line of sight adds to its complexity. In this work we have be able to implement an object tracking system using the MATLAB environment. The system uses the mean shift algorithm, which is based on color channel histogram analysis and the algorithm is modified that it includes the object texture information using the LBP operator. We have been able to enhance the object tracking capability of the system.

I. INTRODUCTION

The real-time target tracking is a hot topic in computer vision application, which is widely used in the fields such as intelligent transportation, military surveillance, medical diagnosis, intelligent home, human-computer interaction and so on. The essence of target tracking is to determine the target position in image frames and then to associate front and rear frames for obtaining the target trajectory. The tracking algorithm should be able to adapt to a wide variety of complex environment, such as illumination changes, background interference and target occlusion. A popular algorithm in moving target tracking area is Mean Shift (MS) method [1], which receives the widespread attention with its low computational complexity and real-time performance.

Object detection is one of the most important tasks of computer vision and as such has received considerable atten- tion from the research community. Typically object detectors identify one or more bounding boxes in the image containing an object and associate a category label to it. These detectors are specific for each class of objects, and for certain domains exist a vast literature of specialized methods, such as face detection [9] and pedestrian detection [11]. In recent years the objectness measure, that quantifies how likely an image window is containing an object of any class [2], has become popular [3], [8] . The popularity of objectness proposal methods lies in the fact that they can be used as a pre-processing step for object detection to speed up specific object detectors.

The idea is to determine a subset of all possible windows in an image with a high probability of containing an object, and feed them to specific object detectors. Object proposals algorithms perform two main operations: generate a set of bounding boxes and assign an objectness score to each box. The window proposal step is typically much faster than the exhaustive evaluation of the object detector. Considering that a “sliding window” detector has typically to evaluate 106 windows, if it is possible to reduce this number to 103– 104, evaluating only these proposals, then the overall speed is greatly improved. In this sense objectness proposal methods can be related to cascade methods which perform a preliminary fast, although inaccurate, classification to discard the vast majority of unpromising proposals. Reducing the search space of object bounding boxes has also the advantage of reducing the false positive rate of the object detector.

The great majority of methods for objectness proposal have dealt with images, while approaches to video objectness proposal are oriented toward segmentation in supervoxels , deriving objectness measures from the “tubes” of superpixels that form them . This process is often computation- ally expensive and requires to process the whole video.

II. LITERATURE REVIEW

JI Xiaoyan, QU Shiru in their work“A Target Tracking Algorithm Based on Mean Shift with Feature Fusion” have proposed an improved Mean Shift tracking algorithm based on texture and color feature fusion.. Experimental results show that the proposed algorithm is more robust and more adaptable than the classic Mean Shift and Particle Filter methods in complex environment, such as the similar background colors, rapid illumination changes and full occlusion.

K. V sriharsha et al in their work “Dynamic scene analysis using Kalman filter and mean shift tracking algorithms” have presented a work which is about locating a moving object (or multiple objects) over a time using a stationary camera and associating it in consecutive video frames. In this perspective, a video captured by digital camera is used for motion analysis. In the first stage of experiment background subtraction and frame differencing algorithms are used for object detection and its motion is estimated by associating the centroid of the moving object in each differenced frame. . In the second stage of experiment same algorithm is chosen for object detection but motion of each track is estimated by Kalman filter. However the best estimate is made by combining the knowledge of prediction and correction mechanisms that were incorporated as part of Kalman filter design. The idea of combining Kalman filter theory and mean shift theory has given a direction in bringing out the efficient and reliable tracking results in case of partial occlusion.

Songmin Jia in his work tilted as “Improved Target Tracking Based on Spatio-Temporal Learning
has proposed a template- matching algorithm is an efficient and fast detection algorithm that find the maximum probability point in the image that similar to the template. In order to decrease the calculating time, the search region is not the whole image but the context region of STC tracking method. What’s more, after tracking and detecting we update the scale parameter to adapt the change of the target’s appearance. Finally, experimental results demonstrate that the tracking method has improved the robustness of tracking.

Jae Pil Hwang, Jeonghyun Baek, Baehoon Choi, and Euntai Kim in their work titled as “A Novel Part-based Approach to Mean-Shift Algorithm for Visual Tracking” have presented a novel method of visual tracking algorithm named part-based mean-shift (PBMS) algorithm is presented. In the proposed PBMS, unlike the standard mean-shift (MS), the target object is divided into multiple parts and the target is tracked by tracking each individual part and combining the results. For the part-based visual tracking, the objective function in the MS is modified such that the target object is represented as a combination of the parts and iterative optimization solution is presented. Further, the proposed PBMS provides a systematic and analytic way to determine the scale of the bounding box for the target from the perspective of the objective function optimization. Simulation is conducted with several benchmark problems and the result shows that the proposed PBMS outperforms the standard MS.

On the basis of literature review carried out we observe that Visual object tracking is a challenging problem in computer vision. A feature vector is required that identifies the object to be tracked such that the tracking system is able to track the object in the presence of translation in the view field, at the minimum. An added complexity to the problem is change in scale of the object due to motion along the perpendicular to the line of sight. A currently intractable problem with object tracking is rotation of the object perpendicular to the plane of the visual field, so our study will be limited to two dimensional visual fields.

The aim of their work is to implement an object tracking system using the MATLAB environment. The algorithm to be used is the mean shift algorithm, which is based on color channel histogram analysis. The mean shift algorithm is modified so as to include object texture information using the LBP operator. This will enhance the object tracking capability of the system. This will be accomplished in the following way:

1. Implementation of mean shift algorithm using MATLAB.
2. Implementation of local binary pattern algorithm using MATLAB.
3. Conversion of video feed to frames.
4. Determination of mean shift feature vector and LBP feature vector.
5. All the above will be combined into the final object tracking system.
6. Validation of the system using open source datasets available online.
7. Analysis of system performance and comparison with benchmarks available in the literature.

III. PROPOSED METHODOLOGY

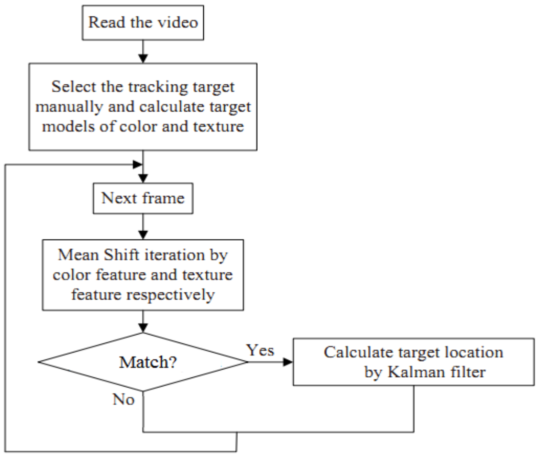

Figure 1. Overall Approach

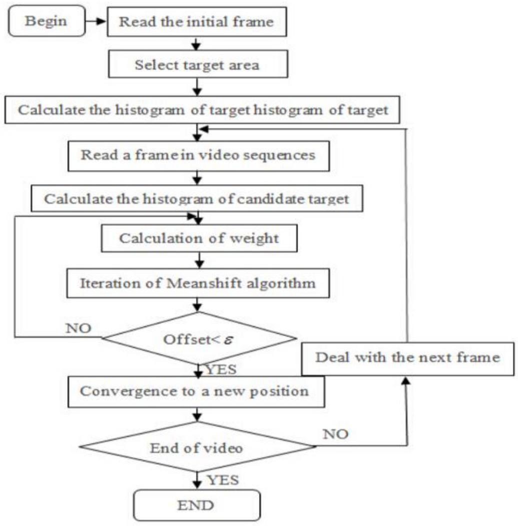

Figure 2. Detailed Flow Diagram

3.1 Mean Shift Tracking

MS algorithm uses iterative method to find the maximum of probability density estimation in the neighborhood, i.e. the target position. Target region of the tracking algorithm is usually chosen by a rectangular or ellipsoidal region. The target is represented as feature histogram.

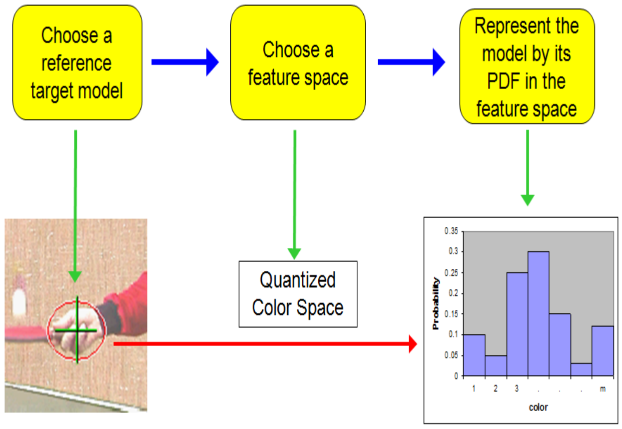

Figure 3. Feature Generation

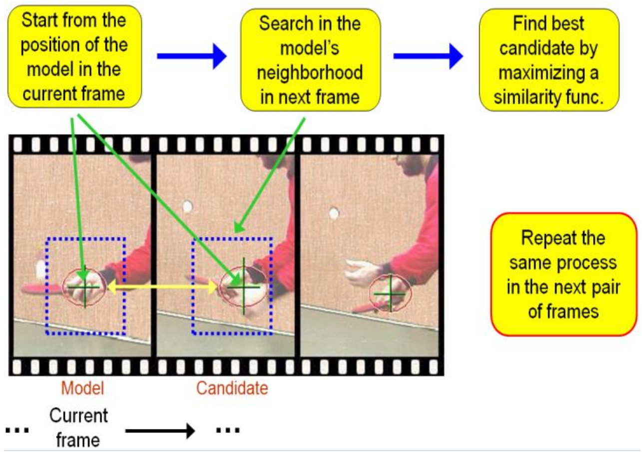

Figure 4. Mean Shift Action

3.2 LBP Texture Feature

Texture is a visual feature revealing homogeneous phenomenon in image, which reflects the spatial structure of the target with independent on the color or brightness, and has the characteristics of rotational invariance and strong noise immunity. Gray level co-occurrence matrix method and Gabor filtering method are more commonly used among various methods of target texture extraction, both of which have the disadvantages of high computational complexity and much redundant information of extracted texture features. In summary, the LBP operator is chosen to extract texture feature in their paper with fast computation, low complexity and gray-scale invariance.

LBP operator works by the means of thresholding pixels in the neighborhood of the pixel and considering the result as a binary number, then the LBP value is obtained with the binary number converted to a decimal number.

example			thresholded			weights		
6	5	2	1	0	0	1	2	4
7	6	1	1		0	128		8
9	8	7	1	1	1	64	32	16

Pattern=10001111

LBP=1+16+32+64+128=241

Figure 5. LBP Calculation

3.3 Target Occlusion

The target will be lost with classic MS tracking algorithm since Bhattacharyya coefficient dramatically reduces when the target is completely occluded. Kalman filter is used to solve this problem as the prediction compensation of occluded target. It is feasible to assume that the target is uniform motion during full occlusion since the acquisition time interval of video is very short. The moving parameters of the target can be predicted by Kalman filter. When the target appears again, MS tracking algorithm based on feature fusion works continuously.

Kalman filter is the most famous algorithm of tools for stochastic prediction estimation. In 1960, Kalman published his famous paper. In their paper, he solved the problem of discrete data linear filtering using recursive method [5].Kalman filter was named after Rudolph E.Kalman. Because of its simplicity and robustness, the Kalman filter to get the wide attention from researchers. Kalman filter

IV. RESULT AND DISCUSSION

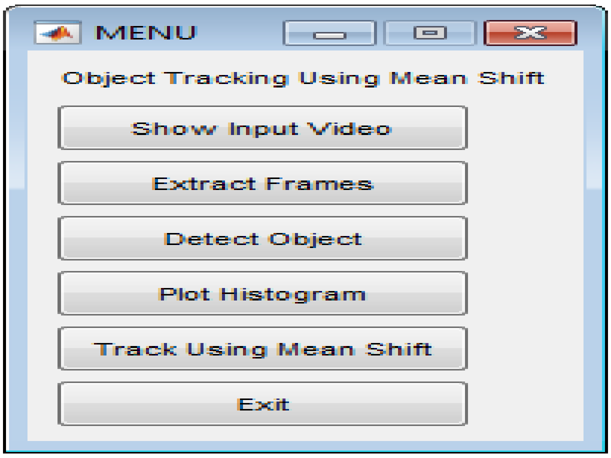

Figure 6. The overall execution flow

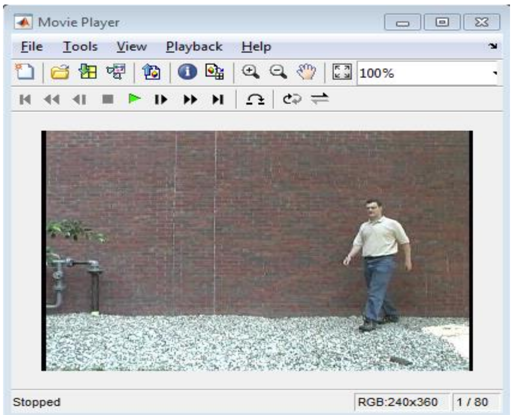

Figure 7. The input video

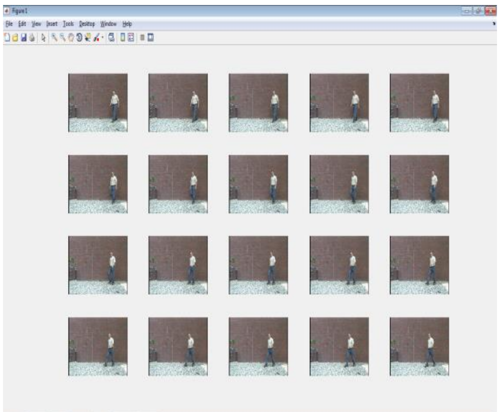

Figure 8. The Extracted frames from the input video

Object detection is the process of finding instances of real-world objects such as faces, bicycles, and buildings in images or videos. Object detection algorithms typically use extracted features and learning algorithms to recognize instances of an object category. Figure 9 below gives the detected object. Plotting the histogram helps in finding the threshold for object detection and is shown in figure 10 below

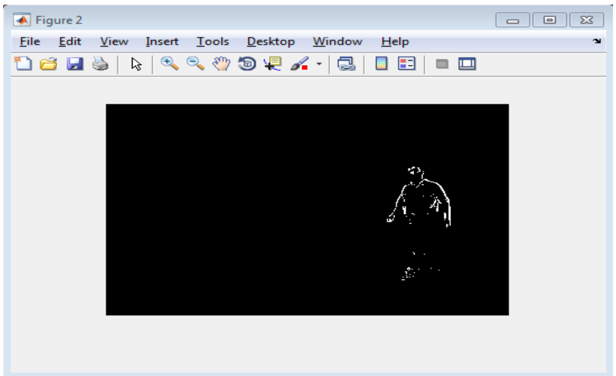

Figure 9. The object detection

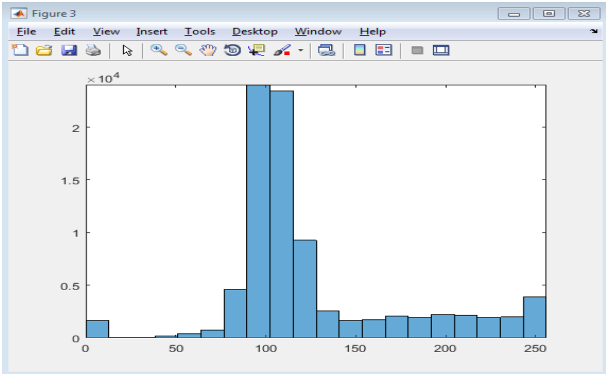

Figure 10. The plotted Histogram

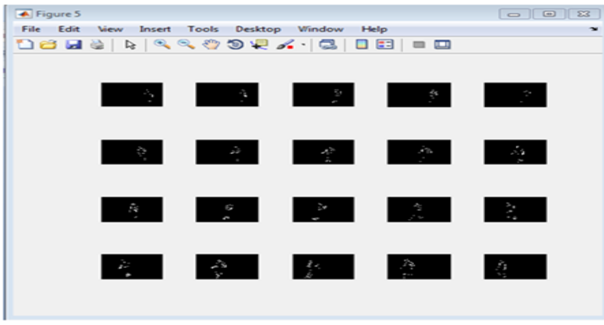

Figure 11. The object tracking using

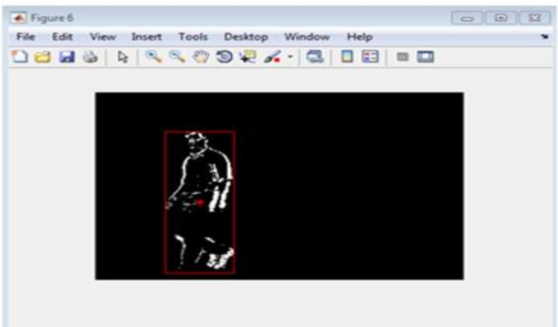

Figure 12. The tracked object tracking using Mean shift Algorithm Mean shift Algorithm

Motion estimation and tracking are key activities in many computer vision applications, including activity recognition, traffic monitoring, automotive safety, and surveillance Tracking is the process of locating a moving object or multiple objects over time in a video stream which is shown in figure 4.5 and the figure 4.5 shows the tracked object using mean shift algorithm

V. CONCLUSION

We come to a conclusion that visual object tracking is a challenging problem in computer vision. To achieve the goal of object tracking they need to obtain a feature vector which is capable of identifying the object to be tracked despite of presence of translation in the view field, at the minimum.

We also observe that the change in scale of the object due to motion along the perpendicular to the line of sight adds to its complexity. In their work we have been able to implement an object tracking system using the MATLAB environment. The system uses the mean shift algorithm, which is based on color channel histogram analysis and the algorithm is modified that it includes the object texture information using the LBP operator.We have been able to enhance the object tracking capability of the system.

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