Research on Moving Object Detection Algorithm Based on Gaussian Mixture Model

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Abstract. In order to effectively detect the moving object in the surveillance video, the novel moving object detection algorithm on the basic of GMM is proposed. The improved algorithm uses dynamic updating method to get the current frame's threshold value, and then processes the exacted foreground and background with this threshold value. The opening and closing operation and some other morphological operations is also used to eliminate wisps and isolate objects on the gray scale image gained on the first step. Experimental results show that the accurate detection result of every frame is obtained with our algorithm.

Keywords: Gaussian Mixture Model, Object detection.

1. Introduction

As a new research interest of computer vision, intelligent surveillance [1] has received extensive attention. Moving object detection is the fundamental link of intelligent surveillance, which principle is distinguishing interesting moving objects from background and other uninteresting objects. Therefore, the performance of object detection plays a particularly important role in the following research of object classification and tracking, behavior understanding and recognition. But the effects of varying illumination, abrupt changing weather, shadow, background interference and some dynamic changes make object detection becoming a hard work. So, the research of object detection in complex background has been the hotspots in the field of intelligent surveillance.

The technology of moving object detection is widely used in many fields. For one thing, in some special scenes like bank and market, through classifying the detected moving objects, we can distinguish different objects, reducing the time complexity of real-time monitoring and some other following work, which are used in safe guarding, detection and tracking. For another thing, moving object detection and classification have a great influence in the development of medical diagnosis, visual analysis of body movement, traffic behavior event analysis, traffic surveillance, visual navigation of intelligent wheelchair and some other fields.

Moving object detection and classification has its own realistic meaning. China, a multi-ethnic country, due to some separatists attempt to split the motherland, usually occurs some vandalism burning incidents. In fact, there is a great deal of CCTV in the main streets of many cities, but because of limited human resources, we cannot arrange staffs detect the video on the real time everyday 24 hours. In this situation, moving object detection and classification determines the realization of the following researches.

2. The Summarization of Target-detection Algorithms

Currently, common moving object detection technologies such as two consecutive frames subtraction [2], background subtraction [3], and option flow method [4] and so on. The algorithm of two consecutive frames subtraction is simple, very less amount of calculation, so it has a high speed. But it is very easily affected by noise and difficult to adapting outdoor environment such as common leaves' shaking, glittering water surface and some complex sports scenes. When moving objects

whistle stop, it's hard for two consecutive frames to extracting moving object, which will lose objects. Option flow method can extract and track moving object when CCTV is moving. But the amount of calculation of it is very large and the amount of iteration is not a few. So without special hardware support, it's hard to calculate the option flow of full frame image, that is to say option flow method cannot extract moving object on real time. What's more, it's weak in anti-noise and sensitive to the change of illumination, so it is difficult to apply in outdoor environment. As the first choice of moving object detection in practically application, background subtraction through constantly updating background model to ensure accurate to the practical background. How to choose the right updating method of background model is the difficulty point for background method, while the choice of model is the key of this method.

For the background modeling of background subtraction, the most widely used is GMM (Gaussian Mixture Model [5]. GMM algorithm allows the existing of moving object when background modeling and also updates in real-time according to the change of scenes, so it is suitable for detecting object in the situation of slight light, a little change weather and the object with high speed, exacting the complete moving object region. However GMM has many parameters whose calculation is more than a little, what's more, the performance of detecting object with a low speed is not good, and the foreground with low contrast or the region without obvious texture is easily taken as background. In addition, it's sensitive to the brightness variations of the environment, which leads to taking background as the region object.

Therefore, even though the current algorithm can do real-time detection, the efficiency and accuracy are relatively poor, far away from satisfaction. Because of the effect of complexity application scenes to detection and classification, so there still haven't one general algorithm can face all the challenge.

3. GMM based moving object detection algorithm

On the basis of previous research, this paper proposes a relatively general and stable improved algorithm about moving object detection. Based on this algorithm we design a classification algorithm which applies to distinguish human between animals and vehicles and other different objects, making it is capable of detecting some particular scenes on real time.

On the field of computer vision process, each algorithm of moving object detection and classification has its own merits. In this paper, GMM is used to do the moving object detection and classification in the videos, constantly reducing the shortcomings, improving the accuracy classify algorithm, making it can dynamic update background model to adapt a variety of specific scenes and reaching an accurate and stable statue.

4. Gaussian mixture mode

GMM (Gaussian mixture mode, GMM) classic background model, can accurately detect moving object in static scenes. In order to adapt to the change of complex scenes, Chris Stauffer and some other people brought out the algorithm which using GMM [5] to describe background and modeling different Gauss models for different situations. The basic thought of it is using 3 to 5 Gauss models to represent pixel value of background, through estimating the distance deviation between the current pixel value and these Gaussian models to distinguish region and background. It can describe the multi peak state of pixel value, so it can do accurately modeling in some complex situation such as lighting changing, trees swaying and so on. The moving object detection based on GMM concludes three steps: Gauss mixture modeling, extracting background, and detecting foreground [6]. Background subtracting can easily get the accurate describe of object, which applies to static and non-static object, but the amount of calculation is relatively large, and background subtracting needs to build suitable model[7].

5. Improved GMM

On the basic of GMM, the improved algorithm this paper proposed uses dynamic updating method to get the current frame's threshold value, and we can process the exacted fore background or background with this threshold value. Then, we can do the opening/closing operation and some other morphological operations after gaining gray scale image, the aim of which is to eliminate wisps, isolate objects in fine point, fill the small holes in objects, link adjacent objects. At last, we get the accurate detection result for every frame. The structure flowchart of this algorithm is shown in Fig. 1.

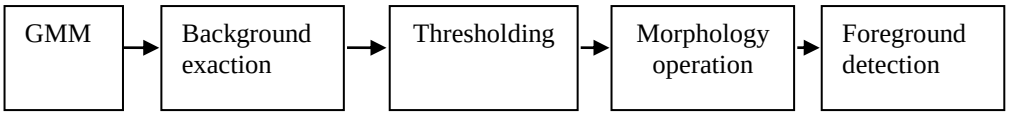

Fig. 1 Algorithm flowchart

6. Experimental Results

The classification algorithm in this paper through doing edge extracting to the foreground object which from foreground object's detection result gains the contour area of moving object. Setting some conditions to limit rectangle area of moving object's outline, distinguishes human, vehicle, animals and so on, The result of human-vehicle classification algorithm is shown in Fig. 2.

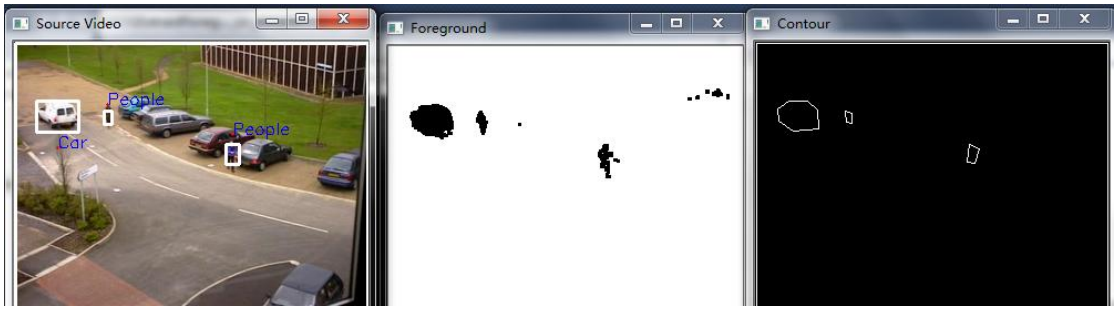

Fig. 2 Human-vehicle classification results

According to the outside weather change, lighting conditions and some other factors, the paper does comprehensive study of foreground detection algorithm of background modeling on the basis of GMM. In addition, this paper also proposes a simple and fast moving object algorithm for the background of human and vehicle show at the same time. The experimental results show that the improved GMM makes the sensitivity of detection algorithm better; meantime, the algorithm draws the threshold of judging whether the object exist into, reducing the amount of calculation; updating strategy for different GMM of object's and background area, improving convergence rate; choosing one and more characteristics of special scenes about accurate classification of human and animals. From the experimental results, the algorithm reaches a faster, more accurate and stable result applied to video monitoring system.

7. Conclusion

As a basic part of movement analysis, moving object detection gets more and more attention in these years. At the same time, the detection result has significant influence on other research areas in computer vision. This paper mainly introduces a few typical algorithm of moving object detection, and also compares and analyses them. A plenty of experimental results shows that improved algorithm has heightened the detection performance, the way of morphological processing effectively reduce the effect of weather change, lighting conditions and some other factors, making the basis for the following works about improving the performance of algorithm. For the further improving of

foreground detection rate and classification, the work mentioned in this paper can be enhanced in these following aspects: (1) Through many times of optimizing structure factors, we will propose more effective factors about morphological structure;(2) On the basic of recent classification algorithms, finding more suitable classification characteristic of special videos and objects to improve the flexible application of our algorithm.

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