

The review of the Camshift algorithm and its improved algorithm of target tracking research

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Abstract: In the field of target tracking algorithm Camshift algorithm due to the advantages of simple calculation and by in-depth research and application. But Camshift algorithm because of only considering H component is vulnerable to the interference of background color, the same also in the case of the target obscured or half shade easy to lose track targets, aiming at the shortcomings of the Camshift algorithm, scholars put forward a lot of improved algorithms to make up for those shortcomings. In this paper, a comprehensive analysis of the shortcomings Camshift algorithm will be given, also this paper will review and analysis the deficiency and advantages of the improved algorithms based on Camshift algorithm, finally put forward the direction of improvement of Camshift algorithm in the future research.

The keyword: Camshift algorithm; Target tracking; review

I. Introduction

Moving target detection and tracking technology is one of the highlights in agro-scientific research in the computer vision, is the core of intelligent surveillance video technology. The main factors influencing the target detection and tracking are: 1) the interference of the noise in the video image mining; 2) environmental factors of disturbance in the scene, the motion of the leaves, the ripple of water, and so on; 3) the movement of the camera; 4) the change of the target itself, such as the target's movement speed or shape change. These changes cause target and changeability of the environmental factors and instability, bring difficulty to target tracking.

In the field of target tracking, Camshift algorithm^[1] because of the small amount of calculation, easy to operate, high real-time performance and the advantages of adaptive change of the target window size and received extensive attention of the researchers. But Camshift algorithm of objective function based on the probability of a single color histogram^[2~4], which causes tracking target are vulnerable to the interference of the same color background and fall into local optimum, moreover Camshift algorithm in target occlusion serious when can easily lead to loss, easy to cause the failure of tracking, when target fast moving in the target rotation is easy to cause the inaccurate tracking and so on. In order to solve the above problems, researchers have proposed all sorts of improved algorithm in order to make up for the inadequacy of Camshift algorithm. Improved algorithm based on Camshift algorithm according to the different method of combination can be divided into Camshift algorithm combined with target detection algorithm, with many features fusion, and the combination of SIFT feature matching, combined with Kalman filter, combined with particle filter tracking algorithm.

II. Camshift algorithm principle and its analysis

2.1 Camshift calculation principle of the algorithm

Camshift algorithm is put forwarded by Bradski^[2] in 1998 to solve the problem that Mean-Shift algorithm

can not self-adapt to scale changes. Mean-Shift algorithm is a kind of probability of along the gradient direction iterative algorithm to find the optimal value of objective function, to calculate the current point of the mean deviation, move the point to the average deviation, and then continues to move up as a new starting point, until the end of the algorithm convergence is calculated. Camshift algorithm a maximum of the previous frame image location is passed to the next frame image as the initial position of the search, with a Mean-Shift algorithm to calculate maximum probability, Camshift algorithm at the same time to add the self-adaptive mechanism, the tracking precision is improved. Camshift algorithm calculation principle is to target the RGB color space to HSV color space, in the target area is carried out on the H component and density estimation, which statistics target pixel probability into the histogram, and reverse projection probability values, the last on the probability of image with the Mean Shift algorithm for maximum probability.

Here is the detailed algorithm steps are as follows:

Step1: read a frame, to convert the RGB space to HSV space;

Step2: manual initialization window select the target area, statistical H component histogram of the target area.

Step3: using the histogram of Step2 the probability values of pixels instead of the image pixels is worth to the probability distribution of the current frame;

Step4: use MeanShift algorithm iteration for a maximum of the objective function;

Step5: repeat Step4 until convergence;

Step6: update the oval window of the long axis and short axis and the parameters of the direction of rotation, the output tracking results and returns Step1.

2.2 Camshift algorithm analysis

Camshift algorithm because of its simple calculation, calculation time overhead is small, the advantages of good robustness and is widely used in target tracking. However, the traditional Camshift algorithm is difficult to meet the high demand of complex scenes. The shortages of Camshift algorithm as following:

(1) manual initialization target window can not meet the requirement of the automation. Traditional Camshift algorithm need to select the target window by mouse, which can not meet the requirement of automation. Usually use target detection method to initialize the target window so as to realize the automation of track start.

(2) the tracking of Camshift algorithm is based on the target probability of single color histogram, so when the target and the background color are the same or similar, the histogram cannot accurately reflect the characteristics of target, pixel probability value cannot be accurately calculated by express. Which can easily lead to track into local optimum. In order to solve such problem, Camshift algorithm based on multiple features fusion was proposed.

(3) if the target scaling and rotation, the image in the target area is too small, is obtained by color histogram of color projection after color probability distribution of target area due to the smaller cannot achieve effective tracking^[5].

(4) when the target pixels in the interframe displacement is larger, Camshift algorithm based on a frame of image tracking results have may have no connection with the target's new search window, lead to track lost.

(5) when the noise interference or target obscured problems easy to fall into local maximum, often tracking failure on fast moving targets at the same time, and can't recover from failure [6].

III. target detection algorithm introduced initialization

Traditional Camshift algorithm need to manually choose moving target, which bring obstacles to the entire system automation, in order to solve this problem, some scholars put forward the frame difference method such as target detection method is introduced into the Camshift algorithm^[7~9].

In the literature [7] Yang jie put forward by using the three frame difference method is used to initialize the tracking target, then the between-cluster variance method is used to determine the segmentation threshold, then using Camshift algorithm for target tracking. This method is not only three frame difference method is used to initialize the tracking window, still in the process of Camshift algorithm tracking fusion three frame difference method. This method can solve the problem of target initialization, also can prevent tracking window in case of target and background color or light change at the same time. But this algorithm computational complexity, time is costly, difficult to meet the real-time requirements, and in the process of tracking using three frame difference method is used to make traditional Camshift algorithm by a simple change, time overhead.

Three frame difference method than two frames difference method to overcome to a certain extent due to the target movement too fast and the phenomenon of "double", but the frame differential method to detect the moving target inevitably produce caused by target motion and slow "hollow" phenomenon. The background difference method is difficult to detect the moving targets in close to background color [10 ~ 11]. In the literature [12] zhang chunlin will be put forward by the combined method of frame differential method and background difference method is used for target detection and integrated into the Camshift algorithm. Three frame difference method that solves the traditional shortage at the same time the Camshift algorithm in the target window can be automatically initialized, but the method to calculate time consumption is still large.

IV. Camshift algorithm of multiple feature fusion

Traditional Camshift algorithm only considers a single color probability histogram, this simplifies the calculation to some extent, but when the target color and background color close easily disturbed, moreover after the Angle change changes color features provided by the target, single color features is difficult to meet the target deformation after the shift of perspectives or tracking, so many scholars put forward many features fusion Camshift algorithm to change a single color.

In the literature [13], in order to solve the target color in Camshift algorithm as the only features prone to target the problem such as susceptible to interference and multiple features fusion Camshift algorithm is put forward.

In the literature [5], ji-cheng liu targets such as color histogram and gray gradient histogram weighted combination of the target. This approach to the target R, G, B, gray gradient is set to 16 level respectively, 64, 48 level for color features, before after 16 level gray gradient feature, when the candidate target was calculated by the Meanshift so color histogram reflects the goal of the whole distribution, when the target color and background color close prone to error tracking, the target can reflect the variance of the structural features of the object, so consider target gray gradient histogram can target structure characteristics into consideration so as to avoid tracking failure caused by the background color is similar to the target color.

In the literature [14] eng JHF put forward the use the multiple features such as color, texture, edge gradient adaptive fusion Camshift algorithm [14]. This method improves the ability of algorithm to deal with the light changes; And through the correct feature histogram, setting up reasonable search scope to further improve the algorithm to solve the problem of the interference of similar background. Although the algorithm complexity increases, the computing time longer but still can meet the real-time requirements. The algorithm is fairly good feature fusion tracking algorithm.

Because of the complexity of the target using single color features is not enough to express the target, so the target color, gray gradient, texture information fusion of Camshift algorithm can effectively overcome the inaccuracy of single feature expression.

V. Camshift tracking algorithm based on SIFT feature matching

Due to target under complex background, scaling and rotation motion image of target in the search window between the centroid and the center of mass over time beyond the threshold, the target wide search window, CamShift tracking algorithms. And Scale Invariant Feature Transform algorithms SIFT (Scale Invariant Feature Transform) is David Lowe in 2004 put forward a kind of famous point matching algorithm [15]. SIFT has scale invariance and rotation invariance, the perspective, illumination changes, an object moves, noise also has a good stability. So will SIFT and the integration of CamShift algorithm can solve the zooming and rotation on the target tracking [16 ~ 20].

In order to solve the complex background using general CamShift algorithm is prone to failure, tracking Ma Zhenghua etc will SIFT feature points matching into CamShift algorithm. The algorithm using the SIFT features to realize the continuous image sequence has nothing to do with direction characteristic scales of precise matching, with the scale zoom, target rotation and brightness change to keep the advantages of invariance. This method not only makes up for the general CamShift algorithm with color only for key information is insufficient, and target tracking window can be 1:2 displacement between the centroid and the center of mass stability within the set threshold.

In the literature [16], Yang are congruent in order to solve the gestures in zooming and rotating track, this paper proposes a DI - based CamShift visual words (SLvw) sign and sign language recognition algorithm. First USES the video device for manual alphabet gestures and depth of information; Then sign language gestures depth images are acquired by calculation of principal axis direction Angle and centroid position, calculate the search window to gesture tracking; Then use of Ostu algorithm based on depth integral image segmentation gestures and extract the scale invariant feature transform (SIFT) features; The last build SLVW word package using support vector machine (SVM) for identification.

VI. Camshift algorithm and Kalman predictor tracking algorithm combining the current research status

Target by most sheltered or fast moving with Camshift algorithm is easy to lose target tracking, and Kalman predictor has good prediction effect, so many scholars put forward the Camshift algorithm combined with Kalman predictor to overcome Camshift algorithm for target occlusion often lead to failure problems [21 ~ 26].

In the literature [21], serious situation jun hua Yan etc. According to the target. Please update Kalman predictor of measuring parameters: if not obscured, use CAMShift algorithm for target location update Kalman predictor of parameters; If the block is not serious, using Kalman predictor of predictive value as the size and location of the target, and with the group value update Kalman predictor of parameters; If the shade is very severe, then using Kalman predictor predictive value as the target of the current position, target size for a fixed value, use the group update Kalman predictor of parameter values. To some extent, this method can solve the problem of the occlusion when failure, but in the literature because use Bhattacharyya coefficient and the size of the target to judge whether the target obscured and obscured, and Bhattacharyya coefficient itself can only approximate concerns two histogram similarity, and determine whether obscured the size of the threshold selection has certain subjectivity, so tracking Kalman predictor of target location and size parameters still have error.

In the literature [22] proposed method based on improved Camshift target tracking algorithm is in the original Camshift target tracking method based on distance constraint and tracking box size constraints, two constraints of an improved algorithm is proposed. This method can effectively avoid divergence problem caused by blocked the tracking window.

VII. summary

Although there are already have been improved by combined with other Camshift algorithm model, but here still have the following problems need to study.

(1) the Camshift and multiple features fusion, Camshift algorithm and algorithm in the process of target detection algorithm of combining the time cost is still high, how to improve the algorithm saves time overhead will be a research point in the future.

(2) through Kalman predictor to solve the problem of the track the object shelter is essentially a estimate of the target motion is used to predict the goal, but the target movement might change after shade, so after the target obscured Kalman predictor of predicted value may be inaccurate, likely to lose target when the target again. Therefore, how to use the mask on the edge of the information in the target may be looking for targets.

(3) when the target is color interference, just using Kalman predictor forecast to solve most of the literature, on the edge of the target from color interference area through the very good tracking effect, however, when the target through the interference color area is easy to lose track targets, therefore, how to put forward a more reasonable Kalman predictor with Camshift algorithm tracking algorithm combining the color interference problem is a problem worthy of studying.

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