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A Quick Browsing System with Image Enhancement for Surveillance Videos

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Abstract*— Surveillance cameras have been widely installed in large cities to monitor and record human activities for different applications. Since surveillance cameras often record all events 24 hours/day, it necessarily takes huge workforce watching surveillance videos to search for specific targets, thus a system that helps the user quickly look for targets of interest is highly demanded. This paper proposes a quick surveillance video browsing system with colour image enhancement. The basic idea is to collect all of moving objects which carry the most significant information in surveillance videos to construct a corresponding compact video. The compact video rearranges the spatiotemporal coordinates of moving objects to enhance the compression, but the temporal relationships among moving objects are still kept. The compact video can preserve the essential activities involved in the original surveillance video. This paper presents the details of browsing system and the approach to producing the compact video from a source surveillance video. At the end we will get the compact video with high resolution.

***Key words*- Image segmentation, Background Subtraction, Pre-processing, Indexing, Colour image enhancement.**

I. INTRODUCTION

Surveillance cameras are widely installed in large cities to monitor and record human activities either in inside or outside environments. To efficiently utilize surveillance videos, how to extract valuable information from hundreds-of-hours videos becomes an important task. An intuitive method is to retrieve relevant segments according to the user's queries in surveillance videos.Unfortunately; it is still difficult to automatically understand the user's intentions and the video contents. Video retrieval based on the semantic level is still a challenging task. Video understanding and analysis is a key technology when we try to automatically extract valuable information from hundreds-of-hours surveillance videos.A basic method is to extract video segments that can represent most of informative contents of the source video. These informative segments are also known as key frames [1] in a video. The collection of key frames is the simplest way to compactly represent a video. Other possible methods for video understanding and analysis are called video summarization or video abstraction that extracts key frames based on a semantic level from a video and fuses them to form a shorter one. In a real application for the surveillance video, all of moving objects may not be negligible because it may be necessary to preserve them for the witness while crimes occur. In general, the most informative parts involved in surveillance videos are the foreground, i.e., the moving parts appearing in video frames. It is similar to a movie trailer: the user can roughly understand the contents of a movie by watching the trailer and then determine whether to watch the movie or not. A. Rav-Acha et al. [5] proposed the dynamic video synopsis to shorten videos by defining an energy function that describes activities of moving objects in a video. The energy function is minimized to optimally compress the corresponding behaviours of the moving objects to form the video synopsis. Their method can achieve a very large compression ratio in video representation, with destroying temporal relationship among objects. It may be difficult to focus on correct targets when the user looks for subjects of interest insurveillance videos. P. De Camp et al. [6] designed an interactive browsing and visualization system called House Fly for home-surveillance applications. Manual browsing of millions of hours of digitalized video from thousands of cameras proved impossible writhen a time sensed period but our proposed system is very beneficial for quick browsing of digitalized video.

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

Block diagram of project is as shown in Figure 1.For each short-time segment from surveillance videos, a background model can be constructed under the assumptions of the fixed camera view and the unchanged delighting, and thus the corresponding background images are generated. We employ a background model for executing the difference between the current image and background image [11], to eliminate all same frames. The compact video is the collection of all compact frames. The compact video not only compactly represents for a copious surveillance video but also preserves all essential components of moving objects appeared in the source video. Using our system, the user can spend only several minutes watching the compact video instead of hours monitoring a large number of surveillance videos. This paper is organized as follows,

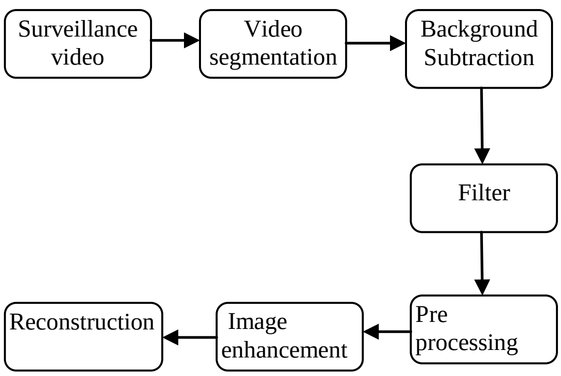

Fig.1.Block Diagram of Project

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III BACKGROUND SUBTRACTION METHOD

The background subtraction [18] 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 motion region [9], and it is generally able to provide data included object information. 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.Therefore, this paper uses an effective method to initialize thebackground, and update the background in real time.

A. Background image initialization:

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 cannot deal with the background image (especially the region of frequent movement) which has the shadow problems. While the method of taking the median from continuous multi-frame can resolve this problem simply and effectively. So the median method is selected in this paper to initialize the background. Expression is as follows:

$$B_{init}(x,y) = median\, f_k(x,y) \qquad k = 1,2,\ldots n \quad (1)$$

Where B_{init} the initial background, n is the total number of frames selected.

B. Background Update

For the background model can better adapt to light changes, the background needs to be updated in real time, so as to accurately extract the moving object. In this paper, the update algorithm is as follows: In detection of the moving object, the pixels judged as belonging to the moving object maintain the original background gray values, not be updated. For the pixels which are judged to be the background, we update the background model according to following rules:

$$B_{init}(x,y) = median\, f_k(x,y) \qquad k = 1,2,\ldots n \quad (1)$$

Where $F_k\ (x,y)$ is the pixel gray value in the current frame? $B_k(x,y)\, and\, B_{k+1}(x,y)$ Are respectively the background value of the current frame and the next frame? As the camera is fixed, the background model can remain relatively stable in the long period of time. Using this method can effectively avoid the unexpected phenomenon of the background, such as the sudden appearance of something in the background which is not included in the original background. Moreover by the update of pixel gray value of the background,the impact brought by light, weather and other changes in the external environment can be effectively adapted.

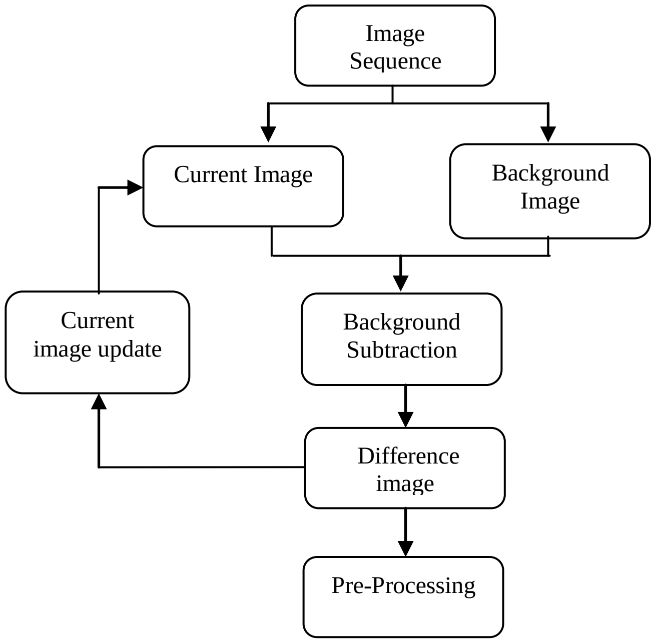
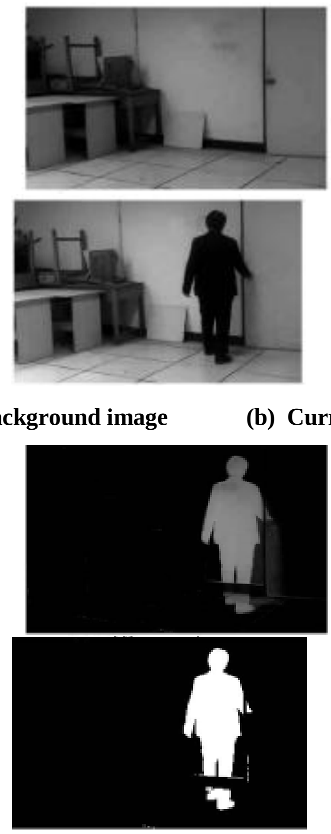


Fig.2.Flowchart of Background Subtraction

C. Pre-processing:

In pre-processing median filter is used to remove the noise from the difference image.



(a) Background image (b) Current image

(c) Difference image (d) Preprocessing

Fig.3. Background Subtraction Output

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IV. COLOUR IMAGE ENHANCEMENT ALGORITHM

The algorithm proposed consists of three major parts:
(1)Obtain luminance image and background image,
(2)Adaptive adjustment,
(3) Colour restoration.

Firstly, we get the luminance image and background image using colour space conversion, and then adaptively adjust the luminance image to compress the colour image dynamic range and enhance local contrast. The intensity level human eyes can identify at one time is small, so the high dynamic range image is intended to be compressed. Contrast enhancement can improve important visual details so that we can get an image with better visibility. Finally, we obtain the enhanced colour image after a linear colour restoration process. The process of colour image enhancement is shown in Fig.4. The luminance image of the original colour image is$I_L(x,y)$we get the background image $I_B(x,y)$ through adaptive filtering. Then, we adaptive adjust in both global and local range to obtain the local enhanced image $I_E(x,y)$ after index transformation and colour restoration we can get the enhanced colour image.

$$I_E(x,y) = \beta(x,y).I_L(x,y) \qquad (1)$$

$\beta(x,y)$ is the function of adaptive regulation.$I_E(x,y)$ is local enhanced colour image, and the enhanced colour image can be obtained after the colour restoration for I_E

A. *Obtain Luminance Image and Background Image*

The colour images we usually see are mostly in RGB colour space, which employ red, green, and blue three primary colours to produce other colours. In RGB colour space, other colours are synthesized by three primary colours, which is not effective in some cases. Consequently, we use another colour space YUV colour space instead of the RGB colour space in the algorithm proposed. The importance of using YUV colour space is that its brightness image Y and chrome images U, V are separate. Y stands for the luminance, and U, V are colour components, which constitute the colour information of colour image. If we remove the U, V images, the original colour image will become a gray image. The intensity of the pixel at (*x*, *y*) is the Y value at the point. Subjective luminance is the logarithmic function of the light intensity into human eyes [10]. We get the logarithmic function of the original luminance image and then normalize it to get the subjective luminance I_L.

$$I_{L(x,y)} = \frac{\log(Y(x,y))}{\log(255)} \qquad (2)$$

Where, *Y*(*x*, *y*) is the Y value of the pixel (*x*, *y*) in YUV space. We use the formula (3) to get the background image.

$$I_B(x,y) = \frac{\sum G_R\ G_N\, N(x,y)}{\sum G_R\ G_N} \qquad (3)$$

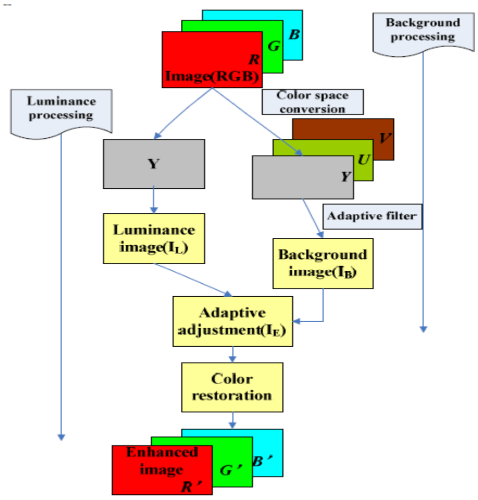

Fig.4.Colour Image Enhancement

The *N*(*x*, *y*) represents the pixel of (*x*, *y*), G_N is the scale parameter of pixel filtering, and G_R is the distance parameter. In classical filter, *N*(*x*, *y*) is the intensity of the pixel (*x*, *y*). But the pixel (*x*, *y*) of colour image has three values in fact, which are Y, U and V values. We usually over look the colour information of colour images in filtering. In the paper, when we get the background image,we take all this three values into consideration. It means that *N*(*x*, *y*) has three components, Y is luminance value, and U, V are colour values. Therefore, to obtain thebackground image, we modify the formula (3) accordingto the Y, U, V values at pixel (*x*, *y*) ,

$$I_B(x,y) = \frac{\sum_{i,j=-W}^{W} G_R\ G_I G_C\, I(x_i,y_j)}{\sum_{i,j=-W}^{W} G_R\ G_I G_C} \qquad (4)$$

$$G_R(x,y,x_i,y_j) = \exp\left\{-\frac{((x-x_i)^2+(y-y_j))}{2\sigma_R^2}\right\} \qquad (5)$$

$$G_I(x,y,x_i,y_j) = \exp\left\{-\left(\mathrm{I}(x,y)-\mathrm{I}(x_i,y_j)\right)/2\sigma_I^2\right\} \qquad (6)$$

$$G_c(x,y,x_i,y_j) = \exp\left\{\frac{\left(U(x,y)-U(x_i y_j)\right)^2 +((V(x,y)-V(x_i,y_j))^2)}{2\sigma_C^2}\right\} \qquad (7)$$

Where,$I(x,y)$ is the intensity at(x,y);$U(x,y)$,$V(x,y)$ are the color values of the pixel (*x*, *y*) ; σ_R σ_I *and* σ_C are the corresponding scale parameters. Transforming the RGB color image into YUV color space, we can get directly the luminance image. Let the YUV color image through the adaptive filter, and the background image can be obtained. Fig.5 shows the example of luminance image and background image.

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Fig.5 the Example of Luminance Image and Background Image: From Up To Down, the Original Image, Luminance Image and Background Image

B. Adaptive Adjustment

The image human eye seeing is related to the contrast between the image and its background image [19]. We enhance the image by making use of the relationship between the image and its background image. We use formula (1) to adaptive adjustment, and define:

$$\beta(x,y) = (a\alpha + b).\omega(x,y) \qquad (8)$$

Where, α is intensity coefficient according to the cumulative distribution function (CDF) of the luminance image $\omega(x, y)$ is the ratio value between the background image and the intensity image. *a* and *b* are constants, we can adjust them to achieve good adjustment results.

$$\alpha = \begin{cases} 0, & g \le 60 \\ (g-60)/130, & (60 < g \le 190) \\ 1, & g > 190 \end{cases}$$

(9)

g is the grayscale level when the cumulative distribution function(CDF) of the intensity image is 0.1. If more than 90% of all pixels have intensity higher than 190, a is 1; when 10% of all pixels have intensity lower that 60, a is0; other times a linear changes between 0 and 1

$$\omega(x,y) = I_B(x,y)\,/I(x,y) \qquad (10)$$

C. Color Restoration

Through index transformation of *I* (*x*, *y*) *E* we can get the image. Subsequently, we use the color restoration to obtain the enhanced color image, which is based on a linear process of the original color image.

$$R'(x,y) = R(x,y)\frac{I'(x,y)}{I(x,y)} \qquad (11)$$

$$G'(x,y) = G(x,y)\frac{I'(x,y)}{I(x,y)} \qquad (12)$$

$$B'(x,y) = B(x,y)\frac{I'(x,y)}{I(x,y)} \qquad (13)$$

R(*x*, *y*), *G*(*x*, *y*),*B*(*x*, *y*) represent the R, G, B values of the original color image, *R*' (*x*, *y*),*G*' (*x*, *y*),*B*' (*x*, *y*) are the R, G, B values of enhanced color image.

D. Image Enhancement Process

Using the algorithm proposed in the paper do experiments and the results are shown in Fig.6.shows the enhanced results for three different color images, and they can have good visibilities by adjusting the parameters. The figures demonstrate that the enhanced color images are effective in retaining color and reducing halo.

V. RECONSTRUCTION

After this in reconstruction, all enhanced frames reconstructed into compact video.

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Fig.6.Enhanced results of using the proposed algorithm. The left are original images, and the rights are enhanced images.

VI. CONCLUSION

In this paper, we are reducing the video length of Surveillance video, by using Quick browsing system. We establish reliable background model for finding the motion between two frames and in pre-processing suppress the unwanted frames and enhance the image by using Adaptive filter, then finally reconstruct all those frames to video. (Quick Browsing system).

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