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Object Tracking and Detecting Based on Adaptive Background Subtraction

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Abstract

A tracking algorithm based on adaptive background subtraction about the video detecting and tracking moving objects is presented in this paper. Firstly, we use median filter to achieve the background image of the video and denoise the sequence of video. Then we use adaptive background subtraction algorithm to detect and track the moving objects. Adaptive background updating is also realized in this paper. Finally, we improve the accuracy of tracking through open operation. The simulation results by MATLAB show that the adaptive background subtraction is useful in both detecting and tracking moving objects, and background subtraction algorithm runs more quickly.

Key words—Adaptive background subtraction; Motion detection; Object tracking

1. Introduction

Over the last decade, the visual analysis of human activity has attracted many scholars' attention and become the emerging research field of computer vision. This technology not only has high academic value and theoretical significance, but also has very bright prospects. It can be applied in intelligent monitoring, human-computer interaction and virtual reality. Object motion detection technology concerns how to extract moving object from surveillance videos and eliminate the background and noise as much as possible. We use adaptive background subtraction method to realize it and update the background image on time. Adaptive background subtraction method is an more effective moving object detection algorithm. It is easy to implement, and extracts the characteristics of the target data more accurately. Video tracking

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is the process of locating a moving object or multiple objects over time using a camera. For the moving target tracking problem, we also use background subtraction method to realize the moving target tracking which is always using to detect moving objects.

2. Method

Algorithm based on background subtraction is one of the most popular methods to realize tracking of moving objects. It's a technology that utilizes the current image to compare with the background image and detect the moving section. The basic principle of background subtraction technology is to create a background model which is quite similar to the real one. After that, make differential operation with every frame of video and background image to set changing area as moving objects.

3. Process of detecting and tracking based on background subtraction

There are 5 steps in the processing of detecting and tracking based on background subtraction, which are pretreatment, moving objects detection, after-processing, tracking and background updating. The basic process is shown in Figure 1.

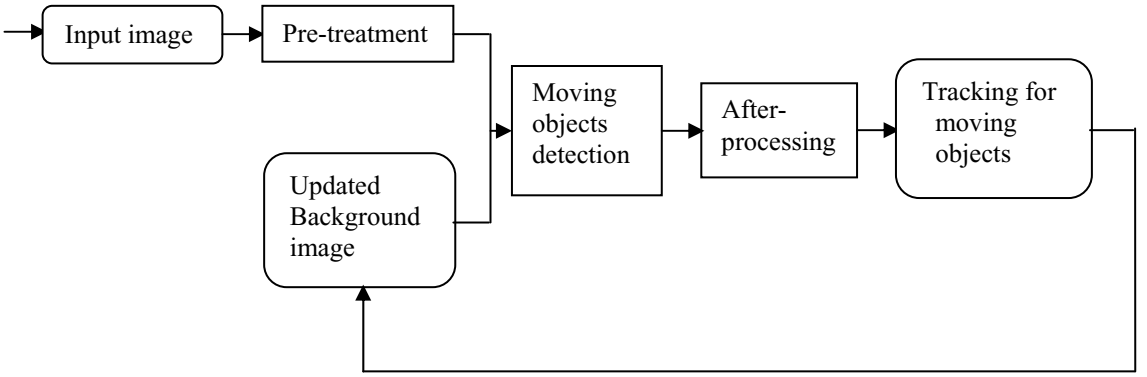

Figure 1 processing of adaptive background subtraction

3.1. Pretreatment

Traditionally, Space-time smoothing is popular used to reduce the camera noise. Meanwhile, this step also is used to reduce transient noise like outdoor camera works when rainy day or snow day. Another point is that the algorithm based on background subtraction about the video detecting and tracking moving objects need to convert data format.

3.2. Background Modeling

Background Modeling is the core of background subtraction algorithm. Background Modeling must sensitive enough to recognize moving objects. Currently, mean filter and median filter are widely used to realize background modeling. The mean filter is a simple sliding-window spatial filter that replaces the center value in the window with the average (mean) of all the pixel values in the window. The median filter is also a sliding-window spatial filter, but it replaces the center value in the window with the

medianof all the pixel values in the window. So the advantage of median filter is that it is able to remove impulse noise.

Mean filter and median filter results are shown below:

Figure 2 Median Filter result and Mean filter result

Obviously, from figure2, we know that median filter has better effect than that of mean filter, since median filter reduces impulse noise.

3.3. Target detection

Detection of Moving objects is realized by subtract background image from every frame of video to judge which sections of frame are stationary or moving.

$X_t(x,y)$ is the pixel value of current frame and $B_t(x,y)$ is the pixel value background image. T is a threshold to decide whether this pixel belongs to moving target. When $|X_t(x,y)-B_t(x,y)|>T$, pixels are defined as foreground objects, and set the values of these pixels as 1. Similarly, when $|X_t(x,y)-B_t(x,y)|>T$, pixels are defined as background, and set the values of these pixels as 0. Finally, the result is a binary image. The result is shown below in Figure 4.

In this paper, we realized adaptive background updating. Due to the changes of the moving of objects and other environment disturbance, the background image always changes. So we need continually update the background image.

In the formula (2), $B_n(x,y)$ means the current background image, $F_n(x,y)$ means the current frame image. When the difference between $F_n(x,y)$ and $B_{(n-1)}(x,y)$, the last frame's background image is less than threshold, T, we consider that the current pixel is the background, and update the background image. Otherwise, the pixel is moving foreground. The T should be adapted by different environment to guarantee the accuracy about the background image. A is the parameter for the adaptive background updating, and its value effects the speed of updating. We set a reasonable and scientific value by mass by mass of experiments. The result is shown as Figure 3.

Figure 3Original frame 399, frame 399 after background subtraction and after updated background subtraction frame 399

3.4. After-treatment

Owning to the noise and instability of nature environment, the isolated foreground sections include real moving objects and interference area which will lead to incorrect tracking. Therefore after-treatment is necessary to revise the foreground sections like, noises and interference. In this paper, we use filter to remove unreasonable foreground sections.

Mathematical morphological is a tool of extracting image components that are useful in the representation and description of region shape, such as boundaries, skeletons, and so on. Mathematical morphological can also use as morphological filtering, thinning and pruning. It is a cornerstone of the mathematical set of tools underlying the development of techniques that extract 'meaning' from an image. For instance, the morphological closing is combined dilation and erosion. Morphological closing tends to smooth the contours of objects. It generally joins narrow breaks, fills long thin gulfs, and fills holes smaller than the structuring element. The result is shown in Figure 4.

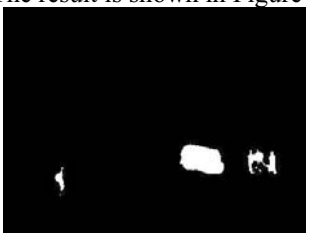

Figure 4 frame 399 after after-treatment

3.5. Detecting and tracking of moving objects

After morphological closing, we should labeling connected components, which are also called objects, to obtain the location of the moving objects. Labeling connected components is used to detect connected regions in binary images. It scans an image and groups its pixels into components based on pixel connectivity. For any foreground pixel, p, the set of all foreground pixels connected to it is called the connected component containing p. The term connected component was just defined in terms of a path, and the definition of a path in turn depends on adjacency. This implies that the nature of a connected component depends on which form of adjacency we choose, with 4- and 8-adjacency being the most common. In this paper, we use 8-adjacency.

After labeling connected components, the next step usually is to represent and describe the aggregate of regions. The centroids of objects will not move with the objects' rotating, extending and noise. The cenroids of objects is a kind of global description various, and location of centroid is based on the pixels of the connected components.

In the formula, I(x,y) is the value of the pixel. The centroid of a objects is near the center of the region. We can use the centroid to label the moving objects and track them. The results are showing in Figure 5 and 6.

4. Conclusions

A tracking algorithm based on adaptive background subtraction about the video detecting and tracking moving objects is realized in this paper. The simulation results by MATLAB show that the background subtraction is useful in both detecting and tracking moving objects, and the background subtraction

algorithm runs more quickly. Adaptive background subtraction is more efficient and effective in detecting and tracking.

Figure 5 detecting moving objects in frame 399

Figure 6 tracking moving objects in frames 360-362

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