The research of real-time moving target detection method based on multiple algorithm fusion

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Abstract

The moving target detection is a key step in computer vision research, it is the key step to influence the subsequent target tracking, pattern recognition and information extraction. But in the process of target motion detection, the detection result is inaccurate or missing object due to the factors such as the complexity of the environment and the uncertainty of test object motion. Aiming at this situation, this paper proposes a motion detection method including a frame differential method, Kirsch edge detection and morphological filtering method. This method not only can effectively avoid the influence of the outside noise, but also can effectively separate the moving objects from the video sequence in real time.

Keywords

Motion detection; Three frame difference method; Kirsch edge test; Morphological filtering.

1. Introduction

Moving target detection is the foundation of the follow-up to realize the target recognition and target tracking[1], the testing purpose is to extract the foreground change region from the background image in the video images or other image sequence.Based on camera real-time acquisition of image sequence as the research object, taking preprocessing, frame difference ,edge detection, morphological filtering and other processing of every frame image, and then complete the real-time identification of moving objects in image sequence.

2. Image preprocessing

The video image quality can not meet expectations due to the equipment quality and influence of factors such as noise in the process of acquisition and transmission when using cameras for image acquisition. Therefore, in order to reduce the influence of noise signals in the subsequent image processing, we need to take simple filter processing based on space domain.

The median filtering is a nonlinear signal processing technology based on the order statistical theory, it can effectively suppress the noise[2].The essence of it is to use the mid-value of each point within the territory of this point to substitute the value of a point in image sequence.

Setting as the pixel value of image point ,constantly moving the 3x3 median filter in image and taking the mid-value of it, then getting the filtered image, namely:

$$M(x, y) = median\{f(x-1), f(x, y)...f(x+1, y), f(x+1, y+1)\} \quad (1)$$

3. Motion detection

3.1 Three frame differential motion detection

This paper adopt the three frame difference method to realize motion object detection[3].Assuming that the current moment is t, the current frame is $f(x,y,t)$,before and after the t is $t-1$and $t+1$,the frame of them are $f(x,y,t-1)$, $f(x,y,t+1)$ respectively. According to the principle of three frame difference method, computing the difference of two near frames and taking binary processing of the results,then two corresponding mask images can be got, namely:

$$D_{t,t-1}(x,y,t)=\begin{cases}1 & |f(x,y,t)-f(x,y,t-1)|\geq Th\\ 0 & |f(x,y,t)-f(x,y,t-1)|<Th\end{cases} \tag{2}$$

$$D_{t,t+1}(x,y,t)=\begin{cases}1 & |f(x,y,t)-f(x,y,t+1)|\geq Th\\ 0 & |f(x,y,t)-f(x,y,t+1)|<Th\end{cases} \tag{3}$$

In the formula, Th is the threshold value of the binarization.

Due to the difference between the two series is not entirely moving targets, it is possible that the background covered by the moving target in the previous frame[4], therefore, AND the two income mask value, then get the final mask images:

$$D_t(x,y,t)=D_{t,t-1}(x,y,t)\times D_{t,t+1}(x,y,t) \tag{4}$$

As shown in figure 1,(a) (b) (c)is three consecutive frames images extracted from the umbrella shaking process,(d) (e) (f) is the corresponding difference image respectively.

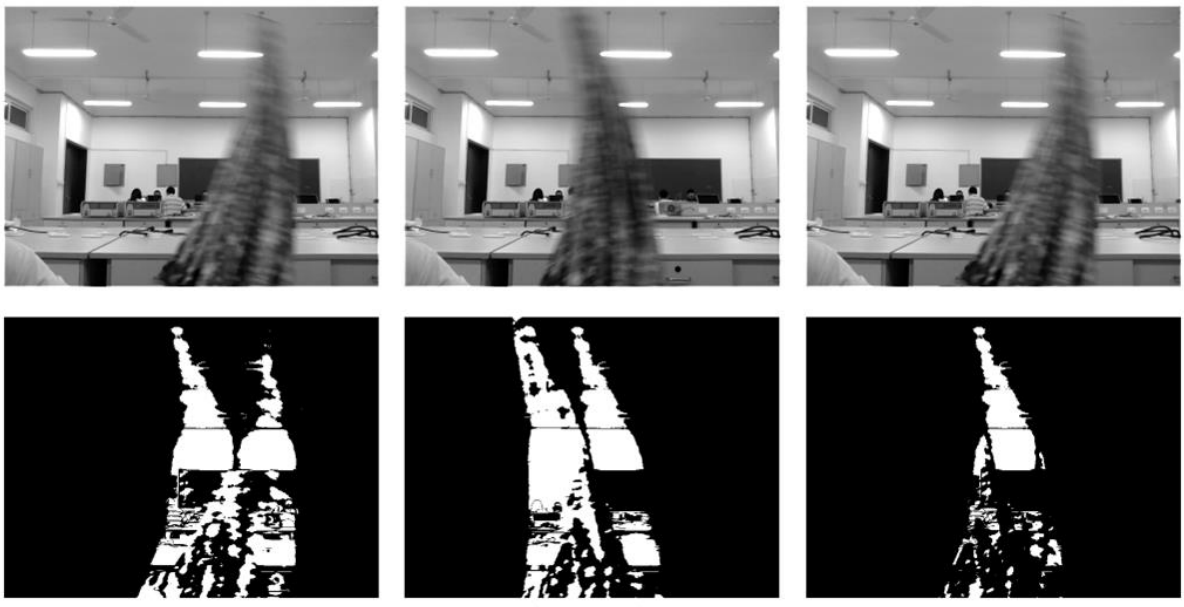

Figure 1 The moving object detection of frame difference method

3.2 Morphology filtering

There may be line breaks in the image of moving targets obtained by three difference frame method. In order to prevent the influence of subsequent information extraction due to key line loss, it is necessary to use morphological filtering method to take further processing of the final mask $D_t(x, y, t)$ obtained by three frame difference method, completing the repair connection of fracture line.

Morphological filter is a kind of method based on selective inhibition image structure of the set algebra and then quantitatively describe the geometry. Its basic morphological operators includes inflation, corrosion, opening operation, closing operation. By the operator or a combination of multiple operators can complete the repair of fracture line.

Dilation: using the structure element B to scan each pixel of image A,AND the structural elements and the binary image covered by them. If all the result is 0, so the pixel value is 0, or 1.Its role is mainly to expand the border of a circle of binary image.

Erosion: using the structure element B to scan each pixel of image A,AND the structural elements and the binary image covered by them. If all the result is 1, so the pixel value is 1, or 0.Its role is mainly to reduce the border of a circle of binary image.

3) Opening operation: firstly corrode and then swell for the image. The use of opening operation can smooth contours ,suppress the boundary of small discrete points and peak points, as well as, separate object and the boundary of larger objects without changing the acreage of the objects in tenuity point.

4) Closing operation: firstly swell and then corrode for the image. It can fill the small hole in the object, connect to the adjoining objects and the boundary of smooth objects but not change the acreage of the objects.

In order to cope with the next edge detection algorithm, it is needed to repair the fracture line as far as possible under the premise that the extracted the boundary of moving image slightly wider than that of actual image. Therefore, in the image morphological filtering algorithm, the motion detected images were repeated twice by closing operation, and then were repeated twice by dilation operation. So fracture lines were repaired ,at the same time, a motion image of a large margin of two times was obtained. The results as shown in Figure 2.

Figure 2 The effect of morphological filtering

Assuming that $M_k(i, j)$ is the value of the K template in the i row at j column. $f(x, y)$ is the pixel value of the pixel point (x, y). Then the value of the K template processed by the filtering of the pixel points is:

$$f_k(x, y) = \sum_{(i,j)\in S} f(x+i, y+j) M_k(i, j) \quad (5)$$

Selecting the maximum value in the obtained eight filtering process, and forming a new image sequence:

$$f_{\max}(x,y) = \max\{f_1(x,y),\cdots f_8(x,y)\} \tag{6}$$

And then by setting the threshold for binarization processing, you can get an edge image:

$$F(x,y)\begin{cases}1 & f_{\max}(x,y) \geq Th \\ 0 & f_{\max}(x,y) < Th\end{cases} \tag{7}$$

Combining morphological filtering results, you can get a more accurate contour image of the moving target:

$$O(x,y) = F(x,y)\cdot G(x,y) \tag{8}$$

5	5	5
-3	0	-3
-3	-3	-3

-3	5	5
-3	0	5
-3	-3	-3

-3	-3	5
-3	0	5
-3	-3	5

-3	-3	-3
-3	0	5
-3	5	5

5	5	-3
5	0	-3
-3	-3	-3

5	-3	-3
5	0	-3
5	-3	-3

-3	-3	-3
5	0	-3
5	5	-3

-3	-3	-3
-3	0	-3
5	5	5

Figure 3 8 filter templates for Kirsch edge detection

4. Experimental results

Two cups kept non-stop free sloshing around in front of the camera, as shown in Figure 4,through the above process, moving objects will be recognized in real-time, and be identified in a rectangular box, the rectangle red dot represents the calculated the center of moving objects.

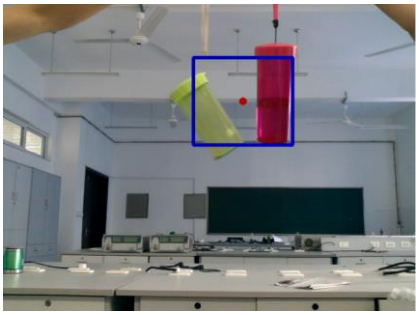

Figure 4 The experimental result

5. Conclusion

The moving object detection method in which three frame difference has less effect on environmental mutation, and robustness, Kirsch edge detection and morphological filtering method can effectively eliminate the ‘empty’, ’ghosting’ and other problems existing in the frame difference method ,increase its noise immunity, and improve the edge detail of objects so that the camera in real-time recording, can effectively extract moving object in the image information in a complex background. Experimental results indicate that the multi-fusion algorithm method can quickly and accurately identify the moving objects in real scenes.

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