Target Detection Via Combining Canny Operator With Vibe Method

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Abstract.

Due to the complexity of human motion, the target detection results by using traditional ViBe algorithm are not so satisfactory. Therefore, this paper proposes a method to deal with the target detection issue by fusing an improved Canny operator with Vibe algorithm. Specifically, the ViBe algorithm is utilized to achieve the initial foreground region of a moving object; then, the improved Canny operator is applied to extract the edge information of a moving object; finally, the extracted foreground region and edge information are fused to obtain more accurate foreground region. The experimental results performed on KTH human behavior database demonstrate the effectiveness of the proposed scheme.

Keywords: Vibe Method, Body Contour, Motion Recognition

Introduction

Up to date, the existing target detection methods can be broadly divided into the following two categories: (1) In the first category, the temporal information of moving target is utilized to deal with the issue of target detection, such as the adjacent frame difference model method[1], the optical flow method model[2], the background difference model method[3], the pixel-wise model method[4]; (2) In the second category, the spatial information of moving target is utilized to deal with the issue of target detection, such as the active contour model method[5], the edge detection operator model method[6], the local binary feature model

method[7] , the gradient histogram pyramid model method[8].

In this paper, we propose a method to deal with the target detection issue by fusing an improved Canny operator with Vibe algorithm. Specifically, the ViBe algorithm is first utilized to obtain the initial foreground region of a moving object, but there are a number of holes within the obtained foreground region; then, the improved Canny operator is utilized to achieve the edge contour of the moving object; finally, the obtained initial foreground region edge contour are fused to achieve the satisfactory foreground region detection result of a moving object. Compared with the traditional ViBe algorithms, the proposed method by fusing Canny operator with ViBe algorithm can remove the produced hole areas.

Vibe Algorithm

Compared with other target detection algorithms, ViBe algorithm[9], as a pixel-level algorithm, has the following advantages: smaller memory footprint, faster processing speed. The main idea of the ViBe algorithm is described as follows: a sample set is first constructed for each pixel, where the sample elements include the pixel itself and its neighbor pixels; then, a new pixel is determined to whether come from the background based on the constructed sample set. The ViBe algorithm mainly includes three steps: model initialization, foreground detection, and model update.

● **Model Initialization**

For the Vibe algorithm, the process of model initialization is just the process of constructing the pixel sample set. Due to the fact that an image pixel can not describe the distribution information of its spatial and temporal, the Vibe algorithm utilizes the information of its neighborhood pixels to construct the spatial and temporal distribution characteristics.

● **Foreground Detection**

The foreground detection process is executed from the second frame image, and the detection process includes the following two steps: the first step is to determine whether the current pixel is matched with the background model based on the constructed N sample set; the second step is to count the number of foreground sample points and background sample points respectively.

● **Model Update**

In order to improve the detection performance of moving objects with respect

to changing background, the ViBe algorithm proposes a model updating method. The main idea of the model updating is described as follows: suppose the probability of each background point to update the neighbor sample points is $1/\gamma$, and the probability of each background point to update itself is also $1/\gamma$; then, foreground points can be set as the background points when the number of these foreground points reaches the pre-set threshold, and the probability to update the current sample model is also $1/\gamma$.

Improved Canny operator

● Canny Edge Detection Operator

Canny edge detection operator is the first derivative of Gaussian function, which has the following three advantages: (1) The optimal detection result; (2) The optimal location criterion; (3) The optimal correspondence between true edge points and detected edge points.

● Improved Canny operator

From the above disccused, it can be seen it is very important to select appropriate thresholds H_{th} and L_{th} for Canny edge detection operator. However, for traditional Canny edge detection operators, it first needs to repeat several times to find suitable thresholds; then, the ratio between H_{th} and L_{th} is set to be an constant value according to prior experiences. However, the image quality is likely to be affected severely by several factors, such as illumination change and pedestrians occlusion, the optimal ratio between H_{th} and L_{th} shoule not be the same. Considering the above disadvantages of the traditional Canny edge detection operator, this paper presents an improved Canny operator to automatically adjust the high threshold H_{th} and low threshold L_{th}.

An iterative algorithm[10] is chosen here to reduce the effects of video sequence noise on chosing high threshold and low threshold. The chosen iterative algorithm has the following two advantages: (1) on the one hand, the impact of noise on selecting thresholds is greatly reduced; (2) on the other hand, the adaptability of Canny edge detection operator is greatly improved.

Detection optimization

The holes may be seen in the target area when using ViBe algorithm to detect moving targets. Therefore, the holes will still exist when fusing the detected target areas with the edge contour extracted by Canny operator, which will affect

the performance on the latter target tracking and behavior analysis. The scan line filling method[11] is here utilized to optimize the results of foreground detection, the advantage of which is that there is no need specifing seeds in advance. That is, the scan line filling method is suitable for computer to fill the holes automatically.

The scan line filling method is a kind of area filling methods, and the main idea of which is described as follows: all pixels within a hole are first set to be new pixels; then, the filling procss ends when all pixels within the hole.

The filling procss consists of the following four steps:

(1) Calculating the intersection points: calculating the intersection points between a polygon and scanning lines;

(2) Sorting intersections points in ascending order: each intersection point is sorted in ascending order based on the value of abscissa(x);

(3) Filling color: connecting all of the intersection points and filling color respectively;

(4) Ending iterative process conditions: if all of a polygon has been scaned, then the scaning process ends; otherwise, turning to the step (1) and starting the scaning process from the next line.

Experimental results

The experimental results in this paper are conducted on the KTH human behavior database, which is performed by 25 different people under four scenarios and includes six categories of behavior: walking, jogging, running, boxing, hand waving, hang clapping. The backgrounds of the KTH database are relatively static, and the camera movement is slight.

The comparative experiments are conducted on the following three methods: (1) traditional ViBe algorithm, (2) Canny edge operator, (3) the proposed method, and Figure 6- 8 show the results of comparative experiments.

It can be seen form the results of comparative experiments as shown in Figure 1-2 that the performance of the proposed method is better than the other two methods. Specifically, among the three methods, the detection results of the traditional ViBe method are the worst since it can only detect the moving area of a target, while the proposed method by fusing improved Canny edge detection operator with ViBe method can provide the original image features with a good supplement and achieve a clear foreground contour. Furthermore, the optimal threshold of Canny edge detection operator is obtained by using an iterative algorithm and the scan line filling method is introduced to fill the holes, which
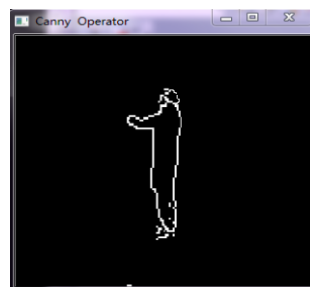
helps to achieve better target detection results. The proposed method can not only accurately extract the edge information but also efficiently adapts to different images.
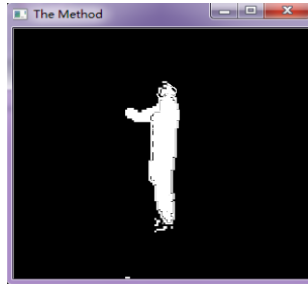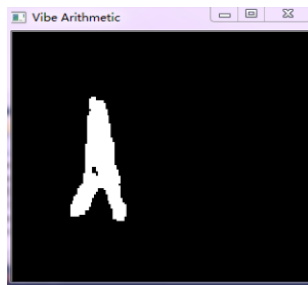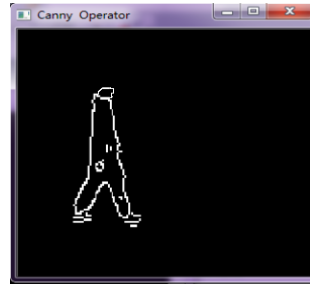

(a)
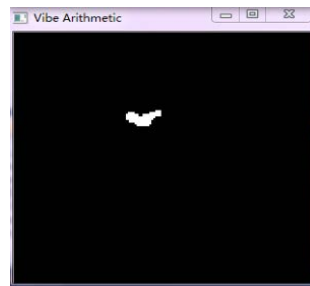
(b)

(c)

(d)

Figure 1: Detection results of boxing motion where (a): original image, (b) detection result by ViBe algorithm; (c): detection result by improved Canny operator, (d): detection result by the proposed method.
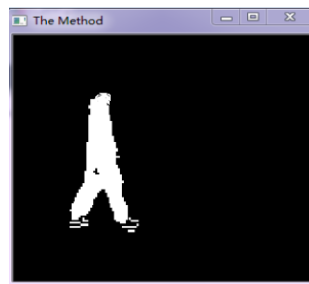

(a)

(b)

(c)

(d)

Figure 2: Detection results of walking motion where (a): original image, (b) detection result by ViBe algorithm; (c): detection result by improved Canny operator, (d): detection result by the proposed method.

Conclusions

Fruitful results have been achieved in the field of foreground extraction, there still remain lots of problems that need to be solved in order to execute subsequent target tracking and action recognition. As an important research direction on intelligent monitoring, foreground extraction is a good way to improve the efficiency and accuracy in the monitoring process. This paper deals with the target detection problem by fusing improved Canny operator with ViBe algorithm and shows good performance in experimental results.

Acknowledgement

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