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Moving Object Detection Using Median Filter For Video Surveillance

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Abstract:

Video surveillance has been a very active research topic in the last few years due to its growing importance in security, law enforcement, and military applications. This work presents moving object detection based on complex wavelet based moving object segmentation using similar median filter based method. The proposed method is dealing with the drawbacks such as shadows and noise present in other spatial domain methods. The performance of the proposed method is examined and compared with other standard spatial domain methods. The various performance measures used for comparison include RFAM (relative foreground area measure), MP (misclassification penalty), RPM (relative position based measure), NCC (normalized cross correlation) and the various methods are tested on standard Pets dataset. Finally, The proposed simulated result shows that used methodologies for effective object detection has better accuracy rather than existing methods.

Keywords:
similar median filter; Daubechies complex wavelet transform; Video object segmentation; Video Surveillance.

1. INTRODUCTION:

Surveillance is the monitoring of behavior. Systems surveillance is the process of monitoring the behavior of people, objects or processes within systems for conformity to expected or desired norms in trusted systems for security or social control. The word surveillance is commonly used to describe observation from a distance by means of electronic equipment or other technological means.


Fig.1 Example of CCTV camera

At a basic level, computers are a surveillance target because large amounts of personal information are stored on them. Anyone who can access or remove a computer can retrieve information. If someone is able to install software on a computer system, they can turn the computer into a surveillance device. Closed circuit television is a collection of video cameras used for video surveillance. CCTV is generally used in areas where there is an increased need for security, such as banks, airports, traffic centers and town centers. A basic CCTV system comprises of the Camera, lens and power supply. Recording device VCR or a digital video recorder and monitor. Closed circuit television (CCTV) is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. The main tasks in visual surveillance systems include motion detection, object classification, tracking. Our focus here is on the detection phase of a general visual surveillance system using static cameras. The usual approach for moving object detection is through background subtraction that consists in maintaining an up to date model of the background and detecting moving objects as those that deviate from such a model. The background image is not fixed but must adapt to: Illumination changes, sudden (such as clouds), Motion changes, camera oscillations, high-frequencies background objects (such as tree branches, sea waves, and similar) Changes in the background geometry.

2. RELATED WORK:

Several problems arise while segmenting the video sequences because of changing background, clutter, occlusion, varying lighting conditions, automatic operation, adverse weather conditions such as fog, rain, snow, camera angle, and real time processing requirements etc. The segmentation techniques into six groups: - Threshold based techniques, Pixel classification based techniques, Range image segmentation, Colour image segmentation, Edge detection based segmentation and techniques based on fuzzy set theory.

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According to Cheung and Kamath [6], background adaptation techniques could also be categorized as: 1) no recursive and 2) recursive. A non-recursive technique estimates the background based on a sliding-window approach. Various interesting video object segmentation techniques can be found in literature [1-5] such as Running Gaussian Average , Temporal Median Filter , and Mixture of Gaussians. These methods are either too time consuming (like GMM with online EM algorithm) or too space consuming (like Temporal Median Filter proposed in .All the methods discussed as above for the segmentation of moving objects suffer from the problem of either slow speed or inaccurate segmentation of moving object due to non-removal of noise in consecutive frames. The other limitations include detection of only moving object and the presence of ghosts like appearances in segmented object.

Cheng et al. [11] proposed a discrete wavelet transform (DWT) based method for approach, inter-frame differencing method is used for segmentation of moving object in DWT domain. DWT based methods are shift-sensitive. Any shift sensitive method will not give good results for video applications because in video applications, objects are present in shifted form. Motivated by these facts, a new method for video segmentation using discrete wavelet domain is proposed in this paper. The Discrete wavelet transform have advantages of shift invariance and better directional selectivity as compared to DWT. The performance of the proposed method is compared with other standard methods available in literature such as Frame Difference, Background subtraction.

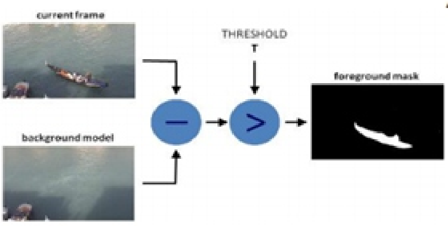

Fig. 3 Example of Background subtraction method.

OUTPUT RESULT FOR RELATED WORK

(a) Image 1

(b) image2

(c) image 3

Image (a),(b) and (c) are the input images of the video sequence and corresponding ouput are shown in the below images (d),(e) and (f).

(d) image 4

(e) image 5

(f) image 6

3. PROPOSED SYSTEM:

The proposed method is an approximate median filter based method in Daubechies complex wavelet domain. It uses frame differencing for obtaining video object planes which gives the changed pixel value from consecutive frames. First, we decompose two consecutive frames (In-1 and In) using complex wavelet domain and then apply approximate median filter based method to detect frame difference. For every pixel location (i, j) the co-ordinate of frame .

$$FD_n(i,j) = wI_n(i,j) - wI_{n-2}(I,j) \qquad (1)$$

where (,) WI i j n and 1(,) WI i j n− are wavelet coefficients of frame (,) n I i j and 1(,) n I i j − respectively. Obtained result may have some noise. Applying soft thresholding to remove noise. In presence of noise, equation (1) is expressed as:

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$$FD_n(i,j) = FD_n(I, j) - \lambda \quad (2)$$

Where FD_n (i j) is frame difference without noise, λ represent corresponding noise components. For de-noising, soft thresholding technique [17] in wavelet domain is used for estimation of frame difference FD_n(I, j). After noise removal, Sobel edge detection operator is applied on FD_n(I, j) to detect the strong edges of significant difference pixels in all sub-bands as follows:

$$DE_n(I, j) = \text{sobel}\ (FD_n(I,j)) \quad (3)$$

After finding edge map $DE_n(i,j)$ in wavelet domain, inverse wavelet transform is applied to get moving object segmentation in spatial domain i.e. En. The obtained segmented object may include a number of disconnected edges due to non-ideal segmentation of moving object edges. Therefore, some morphological operation is needed for post processing of object edge map to generate connected edges. Here, a binary closing morphological operation as described in [18] is used. After applying the morphological operator ( ) M En is obtained which is the segmented moving object, and finally temporal updating of the background model is needed in order to adapt the changes in background and in lighting conditions as follows:

$$if\ (I_n(I, j) > I_{n-1}(i,j)) \quad (4)$$
$$I_{n-1}(I, j) = I_{n-1}(I,j)+1 \quad (5)$$

$$\text{Else } I_{n-1}(I, j) = I_{n-1}(I, j) - 1 \quad (6)$$

Here In(I, j) is the value of (i, j)th pixel of nth frame and 1 In(I, j) − is the value of (i, j)th pixel of (n-1) th frame

The process algorithm is described as follow:
1. Input video
2. Frame Separation
3. Image Sequence
4. Separation of Image Sequence in Current Frame Image and Background Frame Image
5. Apply complex wavelet transform for both background and current image
6. Sub band Differencing
7. Soft threshold
8. Inverse complex wavelet transforms
9. Threshold for foreground detection
10. Noise removal
11. Morphological filtering
12. Detection of Moving Object
13. Performance measurement (Similarity/MSE/PSNR/Correlation)

4. EXPERIMENTS AND RESULT:

In this work the aim is to build such a surveillance system, which will detect motion even if the moving background, gradual illumination variations and camouflage and shadow into the background, thus achieves robust detection for different types of videos taken with stationary cameras. To fulfill this aim , a strong computing software called Matlab is used. Matlab provides image Acquisition and Image Processing Toolboxes which facilitate us in creating a good code.Experimental results for moving object detection using the proposed methods have been produced for input video, that represent typical situations critical for video surveillance systems, and present qualitative results obtained with the proposed method and other three methods also. Efficiency in terms of accuracy is better than other methods.

(h) Image 7

Image 7 shows the input of the image which recognize the moving objects as final results It shown in below figures (i),(j),(k) and (l)

(i)Image 8

(j) image 9

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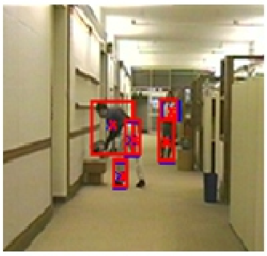
(k) image 10



(l) image 11

4. PERFORMANCE EVALUATION:

It can be observed from the results that none of the previously proposed segmentation algorithms give accurate segmentation result as compared to ground truth frames. In this paper, the performance of the proposed method has been compared quantitatively with other state-of-the-art methods. The proposed system is experimented with different settings of adjustable parameters which can be used for performance evaluation. Performance of the proposed method is found better in terms of visual performance and a number of quantitative measures viz. MSE, PSNR, correlation coefficient and similarity This section outlines the set of performance evaluation metrics that have implemented in order to quantitatively analyze the performance of object detection methods. For measuring accuracy we adopted different metrics,

A.Mean Square Error (MSE) and Peak Signal to Noise ratio(PSNR) :

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:

$$MSE = \sum_{M,N} \left[\frac{(I_{1(M,N)} - I_{2(M,N)})}{M * N} \right]$$

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

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

The PSNR between two images having 8 bits per pixel or sample in terms of decibels (dBs) is Generally when PSNR is 40 dB or greater, then the original and the reconstructed images are virtually indistinguishable by human observers . In this equation, R is the maximum fluctuation in the input image data type. For example, if the input image has a double precision floating-point data type, then R is 1. If it has an 8-bit unsigned integer data type, R is 255, etc.

B. Correlation coefficient:

This gives statistical relationship between two or more random variable or observed data values. This computes the correlation coefficient between A and B, where A and B are matrices or vectors of the same size.

C. Similarity:

We considered the pixel-based Similarity measure as

$$\text{Similarity} = \frac{t_p}{t_p + f_n + f_p}$$

Greatest value of similarity shows accurate detection of moving object.

5. CONCLUSION:

In video surveillance, there are many interference factors such as target changes, complex scenes, and target deformation in the moving object tracking. In this paper moving objects detection using discrete wavelet transform domain have been proposed. The performance of the proposed method have been evaluated and compared with other standard methods in consideration in terms of various performance metrics. From the obtained results and their qualitative and quantitative analysis, it can be concluded that the proposed method can reduce noise and occlusion problems and well as it also capable of alleviating the problems associated with other spatial domain methods such as ghosts, clutters, noises etc. used . Future work will address on techniques to get better results to improve the human detection methods and occlusion handling in surveillance applications.

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TABLE 1 : Values of RFAM, MP, RPM and NCC for test case of video sequence.

No of frames	Different Measures	McFarlane and Schofield	Kim et	Oliver et	Liu et	Stauffer And Grimson	Zivkovi	Proposed method
125	RFAM	0.8219	0.4220	0.1045	0.0582	0.2413	0.57074	0.8745
	MP	0.0011	8.1778e-004	0.0011	0.0011	0.0151	0.0058	7.6967e-004
	RPM	0.9214	0.9537	0.8993	0.8965	0.6789	0.8091	0.9688
	NCC	0.8995	0.3598	0.3147	0.3065	0.9201	0.8913	0.9804
175	RFAM	0.8883	0.5719	0.6239	0.5988	0.2867	0.5266	0.9534
	MP	2.0797e-004	0.0067	0.0027	0.0027	0.0088	0.0025	1.4904e-004
	RPM	0.9576	0.8328	0.8460	0.8460	0.7920	0.8941	0.9626
	NCC	0.8747	0.3692	0.4045	0.3919	0.9760	0.9622	0.9777
200	RFAM	0.9167	0.5084	0.8336	0.8132	0.2962	0.5656	0.9026
	MP	2.1236e-004	0.0189	4.5552e-004	4.5552e-004	0.0153	0.0082	5.8910e-005
	RPM	0.9834	0.6775	0.9470	0.9470	0.7074	0.7939	0.9824
	NCC	0.7894	0.3890	0.4830	0.4713	0.8003	0.7150	0.8364