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A Novel Approach of Entropy based Adaptive Thresholding Technique for Video Edge Detection

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Abstract—Motion estimation and Edge detection are one of the bottlenecks in terms in image processing and computer vision, particularly in the areas of feature detection and feature extraction, to refer to algorithms which aim at identifying points in a digital image frames of an video at which the frame-image brightness changes sharply or more formally has discontinuities. Real-time video and image processing is used in a wide variety of applications from video surveillance and traffic management to medical imaging applications.

In this paper a novel methodology has been carried out to generate an adaptive threshold technique, based on Entropy, is used to filter the edges from its background from a video. An automatic approach for a vehicle crosses a speed limit this can be highlighted by counting the number of image frames generated in a defined background region.

Keywords — Entropy, Gradient, Adaptive Threshold, Motion Generation, Frame-image.

I. INTRODUCTION

The most important image processing steps in objects recognition system consist of edge detection process from a video. Edge detection is a very important low-level image processing operation, which is essential in order to carry out various higher level tasks such as motion and feature analysis, understanding, recognition and retrieval from databases. The amount of digital video available has increased dramatically in the last few years. Video is a rich and most convenient way to get information due to advanced and friendly multimedia techniques available.

In this paper at first a video (.avi file) is translated into image frames and then the image frames are converted into JPEG form. Then the above mentioned edge detection is applied on each of the image frames to filter the edges. All edge images are again translated into frame image. Lastly the resultant frames are translated into video file (.avi).

II. RELATED WORK

ShwuHuey Yen, HsiaoWei Chang,ChiaJenWang, ChunWei-Wang[3] have proposed the temporal information of video and logical AND operation to remove most of irrelevant background and it processes 4 frames out of frames if the video is played on a frame rate of frames per second .Michael Lee, Surya Nepal, Uma Srinivasan [2] used spatial-domain synthetic edge model, which is defined using interrelation-ship of two DCT edge feature, (a) horizontal, (b) vertical. A major drawback is that the detected edges have poor connectivity with each other because each of them is individually processed within a block boundary .Kavitha Gane-san and Shanmugam Jalla [1] have proposed an algorithms for automatic segmentation of objects in image sequences. The number of objects in the images increases, boundary inaccuracy increases in case of change detection methods. Model matching techniques partially overcomes the drawbacks of change detection method. rung Quy Phan, Palaiahnakote Shivakumara and Chew Lim Tan [4] propose an eficient text detection method based on the Laplacian operator.Wei Zhao, Zuying Luo, Jefirey Fan, Sheldon X.D. Tan [5] proposed ”Vector Edge” of the current frame to store all the vectors’ information within a frame and put them in the Laplacian of Gaussian edge detection operator. ChongWah Ngo, ChiKwong Chan [7] proposed an repeated shifting operators, are applied for the noise removal of images with high edge density of an video.

III. PROPOSED METHOD

Normally a viewer needs 2 seconds or more to process a complex scene. In this paper introduced a novel methodology to development of Entropy based adaptive thresholding tech-nique for edge detection in videos. First we propose to get the frame images from video. The videos are played ’X’ frames per second, we are interested in detecting video object edge stay-ing on different location for at lest ’2X’ consecutive frames. Now we get these frames images and proposed Entropy based Adaptive thresholding technique for Edge Detection in Frame Images using below processes.

A. Get the frame images from video

We know that a person needs 2 seconds or more to process a complex scene. So the videos are played ’f’ frames per second, we are interested in detecting video object edge staying on different location for at lest ’2f’ consecutive frames.[X; Map] = frame2im(F) returns the indexed image ’X’ and associated colormap Map from the single video frame ’F’ to return image data associated with video frame. Now we get these frames images and proposed Adaptive Thresholding Technique for Edge Detection in Frame Images using below processes.

B. Entropy based Adaptive Thresholding Technique

For Entropy based thresholding we compute adaptive threshold of local intensity variations as:

1) First the overall mean value of the gradient image is calculated. So the pixels having lower edge strength than this mean value are already discarded.
   Threshold1 = mean (G)

2) Then a 3 X 3 window is splits over the gradient image where the mean and variance of the gradient image within this window are calculated. Then taking the sum of this mean value and standard deviation and Entropy and this is considered as the threshold value of that pixel.

Now if the gradient of this image exceeds this threshold then the pixel is treated as edge.

If G is a gradient image then the threshold value is generated as follows:

First mean of the overall gradient image is calculated:

$$T_1=\frac{1}{9}\sum_{k=-1}^{1}\sum_{h=-1}^{1} G_{(i+H;\, j+K)}$$

After this the pixels which have less gradient of this mean T_1 are already discarded. Next the standard deviation of the intensity variation of the local pixels is calculated:

$$\delta=\sqrt{\left(\frac{1}{9}\sum_{k=-1}^{1}\sum_{h=-1}^{1}(G_{(i+H;\, j+K)} - T_1)\right)}$$

Also we calculate the Entropy that means to consider the neighborhood of the pixel of a frame image. Next the Entropy of the local pixels is calculated:

$$E= -\sum_{i=1}^{n} P(X_i)\log_b P(X_i)$$

At last this mean and standard deviation is summing up to generate the ultimate threshold for the candidate pixel,

$T=T_1+\delta-E$.

In this way threshold value is generated dynamically and region wise for each pixels so that the possibility of data loss or noise is quite reduced.

If the gradient of the pixel is greater than or equal to this adaptive threshold then only the pixel is treated as edge other wise it is discarded.

G(I, j) = 1 if G(I, j) ≥T
= 0 otherwise

C. Non-maximal Suppression (NMS)

The NMS operation considers the fact that an edge at a pixel is legitimate only when the gradient magnitude at that pixel assumes a maximum in the gradient direction within a local surrounding. We calculate the gradient direction at each location in the image under consideration using the following expression:

$$\Theta= \arctan(G_Y / G_X)$$

For simplicity, the values of the directions obtained are then approximated x,y to the closest among the following set, [0, 45, 90,135]. We then retain only those $G_{x,y}$ which are greater than the other gradient values in local surrounding and in the corresponding gradient directions x,y.

D. Get the Edge video

After completing edge detection from Frame-images we convert Frame-images to movie frame.

f = im2frame(X; map) converts the indexed image 'X' and associated colormap map into a movie frame 'f'.

IV. Proposed Algorithm

1) Start.
2) At first we get a video (.avi file) and translated into image frames and then the image frames are converted into JPEG form.
3) Obtain gradient of each pixel by convolution using 5X5 mask.
4) Generating threshold adaptively as follows:
If G(x,y) ≥ Threshold1 then

$$\text{Mean}(x,y)=\frac{1}{9}\sum_{i=0}^{n}\bar{G}_{(x+n;\, y+n)}$$

$$\delta(x,y)=\sqrt{(\text{variance}(x,y))}$$

$$E= -\sum_{i=1}^{n} P(X_i)\log_b P(X_i)$$

Threshold (x, y) = mean(x,y) + δ(x,y) - E
Else the pixels are treated as non edge.
Edge(x; y) = 1 if G(x; y) ≥ Threshold(x,y)
= 0 otherwise

5) Suppressing the binary image using canny non maximal suppression.
6) Edge image is obtained.
7) All edge images are again translated into frame image.
8) The resultant frames are translated into video file (.avi).
9) Stop.

V. Experimental Results

Input video and the frames images: Now we get the frame and final edge image of given image

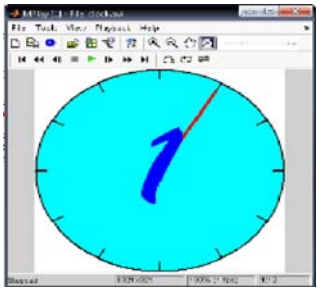

Fig.1. Input Video

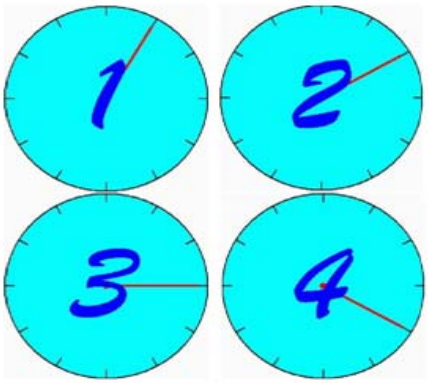

Fig 2.: 1st, 2nd, 3rd and 4th frame Edge

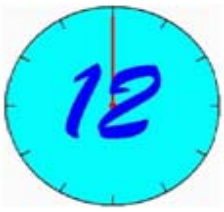

Fig 3. Last frame images

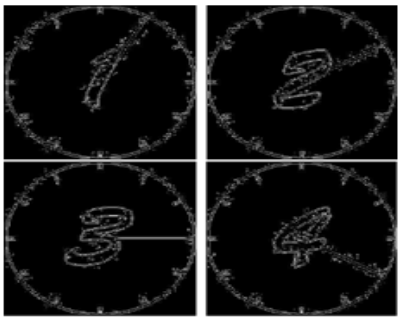

Fig 4.: 1st, 2nd, 3rd and 4th Edge Images

Fig 5. Last frame Edge images

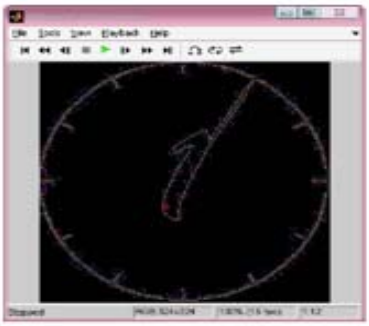

Fig 6. Edge Video

VI. CONCLUSION

Detecting the edges in an image using auto generate thresh-old value based on entropy, that is a statistical measure of randomness that can be used to characterize the texture of the input image.

The novel methodology described in this article, which determines a threshold from a gradient mean and standard deviation and entropy to be used as the threshold of that pixel, thus the threshold value is generated dynamically for different regions as well as no manual threshold is required to provide. And applying the edge detection on video gives a way to generate motion information of an moving object. In general traffic rules there exists a speed boundary.

Moreover, the proposed methodology of entropy based adapting thresholding has been seen to score over the few existing techniques but still some noise occurred in the result.

REFERENCES

[1] Kavitha Ganesan and Shanmugam Jalla," Video Object Extraction Based on a Comparative Study of Efficient Edge Detection Techniques", Proc. The International Arab Journal of Information Technology, Vol. 6, No. 2, April 2009.

[2] Michael Lee, Surya Nepal, Uma Srinivasan," Role of Edge Detection in Video Semantics",Proc, Conferences in Research and Practice in Informa-tion Technology, Vol. 22, 2003.

[3] Shwu-Huey Yen, Hsiao-Wei Chang,Chia-Jen Wang, Chun-Wei Wang,Proc," WSEAS TRANSACTIONS on SIGNAL PROCESSING", Issue 4, Volume 6, October 2010.

[4] Trung Quy Phan, Palaiahnakote Shivakumara and Chew Lim Tan,"A Laplacian Method for Video Text Detection", 2009 10th International Con-ference on Document Analysis and Recognition, IEEE DOI 10.1109/IC-DAR.2009.153,2009.

[5] Wei Zhao, Zuying Luo, Jeffrey Fan, Sheldon X.-D," Vector Edge Detection in H.264 Implementation", The 2008 International Conference on Embedded Software and Systems Symposia (ICESS2008), IEEE DOI 10.1109/ICESS. Symposia.2008.31,2008.

[6] Marimont,D.H.,Rubner, Y.,"A probabilistic framework for edge detection and scale selection",Computer Vision, 1998. Sixth International Conference on Issue Date: 4-7 Jan 1998 On page(s): 207- 214.

[7] Chong-Wah Ngo, Chi-Kwong Chan ,"Video text detection and segmen-tation for optical character recognition",Digital Object Identifier (DOI) 10.1007/s00530-004-0157-0

[8] Lindeberg T.,"Edge Detection and Ridge Detection with Automatic Scale Selection",International Journal of Computer Vision, vol. 30, number 2, 117-154,1998.

[9] Narendra Ahuja,"A Transform for Multiscale Image Segmentation by Integrated Edge and Region Detection",IEEE Computer Society,Dec 1996 Volume: 18 Issue:12.

[10] J. Jarvis and C. Roberts, "A new technique for displaying continuous tone images on a bilevel display," IEEE Trans. Commun., pp. 891-898, Aug. 1976.

[11] H. Wong and L. Guan, "A Neural Learning Approach for Adaptive Image Restoration Using a Fuzzy Model-based Network Architecture," IEEE Trans, Neural Network 12 (3) 516-531, 2001.

[12] M. Tabb and N. Ahuja, "Multiscale image segmentation using a recent transformation," in Proc. ARPA Image Understand. Workshop, 1994, vol.2.

[13] B. Widrow and S. Stearns, Adaptive SignalProcessing. Englewood Cliffs, NJ: Prentice-Hall, 1985.

[14] Venkatesh, Svetha, Rosin, Paul L., "Dynamic-threshold determination by local and global edge evaluation",Applications of Artificial Intelligence 1993,Vol. 1964,p. 40-50.

[15] Marimont, D., Rubner Y., "A Probabilistic Frameword for Edge Detection and Scale Selection", Proceedings of the IEEE International Conference on Computer Vision, 207-214, January 1998.

[16] Lindeberg T., "Edge Detection and Ridge Detection with Automatic Scale Selection", International Journal of Computer Vision, vol. 30, number 2, 117-154, 1998.

[17] A. Cumani, "Edge Detection in Multispectral Images," CVGIP: Graph-ical Models and Image Processing. Vol. 53, pp. 40-51, 1991