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Empirical Evaluation of Edge based Background Subtraction Methods for Object Detection in Video Surveillance System

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Abstract

This paper evaluates different "Object Motion" detection techniques using edge based background subtraction of frames in video streams, with existing edge-based methods, such as Sobel and Canny. It also implements edge-based framework for "Motion Labeling" of edges by using Cellular Logic Array. The main limitations of the existing methods are that these represent an object with a few edges only in uncertain conditions and there are lack of continuity of object contours making them difficult to converge for the global maximum. Discontinued skeleton also fails to fill the objects properly; this results into poor edge labelling and inferior object detection. The results obtained in the experiments (explained in this paper) establishes this fact.

Keywords: Edge Detection, Precision-Recall Curves, Motion Detection, Background Subtraction, Video Surveillance.

INTRODUCTION

Object detection is a fundamental process in analysis of video surveillance systems. Several methods for object detection has been proposed in the past but none presents a panacea to the various problems of object detection such as dynamics of scene, occlusion, shadow, ghost, interleaved movements etc. These methods range from a simple and fast, with ineffective frame difference method, to effective but more complex, time consuming parametric or nonparametric methods such as Mixture of Gaussian (MoG) and Kernel Density Estimation (KDE) respectively. Many algorithms such as optical flow, clustering based detection are just of academic interest due to their unsuitability in real time video streams. In between these contrasts, there remain many good statistical methods, which produce good results in varying situation in a reasonable time limit. Which make them easily employable in real time video streams. There are methods such as KDE, which provides good quality results in different scenario but consume excessive time. On the other side, statistical based adaptive average or adaptive median based background subtraction methods are not far behind from KDE in detection quality and is simultaneously less time consuming, making them better alternative than others in real time video surveillance application. There is a lot of scope for further improvement in these. Edges in an image being less sensitive and robust to noise, shadow, dynamics of scene etc. may be effectively used in conjunction with these methods for better object detection.

Differential colour and/or intensity against the background is sufficient to identify a moving object in an image. Due to this simple fact, edges act as an important tool in motion detection. Edges are high gradient features that easily helps in identifying slightest of movement in the image thus provide accurate and robust motion information. There are other features such as texture, corners which can be used for motion detection but these are too few and costly on computation. Edges on the other side are macroscopic which provide enough motion information. Besides this, edges are photometric and geometric invariant to change between contiguous frames making matching and tracking effective. They also provide reliable detection due to their long extent and continuous contour forcing all the pixels along an edge to follow the object's motion. The edge pixels, which are only around 4% in average of total image, also helps to reduce time taken for motion detection analysis. Moreover, human eyes are more sensitive to object edges than other image characteristics making them ideal for detection of objects in motion.

This work evaluates existing popular methods Sobel and Canny with newly proposed Cellular Logic Array Processing (CLAP) based edge detection algorithm for detecting moving objects in video streams. In a statistical background subtraction based object detection method, edges could be extracted at three different points. In order to find the most suitable point of application of edge detection, all three results are compared to find the best solution. Once a point of applicability for edge detection is fixed, the CLAP edge detection result is compared with two other methods; Sobel and Canny. The effectiveness of these methods is measured on two scales, time and quality. Finally, several extreme scenarios are applied to test the proposed method on larger scale with an adaptive threshold.

This paper is organized as follows: Section 1 identifies the background on the need of edge map in object detection. Section 2 presents the history of application of edge detection in object detection starting from 2000 onwards. Section 3 describes various existing edge detection methods. Section 4 presents and compares CLAP based edge detection method with other methods. Section 5 explains the application of edge map in object detection methods followed by results and discussion in section 6. Finally, conclusion is drawn in section 7.

RELATED WORKS

Lot of efforts have been made in the past to employ edge maps to extract object motion but due to lack of generalization and acceptability, there remains a lot of scope of improvements in this area. The following discussion presents a comprehensive study of work done in this field. Smith, in 2001, [24] proposed an edge based segmentation method in video sequence to detect single object detection and multiple object detection in frames using Baysian's framework. The thesis demonstrated that edges contain sufficient motion information to determine motion labelling in a frame. The technique uses Expectation-Maximization algorithm to segment the frame into similar regions and then Baysian probability is used to detect foreground segments from background segments. The method was applied on multiple video sequences and result claims that the proposed approach provides accurate and efficient motion segmentation.

Kim and Hawang [9] used double-edge map obtained from the difference of successive frames which is used to get moving edges with current frame edges, previous frame edges and background edge model. The proposed algorithm although claimed to be fast for implementing in real-time surveillance system but it failed to update background model making it difficult to handle dynamic scenes.

This work was further extended by [21] by proposing a three equidistant frames technique of motion detection. Two preliminary edge maps extracted from three frames were used for detecting moving edges by AND operation, which is sufficient for high frame rate. For a lower frame rate scenario, it used iterative scheme where equidistant frames are subtracted deducted iteratively until no new edge information is obtainable about background. Once sufficient confidence was gained about the background, the algorithm switches from frame subtraction to background subtraction approach. The method although was fast enough but failed to get good result in camera jitter and random noise scenarios.

The paper [27] proposes an improved edge based object detection from contiguous frames and their difference by using Canny detector; this is followed by detection of moving area from difference image by counting a threshold of non-zero pixels over small blocks. Finally, block-connected component labeling is done to track the moving object. Experimental results claimed to permeate the limitations of the frame difference method by getting a high recognition rate and a high detection speed but needs testing over a large number of scenarios before implementation. Moreover, the method did not provide any solution to over and under sampling of frames.

In this work [10] Canny edge image is used to build "MoGs" background with an objective to reduce the undesirable effect of sudden illumination on MoGs model. Although presented results claim to provide higher performance on real surveillance video but only two scenarios have been presented which does not effectively validate the result. Second the paper has not considered heavy computation cost of canny's detector and MoG model making technique ineffective for real time surveillance. [26] Wang proposed an edge based moving object segmentation algorithm which models background from image pixel values of longest sequence to remove the problem of shadow and also post-processed the extracted image with Gaussian filter to remove random noise. Although method has claimed to remove the effect of shadow and noise but no conclusive evidence of applicability on different scenario except shadow problems has been put forward. The method is also limited its huge memory requirement for background reconstruction.

Article [5] deals with object detection based on perceptual vision. Consecutive frames of a video are processed to find the edge features based on generic curve segments and curve partition points. Then these frames are subtracted to find the average threshold difference to detect moving object in the scene. Authors have only analyzed result subjectively and frame rate taken is also high (5000 frames/sec) limiting the applicability of the proposed method in real time scenario. This [4] proposed a background subtraction technique for object detection based on RGB color space and edge ratio to identify shadow, object and background by using. Separate threshold values were adapted for foreground and objects and finally by calculating the areas and edge ratio were used to rectify the misclassified object and shadow regions. Murshed et al [15], first, modeled a statistical background for each segment in image and then used Canny edge based threshold method for motion detection. Background edge segments and moving edge segments were detected using Statistical Distribution Maps and Chamfer Distance Map respectively. Background was updated continuously to manage the dynamic scenes. In this method, only edge pixels are processed for faster execution.

Cui et al [2] used Canny edge detector to find edge map of contiguous frames and then edge pair difference is used to get moving objects. Although it got better result than simple frame difference method but need to test on different scenarios. Dhar et al [3] proposed a gradient map based method in which gradient map difference of current frame and background are used to extract the moving objects with proper directional masking and threshold processing. The proposed method was applied on different conditions such as indoor, outdoor, and foggy conditions and was claimed to be faster than traditional methods.

Jabid et al [8] mixed edge segmentation with a gradient map like feature called local directional pattern, which provide the direction of an edge to detect moving objects. Watershed algorithm is used to extract a regular boundary of object as post-processing operation in this scenario. Priya et al [18] presented an edge based video segmentation technique for finding the foreground objects in video streams. First, edges of the objects are detected using Canny edge detection method which is followed by a morphology motion filter and filling technique. The main benefits of edge detection based segmentation methods are fast processing and less requirement of storage. Pradnya et. al. [16] implemented a feature extraction technique on “Frame Difference” edge mapping. The extracted features such as color, texture and shape determines the moving edges. Mukherjee and Kundu [14] employed Prewitt operator on background subtraction algorithm and compared it with Canny edge detection operator for extracting the objects in motion from video frames.

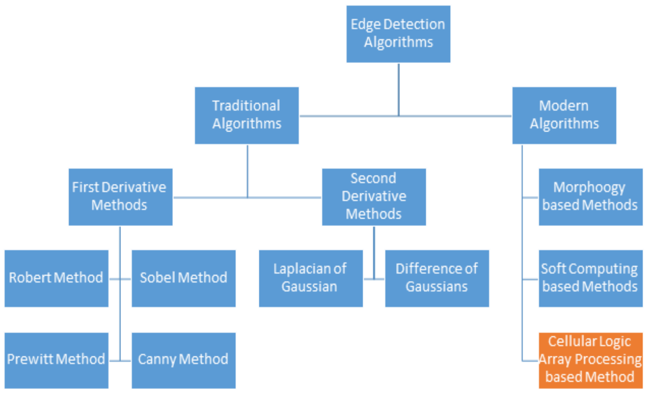

Figure 1: Classification of Edge Detection Methods

Existing Edge Detection Methods

Many traditional edge detection algorithms devised for edge detection can be categorized into First Order Derivatives and Second order derivatives. (Figure 1) As the name suggests, in first order derivatives, the magnitude of the first gradient between adjacent pixels decides about the existence of edge and gradient vector judges the direction of maximum rate of change. In digital image processing, discrete gradient is measured in terms of finite intensity differences between adjoining pixels. These are approximated by different masking filters such as Roberts [20], Sobel [25] and Prewitt [17] operators which are given in figure 2. These filters separately find vertical and horizontal gradient in one dimension (1D) which can be later combined to give a whole edge image. Roberts operator also called cross operators finds only oblique edges. Prewitt improved it by suggesting horizontal and vertical edges masks which is again improved by Sobel by proposing double weight for edge pixel. These methods are not robust to noise and also infested with the problem of double edges. Later, Canny enhanced these methods by using non-maximum suppression, Hysteresis Thresholding and non-major edge points removal techniques to achieve stronger and finer edges in the image [1]. Canny method, although, achieved very fine details of edges but failed to control noise in the edge image. The Canny method also results into discontinued contours making object segments difficult in noisy environments.

Second order derivatives such as Laplacian of Gaussians (LOG), Difference of Gaussians (DOGs) search for zero crossings in the second derivative of the image to find edges [11]. These methods are very sensitive to noise and take much time for edge extraction. Two popular LOG operators are shown in figure 2. Other methods used in the past to extract edges are morphological edge detectors [28], soft computing based techniques [7] shown in figure 1. In 1993, EG Rajan proposed a cellular automata based framework for high-throughput image processing [19] which assumed digital image as *cellular array configuration* and processing algorithm as *evolution (updation rule)* of the automaton. Several image processing operations such as thinning, edge detection, segmentation and morphological operations are effectively implemented by using cellular logic array.

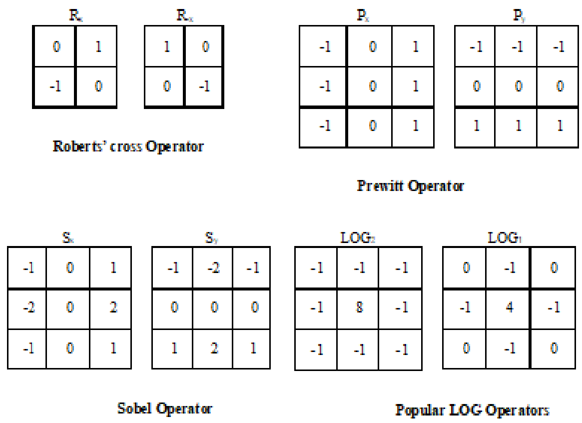

Figure 2: Edge Detection Masks

Cellular Logic Array Processing Based Edge Detection

The concept of Cellular automata (CA) was invented by Ulam and Neumann when they were studying liquid motion in the 1940s. But it was only in 1990s when two-dimensional CA was applied in many fields of computer science such as computer processors and cryptography. EG Rajan is pioneer in application of CA for many software based image processing activity such as morphological operations, edging, thinning etc.

Rajan reported that CA based high-throughput image processing [19]. He also developed a logical video processing system for high throughput video processing techniques. Recently, Tapas et al [29] also implemented edge detection using CLAP by following a slightly different rule which based on the similarity of pixel with its neighborhood. The research work of [13] also compared edge detection methods with CLAP edge detection but without any quantitative evaluation. In [22], authors have not only empirically evaluated CLAP and Canny based method but also improved edge detection by using an adaptive local thresholding instead of fix threshold and global threshold.

Authors have also proposed a CLAP based edge detection using basic BGS methods [23] in which the difference of the current frame and the adapted background is processed for edges extraction and then the resultant image is processed using denoising median filter and filled closed contours with foreground pixels. The CLAP based algorithm explore each pixel and its 5-neighborhood to find uniform intensities and mark the pixel as background pixel. Every pixel is checked for the intensity difference of maximum and minimum value of surrounding 5-neighborhood convex pixels and is then marked as background, if the difference is less than the calculated threshold; otherwise, it is marked as foreground. Threshold value can be a fix value or it can be adapted as the percentage value of Mean/Median of the whole image. Authors in [22] have proposed a novel threshold value based on local average of intensities. The idea is that the local threshold will consider local environment in evolving edges giving better result as compared to global threshold or fixed threshold. This procedure CLAP_EDGE is depicted in the pseudocode of table 1.

Table 1: The CLAP Algorithms for edge detection method

Step1: Set $Th = 20$ **; (Fix Threshold)** **OR** **(Global Thresholding- Th is defined as a percentage of global average)** Find average of image as I_{gm} and Set $Th = \alpha \times I_m$; where $\alpha \in [0, 1]$ **OR** **(Local threshold- Th is defined as a percentage of local block average)** Create 16× 16 blocks of image I and then replicate to recreate the image having uniform average intensity block of equal size called I_{lm}. and Set $Th = \beta \times I_{lm}$; where $\beta \in [0, 1]$

Step2: (CLAP_EDGE)
for every pixel (i, j) of image
scan 5-neighborhood for minimum and maximum intensity value G_{min} and G_{max}
if $diff(Gmax, Gmin) < Th$ then $I_{(i,j)} = 0$
else $I_{(i,j)} = 255$
end if
end for

Edges based Motion Detection in Video Streams

Moving objects in a video can be obtained by taking the threshold of difference of contiguous frames but slow frame rate may create problem. To avoid this, a reference background image is created from initial frames and then continuously updated with running mean (Adaptive Mean – AM) or median (Adaptive Median- AMD) methods. Choosing an optimal threshold is crucial in these methods. Authors have explained these methods in [23].

An edge by virtue of its characteristics is robust to noise but an edge should be continuous giving a clear contour for foreground image detection. We experimented with edge images at three points in BGS algorithm. One way of getting edge map is of taking difference of two edge map of CF and BF respectively. Second option is to get difference first and then apply edge algorithm. Third option is to threshold the difference and then take edge map for post processing functions of median filter and fill function. Out of these three methods second option gave better result in experiments. A BGS algorithm with edge based difference is given below:

Table 2: BGS algorithm with CLAP_EDGE

Step 1: Create an average image BG with some initial frames.
Step 2: For each of remaining frame say CF **Step 2.1:** Find Difference $D = (CF - BG)$ **Step 2.2:** Find edge map $EM = CLAP\_EDGE(abs\ (D))$ **Step 2.3:** Find foreground $FG(EM > Th) = 255$ **Step 2.4:** Update BG with the following equations: **(For AM)** $BG = \varepsilon \times CF + (1 - \varepsilon) \times BG$ **OR** **(For AMD)** $BG(D > 0) = BG(D > 0) + 1;$ $BG(D < 0) = BG(D < 0) - 1;$

RESULTS AND DISCUSSION

A benchmark data set “CDnet2012” [6] has been used for evaluation of six edge detection algorithms on an Intel i3 4GB system. It represents different conditions/challenges of video surveillance system namely baseline, camera jitter, dynamic background, intermittent object motion, shadow and thermal imagery scenes. In each of the sequence some of the video frames are denoted as initial training frame used for initial background modelling. With every sequence groundtruths are also given.

Efficacy/quality of detection of the results are measured quantitatively using recall, precision, F1-measure. [12] For each BGS method of AM and AMD and sequence, ten thresholds are taken stretching from 5 to 50 in the interval of 5 with additional

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two extremes of 0 and 255. These threshold values are used to draw Precision Recall curves (PR curves). PR curves represent the quality of detection and it is taken roughly the area covered by these curves. Higher the area is covered better is the method. A snapshot of the visual output of the AM BGS experiment is displayed in figure 3.

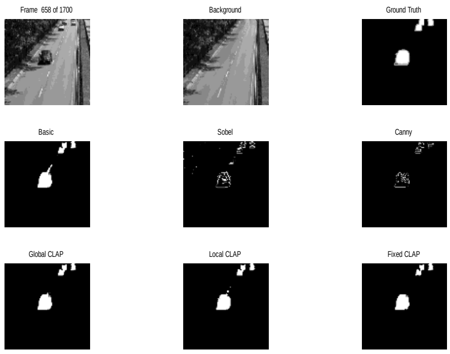

Figure 3: A snapshot of BGS output with different Edge detection algorithm

There are two BGS methods; AM and AMD, and six scenarios resulting total 12 PR curves charts. In each PR curve chart six algorithms namely basic BGS, Sobel Edge, Canny Edge and three flavors of CLAP edge (fixed, local and global threshold) are included. Figure 4 to 9 are for edge based AM method and 10 to 15 are for edge based AMD method.

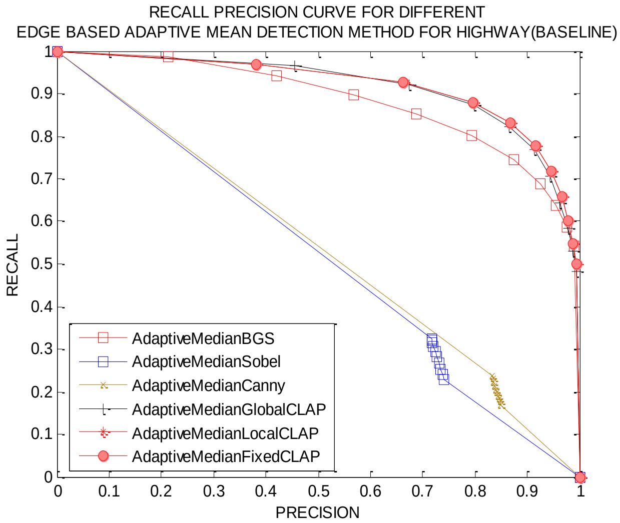

Figure 4: Precision Recall Curve for different Edge based AM object detection methods for Highway data set

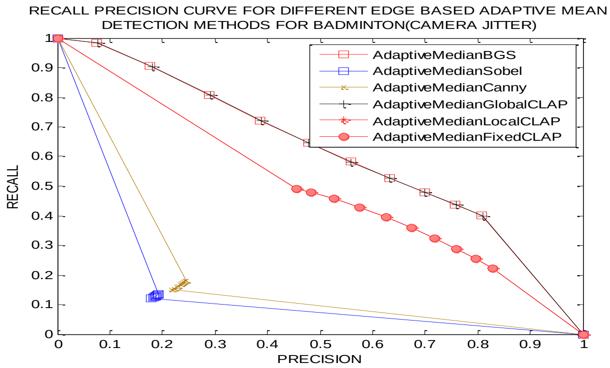

Figure 5: Precision Recall Curve for different Edge based AM object detection methods for Badminton data set

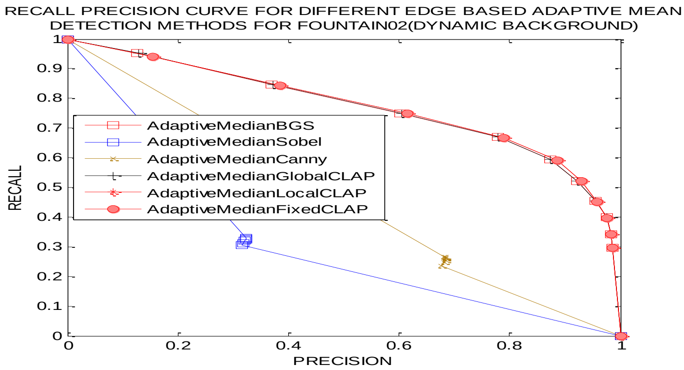

Figure 6: Precision Recall Curve for different Edge based AM object detection methods for Fountain Dataset data set

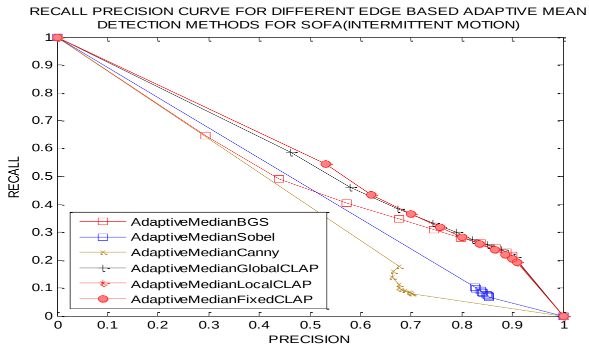

Figure 7: Precision Recall Curve for different Edge based AM object detection methods for Sofa data set

In most of the scenarios, there is only minor improvement if basic BGS and CLAP_EDGE BGS are compared, but when other standard edge extraction methods Sobel and Canny are considered and compared with CLAP_EDGE methods there is remarkable performance achieved by CLAP based method. Besides this we have observed that Canny also takes nearly 2 to 3 times more average time of processing than CLAP method, making it unsuitable for real time video surveillance environment.

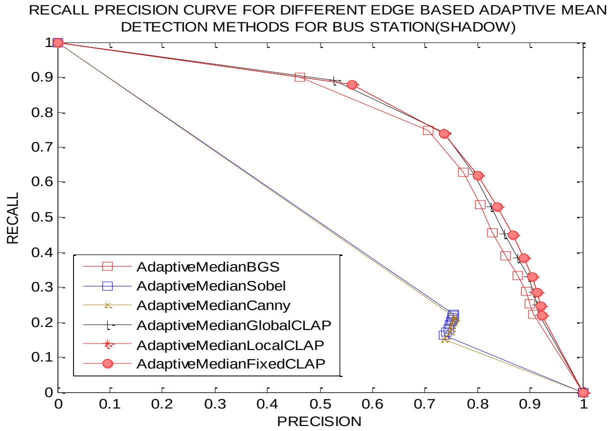

Figure 8: Precision Recall Curve for different Edge based AM object detection methods for Bus Station data set

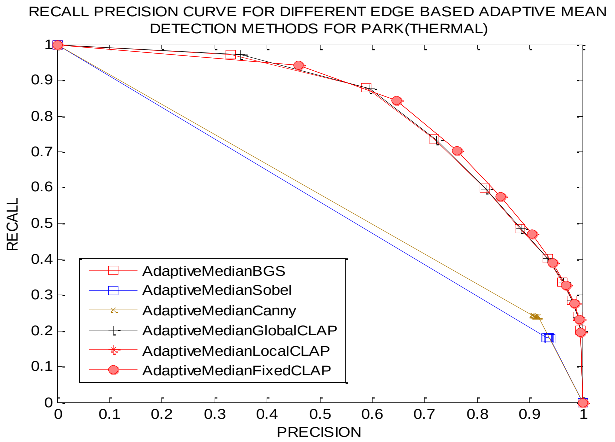

Figure 9: Precision Recall Curve for different Edge based AM object detection methods for Park data set

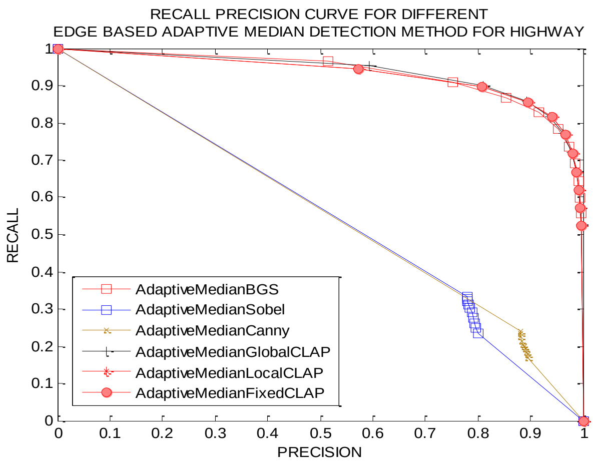

Figure 10: Precision Recall Curve for different Edge based AMD object detection methods for Highway data set

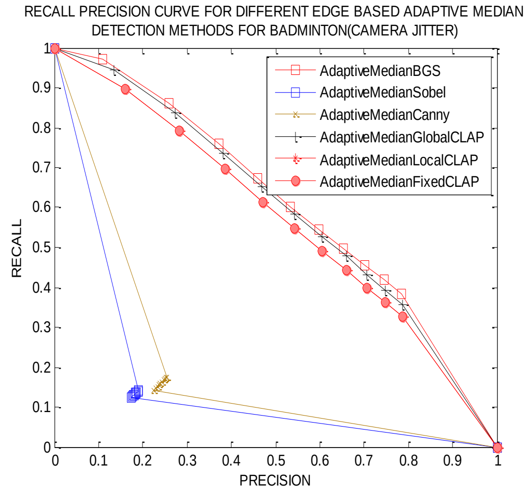

Figure 11: Precision Recall Curve for different Edge based AMD object detection methods for Badminton data set

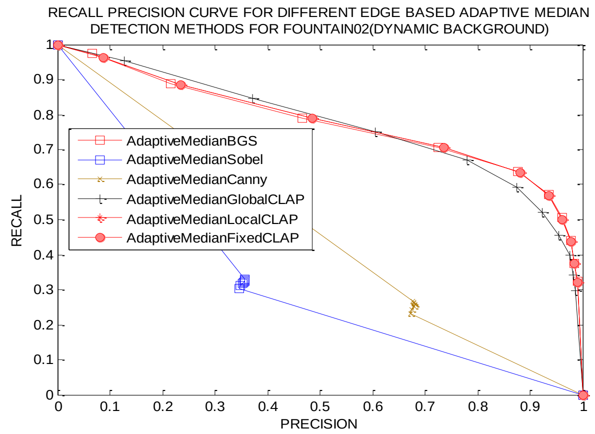

Figure 12: Precision Recall Curve for different Edge based AMD object detection methods for Fountain Dataset data set

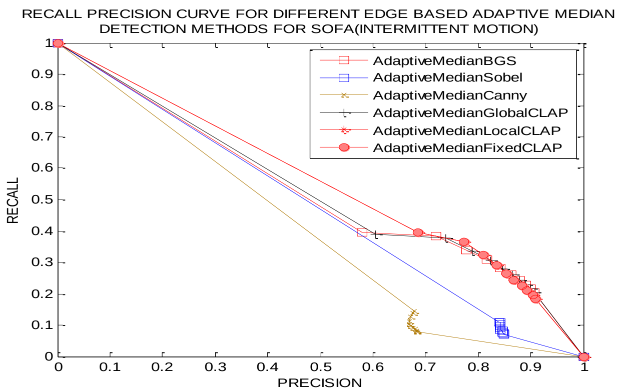

Figure 13: Precision Recall Curve for different Edge based AMD object detection methods for Sofa data set

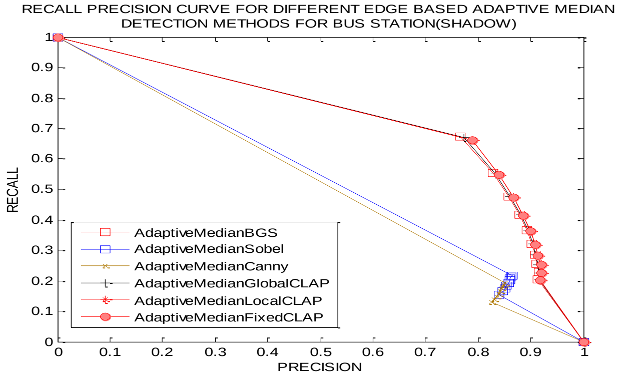

Figure 14: Precision Recall Curve for different Edge based AMD object detection methods for Bus Station data set

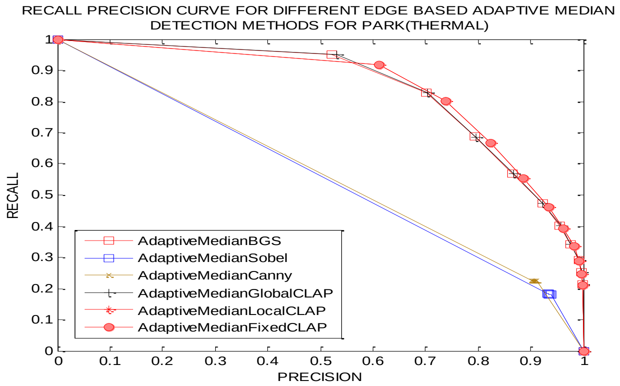

Figure 15: Precision Recall Curve for different Edge based AMD object detection methods for Park data set

Another observation is that there is no remarkable difference of performance among three flavors of CLAP_EDGE detection methods. In paper [22] authors have reported that local thresholding provided better result for edge detection from an image, where threshold is taken as percentage average of 5-neighborhood but in motion detection due to speed consideration of the algorithm, larger size block have been used which might explain the similar performance of all three CLAP edge types.

CONCLUSION

This paper empirically evaluates five edge based background subtraction algorithms with basic AM and AMD BGS algorithm. Although no major improvement is noticeable in comparison to basic algorithms, edge algorithms are simply acting as de-noising filters. However, in comparison to other traditional edge algorithms, the CLAP edge based detection methods performed far better. The results also identified that local threshold process needs smaller 5-neighborhood blocks for better performance and this needs further evaluation.

REFERENCES

[1]. J. Canny, “A computational approach to edge detection”, IEEE transactions on pattern analysis and machine intelligence PAMI-8 (6) (1986): 679-698.

[2]. Yu Yong Cui, Zhi Yuan Zeng, Wei Hong Cui, Bi Tao Fu, Wei Liu, "Moving Object Detection Based on Edge Pair Difference", Advanced Materials Research, Vols. 204-210, pp. 1407-1410, 2011 doi:10.4028/www.scientific.net/AMR.204-210.1407

[3]. Dhar P.K., Khan M.I., Hasan D.M.H., Kim JM. (2011) Enhanced Edge Localization and Gradient Directional Masking for Moving Object Detection. In: Kim T., Adeli H., Ramos C., Kang BH. (eds) Signal Processing, Image Processing and Pattern Recognition. Communications in Computer and Information Science, vol 260. Springer, Berlin, Heidelberg doi: https://doi.org/10.1007/978-3-642-27183-0_25

[4]. X. Dong, K. Wang and G. Jia, "Moving Object and Shadow Detection Based on RGB Color Space and Edge Ratio," 2009 2nd International Congress on Image and Signal Processing, Tianjin, 2009, pp. 1-5. doi: 10.1109/CISP.2009.5301770

[5]. Q. Gao, A. Parslow and M. Tan, "Object motion detection based on perceptual edge tracking," Proceedings Second International Workshop on Digital and Computational Video, Tampa, FL, 2001, pp. 78-85 . doi: 10.1109/DCV.2001.929945

[6]. N. Goyette, P.-M. Jodoin, F. Porikli, J. Konrad, and P. Ishwar, changedetection.net: A new change detection benchmark dataset, in Proc. IEEE Workshop on Change Detection (CDW-2012) at CVPR-2012, Providence, RI, 16-21 Jun., 2012.

[7]. Hamid R. Ezhoosh, “Fast Fuzzy Edge Detection”. Pattern Recognition and Machine Intelligence Lab Systems Design Engineering, University of Waterloo Waterloo, Ontario, N2L 3G1, Canada.,2010

[8]. T. Jabid, T. Mohammad, T. Ahsan, M. Abdullah-Al-Wadud and O. Chae, "An edge-texture based moving object detection for video content based application," *14th International Conference on Computer and Information Technology (ICCIT 2011)*, Dhaka, 2011, pp. 112-116. doi: 10.1109/ICCITechn.2011.6164884

[9]. Changick Kim and Jenq-Neng Hwang, "Fast and automatic video object segmentation and tracking for content-based applications," in IEEE Transactions on Circuits and Systems for Video Technology, vol. 12, no. 2, pp. 122-129, Feb 2002.

[10]. Y. H. Li, C. Z. Xiong, Y. X. Yin and Y. L. Liu, "Moving Object Detection Based on Edged Mixture Gaussian Models," 2009 International Workshop on Intelligent

Systems and Applications, Wuhan, 2009, pp. 1-5. doi: 10.1109/IWISA.2009.5072961

[11]. Marr, D. Hildreth, E."Theory of Edge Detection", Proceedings of the Royal Society of London. Series B, Biological Sciences, 207 (1167): 187–217 doi:10.1098/rspb.1980.0020

[12]. Lazarevic-McManus, N., John-Paul Renno, Dimitrios Makris and Graeme A. Jones. "An object-based comparative methodology for motion detection based on the F-Measure." Computer Vision and Image Understanding 111 (2008): 74-85.

[13]. Sukriti Mehrotra, Sohini Das, Shilpi Shikha and Chinmoy Kar. Article: Comparative Analysis of Traditional Methods with Game of Life in Cellular Automata for Edge Detection. *International Journal of Computer Applications* 118(17):18-24, May 2015.

[14]. Anupam Mukherjee, Debaditya Kundu, "Motion analysis in video surveillance using edge detection techniques", IOSR Journal of Computer Engineering (IOSR-JCE), Volume 12, Issue 6 (Jul. - Aug. 2013), PP 10-15, ISSN: 2278-0661.

[15]. M. Murshed, A. Ramirez and O. Chae, "Statistical Background Modeling: An Edge Segment Based Moving Object Detection Approach," *2010 7th IEEE International Conference on Advanced Video and Signal Based Surveillance*, Boston, MA, 2010, pp. 300-306. doi: 10.1109/AVSS.2010.18

[16]. Pradnya P. Warade, S. N. Kale, V. M. Thakare, Edge Detection for Moving Object Tracking, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 4, April 2015 ISSN: 2277 128X

[17]. J.M.S. Prewitt "Object Enhancement and Extraction" In "Picture Processing and Psychopictorics", Academic Press,1970

[18]. C.Suganthi Priya, K. Mahesh, K.Kuppusamy, Contour based foreground moving object extraction in video segmentation, *ijipdv international journal of image processing and data visualization, 2014.*

[19]. E G Rajan, "Cellular logic array processing techniques for high-throughput image processing systems", Trends In Computer Vision, Sadhana, Volume 18, Issue 2, pp 279-300, June 1993

[20]. Roberts, L.G. (1963) - Machine Perception of Three-Dimensional Solids. Massachusetts Institute of Technology. Department of Electrical Engineering, Massachusetts Institute of Technology, Dissertation

[21]. Sappa A.D., Dornaika F. (2006) An Edge-Based Approach to Motion Detection. In: Alexandrov V.N., van Albada G.D., Sloot P.M.A., Dongarra J. (eds) Computational Science – ICCS 2006. ICCS 2006. Lecture Notes in Computer Science, vol 3991. Springer, Berlin, Heidelberg

[22]. S. Singh, A. Prasad, K. Srivastava and S. Bhattacharya, "Threshold Modeling for Cellular Logic Array Processing based Edge Detection Algorithm" , IEEE international conference on computing. Communication and automation (ICCCA-2017), Greater Noida May 5-6, 2017.

[23]. S. Singh, A. Prasad, K. Srivastava and S. Bhattacharya, "Cellular Automata based Edged Background Subtraction Methods for Motion Object Detection in Video Streams", Doctoral Colloquium in Management, Economics and Information Technology (DCMEIT-2017) on 18th November 2017.

[24]. P. Smith, T. Drummond and R. Cipolla. Segmentation of multiple motions by edge tracking between two frames. In Proc. 11th British Machine Vision Conference, volume 1, pages 342–351, Bristol, September 2000.

[25]. I. Sobel and G. Feldman, "A 3x3 isotropic gradient operator for image processing, presented at a talk at the Stanford Artificial Project," in Pattern Classification and Scene Analysis, R. Duda and P. Hart, Eds., pp. 271–272, John Wiley & Sons, 1968.

[26]. P. Wang, "Moving Object Segmentation Algorithm Based on Edge Detection," *2010 International Conference on Computational Intelligence and Software Engineering*, Wuhan, 2010, pp. 1-4. doi: 10.1109/CISE.2010.5677227

[27]. C. Zhan, X. Duan, S. Xu, Z. Song and M. Luo, "An Improved Moving Object Detection Algorithm Based on Frame Difference and Edge Detection," Fourth International Conference on Image and Graphics (ICIG 2007), Sichuan, 2007, pp. 519-523. doi:10.1109/ICIG.2007.153

[28]. Shihu Zhu, "Edge Detection Based on Multi -structure Elements Morphology and Image Fusion", ICIE, IEEE 2nd International Conference Vol. 2, 2011.

[29]. Tapas Kumar and G Sahoo. A Novel Method of Edge Detection using Cellular Automata. International Journal of Computer Applications 9(4):38–44, November 2010.