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Card Event Detection in Soccer Video

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ABSTRACT: It is necessary to have a tool for doing the video analysis and summarization for extracting important events from original video in order to produce general summaries for the most important moments in which viewers may be interested. One way for creating a video summary is by segmenting the video based on low level features and then selecting key frames from these segments. In this paper, the proposed technique is used to find a card occurrence in soccer video. Card Event Detection is done in two steps. The first step based on HSV color model and in the second step; Edge Change Ratio is used to decide the card view. Card event will be discovered based on the detected card views without user interaction.

KEYWORDS: Video Abstraction, Card Event, Segmentation, Video key frame selection, Event Detection, Low level features. labelling.

I. INTRODUCTION

Rapid revolution in digital video has brought many applications at home in affordable cost. The volume of digital data has been increasing rapidly due to the wide usage of multimedia applications in the areas of education, entertainment, business, medicines etc. Video summarization helps to meet these needs by developing condensed version of full length video [1, 2].

Raw video is an unstructured data stream, physically consisting of a sequence of video shots. A video shot is composed of a number of frames and its visual content can be represented by key-frames. Figs. 1 illustrate the relationship among them. Video summarization is defined as a collection of key-frames extracted from a video. This summary can be a sequence of stationary images or moving images (video skims) In general, content-based video summarization can be thought as a two-step process. The First step is partitioning the video into specific events indicated within the text or graphics, called video segmentation or video shot boundary detection. The second step is to find these suitable key frames. Thus, video can be organized as video, shot and key frames[3].

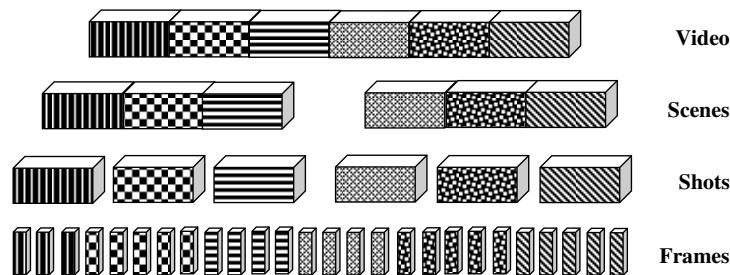


Fig. 1. Structure of Video

Paper is organized as follows. Section II describes related work. Our proposed approach has been described in section III along with the steps of algorithm. Section IV discusses experimental results. Finally, Section V presents conclusion.

II. RELATED WORK

The principal methodology of shot boundary detection is to extract one or more features from the frames in a video sequence and then difference between two consecutive frames is computed. If the difference is more than a certain threshold value, a frame is detected. There are number of techniques have been attempted by the researchers to segment the video [4]. Color and motion are most important features used for video frames. There are different color histograms based approaches in which consecutive frames are compared to decide the selection of key frames. In [5, 6], HSV colorspace is used to measure interframe difference. HSV colorspace has outperformed RGB color space due to its perceptual uniformity. RGB mutual information and joint entropy of adjacent two frames have been used in [7]. A color is insensitive to camera and object motion. Therefore color based key frame selection may not be enough to render the visual contents of a shot. Optical flow components are extracted and motion function is computed between two frames. There are several well-known methods to compute optical flow among which Lucas & Kanade is popular and also faster [8, 9, 10]. In last recent years, machine learning based approaches have dragged the attention. A machine learning system is developed that learns to predict video transitions based on feature information derived from frames. In supervised learning, low level features are employed to train the system that can predict transitions on unseen data [11, 12]. Various unsupervised learning approaches have been attempted by the researchers to extract key frames and found faster as they do not require training [13].

III. PROPOSED ALGORITHM

In Sport videos (soccer game) a penalty card is used as a warning, reprimanding or penalising a player, coach or team official. Penalty cards are most commonly used by referees to indicate that a player has committed an offense. In this paper we proposed an algorithm which automatically detect card event which uses frame based feature extraction approach. The algorithm uses low level features like HSV color model and ECR (Edge Change Ratio) to detected card views.

Our system aims at the automatically detect yellow card events. The algorithm steps are summarized as follows.

- Step 1: Read every image.
- Step 2: Crop bottom part of the image which shows the caption in image.
- Step 3: Convert cropped RGB image to grayscale image.
- Step 4: Apply Canny Horizontal edge detection operator on grayscale image.
- Step 5: Erodes the grayscale image with flat linear structuring element.
- Step 6: Convert the cropped RGB image into HSV image.
- Step 7: Find indices of nonzero elements of HSV image for hue, saturation & value at particular threshold.
- Step 8: Convert cropped image to binary image.
- Step 9: Find connected components in binary image.
- Step 10: If number of connected components (objects) in binary image is less than threshold then find the pixels in the object and if connected components are present then mark it as likely yellow frames.
- Step 11: Find the difference between beginning yellow card and ending yellow card frames.
- Step 12: If difference is greater than threshold then mark such all the frames as probable yellow frames.
- Step 13: Read intermediate frame from beginning of probable yellow frame.
- Step 14: Crop bottom part of the image which shows the caption in image.
- Step 15: Convert cropped RGB image to grayscale image.
- Step 16: Apply Sobel Horizontal edge detection operator on grayscale image.
- Step 17: Compute Edge Change Ratio (ECR)

$$ECR = \frac{\text{Total number of edge pixels}}{\text{Total number of pixels in frame}} * 100$$

- Step 18: If ECR is between threshold then declare these frames as actual yellow frames and add those frames for Summarized video.

IV. SIMULATION AND RESULTS

A premier league soccer videos have been used in the experiment with total length of more than 2 hours and 20 minutes. All these video possess varying ground and illumination conditions. All video data sets have the 352x288 resolution at 25 frames/s. Every frame of the video is processed to generate the summary. Various types of yellow card views have been shown in Fig. 2, 3, 4, 5 shows the intermediate results of yellow card view detection algorithm. Experimental results have been shown in Table 1 to find accuracy of card event detection are Precision and Recall.



Fig 2. Original Images of yellow card view

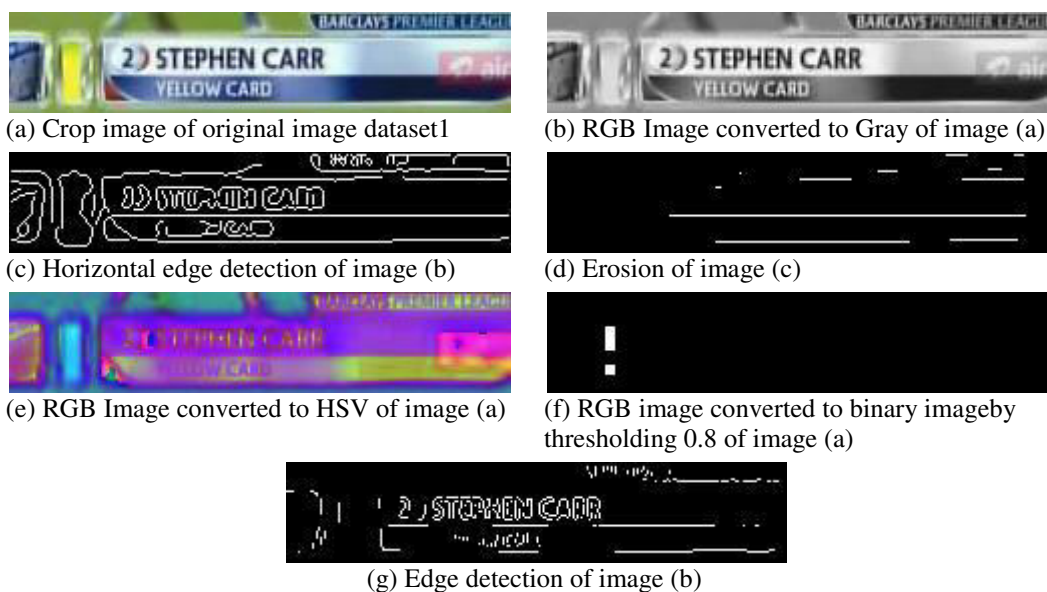


Fig 3. Intermediate results of yellow card detection algorithm on dataset1

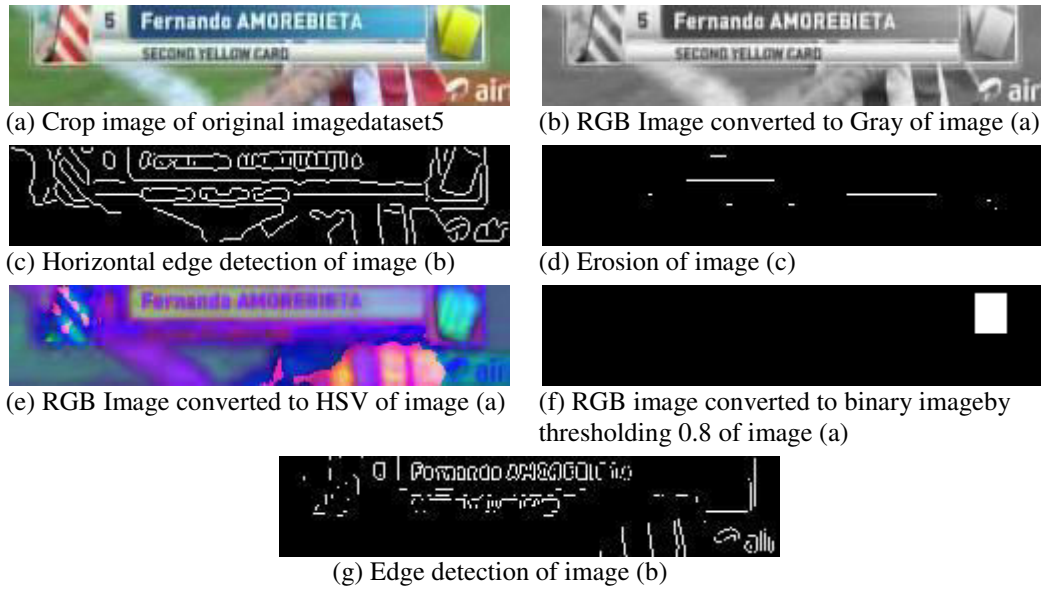


Fig 4. Intermediate results of yellow card detection algorithm on dataset2

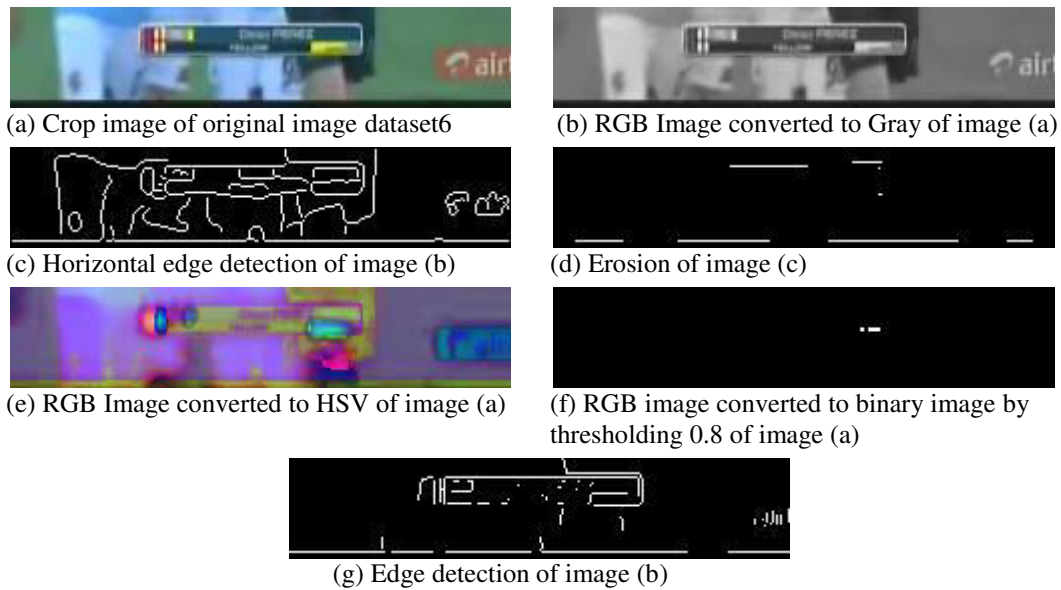


Fig 5. Intermediate results of yellow card detection algorithm on dataset3

Experimental results have been shown in Table 1, where the measures used to find accuracy of card event detection are Precision and Recall. Precision quantifies the detected events are correct while recall quantifies the correct events detected. Precision Rate and Recall Rate has been described in the following equations.

$$Precision = \frac{Correct\ detection}{Correct\ detection + number\ of\ false\ alarm}$$

$$Recall = \frac{Correct\ detection}{Correct\ detection + number\ of\ missed\ detection}$$

Sr. No.	Video Name	False Detection	Detected Card Segments	Miss	Total Overall Detection	Total Card Segments	Precession	Recall
1	Video1	1	1	0	2	1	50%	100%
2	Video2	3	3	0	6	3	50%	100%
3	Video3	1	1	1	2	2	50%	50%
4	Video4	0	2	0	2	2	100%	100%
5	Video5	0	3	0	3	3	100%	100%
6	Video6	0	1	0	1	1	100%	100%
7	Video7	1	3	0	4	3	75%	100%
8	Video8	1	4	0	5	4	80%	100%
9	Video9	0	1	0	3	1	33.33%	100%
10	Video10	1	2	0	3	2	66.67%	100%
Total		8	21	1	31	22	67.74%	95.45%

Table 1. Accuracy analysis of Card Segment Detection

V. CONCLUSION

In this paper, we proposed novel approach for the card event detection in soccer video that can help to bridge the gap between low level features and high level semantic events. We have used low level features like color and edges to detect the yellow card frames. We have conducted large number of experiments on varying condition video datasets of soccer game. Experimental results show that proposed approach is robust and efficient. The proposed approach succeeds to achieve high recall as well as satisfactory precision. In future we would like to improve the algorithm so that false detections can be further reduced.

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