IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 5, May 2018

Wavelet Transform Based Moving Object Detection in Video Surveillance System

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Abstract: Automatically performance of video surveillance system is an important research area in the commercial sector. Visual surveillance and monitoring of human activity requires people to be tracked as they move through a scene and tracking a moving object through a captured video. A new method for detecting and tracking moving objects based on wavelet transform and background subtraction algorithm and identifying the moving objects. By using wavelet transform can divide a frame into four different frequency bands without loss of the spatial information. Localization in both frequency and time/spatial domains is the greatest advantage of wavelet transform over Fourier transform based methods. The algorithm uses Background Subtraction. The proposed model has proved to be robust in different types of static background scenes. The Experimental results prove the feasibility of the proposed methods.

Keywords: Wavelet Transform, Background subtraction algorithm, Video surveillance system, Background model.

I. INTRODUCTION

Video surveillance and monitoring system has a rich history. Technology has reached a stage where mounting cameras to capture video imagery is cheap, but finding available human resources to sit and watch that imagery is expensive. Surveillance cameras are already common in commercial establishments. After a crime occurs, a store is robbed or car is stolen, investigators can reach the place but then of course it is too late. What is needed is a 24-hour monitoring and analysis of video surveillance data to alert security officers to a burglary in progress. Keeping the track of people, vehicles, and their interactions in an urban or battlefield environment is a difficult task. Multiple objects tracking represent the essence of any video surveillance system. The knowledge of the positions of the moving objects is mandatory to understand the situations in the visual environment of the surveillance system. Therefore, the tracker requires the analysis of video sequences in order to trace the evolving position of each object in each frame. In this paper, a new method for detecting and tracking multiple moving objects based on wavelet transform is proposed. Discrete wavelet transform has a property that it decompose original image into four-sub band images. The four-sub images that wavelet transform preserves not only the frequency features but also spatial features. After discrete wavelet transform take place, spatial localization implies that coefficients in a certain position at the wavelet sub-images correspond to the details of different frequencies in the corresponding spatial location. When original image is decomposed into four sub band images, it has to deal with row and column separately.

II.MOVING OBJECT DETECTION AND TRACKING

A.Discrete wavelet transform

Discrete Wavelet Transform (DWT) based on sub-band coding is found to yield a fast computation of Wavelet Transform. Wavelet transform provides a special basis that a signal can express easily and efficiently. Thetwo-dimensional (2-D) DWT has a gained popularity in the field of image and video coding since it allows good complexity –performance trade-offs. A 2D DWT of an image is shown in Fig. 1. If image size is less than 320 proposed methods used one-dimensional (1-D) DWT but if image size is greater than equal to 320 and less than 640 proposed methods used 2-D dimensional DWT otherwise three dimensional (3-D) DWT is used. Two dimensional DWT can be used to decompose an image into four sub-images. The four sub images that the wavelet transform preserves not only the frequency features but also spatial features. Filters are applied in one dimension first, vertically or horizontally and then in other dimension as shown in fig. 1.

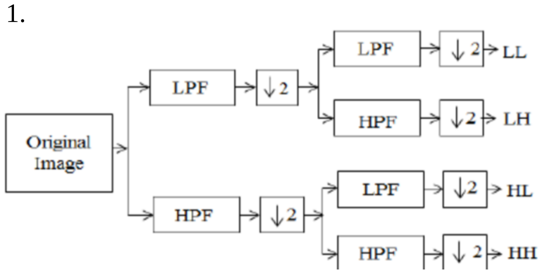

Fig1.DWT Image Decomposition

When the original image decomposed into four-sub band images it has to deal with row and column separately. First, the high-pass filter G and low pass filter H are exploited for each row data, and then down sampled by 2 to get high and low frequency components of the row. Next, the high and the low pass filters are applied again for each high- and low-frequency components of the column, and then are down-sampled by 2. By way of above processing, the four sub band images are generated: HH, HL, LH, and LL. Each sub band image has its own features, such as the low-frequency information is preserved in the LL-band and the high frequency information is almost preserved in the HH-, HL-, and LH-bands. The LL-sub band image can be further decomposed in the same way for the second level sub band image. In the proposed method, only low frequency information is used for processing due to the consideration of low computing cost and noise reduction.

B. Background subtraction

Object detection can be done by using background model which has a static information. If there is a deviation of captured video from background model is a part of moving object.

C. Background Image Initialization

There are many methods to obtain the initial background model. For example, the average pixel brightness of the first few frames as the background or with the first frame as the background directly, or using a background image sequences without the use of moving objects to estimate the background model parameters and so on. From these methods, the time average method is the mostly used method of the obtaining of an initial background however, this method cannotuse with the background model (especially the region of frequently changed movement) which has the shadow problems. While by taking the median from continuous multi-frame can resolve shadow problem simply and effectively. So the median method is selected in this paper to initialize the background. Expression is as follows:

$$Binit\ (X, y) = median\ fk\ (x, y)\ k = 1, 2,''\cdot n$$

Where Binit is denoted as initial background, n is denoted as total number of frames selected.

D. Background Update

Background model needs to adapt to light changes therefore the background model needs to be updated in real time,so we can accurately extract the moving object. In this paper, the algorithm for update background model is as follows:In process of detection of the moving object, the pixels are observe whether that are part of the moving object maintain the original background gray values, not be updated. The pixels which are part of background model, we update the background model according to following rules:

$$Bk+1(x, y) = \beta Bk(x, y) + (1-\beta)\ Fk(x, y)$$

Where β belongs to (0, 1) is update coefficient, in this paper f3 = 0.004. Fk(x, y) is current frame's pixel gray value in the captured video. Bk(x, y) and Bk+1(x, y) are respectively the background value of the current frame and the next frame.Camera is in fixed position, the background model can remain relatively stable in the long period of time. The main purpose of this method is to avoid unexpected objects in background model such as the sudden appearance of something in the background which is not included in the original background. The impact of light, weather, changes in environment can be effectively adapted by updating of pixel's gray value of the background.

E.Moving Object Extraction

Background subtraction is a regular method which separates the moving object within a frame. The method contains reducing an image containing the object found in the earlier background image and has no important foreground objects. The region found within the image plane where a noticeable contrast can be seen in these images shows the location of the pixel of the object in motion. Expressed by clusters of pixel, the objects are disjoined from the background image with the use of the threshold method. When the background image beta k(x, y) is retrieved, it is deducted from the existing frame f k(x, y). In the event that the pixel distinction is large compared to the set threshold Th, the pixels then appear in the objects in motion. If this does not occur, they appear as background pixels within the frame. If pixel value is greater than threshold value then considered as object is in motion otherwise object is in stationary position.

F. Removal of Noise

The variation in the image obtained includes the noise amount in addition to the region of motion. These noises may or may not be contained in the illumination changes or environmental factors during transmitting the video from the camera. Disadvantages of background algorithm is that images obtain after performing all operation it gets some noise or shadowed images. Hence noise to be removed from the output using median median filter with the 3 X 3 window for filtering some noise. Filtering provides result along with human motion it include moving cars, flying. Birds, flowing clouds and swaying trees and other non-body parts. For further processing morphological processing works.Corrosion

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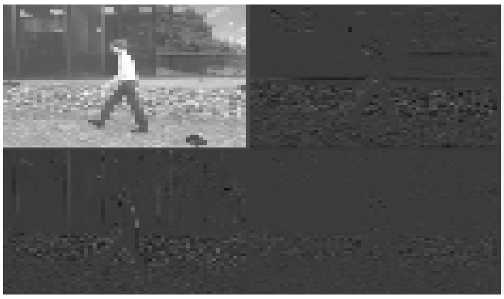
and dilation processes are used to filter out non-human activity areas and filter out most of the non-body motion regions while preserving the shape of human motion without injury respectively. Some isolated spots of the image and some interference of small pieces are eliminated, and we get more accurate human motion region after morphological processing.

III.EXPERIMENTAL RESULT

Following images shows results for moving object detection using background subtraction algorithm. Here we used static camera to capture video images Fig.2 shows captured video. For object detection we subtract reference background frame from current frame with some object so we get subtracted frame means difference between original image and current image. Moving Object detection result using simple background subtraction method.

Fig 2. Captured VideoFig 3.Reference Image



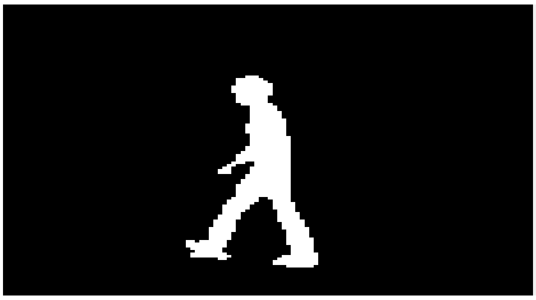


Fig 4.Wavelet Transformed image Fig 5.Result of Background Subtraction

IV. CONCLUSION

Nowadays visual surveillance system has been used in many areas. All video surveillance system used in this field can be treated as adjusting systems because it can be used for many of the applications without changing hardware but only slight changes in the algorithms. Our system can detect human using background subtraction algorithm and used wavelet transform to get accurate result. It is used in many applications such as occlusion detection, crowd detection, and crowd density estimation etc. In the presence of dense crowd, accurate counting of people is troublesome if single camera is used. To deal with this, we proposed advance crowd detection in a frame before it actually happened.

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DOI 10.17148/IJARCCE.2018.7552