OBJECT TRACKING BY ADAPTIVE MEAN SHIFT WITH KERNEL BASED CENTROID METHOD

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ABSTRACT

An approach towards the object tracking, the impactful method object improve localization, is proposed. Object is firstly optimize by the adaptive mean shift, if there is high localization then current frame of video replace by the next frame and adaptive mean shift is use to maximize the Bhattacharya coefficient .If there is low localization by adaptive mean shift then histogram based target representation is regularized by an isotropic kernel and then centroid is calculated by the binary gradient matrix. This means we add some structure information in feature space. This method is successfully coped with fast moving object, camera video, target scale change and partially occlusions. The proposed method is very efficient in case of both computational and space criteria.

Keywords: Tracking,Localization,Target representation,Bhattacharya coefficient

1. INTRODUCTION

Because of the advance technology, there are many applications in field of object tracking. It is widely applied in the field of robotic control, traffic surveillance, smart rooms, driver assistance and many homing technologies. Many object tracking algorithm generated in literature, and among them kernel based object tracking is most efficient and robust.comanciu in [1,2] used first time kernel based mean shift to track moving object. He used Bhattacharya coefficient to relate the target model and target candidate and used mean shift algorithm to track and search the target candidate and optimize it. This method is successful to track object in many application and after his research many object tracking researcher used this algorithm as a base in their modified algorithms. Peng [3] used updated model of mean shift algorithm to track object. In[3], peng proposed the method in which automatic selection of bandwidth of kernel is selected. For many years mean shift remains the base of the object tracking. However mean shift has many drawbacks like background noise, localization error, object loss etc. When object moves outside the tracking window mean shift algorithm is unable to track target candidate at boundary of the tracking window because mean centre of the window is unable to move with target candidate. In this case object will be loss and tracking error occurs. Localization error occurs because of the background pixels, these background pixels certainly introduced due to target model which contains target candidate. To reduce localization error background pixels is removed from the target model when the histogram is computed. Collins [4] used approach in which he samples the pixels

of the target model contains target candidate and made a circular centred ring of pixels to omit the background pixels and create colour histogram then mean shift is used to track the object. Yilmaz [5] used asymmetric kernel mean shift with automatic scale and orientation in which mean shift algorithm is performed by translating a kernel in feature space in such a manner that object observation in current and past frame are similar. This approach solved the problem of change of scale and orientation of object frame by frame, it extend the traditional mean shift. But this method is also suffers from the constancy of kernel shape because of contour tracking. All above method used colour and grey level histograms as base of kernel based object tracking and work efficiently for many application. Still in many complex object tracking algorithm colour and grey level histograms is not sufficient alone because it create problem when similar colour objects occurs in single frame. In[6], To make traditional mean shift more efficient with kernel based object tracking some structure feature is applied with histogram feature. In [6] edge based centroid tends to converge the target original centre and determine object structure. In proposed method we used adaptive mean shift to track the object frame by frame even when its scale and orientation of the target changes. When object moving fast and tend to move outside the target model window traditional adaptive mean shift is modified. We modifying it by add structure information in traditional method to locate and optimize the target true centroid.

This report is organized as follows: In Section II, We give overview of traditional mean shift. In Section III asymmetric kernel based object tracking is described. In Section IV, adaptive mean shift with kernel base centroid

method is described. In Section V, comparative results of both methods are given. In Section VI contains Conclusion and future work.

2. MEAN SHIFT ALGORITHM

Mean shift algorithm is very efficient and robust technique in object tracking application. It is broadly classified in two components: target representation and target localization. It is originally developed by Fukunaga and Hostetler [7].

2.1. Target Representation

In object tracking algorithms target representation is mainly rectangular or elliptical region. It contain target model and target candidate. To characterize the target colour histogram is choosen. Target model is generally represented by its probability density function (pdf). Target model is regularized by spatial masking with an asymmetric kernel.PDF is calculated through kernel density estimation.

$$f(x) = \frac{1}{nh^d} \sum_{i=1}^{n} \left[K \left(\frac{x - x_i}{h} \right) \right]$$

Here h is the bandwidth of the kernel, n is the total number of point in the kernel.In target representation target is selected manually in first frame and the pdf of the second frame is calculated through

$$\hat{p}(y) = C_h \sum_{i=1}^{n} K \left[\left\| \frac{y - x_i}{h} \right\|^2 \right] \delta[b(x_i) - u]$$

Here $Ch = \dfrac{1}{\sum_{i=1}^{n} K \left[\left\| \dfrac{y - x_i}{h} \right\|^2 \right]}$

C_h is the normalization constant. It is not depend on the value of y and can be calculated earlier for given kernel and different value of h.h defines the scale of the target candidate. The presence of the continuous kernel introduces interpolation process between location and image.

2.2. Bhattacharya Coefficient

This similarity function define the correlation between target model and target candidate. It generally gives the distance between target model and target candidate, the distance should have metric structure. It is specified in the form of distance between two discrete distribution given by

$$d = \sqrt{1 - \delta(y)} \qquad (3)$$

Where $\hat{p}(y) = \hat{p}[\hat{p}(y), \hat{q}] = \sum_{u=1}^{m} \sqrt{\hat{p}_u(y), \hat{q}_u}$ (4)

Where $\hat{p}(y)$ is referred as Bhattacharya coefficient. New target location y_1 in current frame is found by iteratively proceeding towards the maxima in neighborhood. y_1 Is found by travelling through its initial position y_0 it is given by

$$y_1 = \frac{\sum_{i=1}^{n_h} x_i y_i}{\sum_{i=1}^{n_h} w_i} \qquad (5)$$

Where are representative weights.

3. ADAPTIVE KERNEL BASED OBJECT TRACKING

The scale of the target often changes in time so bandwidth of the kernel has to be adapt according to target size. This is possible due to scale invariance property of the adaptive mean shift algorithm. As target can enlarge or shrink gradually in consecutive frame, no tracking algorithm can track object effectively. For solving this problem adaptive kernel based mean shift is developed. In this algorithm area of the target is estimate in previous frames and in the current frame the area of the target candidate region be a little bigger than the estimated area of the target. Therefor, if the scale and orientation of the target change, target will get little bigger area in the current frame then the previous frame. Real estimation of area done through the mean shift algorithm, the weight image where the weight of the pixels is the square root of the ratio of its color histogram of target model to its color probability in target candidate. The target is usually in the big target candidate region. Due to the existence of the background features in the target candidate region, the probability of the target features is less than that in the target model. This method is more reliable then CAMSHIFT because of its better estimation result. The main advantage of the adaptive kernel based tracking is that the more non object region resides outside the kernel.

4. Kernel Based Adaptive Mean Shift with Centroid Estimation

Traditional kernel based mean shift is basically rely on the spectral features of image, which create problem when the same colour objects comes in same frame and produce localization error. To avoid this error some structure information has to be add with spectral features which combine effect of both colour and grey level feature. Basic mean shift rely on many things like surrounding, size, shape and when objects goes outside of the target window tracker will fail to estimate the position of the objects. In the proposed algorithm kernel based adaptive mean shift is used to track the object when it produce localization error . When object moving in different direction and changing its size and shape continuously and also tends to go outside the target window, window will adjust its size by taking its centre to the new position. We used adaptive window size to maximize the Bhattacharya coefficient.

Following steps are taken in the proposed algorithm to track object:

1. In first frame target is selected manually in the target window whose centre is proposed by the mean shift and application of kernel based object tracking is applied.

2. If the kernel based mean shift is working properly then we put the adaptive window size and maximize the Bhattacharya coefficient. It means high localization is achieved.

3. If the kernel based tracking is not working properly then low localization is achived. Low localization means object is going outside the target window and window is unable to shift its centre with it. In this scenario we add structure information with its spectral feature and calculate the centroid by binary graded matrix (BGM) at current position in the window.

4. In case of worst localization, it means if occlusion occurred then both step 2 and 3 will not work properly and current frame changes to the next frame and repeat algorithm from step 1.

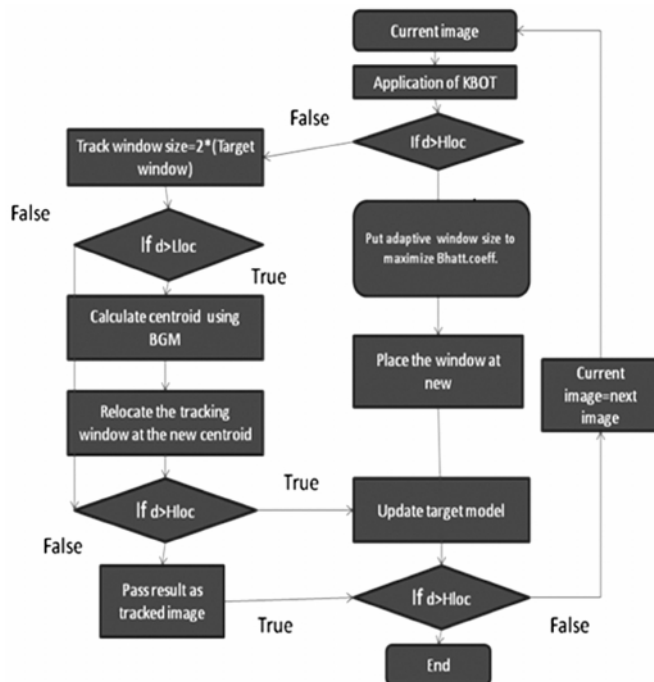The complete algorithm flow chart is shown in Fig .1

Figure 1: Flow Chart for Proposed Algorithm

5. EXPERIMENTAL RESULTS

Both kernel based adaptive mean shift and kernel based adaptive mean shift with centroid estimation are performed on different video files and results founds is satisfactory. In it we find that proposed method has less localization err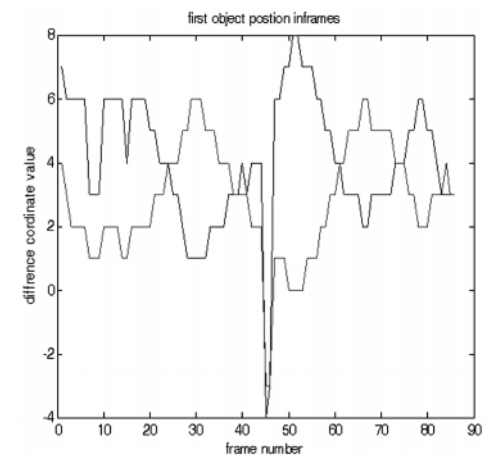or then past one. Both x and y direction coordinate first calculate with adaptive kernel based mean shift and then their corrected value is find by our method.
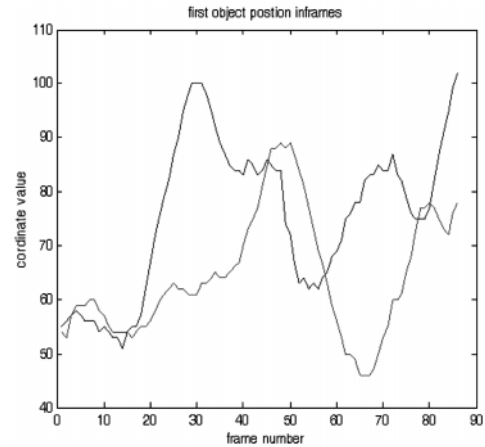
(a)
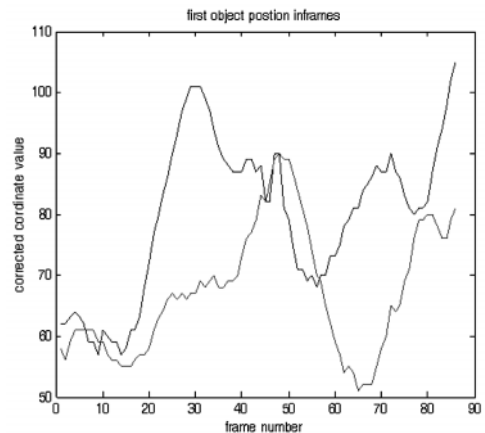
(b)

(c)

Figure 2(a): It Gives Coordinate Value by Kernel Based Adaptive Mean Shift. (b) It Gives Corrected Coordinate Value by Proposed Method. (c) It Gives Difference Coordinate Value by Two method

Table 1
Comparative Results

	Comparision of tracking	Adaptive kernel based mean shift	Adeptive kernel based mean shift with centroid estimation
1	Coordinate	84(original) value	72(corrected)
2	Bhattacharya coefficient	.896	.948
3	Number of iterations	30.45	24.67

6. CONCLUSION AND FUTURE WORK

In proposed method problem weak localization with changing of object shape and size, partial occlusions is solved. This method is more efficient and robust as comparison to original adaptive mean shift in many applications like visual surveillance, human computer interaction, traffic monitoring, vechicle navigation etc.

Future work is done towards the enlarging the capabilities of trackers by making it more robust to track object in more noisy condition like full occlusion, changing light condition complex object motion etc .The multiple object tracking in single frame will also be proposed by this technique.

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