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A Smart Browsing System with Colour 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 smart 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 by tuning positions of these moving objects. 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.

Keywords *-Input video, Image segmentation, Background Subtraction, Filter, Pre-processing, Indexing, Colour image enhancement, Adaptive filter.*

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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.

In their work, Cheng-Chieh Chiang, Ming-Nan, Huei Fang Yang et al. [1] introduced the quick browsing system for surveillance video. A quick surveillance video browsing system is introduced. 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 by tuning positions of these moving objects. 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 our browsing system and the approach to producing the compact video from a source.

In their work, Shizheng Wang, Jianwei Yang, Yanyun Zhao, Anni Cai, Stan Z.Li et al. [2] proposed a framework for efficient storing and scalable browsing of surveillance video based on video synopsis. The framework employs a novel synopsis analysis scheme named Detail-based video synopsis to generate a set of object flags to store and browse surveillance video synopsis. The main contributions of project work are: 1) highlighting important contents of surveillance video; 2) improving the storage efficiency of original video and synopsis video; 3) realizing multi-scale scalable browsing of synopsis video while reserving essential information.

In their work, Y. Pritch, A. Rav-Acha, and S. Peleg, et al. [3] introduced Nonchronological Video Synopsis and Indexing. They 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 behaviors 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 in surveillance videos.

In their work, Rohit Nair, Benny Bing et al. [4] proposed Video surveillance systems are becoming increasingly popular due to the emergence of high-speed wireless Internet (such as Wi-Max and LTE), bandwidth efficient video compression schemes (such as H.264), and low-cost (and high-resolution) IP video cameras. This presents two applications of an advanced surveillance system, specifically in suspicious activity detection and human fall detection, for both indoor and outdoor environments. The implemented prototype captures and analyzes live high-definition (HD) video that is streamed from a remote camera.

In their work, Lijing Zhang and Yingh Liang et al. [5] proposed the motion human detection based on background subtraction. According to the result of moving object detection research on video sequences, they proposed a new method to detect moving object based on background subtraction. First of all, we establish a reliable background updating model based on statistical and use a dynamic optimization threshold method to obtain a more complete moving object. And then, morphological filtering is introduced to eliminate the noise and solve the background disturbance problem. At last, contour projection analysis is combined with the shape analysis to remove the effect of shadow; the moving human body is accurately and reliably detected. The experiment results show that the proposed method runs quickly, accurately and fits for the real-time detection.

In their work, Fei hui and Xiang-mo Zhao et al. [6] They were described a morphology method for moving body tracking system. They were established a simple technique for dynamic human body tracking based on image sequence. They presented a novel method of template matching and predictive tracking for moving body in clutter background. The method exploits the fact that moving human body changed in approximate rigid parts

In their work, Xinghalo Ding,Xinxin Wang,Quan Xiao et al. [7] proposed the colour image enhancement with a human visual system based on Adaptive Filter by considering the adaptive characteristics of human visual system. The new algorithm is divided into three major parts: obtain luminance image and background image, adaptive adjustment and colour restoration. Unlike traditional colour image enhancement algorithms, the adaptive filter in the algorithm takes colour information into consideration. The algorithm finds the importance of colour information in colour image enhancement and utilizes colour space conversion to obtain a much better visibility. Using the adaptive filter can overcome the inaccurate estimation of background image in traditional technologies. In their work, Meylan L, Susstrunk S. et al. [8] proposed High dynamic range image rendering with a retinex-based adaptive filter. Retinex is an effective technique for colour image enhancement, which can produce a very good enhanced result. But the enhanced image has colour distortion and the calculation is complex.

In their work, Li Tao, Vijayan K.. Asari. et al. [9] Proposed a robbust image enhancement technique for improving image visual quality in shadowed scenes. The algorithm can enhance colour image without distortion, but the edges of the colour image could not be handled well. The algorithm use Gaussian filter to estimate background image. Gaussian kernel function is isotropic, which leads to the inaccurate estimation of background image, resulting in the halo phenomenon.

In their work, Wang Shou-jue, Ding Xing-hao, Liao Ying-hao, Guo dong-hui, et al. [10] proposed A Novel Bio-inspired Algorithm for Colour Image Enhancement, Considering the above two algorithms, a new bio-inspired colour image enhancement algorithm is proposed by the author . The algorithm is based on bilateral filter and has much better effect than the abovementioned two algorithms. However, the image still exhibits halo phenomenon at the edges in spite of the algorithm improving it. In distance and luminance information of pixels are considered in the bilateral filter instead of only considering distance information in Gaussian filter. But the colour information is still not taken into consideration.

In their work, Ms Jyoti J. Jadhav, et al. [11] Moving object detection and Tracking has been widely used in diverse discipline such as intelligent transportation system, airport security system, video surveillance applications, and so on. This paper presents the moving object detection and tracking using reference Background Subtraction. In this method, we used Static camera for video and first frame of video is directly consider as Reference Background Frame and this frame is subtract from current frame to detect moving object and then set threshold T value. If the pixel difference is greater than the set threshold T, then it determines that the pixels from moving object, otherwise, as the background pixels. But this fixed threshold suitable only for an ideal condition is not suitable for complex environment with lighting changes. So that in this paper we used dynamic optimization threshold method to obtain a more complete moving objects. This method can effectively eliminate the impact of light changes.

II. PROBLEM DEFINITION

Surveillance is very useful to governments [1] and law enforcement to maintain social control, recognize and monitor threats, and prevent/investigate criminal activity. Surveillance cameras such as these are installed by the millions in many countries, and are now a days monitored by automated computer programs instead of humans. Surveillance cameras are widely installed in large cities to monitor and record human activities either 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.

III. .NEED OF QUICK BROWSING SYSTEM

The number of surveillance cameras is fast increasing. The Heathrow airport in London has 5,000 surveillance cameras. The number of surveillance cameras will increase worldwide more than 40% per year in the next five years. Due to temporal nature of data storage space consumption problem typically assignment 2-16 cameras, 7 or 30 days of recording is 2-10 Mb / min.1.5 GB per day per camera 20 - 700 GB total. The data management and data retrieval problem occurs. In London bombing video backtracking experience. Manual browsing of millions of hours of digitized video from thousands of cameras proved impossible within time-sensed period.

IV. PRESENT THEORY & PRACTICES

Presently the dynamic video synopsis [3] is used 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 behaviors of the moving objects to form the video synopsis. This 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 in surveillance videos.

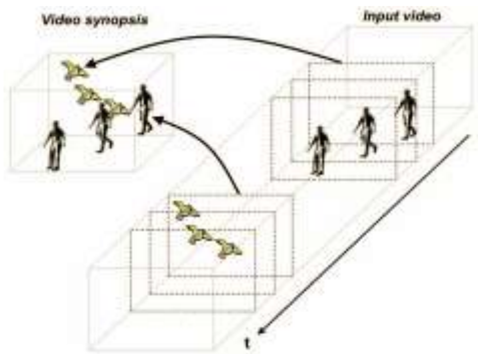

Fig.1 Video Synopsis

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Fig.2 Video Synopsis Image

V. .PROPOSED SYSTEM

In project [1] presents a quick surveillance video browsing system. 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 by tuning positions of these moving objects. The compact video rearranges the spatiotemporal coordinates of moving objects to enhance the compression, but the temporal relationships among moving objects are still kept by using background subtraction. The compact video can preserve the essential activities involved in the original surveillance video. We can easily find out the suspected target by using quick browsing system. The colour image enhancement by using adaptive filter is used to increase the clarity of image.

Block diagram of project is as shown in Figure 3.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 lighting, and thus the corresponding background images are generated. We employ a background model for executing the difference between the current image and background image [4], 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 the follows.

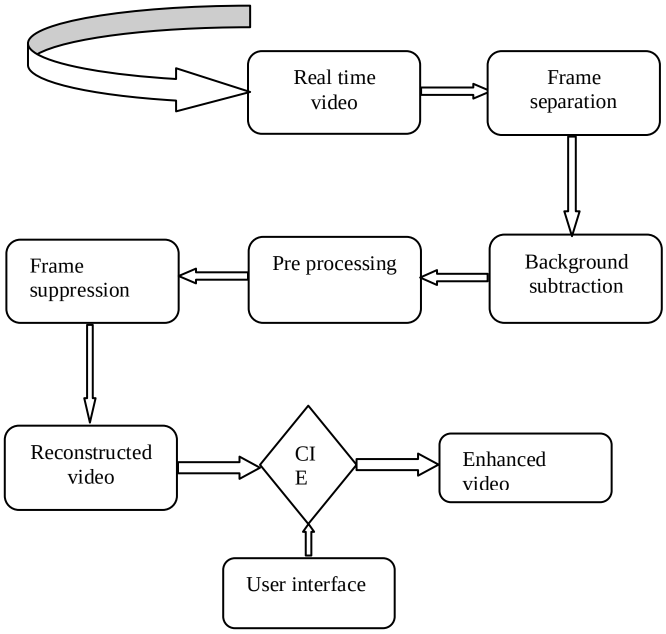

Fig.3 Block Diagram of Smart Browsing System with Colour Image Enhancement

VI. .BACKGROUND SUBTRACTION METHOD

The background subtraction [5] 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, 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 the background, 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:

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

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

B. Background Update:

For the background model can better [6] adapt to light changes, the background needs to be updated in real time, so as to accurately extract the moving object. 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:

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

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.

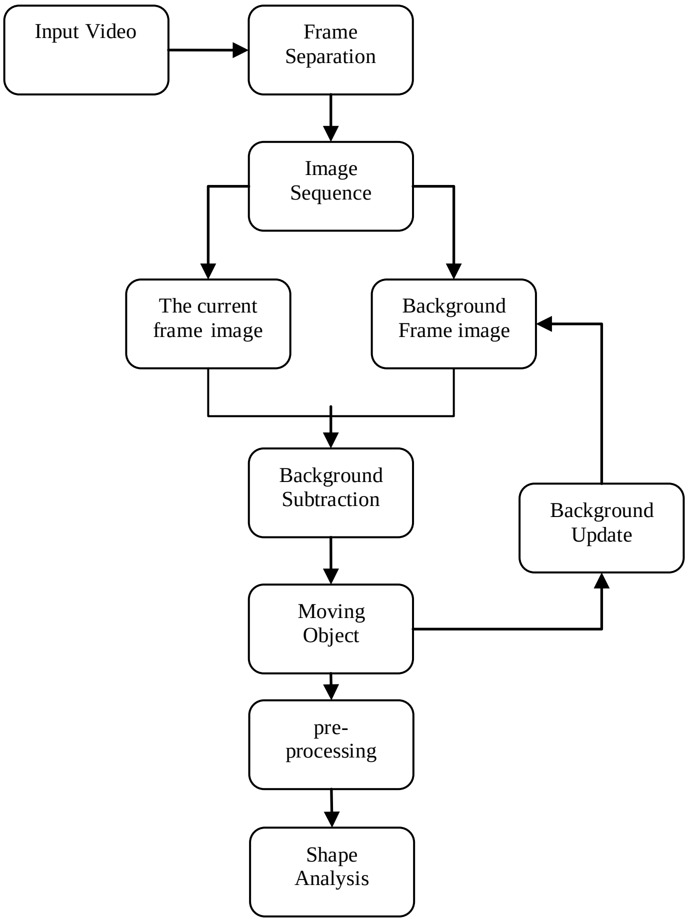

Fig.4 Flowchart of background subtraction

Fig.5 Background image

Fig.6 Current image

Fig.7 Difference & Pre-processing image

VII. COLOUR IMAGE ENHANCEMENT ALGORITHM

The algorithm proposed [7] 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.8.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.

$$I_E(x,y) = \beta(x,y).I_L(x,y) \qquad (3)$$

$\beta(x,y)$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 were moves 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 luminanceI_L.

$$I_{L(x,y)} = \frac{\log(Y(x,y))}{\log(255)} \qquad (5)$$

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.

$$I_B(x,y) = \frac{\sum G_R\, G_N N(x,y)}{\sum G_R\, G_N} \qquad (6)$$

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The $N(x, y)$ represents the pixel of (x, y),G_N is thescale parameter of pixel filtering, and G_R is the distanceparameter. 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 overlook 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 is colour values. Therefore, to obtain the background image, we modify the formula (3) according to the Y, U, V values at pixel (x, y),

$$\boldsymbol{I_B(x,y)} = \frac{\sum_{i,j=-W}^{W} \boldsymbol{G_R\, G_I G_C I(x_i, y_j)}}{\sum_{i,j=-W}^{W} \boldsymbol{G_R\, G_I G_C}} \qquad \textbf{(7)}$$

$$G_R(x,y,x_i,y_j) = \exp\left\{-\frac{((x-x_i)^2 + (y-y_j))}{2\sigma_R^2}\right\} \qquad (8)$$

$$G_I(x,y,x_i,y_j) = \exp\left\{-\left(\mathrm{I(x,y)} - \mathrm{I(x_i,y_j)}\right)/2\sigma_I^2\right\} \qquad (9)$$

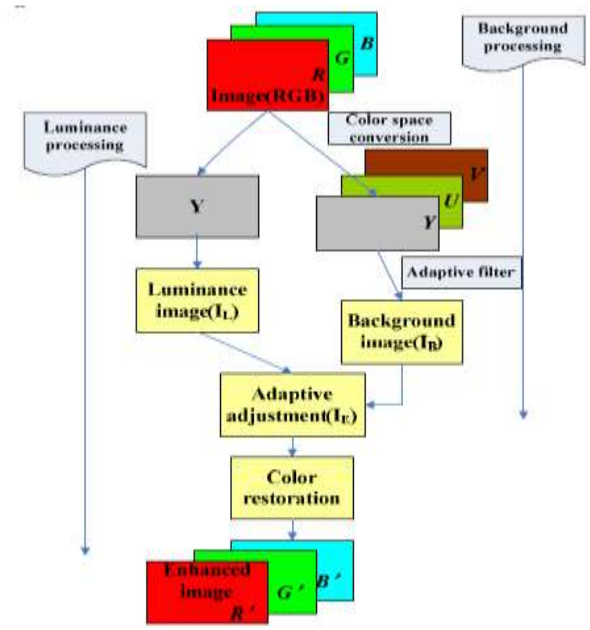

Fig.8.colour image enhancement

Where,$I(x,y)$ is the intensity at(x,y);$U(x,y), V(x,y)$ are the colour values of the pixel (x, y) ;$\sigma_R\ \sigma_I$ *and* σ_C are the corresponding scale parameters. Transforming the RGB colour image into YUV colour space, we can get directly the luminance image. Let the YUV colour image through the adaptive filter, and the background image can be

$$G_c(x,y,x_i,y_j) = \exp\left\{\frac{\left(U(x,y) - U(x_i y_j)\right)^2 + ((V(x,y) - V(x_i,y_j))^2)}{2\sigma_C^2}\right\} \quad (10)$$

obtained.Fig.8 shows the example of 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 [7]. 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:

$$\beta(x,y) = (a\alpha + b).\,\omega(x,y) \qquad (11)$$

Where,α is intensity coefficient according to thecumulative 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.

$$\alpha = \begin{cases} 0, & g \le 60 \\ (g-60)/130, & (60 < g \le 190) \\ 1, & g > 190 \end{cases} \qquad (12)$$

g is the grayscale level when the cumulative distribution function(CDF) of the intensity image is 0.1. If more than90% 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.

$$\omega(x,y) = I_B(x,y)\,/I(x,y) \qquad (13)$$

C. Colour Restoration:

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

$$R'(x,y) = R(x,y)\frac{I'(x,y)}{I(x,y)} \qquad (14)$$

$$G'(x,y) = G(x,y)\frac{I'(x,y)}{I(x,y)} \qquad (15)$$

$$B'(x,y) = B(x,y)\frac{I'(x,y)}{I(x,y)} \qquad (16)$$

$R(x, y)$, $G(x, y)$, $B(x, y)$ represent the R, G, B values of the original colour image, $R'(x, y)$,$G'(x, y)$,$B'(x, y)$ are the R, G, B values of enhanced colour image

Fig.8 Original Image

Fig.9Enhanced Colour Image

VIII. OBSERVATIONS

Here some observations are given from the experimental study of one real time video. Normalized Correlation between input, output and colour image enhanced video is mentioned below. There is change in number of frames, length of video, size of video. As compared to input video the size and length of output video is less. There is lots of difference between the input and output video in all manner. After colour image enhancement also there is no change in the length and size of the output video and the colour image enhanced video.

TABLE.I OBSERVATIONS

Video	Type of video	No of frames	Length of video	Size of video
Input video	AVI Video File (.avi)	200	13 sec	219MB
Output video	AVI Video File (.avi)	34	2sec	42.4 MB
Colour image enhanced video	AVI Video File (.avi)	34	2sec	42.4 MB

IX. CONCLUSIONS

This work is based on background subtraction algorithm. It reduces the video length of Surveillance video. The reliable background model is established for finding the motion between two frames so we can easily collect the moving objects which carry the most significant information and in pre-processing the nose is suppressed. The threshold is set for difference between the background image and current image. If the difference between the background image and current image is greater than threshold then those images are kept and other images are discarded. Then the video of these images is reconstructed. This video is having very small length and requires less memory for storage. Then colour image enhancement by using adaptive filter is applied on the reconstructed video. This algorithm is simple and it reduces halo effect. Finally we get the small video with colour image enhancement**.**

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