

Effective Moving Object Detection Using Background subtraction in Complex Wavelet Transformation

¹S.Rosi, ²W.Thamba Mescach

^{1,2}Computer Science Engineering

PITAM, Chennai, India

¹rosi.june22@gmail.com, ²thmbamescach.cse@prathyusha.edu.in

Abstract— The analysis of human body motion is an important method. This method is widely used in motion detection, motion analysis, intelligent control and many other fields. In the analysis of human body motion; the moving human body detection is important part. The moving human body is detected from the background image in video sequences. In this letter; we propose a complex wavelet transformation domain scheme for videos with moving background and static cameras. This scheme suggests two different methods; the first model is background subtraction and second model is background updating model to extracts the object based on thresholding. The strength of the scheme lies in its simplicity and defines transformation domain to transform the image from time domain to frequency domain to accommodate illumination variation as well as motion in the background. After getting moving object to remove to remove the noise morphological filtering is done. The noise in the form of disturbances which present in the background. The background subtraction method is accurate, faster and fits in detecting real time environment. The performance metrics such as sensitivity, peak signal to noise ratio, root mean square error, and correlation coefficient of the object detected is measured.

Keywords - background subtraction; background updating model; thresholding; simplicity.

I. INTRODUCTION (HEADING 1)

Video surveillance is the monitoring behavior, activities (or) other changing information usually of the people for the purpose of influencing, managing, directing or protecting them. Video surveillance is useful to government and law enforcement to maintain social control, recognize and monitor threats and prevent/investigate criminal activity. Object detection and tracking in video is a challenging problem. It has application in numerous fields such as video compression, video surveillance, video indexing and retrieval etc. Object detection and tracking are two closely related processes. Object detection can be performed through various approaches such as region based segmentation, background subtraction, temporal differencing etc. Object detection is performed to check existence of objects in video and to precisely locate that object. The detected object can be classified in various categories such as humans, vehicles, birds, floating clouds, sawing tree, and other moving object. Sally surveillance system video sequences are generally obtained through static cameras and fixed background. In most of the suggested scheme, the object detected is accompanied with misclassified foreground objects due to illumination variation or motion in the background. Moreover, shadows are falsely detected as foreground objects during object extraction. Presently an additional step is carried out to remove these misclassified object and shadows for effective object detection. To alleviate this problem, we propose a simple but efficient object detection technique which is invariant to illumination variation as well as motion in the background. There are two types of methods mainly used in moving object detection. The methods are frame separation and the background subtraction method. In the frame separation method the difference between two consecutive images is taken to determine the presence of moving object. The background subtraction method is the method in which the difference between the current image and background image is taken for the detection of moving objects by using simple algorithms. One advantage of this method is, it can provide the most complete object information in the case of the background is known. The background is updated on the basis of accurate detection of object. The rest of the paper is organized as follows: section 2 describes some of the related works. In section 3 the proposed methods are presented. Section 4 deals with the concluding remarks.

II. RELATED WORKS

For object detection in surveillance system background models plays a vital role. The direct LL mask band scheme (DLLBS) is used for moving object detection and tracking using low resolution image [1]. The DLLBS (Direct LL mask band scheme) method can effectively reduce this noise, with low computing cost, in both indoor and outdoor environments. Together with DLLBS and CPR (characteristic point recognition), the problems associated with occlusions are alleviated. With a combination of DLLBS and CPR can accurately track various types of obstructed movements. This DLLBS is suitable for real time video surveillance system applications such as object classification and the descriptive behavior of objects. Video surveillance system for the purpose of security has been developed. Many researches try to develop intelligent video surveillance systems [2]. The intelligent video surveillance can detect moving object in its initial stage and subsequently process the function such as object classification, object tracking, and object behavior descriptions. The accurate location of the moving object does not only provide a focus of attention for post processing but can also reduce the redundant computation for the incorrect motion of the moving objects. The background subtraction algorithm is used to detect foreground objects and apply shadow detection algorithm to remove shadows [3]. The background subtraction and shadow detection is used in both indoor and outdoor environment and does not require color cameras. Background detection technique may use gray scale or color images, shadow detection methods make use of chromaticity information. Koller's [4] car tracking system used an adaptive background model based on monochromatic images filtered with Gaussian and Gaussian derivative (vertical and horizontal) kernel. A background model proposed by McKenna combines pixel RGB (Red Green Blue) and chromaticity values with local image gradients. In their W4 system, gray scale images were used by Haritaoglu and collaborators [6] to build a background model, representing each pixel by three values such as its minimum intensity values, maximum intensity values, and the maximum intensity difference between consecutive frames observed during the training period. A non parametric model proposed by Elgammalel [7] based on kernel estimators that can be used to both color and gray scale images. A color image was used by KaewTrakulPong and Bowden [8] for background representation. In their method, each pixel in the scene is modeled by a mixture of Gaussian distributions (and different Gaussians are assumed to represent different colors). Cucchiara's group [9] used temporal median filter in the RGB color space. Shadow detection algorithms have also been widely explored by several authors, mostly based on invariant color features that are not significantly affected by illumination condition.

Salvador [10] adopted the $c1c2c3$ photometric invariant color mode. And explored geometric features of shadows. A few authors [11, 12, 13, and 14] were showed shadow detection in monochromatic video sequences, used in mind applications such as indoor video surveillance and conferencing. Basically, they detect the penumbra of the shadow, assuming that edge intensity of a TUAL moving objects. Clearly, such hypothesis does not used for video sequences containing low-contrast foreground objects especially in outdoor applications. More about background subtraction and shadow removal can be found in [15, 16]. Also, there is several shadow detection algorithms to remove undesired segmentation of cast shadows in video sequences.

However, in accordance with other authors [9,6], we choose to use a background model based on median filtering because it is effective and require less computational cost than the Gaussian or other complex statistics. The background model is improved in [6], and included a novel shadow detection algorithm that is effective for both indoor and outdoor applications. When proposed a method to model the background independently at each pixel location which is based on computation of Gaussian probability density function (pdf) on the previous pixel values [17].

The complex procedure was developed by Stauffer and Grimson to accommodate permanent changes in the background scene [18]. Here a mixture of three to five Gaussians modeled each pixel. Haritaoglu's W4 model is a simple and effective method [6]. It uses three values to represent each pixel in the background images namely, the minimum intensity, the maximum intensity, and the maximum intensity difference between consecutive frames of the training sequences. A small improvement was brought by Jacques to the W4 model together with the incorporation of a technique for shadow detection and removal [3]. McHugh proposed an adaptive thresholding technique by means of two statistical models [19]. One of them is nonparametric background model and the other one is foreground model based on spatial information. In Vibe, each pixel in the background can take values from its preceding frames in same location or its neighbor [20]. Then it compares this set to the current pixel value in order to determine whether that pixel belongs to the background, and adapts the model by choosing randomly which values to substitute from the background model.

From the existing literature, it is observed that most of the simple scheme is ineffective on videos with illumination variation, motion in the background, and dynamically textured indoor and outdoor environments etc. on the other hands, such videos are handled by complex schemes with higher computational cost. Furthermore, to remove misclassified foreground object and shadows, additional computation is also performed. Keeping in this view, we suggest here a simple domain called complex

wavelet transformation domain (CWT) that models the updated background by comparing the current frame with the previous frame.

III. FRAME SEPERATION

Frame processing is the first step in the background subtraction algorithm, the purpose of this step is to prepare the modified video frames by removing noise and unwanted objects in the frame in order to increase the amount of information gained from the frame. Preprocessing of a image is a process of collecting simple image processing tasks that change the raw input video info into a format. Preprocessing of the video is necessary to improve the detection of moving object's. for example; by spatial and temporal smoothing, snow as moving leaves on a tree, can be removed by morphological processing of the frame after the identification of the moving object.

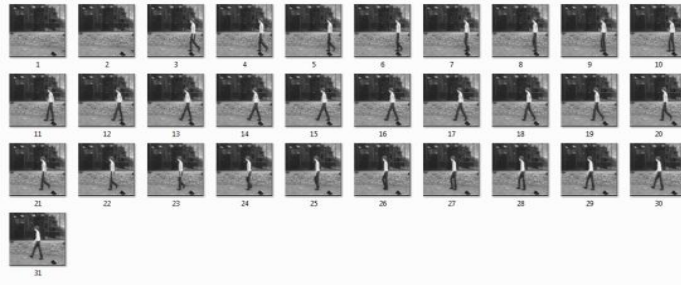


Fig.1 Frame separation

IV. COMPLEX WAVELET TRANSFORMATION

The complex wavelet transform (CWT) is a complex valued extension to the standard discrete wavelet transform (DWT). It is a two dimensional wavelet transform which provides multi resolution, sparse representation, and useful characterization of the structure of an image. Complex wavelet transformation domain is used to transform the image from one domain to another domain (i.e images are normally in time domain), by using complex wavelet transform the images are changed from time domain to frequency domain to accurately detect the object. One can quickly focus on object regions, where object of interest may be found, and then compute additional features through the CWT for those regions only. These additional features, while not necessary for global regions, are useful in accurate detection of object. CWT is used to separate approximation and detailed coefficient from the time domain images. CWT decomposes the image into different sub band images, namely, LL, LH, HL, and HH for embedding the messages in the pixel coefficients of sub bands.

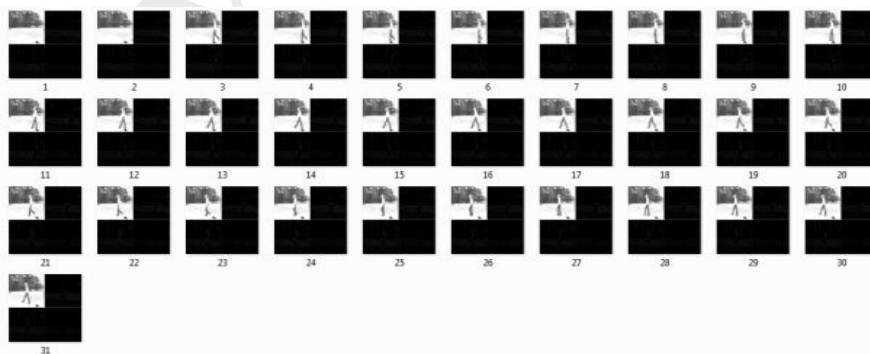


Fig.2 Different sub band images

V. SUB BAND DIFFERENCING

The sub band filtering process will done between background frame and foreground frame. This process is done by subtracting current frame sub band and previous frame sub band for detecting object from background. After that thresholding process is done to detect the foreground object. From a gray scale image thresholding can be used to create the binary images.

Thresholding is done to separate the dark and light region of the image. The foreground object is detected by using the thresholding process. After the sub band differencing inverse complex wavelet transform is applied to get frequency domain image back to time domain image.

VI. BACKGROUND UPDATING MODEL

Background updating model is used to update the background each time after the processing of current frame and the previous frame. Background updating process is the most important feature for object detection in video surveillance system. In our proposed method video frames are taken from a surveillance camera and then for updating previous 40 frames from the video frames are used. Here pixel wise comparison is done for the previous frame so that the maximum common pixel values are stored to get a temporary background. When the temporary background is obtained then it is compared to the last frame's pixel value and the common pixel value is stored as the permanent background. The pixel values which are not common to the both frame then these values are taken from the previous permanent frames which are common with the last frame. Now again if there is any mismatched pixel values remains then the temporary background's pixel value is stored as permanent background for this position. Finally we get the permanent background as an updated background. And now for object detection, the next frame's pixel values are subtracted with the permanent background, if the value goes beyond a threshold value then the object is detected.

VII. MORPHOLOGICAL PROCESS

Morphology processing is the broad set of image processing operations that process the images based on the shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In the morphological operation, the value of each pixel in the output image is based on the comparison of the corresponding pixel in the input image with its neighbor. Morphological operations are applied on segmented binary image for smoothening the foreground region. It processes the image based on shapes and it performs on image using structuring element. The structuring elements will be created with specified shapes (disk, line, square) which contains 1's and 0's value where ones are represents the neighborhood pixels. Dilation and erosion process will be used to enhance (smoothening) the object region by removing the unwanted pixels from outside region of foreground object. After this process, the pixels are applied for connected component analysis and then analysis the object region for counting the objects



Fig. 3 Object detection

VIII. CONCLUSION

In this work we have proposed a simple but robust scheme of background updating model and threshold based of object detection. From this study, background subtraction using complex wavelet transform domain outperforms with all the above mentioned techniques based on moving object detection provides more accurate in segmentation under various illuminations, less time consuming process, flexibility in background updating model, less sensitive to background noise. In Background subtraction using intensity range compares the initial background object compares with all foreground objects and find the moving object in videos, these does not provide more accurate result of object. Likewise many techniques are used to detect the moving object but it is not efficient. In complex wavelet transform domain the foreground object is compared with the entire background object

using background updating model. The result of this domain based object detection provides more accurate result of the object. Accuracy can be estimated based on sensitivity, root mean square error, peak signal to noise ratio, correlation coefficient. Based on this study complex wavelet transform domain is recommended for moving object detection.

References

- [1] Chih hsien Hsia and Jen-shiun Chiang "Real time moving object detection and detection with direct LL-mask band scheme", vol no: 43, July (2011).
- [2] W.-M. Hu.T.- Tan .N, Wang.L and Maybanks. S," A survey on visual surveillance of object motion and behaviors", IEEE Tran. On systems, Man and Cybernetics-Part C: Applications and Reviews, vol.34, no.3, pp.334-352, (2004).
- [3] Jacques .J, Jung .C, and musse .S,"Background subtraction and shadow detection in gray scale video sequences" in eighteenth brazilian symp. Computer graphics and image processing. pp. 189-196,OCT(2005).
- [4] Koller .D, Weber .J, and Malik .J. "Robust multiple car tracking with occlusion reasoning", In *European Conference on Computer Vision*, pages A: 189–196, (1994).
- [5] McKenna .S, Jabri .S, Duric .Z, Rosenfeld .A, and Wechsler .H. "Tracking groups of people" *Computer Vision and Image Understanding*, 80(1):42–56, October (2000).
- [6] Haritaoglu .I, Harwood .D, and Davis .L. "W4: Real time surveillance of people and their activities" *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 22(8):809–830, August (2000).
- [7] Elgammal .A, Duraiswami .R, Harwood .D, and Davis .L."Background and foreground modeling using nonparametric kernel density estimation for visual surveillance", *Proceedings of the IEEE*, 90(7):1151–1163, (2002).
- [8] KaewTrakulPong .P and Bowden .R. "A real time adaptive visual surveillance system for tracking low-resolution color targets in dynamically changing scenes. *Image and Vision Computing*, 21(9):913–929, September (2003).
- [9] Cucchiara .R, Grana .C, Piccardi .M, and Prati .A. "Detecting moving objects, ghosts, and shadows in video streams. *IEEE Transactions on Pattern Analysis and Machine Intelligence*,25(10):1337–1342, October (2003).
- [10] Salvador .E, Cavallaro .A, and Ebrahimi .T. "Cast shadow segmentation using invariant color features", *Computer Vision and Image Understanding*, 95(2):238–259, August (2004).
- [11] Chien .S-Y, Ma .S-Y, and Chen .L-G. "Efficient moving object segmentation algorithm using background registration technique", *IEEE Transactions on Circuits and Systems for Video Technology*, 12(7):577–586, (2002).
- [12] Rosin .P.L and Ellis .T." Image difference threshold strategies and shadow detection", In *6th British Machine VisionConf, Birmingham*, pages 347–356, (1995).