A Background Initialization for Video Surveillance

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Abstract

In this paper, a background initialization for video surveillance is proposed. The proposed algorithm is that the background images are sampled n frames during Δt. All sampling frames are divided by $M \times N$ size block every frame. Average values of pixels for same location block of the sampling frames during Δt are taken, then the maximum intensity α and the minimum intensity β is obtained, respectively. The initial status of the background is set up by the range of the α and β. Frame of the present image is divided by $M \times N$ size block, then average intensity η of pixels for the block is obtained. If the average intensity η is out of the initial range of the background image, it is decided the moving object image, and if the average intensity η is included in the initial range of the background image, it is decided the background image. To examine the propriety of the proposed algorithm in this paper, the accuracy and robustness evaluation results for human and car in the indoor and outdoor environment, the error rate of the proposed method is less than the existing methods and the extraction rate of the proposed method is better than the existing methods.

Keyword: Background, Initialization, Intensity, Block Division, Moving Detection

I INTRODUCTION

A video surveillance has emerged as an important research topic in the computer vision community. The growth in this area is being driven by the increased availability of inexpensive computing power and image sensors as well as the inefficiency of manual surveillance and monitoring systems. Applications such as event detection, human action recognition, and semantic indexing of video are being developed in order to partially or fully automate the task of surveillance. Applications of video surveillance require real time motion detection and tracking algorithm[1 4].

The background initialization is a pre processing in the area of moving objects detection and tracking, and video surveillance system. Detection of moving objects is that moving objects are segmented from background. Representative methods of moving objects detection are frame difference method and background difference method.

The frame difference method is that only moving parts are segmented by eliminating stationary parts with obtaining difference between successive frames. This method is easy to eliminate background, however, has a defect which is eliminated stationary objects together. The background difference method is to subtract the current image from a reference image, which is acquired from a static background during a period of time. Typically, it is the usual approach for extracting moving object from the background scene. The method has been used for years in many vision systems as a preprocessing step for moving object detection and tracking. The pixel average intensity or optimal pixel intensity in the accumulated intensities at each pixel over time in the real time input sequence

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has been used for background initialization and modeling in the previous work. Because errors in the background accumulate over time, it is not robust to scene with many moving objects particularly if they stay for a long time or move slowly. The accuracy and efficiency of background modeling as a basic preprocessing is clearly very crucial to video surveillance and tracking system in indoor and outdoor environment. It is therefore needed to research to a method of an adaptive background image with solving problems of the previous work.

In this paper, a background initialization for video surveillance is proposed. The proposed algorithm is that the background image sequences are sampled n frames. The sampling frames are divided by block, then average values of pixels for each block, block is located in same position in each frame, are obtained. The maximum intensity α and the minimum intensity β for the sampling frames is obtained, respectively. α and β is used for the initial status parameters of the background. Frame of the present image is divided by block, then average intensity η of pixels for the block is obtained. If the average intensity η is out of the initial range of the background image, it is decided the moving object image, and if the average intensity η is included in the initial range of the background image, it is decided the background image.

To examine the propriety of the proposed algorithm, it is simulated with 256×256×8bit gray images obtained in indoor and outdoor environment.

II BACKGROUND INITIALIZATION

Let S_t is sampling image of input image sequence that frames of 2 dimensional sequence images are sampled at regular intervals Δt, sampling images $S_{t_1}, S_{t_2}, \ldots, S_{t_n}$ are sampled at $t = t_1, t_2, t_3, \ldots, t_n$. $B_{M,N,n}$ is that sample image S_t is divided by $M \cdot N$ size.

Fig 1. shows that frames of sequence image are sampled at regular intervals Δt and divided by $M \cdot N$ size. Fig 2. shows pixels for a block.

The average intensity for each block is given by equation (1).

$$B_{av\,M,N,n} = \frac{1}{i \cdot j} \sum_{p=1}^{i} \sum_{q=1}^{j} P_{p,q,n} \qquad (1)$$

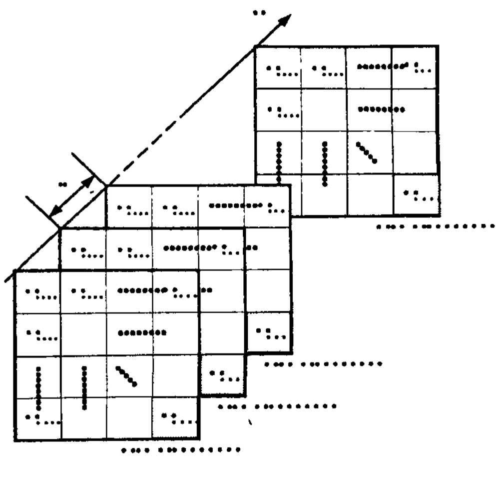


Fig 1. An example of frame sampling

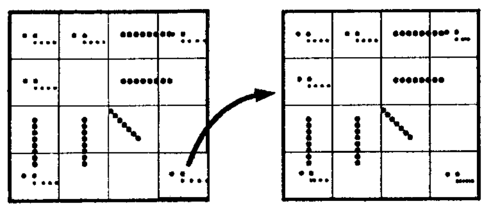


Fig 2. Pixels in a block

Fig 3. shows a graph about average intensity for a block $B_{M,N}$ to n frame. Variation of the graph means intensity variation of pixels for block of background image. The maximum value and the minimum value in fig 3. are defined as the maximum intensity α and the minimum intensity β, respectively. The initial status of the background image is made by using α and β.

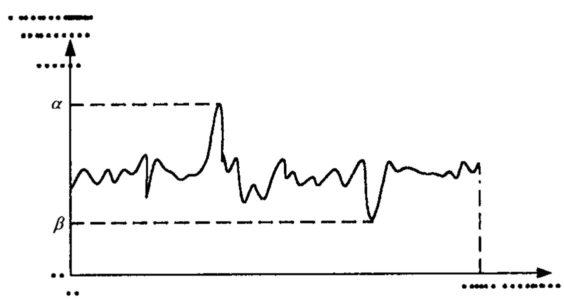


Fig 3. Example of the maximum intensity α and the minimum intensity β for a block

The maximum intensity α and the minimum intensity β can be obtained as follows:

$$B_{initial\,M,N} = B_{max\,M,N} = B_{min\,M,N} = B_{av\,M,N,1} \qquad (2)$$

Block average intensity of the first frame is set up as the initial value of the maximum intensity and the minimum intensity in equation (2).

$$B_{max\,M,N} = \begin{cases} B_{avrM,N,n}, & \text{if } B_{initialI\,M,N} < B_{avrM,N,n} \\ B_{initialI\,M,N}, & otherwise \end{cases} \quad (3)$$

$$B_{min\,M,N} = \begin{cases} B_{avrM,N,n}, & \text{if } B_{initialI\,M,N} > B_{avrM,N,n} \\ B_{initialI\,M,N}, & otherwise \end{cases} \quad (4)$$

where $n>2$.

The block maximum intensity $B_{max\,M,N}$ is obtained by choosing the maximum value among the block average intensities to n frame in equation (3). If the initial value of equation (2) is less than block average intensity in input image, $B_{avrM,N,n}$ is the maximum intensity, otherwise $B_{initialI\,M,N}$ is the maximum intensity. The block maximum intensity $B_{min\,M,N}$ is obtained by choosing the minimum value among the block average intensities to n frame in equation (4). If the initial value of equation (2) is more than block average intensity in input image, $B_{avrM,N,n}$ is the minimum intensity, otherwise $B_{initialI\,M,N}$ is the minimum intensity. The initial status of the background image is the maximum intensity α and the minimum intensity β as equation (5) and (6).

$$\alpha_{M,N} = B_{max\,M,N} \quad (5)$$

$$\beta_{M,N} = B_{min\,M,N} \quad (6)$$

Let frame of the present image is $F_{current}$, and let the divided image that $F_{current}$ is divided by block of $M \times N$ size is $B_{current\,M,N}$. If the average intensity of $B_{current\,M,N}$ is η, we can define η as equation (7).

$$\eta_{M,N} = \frac{1}{i \times j}\sum_{p=1}^{i}\sum_{q=1}^{j} P_{p,q} \quad (7)$$

Moving object extraction is accomplished by equation (8).

$$B_{current\,M,N} = \begin{cases} background\ blocks, & \beta_{M,N} \le \eta_{M,N} \le \alpha_{M,N} \\ moving\ object\ blocks, & otherwise \end{cases} \quad (8)$$

If the average intensity η is out of the initial range of the background image, it is decided the moving object image, and if the average intensity η is included in the initial range of the background image, it is decided the background image in equation (8). Flowchart of the moving object extraction is shown in Fig 4.

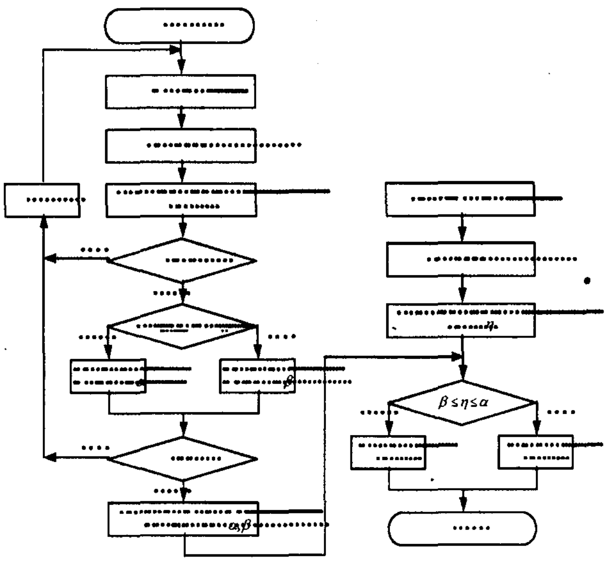
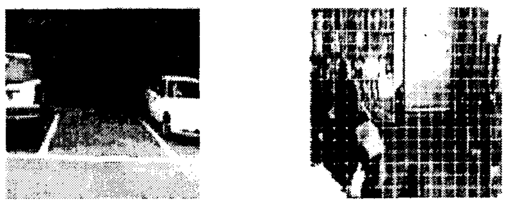


Fig 4. Flowchart of the proposed algorithm

Ⅲ SIMULATIONS

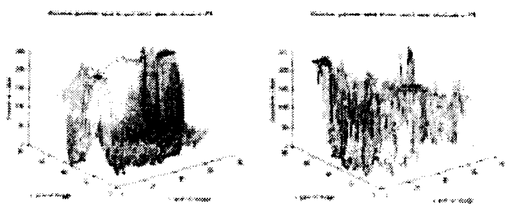
To examine the propriety of the proposed algorithm in this paper, it was simulated with 256×256×8bit gray images obtained in indoor and outdoor environment. Sampling rate of the input image is 30fps, and background images of 300 frames was used for the initialization of background.

Fig 5. shows that sampling frame is divided by $M \times N$ block. Fig 6. shows block maximum intensity $B_{max\,M,N}$, and Fig 7. shows block maximum intensity $B_{min\,M,N}$ in the outdoor and indoor environment, respectively. Fig 8. shows frame of the present image. Fig 9. shows the extracted image of the moving object.



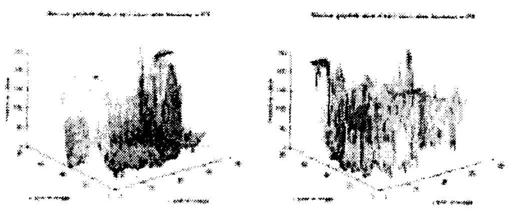
(a) outdoor (b) indoor

Fig 5. Block division image



(a) outdoor (b) indoor

Fig 6. Block maximum intensity $B_{max\,M,N}$



(a) outdoor (b) indoor

Fig 7. Block maximum intensity $B_{min\,M,N}$

(a) outdoor (b) indoor

Fig 8. Input image

(a) outdoor (b) indoor

Fig 9. Extraction image of the moving object

Ⅳ CONCLUSIONS

In this paper, a background initialization for video surveillance is proposed. To examine the propriety of the proposed algorithm, the simulated results show that the error rate of the proposed method was less than the existing methods and the extraction rate of the proposed method was better than the existing methods. The results of this paper can be utilized for traffic control system, security system, video conference system, and video surveillance system, etc.

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