Virtual Advertisement with Live Entertainment Program for Real-Time Video Application

Arpita Patel[1], Pinal Patel[2]
[1] Assistant Professor, V.T Patel Department of Electronics and Communication,
Charotar University of Science and Technology, Changa, Guj, India
arpitapatel.ec@ecchanga.ac.in
[2]ASIC Verification Engineer, eInfochips Ltd., Ahmedabad
pinal.patel@einfochips.com

Abstract: **In today's era one of the most preferred ways for advertisement is the live telecast programs. The innovative idea is to use background for advertisement in dynamic way. It needs real time video processing, as it is required to mix the two signals, i.e. actual video programs and advertisement. For example, logos of the companies (Sponsor) can be shown on the ground, ball and on player's T-Shirts without interfering the program, which makes great impact and remembrance on the mind of people through visualization of dynamically changing for advertisement. This paper presents the use of Modified Hough Transform to perform Ball Detection in football videos, in which the football is replaced with Sponsor's Logo (Coca-Cola). To overcome some disadvantages of Hough Transform the proposed algorithm utilized only 8 edge points to detect the ball. For real time application, the algorithm is designed with simulink model. The design presented here is first verified in with MATLAB Version 7.3 and Simulink model Version 6.5. The corresponding results are verified. The algorithm works 80 % efficiently for videos.**

Index Terms: Ball Detection, Modified Hough Transform

I. INTRODUCTION

Nowadays advertisement has become a great business. Company spends lots of money for just the advertisement purpose. In cricket there is a gap of 5 second time after every over and so broadcaster gets enough slots in between the whole match for the advertisement. Advertisers are ready to pay anything for their advertisement. While in case of Football Match it is worst as they have only one break in between the 90 minute match i.e. time between the two half is very less. So, if some method is found out to do the live advertisement during the match then its a great boon to the broadcaster and advertiser will also pay them the handsome amount of money for that. Singularities usually convey most relevant information in an image; hence it is important to detect them in a reliable way. In particular, circle detection is essential in some image analysis areas. Circle detection technique can be used to count the number of pieces of canes in a bundle [2]. In golf ground after hitting the long shot some times it becomes difficult to find the ball as it is lost in the back ground. One can apply the circle detection algorithm to find ball in the Football Video. In Cricket and Football tracking of a ball is also very important and with this algorithm one can customize to the track the ball in the match.

This paper is aimed for virtual advertisement in real time application. As an application, the football match is targeted for virtual advertisement. So the primary objective is the replacement of the Sponsor's Logo on the ball in the video. Any video is consists of number (sequence) of the still frames. Again the still frame is ultimately a digital image. Therefore to achieve the goal, it required to scan the frames repeatedly and from each frame, we need to find a circle (ball). As radius of circle and circle position are unknown in each frame, an efficient algorithm must be determined that find the circle position and radius. Here the use of Hough transform method with some modification is used to find the circle position and radius to achieve the better speed and higher efficiency. Once the circle is detected, it must be replaced by logo having the same dimension. Therefore, logos having different dimension are also required for replacement purpose. Here MATLAB based algorithm for circle detection in still image is used and finally it is extended for video application. For real time application, the speed of algorithm is major constraint. So the same algorithm is also designed with Simulink model file and thus in future a hardware implementation is possible to achieve higher speed as it is targeted for real time application.

II. RELATED WORK

In [3] authors worked on the area of detecting and tracking the ball. They proposed a novel framework for accurately detecting the ball for broadcast soccer video. In [4] authors proposed a scheme for ball detection and tracking in broadcast soccer video. Author used Viterbi algorithm. In [5] authors presented an algorithm for ball recognition using circle Hough transform and neural classifier. They identified the ball in order to verify the goal event soccer game. Their framework consists of two sequential steps for solving the ball recognition problem: the first step uses a modified version of the directional circle Hough transform to detect the region of the image that is the best candidate to contain the ball; in the second step a neural classifier is applied on the selected region to confirm if the ball has been properly detected or a false positive has been found.

Computer vision has recently been applied to a variety of sports. Much of this work has focused on tracking players or analyzing their motion [11, 12, 13], but in some sports the

978-0-7695-4058-0/10 $26.00 © 2010 IEEE
DOI 10.1109/ACE.2010.30

equipment used by the players is of equal interest. In snooker [14] and football (soccer) [15, 16] for example, tracking the ball or balls can give useful information for the analysis of the game.

III. MODIFIED HOUGH TRANSFORM

In the Modified HT method for finding circle, the intensity gradient is first estimated at all locations in the image and is thresholded to give the positions of significant edges. The positions of all possible center locations are then accumulated in parameter space. Finally, parameter space is searched for peaks that correspond to the centers of circular objects. Since edges have nonzero width and noise will always interfere with the process of peak location, accurate center location requires the use of suitable averaging procedures. This approach requires that a large number of points be accumulated in parameter space. But in this paper only eight edge points are considered instead of taking all the points. This will save computational load as well as memory compared with conventional HT technique which has considerable storage and computation load especially if it is required to locate circles of unknown radius or if high accuracy is required. The detail of modification of Hough transform is discussed in following section.

IV. CIRCLE DETECTION USING MODIFIED HOUGH TRANSFORM & LOGO REPLACEMENT

The procedure for detecting the circle has six steps. In first step divide the video in frames (Image). In second step the edge is detected for frame (Image). In third step the coordinate of inversive image will be calculated. Fourth step is to apply Hough transform algorithm is on that image using that coordinates to find the circle coordinates. Fifth step is to replace the circle detected with logo image and finally combining all the frames to get the modified video.

To find the edges, the horizontal and vertical Prewitt filters are applied on the smoothed image. The filter masks are shown in Fig. 1.

$$\begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \qquad \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix}$$

Fig. 1 Vertical (left) and Horizontal (right) Prewitt filter masks

The prewitt operator measures the two components: vertical edge components and horizontal edge components. Sum of these components gives an indication of the intensity of the gradient in the current pixels. The purpose of this edge detection process is to decrease the number of the points in the search space for the objects. The advantage of the prewitt filter is it does not smear the edges.

The idea of the Modified Hough transform is that perpendiculars to edge points of a circle cross through the centre of the circle. Therefore, if we draw perpendicular lines to every edge point of our edge map, we should obtain bright 'hot spots' in the centers of the circles. We therefore draw following line segments into the (*a, b)* space:

$$\left.\begin{aligned} a &= r\sin\theta \\ b &= r\cos\theta \end{aligned}\right\} r \in (\min r, \max r)$$

$$A(i \pm a, j \pm b) \leftarrow A(i \pm a, j \pm b) + E(i, j)$$

Where (*minr, maxr)* is the range of circle radii that are taken into account (customizable from command-line), A is the (*a, b*)-space array, and *E*(*i, j)* is the strength of the edge, given by merging the two Prewitt filters. Schematic picture is shown in Fig. 2. This transform will create spots with higher brightness in places where centers of circles should be found.

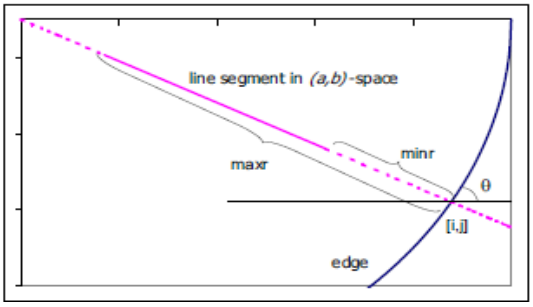

Fig. 2 Schematic diagram for finding circle using Hough Transform

However, these spots can be quite diffused and dimmed, particularly if the circles are rather distorted into ellipses In this paper, eight edge points are utilized as shown in the Fig. 3 to calculate the radius and center of the image. All the edge points are located at an angle 45°. Now for each of the pixel in image a 3- Dimensional (3-D) accumulator array is build with addition of each of the points will be stored. So for each Radius this data will be calculated and put in to the 3-D accumulator array. After getting the 3-D accumulator array for all the radiuses, the Maximum from the 3-D accumulator is found out. After doing the proper matrix reshaping we will be able to find out the x and y coordinates of the circle with its radius r. Instead of using all the edge point on the circle we have used only 8 edge points on the circle to save not only the time but also the memory.

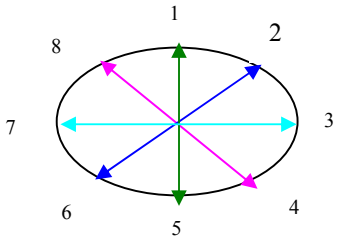

Fig.3 Accumulation into (*a, b*)-space using circular Hough transform

Algorithm is implemented in Matlab (Mfile and Simulink model). Simulink model can be used along with the Code Composer Studio (CCS) to download it onto a DSP processor, which will be the hardware implementation of the

algorithm. That Hardware can increase the speed of processing for real time video application such as live entertainment program.

V. SIMULATION RESULTS

This section shows simulation result of the algorithm tested on video in Matlab (2006b) version 7.3.

Fig. 4 shows result after applying the algorithm on video clip (Here only six frames along with the frame number are shown). Table I gives the details of the number of frames, number of correct and wrong frame detected and percentage of correct detection. Here out of 13 frames of video 11 frames are correctly detected and in two frames wrong detection of circle takes place which gives accuracy around 84 %. Fig. 5 and 6 shows image after applying the algorithm using Matlab Simulink.

Fig. 4 Frame number (1-6) of Video Goal det4.avi

TABLE I. Analysis for Video Goal det4.avi

Movie	No. of Frames	Correct Detected	Wrong Detected	Correct (%) Detection
Goal_det4.avi	13	11	2	84.62

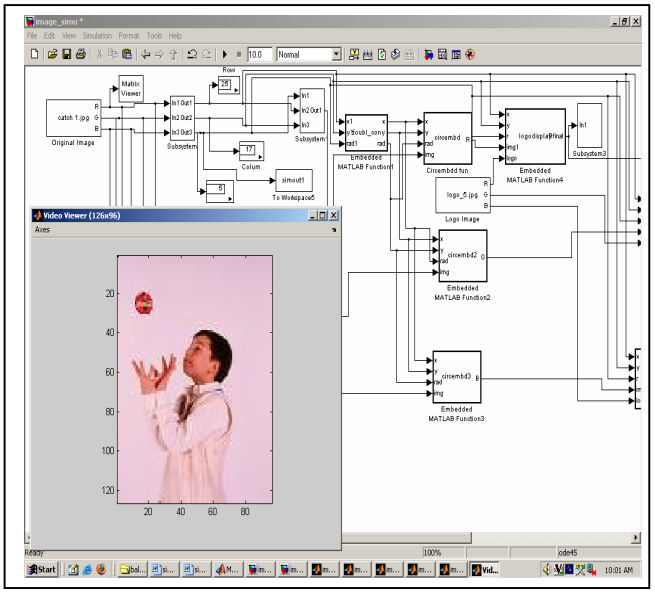

Fig. 5 Simulink result Matlab window

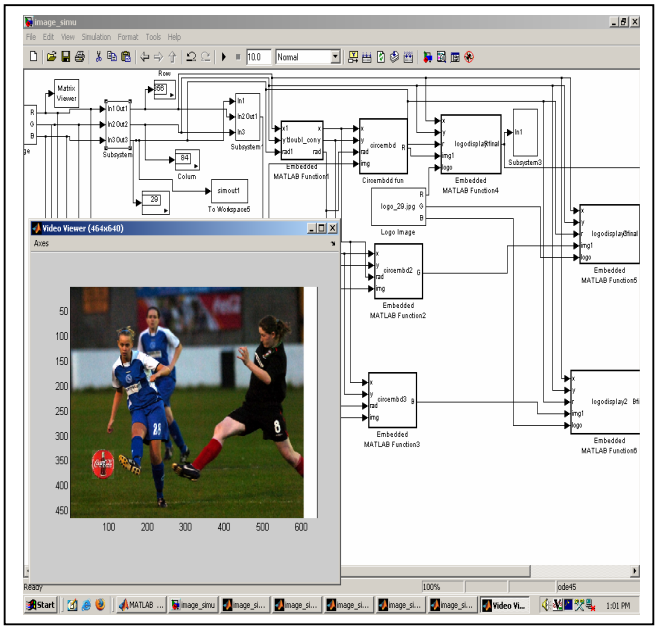

Fig. 6 Simulink result Matlab window

VI. CONCLUSION

Edge detection operators could introduce an inherent inaccuracy. Image noise typically adds a further error. Prewitt filter was utilized for edge detection that reduced edge smearing. The disadvantage of Hough transform had been overcome by doing some modification that is only 8 edge points are utilized so that number of edge point are reduced and thus reduction in High computational cost and large memory requirement with better efficiency is achieved.

The algorithm is implemented for video application. It is found that for still image the algorithm works efficiently. While for video clips it works with 80 % success rate.

ACKNOWLEDGEMENT

The authors wish to thank Research paper review committee, Faculty of Technology and Engineering, CHARUSAT, and Dr. Y. P. Kosta, Dean-Faculty of Technology and Engineering, Charotar University of Science and Technology, Changa for their guidance, encouragement and support in undertaking the present work. Special thanks to the Management for their moral support and continuous encouragement. The authors also wish to thank eInfochips, Ahmedabad for their support.

VII. REFERENCES

[1] Bakk. Medien-Inf. TiCalway:,"Circle detection in Images using classic sobel filter and hough transformation",Image Processing Assignment | COMS 30121.

[2]Web link , http://adsabs.harvard.edu/abs/2004SPIE.5608..128Y [3] Xinguo Yu, Qi Tian, and Kong Wah Wan," A Novel Ball Detection Framework for Real Soccer Video", IEEE, ICME 2003,p II – 265 - II – 268.

[4]Dwei Liang, Yang Liu, Qingming Huang, and Wen Gao, "A Scheme for Ball Detection and Tracking in Broadcast Soccer Video", Y.-S. Ho and H.J. Kim (Eds.): PCM 2005, Part I, LNCS 3767, pp. 864 – 875, 2005.

[5] T. D'Orazioa, C. Guaragnellab, M. Leo, A. Distante, "A new algorithm for ball recognition using circle Hough transform and neural classifier", Pattern Recognition 37 (2004) 393 – 408.

[6] Victor Ayala-Ramirez ,Carlos H. Garcia-Capulin, Arturo Perez-Garcia, Raul E. Sanchez-Yanez , 'Circle detection on images using genetic algorithms',Pattern recocnization Letters 27 (2006) 652–657,doi:10.1016/j.patrec.2005.10.003.

[7] Mohamed Roushdy,"Detecting Coins with Different Radii based on Hough Transform in Noisy and Deformed Image", GVIP Journal, Volume 7, Issue 1, pp 25-29,april 2007

[8] Alexander Mitchell, Steven Mills,"finding fencing foils using hough Transform" , School of Computer Science and IT, The University of Nottingham, United Kingdom.

[9] Mohamed Rizon, Haniza Yazid, Puteh Saad, Ali Yeon Md Shakaff, Abdul Rahman Saad, "Object Detection using Circular Hough Transform**",** American Journal of Applied Sciences 2 (12): 1606-1609, 2005, pp 1606 – 1609.

[10] Shih-Hsuan Chiu, Jiun-Jian Liaw,"An effective voting method for circle detection", Pattern Recognition Letters 26 ,pp 121–133 2005.

[11] F. Cheng, W. Christmas, and J. V. Kittler. "Periodic human motion detection for sports video databases". In International Conference on Pattern Recognition, volume III, pages 870–873, 2004.

[12] P. Figueroa, N. Leite, R. M. d G. Medioni. "Tracking soccer players using the graph representation. In International Conference on Pattern Recognition", volume IV, pages 787–790, 2004.

[13] S. S. Intille and A. F. Bobick, "Recognizing planned, multiperson action", Computer Vision and Image Understanding, 81(3):414–445, 2001.

[14] H. Denman, N. Rea, and A. Kokaram, "Content-based analysis for video from snooker broadcasts", Computer Vision and Image Understanding, 92(2–3):176–195, 2003.

[15] Y. Ohno, J. Miura, and Y. Shirai, "Tracking players and estimation of the 3D position of a ball in soccer games", International Conference on Pattern Recognition, volume I, pages 145–148, 2000.

[16] X. F. Tong, H. Q. Lu, and Q. S. Liu, "An effective and fast soccer ball detection and tracking method", International Conference on Pattern Recognition, volume IV, pages 795–798, 2004.

[17]Web page http://www.pages.drexel.edu/~weg22/edge.html

[18] Thesis of PhD entitled ," Omni-Directional Image Processing for Human Detection And Tracking", Brno University of Technology.

[19] R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Addison-Wesley Publishing Company, Inc., 1993.

[20]Web pagehttp://physics.nyu.edu/grierlab/idl_html_help/H17.html

[21]Webpagehttp://physics.nyu.edu/grierlab/idl_html_help/H17.html

[22]Webpagehttp://cs-alb-pc3.massey.ac.nz/notes/59318/111.html

[23] Davis, E.," Machine Vision: Theory, Algorithms, Practicalities, Elsevier, ISBN 0- 12-206093-8, 2005.