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A Moving Objects Detection Algorithm Based on Improved Background Subtraction

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Abstract

This paper puts forward an improved background subtraction of moving object detection under fixed camera condition. First of all, considering the pixels neighboring relativity, the algorithm through the interval pixels establishment of Gaussian mixture model instead of the traditional point by point establishes Gaussian mixture model in background subtraction. Then, combining the adaptive background subtraction with the symmetrical differencing obtains the integrity foreground image. At last, using chromaticity difference to eliminate the shadow of moving target, effectively distinguishes moving shadow and moving target .The results show that the algorithm could quickly establish background model and detect integrity moving target rapidly.

1 Introduction

At present, there exist three methods to detect moving targets: optical flow method is a complex and bad anti-noise performance, and it can not be applied to real-time processing without special hardware device. Consecutive Frames Subtraction is a simple operation, realizes easily and has strong adaptability on the dynamic changes in the environment. But it can not be completely extracted moving targets. Background Subtraction[1] provides a moving object comprehensive and reliable information, but it is very sensitive to the irradiation which is caused by dynamic scene changes. Its handling procedures are complex. The background of mixed Gaussian Modeling is the best method that is considering the memory demands and the precision of target detection. However, to deal with the changes of background, this method is required to use each pixel which is hybrid modeled in accordance with multi-Gaussian distribution modeling. Thereby it is increased the complexity of the calculation. In light of the above advantages and disadvantages of the algorithm, this paper puts forward that segment integrate moving object based on combining of improvement background

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subtraction and symmetrical differencing which can improve the detection speed and overcome the lack of sensitivity of light changes . At last, it would obtain the integrate foreground moving object.

2 Process of moving object detection

2.1 Establishing of improved mixture Gaussian background model

The stage of establishing background model and updating of Mixture Gaussian model refer to literature [2].The improved mixture Gaussian model is interval pixels to establish Gaussian mixture model(that valid pixels) and judges other pixel (invalid pixels) by the neighboring relativity[3] between adjacent pixels in this paper. Follow this method will reduce the quantity of the Gaussian models and improve the computing time.

2.1.1 Decision procedure of invalid pixels

The process of judging invalid pixels, was shown in Fig 1 (Grey is invalid pixels point, White is valid pixels point) .There is a image template with dimension of M × N, the judgment of valid pixels has been complete. Using the pixel neighborhood relevance to judge invalid pixel point, the process is followed:

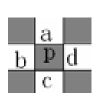

Fig. 1. Image template

1) When one or two valid points are foreground points, to obtain mean value of a , b, c and d, then taken its mean μ_p, in accordance with the standard ,using the formula(1) to distinguish, invalid pixel points. Where X_p is the pixel of current hour, Th is a threshold, X_p is the background when it is satisfying the conditions, otherwise it is the foreground.

$$|X_p - \mu_p| < Th \tag{1}$$

2) When valid points have more than two foreground points, the invalid points are the foreground points.

3) When all the four valid pixel points are to be as the background and the invalid pixel points are to be as the background.

2.2 Calculation of consecutive frames subtraction

The method utilizes current two frames or the differences between the current frame and its previous frame to extract a motion region. In this paper, we adopt its improvement methods namely symmetrical differencing, that means image differences of the three current frames. This method can remove effects of unveiling background which is caused by motion, accurately obtain contour of moving targets. The basic method is referred to literature [4]. Using this method, we obtain a result of separating moving object from background in original image denoted by $D_s^{(t)}(x,y)$.

2.3 The stage of foreground extraction

After obtaining the motion scene background by improving of Gaussian mixture model, foreground image was achieved by subtracting current image frame from background image, denoted as $D_B^{(t)}(x,y)$.

However, if the gray scale of moving object is closed to the gray scale of background image, well then background subtraction will not be able to detect the integrated motion information. Therewithal, we use symmetrical differencing to detect the undetected motion regions. Therefore, at each position of the pixel, the foreground images which are achieved by using background subtraction and symmetrical differencing are processing by logic or operation. After this procedure, we would obtain a accurately foreground image. The description is showed as below:

$$FD(x,y)=\begin{cases}1, & \text{if } D_s^{(t)}(x,y)\bigcup D_B^{(t)}(x,y)=1\\ 0, & \text{else}\end{cases} \tag{2}$$

2.4 The stage of eliminating the shadow

Comparing the foreground pixels with the corresponding background pixels, if the distinction between chroma and brightness distributed is in a certain range, the pixels are considered to be shadow. In this paper, we designed a calculation of color model to separate these two components in RGB space. X_t Pixel color distortion can be expressed as

$$C(X_t)=\arccos\left(\frac{OI\bullet OI_b}{|OI||OI_b|}\right) \tag{3}$$

Where, I_b=[$EF(X_t)$;$EG(X_t)$;$EB(X_t)$] represents the background image's *RGB* expected value, OI_b is a expectation background color vector. In addition, $I=\left[R(X_t);G(X_t);B(X_t)\right]$ represents a current pixel *RGB* value. For separating the foreground's moving target, *RGB* value of the pixel is different from the corresponding value of the pixels in background. Whereas, there is a similar chromaticity between shadow pixels and background pixels. To make sure of the probability distribution of pixel point is according to the Gaussian probability density function. Calculation is followed:

$$\nabla t(X)=\left[\frac{(X_t^r-\mu_t^r)^2}{\sigma_t^{r2}}+\frac{(X_t^g-\mu_t^g)^2}{\sigma_t^{g2}}+\frac{(X_t^b-\mu_t^b)^2}{\sigma_t^{b2}}\right] \tag{4}$$

If one pixel satisfies expressions as follow:

$$\begin{cases}T<\nabla_t(X)<T_p\\ T<\nabla_t(X)<C(X_t)T_c\end{cases} \tag{5}$$

It can be discriminated that this point is in shadow area. In which, T was global threshold; T_p was the upper bound of normalized *RGB* distortion in the case of shadow detection; and T_c was the lower bound. Basically, the value of T_p and T_c were set in accordance with experience. In this way, this pixel point was background point.

3 Experiment

3.1 Preferences in experiment

We detected moving object from video image sequence 320×240 photographed under outdoor background. According to multiple experiments, the weight update rate of Mixture Gaussian model was set at 0.005. The initialization values of Mixture Gaussian model in literature [2] were set at ω=0.05, σ=30, α=0.005, λ=25, *T*=0.7, *K*=5.

3.2 Experiment results analysis

The comparison of the processing speed of detecting moving objects of each algorithm is shown in flowing Table1.

Table 1. Results from each algorithm per second

Algorithm	Frame number/Frame
Gaussian Mixture model	12
Symmetrical Differencing	20
Background Subtraction and Symmetrical Differencing	11
The Suggested Method	17

In Fig.2(a), it is one frame of source image captured from video sequence. In Fig.2(b), it is a background image which is calculated by current Background Modeling Approach. The foreground image obtained by background subtraction shows in Fig.2(c), and in which it can be seen that the information of the moving object could not be detected wholly .The moving object obtained by Symmetrical Frame Difference was shown in Fig.2(d), we can see that, it contains complete contour information but the details had been ignored. And the results shown in Fig.2(c) and Fig.2(d) were subjected to shadow interference. Fig.2(e) shows the detective results which was using Background Subtraction and Symmetrical Differencing but the object detected algorithm was complex. The whole moving foreground was obtained by our algorithm shows in Fig2(f).

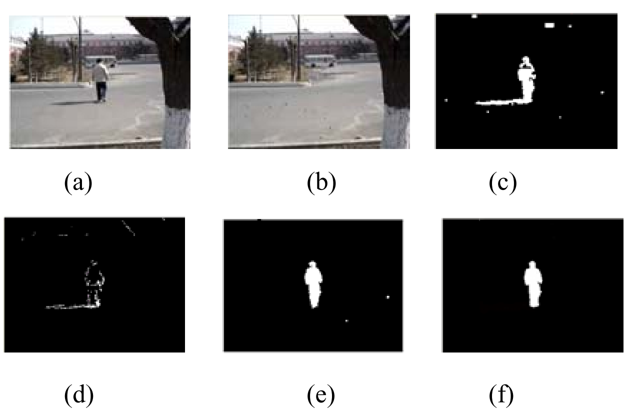

Fig. 2. Image of experimental result

4 Conclusion

In this material, a new efficient moving target detection method which is a improved background subtraction was proposed to detect moving objects, I summed up two significant advantages, one of them is improved the background subtraction and increased algorithm's running efficiency. Another one is to offset sensitive deficiency of the light changes. Experimental results show that the method has fast operation, high accuracy, it meet the real-time detection.

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