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Moving Object Detection and Tracking for Video Surveillance Applications

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Abstract **– Video surveillance has important applications for home and business environments, such as security. In order to get a satisfactory performance these technologies need professional and expensive hardware, complex installations and setups, and the supervision of qualified workers. In this paper, object detection and tracking system is proposed for object counting and surveillance. The paper fulfills requirements of the consumer electronics such as easy installation and configuration, and unsupervised working. Background subtraction algorithms define the background as parts of a scene that are at rest. In this paper, in a single static camera condition, the background subtraction is used for detection of moving object, and update background on the basis of accurate detection of object, this method is effective to enhance the effect of moving object detection. Morphological filtering is introduced to eliminate the noise and solve the background disturbance problem. The experiment results show that the proposed method runs quickly, accurately and fits for the real-time detection.**

Keywords **– Moving Object Detection, Multiple Object Tracking, Video Surveillance Applications, Camera.**

I. INTRODUCTION

Automatic visual detection, tracking of a variable number of objects are crucial tasks for a wide range of home, business, and industrial applications, such as security, surveillance, management of access points, urban planning, traffic control, etc. The moving human body detection is the most important part of the human body motion analysis; the purpose is to detect the moving human body from the background image in video sequences, and for the target classification.

Video surveillance of human activity usually requires people to be tracked. It is important for security purpose and traffic control which is also used to take necessary step to avoid undesired interaction. We present our system for moving object detection and tracking using a static webcam, monitor a typical open work area. Object tracking is central to any task related to vision systems. Methods used in moving object detection are mainly the frame subtraction method, the background subtraction method and the optical flow method [2]. Frame subtraction method [3, 4] is through the difference between two consecutive images to find the presence of moving objects. Its calculation is simple and easy to implement. For a variety of dynamic environments, it has strong adaptability, but it is generally difficult to obtain a complete outline of moving object, as a result the detection of moving object is not accurate. The second one is optical flow method[5,6] is to calculate the image optical flow field, and do clustering processing according to the optical flow distribution characteristics of image. This method can get the complete movement information and detect the moving object from the background better, however, a large quantity of calculation, sensitivity to noise, poor anti noise performance, make it not suitable for real-time demanding occasions. The background subtraction method[7] is to use the difference method of the current image and background image to detect moving objects, with simple algorithm, but very sensitive to the changes in the external environment and has poor anti interference ability. However, it can provide the most complete object information in the case of the background is known.

II. BACKGROUND SUBTRACTION METHOD

The background subtraction method is the common method of motion detection. It is a technology that uses the difference of the current image and the background image to detect the moving object. The key of this method lies in the initialization and update of the background image. The effectiveness of both will affect the accuracy of test results.

There are many ways to obtain the initial background image. For example, with the first frame as the background directly, or the average pixel brightness of the first few frames as the background or using a background image sequences without the prospect of moving objects to estimate the background model parameters and so on. Among these methods, the time average method is the most commonly used method of the establishment of an initial background. However, this method can not deal with the background image (especially the region of frequent movement) which has the shadow problems. In this paper, first frame from the extracted video is taking as the background image.

III. MOVING OBJECT DETECTION

A. Moving Object Extraction

The background image $B(x, y)$ is obtained, subtract the background image $B(x , y)$ from the current frame $F_k(x, y)$.

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If the pixel difference is greater than the set threshold *T*, then determines that the pixels appear in the moving object, otherwise, as the background pixels. The moving object can be detected after threshold operation. Its expression is as follows:

$$D_k(x,y)=\begin{cases}1, & |F_k(x,y)-B_{k-1}(x,y)|>T\\ 0, & \text{Others}\end{cases} \quad (1)$$

where Dk(x ,y) is the binary image of differential results. *T* is gray-scale threshold; its size determines the accuracy of object identification.

B. Reprocessing

The difference image obtained contains additionally the motion region also a large number of noises. Therefore, noise needs to be removed. This paper we use median filter with the 3 X 3 window and filters out some noise.

After the median filter, in addition the motion region, includes not only body parts, but also may include swaying trees, flowing clouds, flying birds and moving cars and other non body parts. Morphological methods are used for further processing. Firstly, corrosion operation is taken to effectively filter out non-human activity areas. Secondly, using the expansion operation to filter out most of the non-body motion regions while preserving the shape of human motion without injury. After expansion and corrosion operations, some isolated spots of the image and some interference of small pieces are eliminated, and we get more accurate human motion region.

C. Object tracking

Fitting a set of box to the output of the background subtraction algorithm, in such a way that each rectangular box represents an independent object. A rectangular box can contain one or several independent moving regions of the foreground detections, accounting for the split detections. To overcome this problem, the first one is to limit the number of box per object to one. The second one is to assist in the estimation of the box parameters restricting their values according to a predetermined range of possible object sizes and orientations.

The *Mean Square Error (MSE)* and the *Peak Signal to Noise Ratio (PSNR)* are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error. The lower the value of MSE, the lower the error. To compute the PSNR, the block first calculates the mean- squared error using the following equation:

$$MSE=\frac{\sum_{M,N}[I_1(m,n)-I_2(m,n)]^2}{M*N} \quad (2)$$

In the previous equation, *M* and *N* are the number of rows and columns in the input images, respectively. Then the block computes the PSNR using the following equation:

$$PSNR=10\log_{10}\left(\frac{R^2}{MSE}\right) \quad (3)$$

The flow chart for moving object detection and tracking:

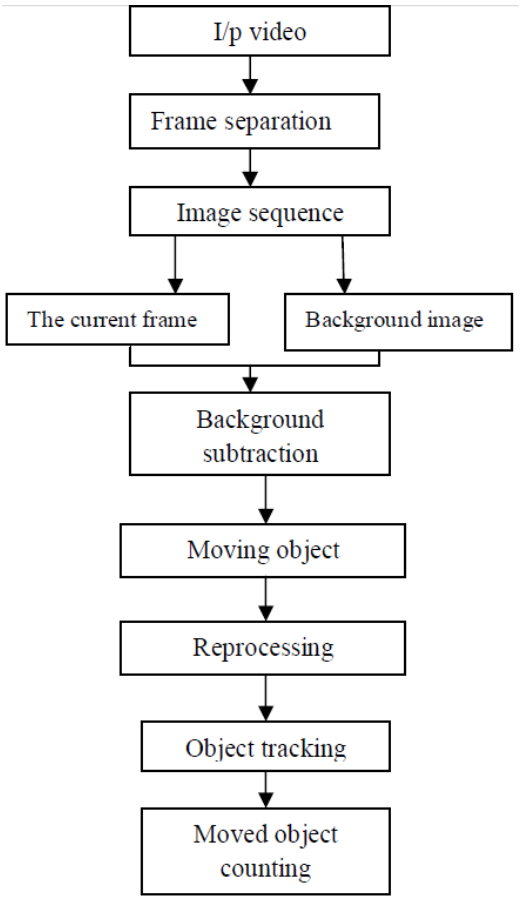

Fig.1. Flow chart for moving object detection, tracking and counting

The detection of moving objects is based on background subtraction technique. The learnt background is used to estimate the foreground, i.e. the moving objects. The output of the detector is a set of independent image regions that have a one-to-one correspondence with a moving object. Split and merged detections, make the trajectory estimation and object counting a challenging task. The problem is overcome by box fitting to the background subtracted object. After fitting the box, the object tracking and counting can be done.

IV. EXPERIMENT

The detection of moving objects is based on an off-the shelf background subtraction technique that performs an online learning of the background of a scene. The learnt background is used to estimate the foreground, i.e. the moving objects, by detecting those image regions that are not compatible with the background model.

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Fig.2. Reference image

Fig.3. Current frame

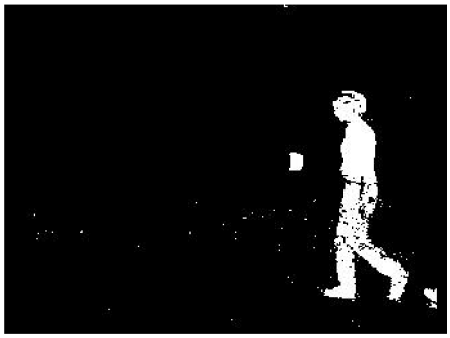

Fig.4. Object is detected

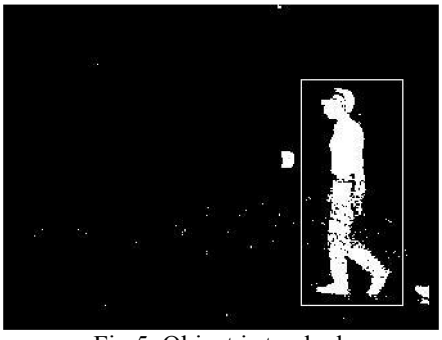

Fig.5. Object is tracked

The diagram above shows the moving object detected. Figure 2 shows the first frame extracted from the video, and the figure 3 is the current image in which moving object is pointed. So by applying the subtraction of current image from reference image we can detected. Shown in figure 4. And detected object is tracked by fitting box to the object. This box represent the particular object tracked and counting process is done by this.

VI. Conclusion

In this paper visual object detection and tracking framework has been proposed for surveillance applications. The method for detection of moving human body is proposed, based on background subtraction. Moving object is detected and tracked by square fitting. This method used is easy to implement and meet consumer electronics requirement. The same procedure will be used for multiple object detection and tracking.

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