DOMINANT COLOR BASED EXTRACTION OF KEY FRAMES FOR SPORTS VIDEO SUMMARIZATION

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ABSTRACT

This paper proposes a novel approach of dominant color based extraction of key frames for sports video summarization. The visual features have been used to obtain play field color shots and non-play field color shots. For the every play field color shots dominant colored key frame has been extracted using color histogram analysis and created video summary. This provides users a way to swiftly browse a sports video in different levels of detail, without the need to view entire video. The promising results from user study on dominant colored key frame extraction indicate that the proposed scheme is efficient for video browsing, retrieval and video summarization for the applications of the internet and mobile devices.

KEYWORDS: *Color Histogram, Play Field Color Shot, Non Play Field Color Shot, and Key Frame.*

I. INTRODUCTION

Worldwide sports video forms a very significant multimedia content which is viewed globally by large crowd on the TV, internet and mobile devices. However because of time constraints for everyone it is not possible to watch lengthy sports video. The mainstream of the viewers, performance analyzers, professional players and coaches are interested to watch particular segments rather than the entire video. Moreover in today's fast-paced news coverage these videos must be processed quickly for production or else their value quickly decreases. Accordingly the need for generating video summaries is fueled from user and production point of view.

The spatio-temporal feature color does not only add beauty to objects but also give more information, which is used as powerful tool in video summarization, indexing, and retrieval. Ekin et al [1] proposed dominant color region detection, shot boundary detection and shot classification algorithms that are robust to variations in the dominant color. Also introduced new algorithms for automatic detection of goal events, referee, and penalty box in soccer videos. Color histogram, which represents the color distribution in an image, is one of the most widely used color features. It is invariant to image rotation, translation, and viewing axis. The effectiveness of the color histogram feature depends on the color coordinate used and the quantization method. Wan et al [2] studied the effect of different color quantization methods in different color spaces including RGB, YUV, HSV, and CIE L*u*v*. When it is not feasible to use the complete color histogram, one can also specify the first few dominant colors (the color values and their percentages) in an image. A problem with the color histogram is that it does not consider the spatial configuration of pixels with the same color. Therefore, images with similar histograms can have drastically different appearances. Several approaches have been proposed to circumvent this problem. Pass et al [3] proposed a histogram refinement algorithm. The algorithm is based on CCV (Color coherence vector), which partitions pixels based upon their spatial coherence. A pixel is considered coherent if it belongs to a sizable contiguous region with similar colors. A CCV is a collection of coherence pairs, which are numbers of coherent and incoherent pixels, for each quantized

color. Similarly, Chen and Wong proposed an augmented image histogram [4], which includes, for each color, not only its probability, but also mean, variance, and entropy values of pair-wise distances among pixels with this color. Peng et al [5] classify shots into different types based on playfield color. For the similarity in playfield color between medium shot and long shot, the accuracy rate of this method may be dissatisfied. Because color histogram is robust to background noises and invariant to image orientations, most researchers proposed color-based key frame extraction methods [6, 7]. Ferman et al [7] constructed an alpha-trimmed average histogram describing the color distribution of a shot. Then compute the distance between the histogram of each frame in the shot and the alpha-trimmed average histogram. Key frame position is located based on the distribution of the distance curve. However, most of these color histogram based methods cannot well capture the underlying dynamics when there is lots of camera or object motion. Although HSI and CbCr space exploited [8, 9] can leverage illumination issue to some extent, they appear hopeless in the case of larger shadow existing, Benjamas et al [10] used color histogram comparison to detect shot boundaries. Flashlight detection is applied from the region histogram difference algorithm described by Benjamas et al [11]. Detected flashlight and distance between players is utilized in efficient summarization of fighting sports videos. Proposed method composed of skin detection, enhancement image and calculation of distance between players. Sandra et al [12] generated summaries based on color attributes and visual features. These attributes are necessary to identify the similarity among the video frames. They were extracted from color histogram adaptation.

Kenichi et al [13] used color histogram of a shot as color information and discovered important intervals having several color change patterns by using the probability model. In this paper attempt has been made to extract dominant colored frame of play field color shot to create video summary.

II. THE PROPOSED APPROACH OF DOMINANT COLOR KEY FRAME EXTRACTION

Video key frame extraction is one of the key problems in video summarization, video content indexing and retrieval. The shot wise extracted collection of salient images from a video sequence is used for visual content summarization. For the extraction of salient images used color histogram analysis.

2.1. Color Histogram Analysis

In the proposed approach color histogram based analysis is used to classify video shots into play field color shots and non-play field color shots. Moreover it is used to extract dominant colored frame from the play field color shots which gives long view of the field. Playfield color shot based sports video summary is potentially effective for browsing purposes because viewers will not miss any important events although they skip most of the break scenes. To classify video into play field color shots and non-play field color shots we employed global color histogram of every frame in the shot.

Frame wise color histogram gives the number of times a particular color has occurred in the frame. These histograms are defined as h0, h1, h2 ... hi and given by the expression.

$$H(k) = \sum_{i=0}^{N-1} hi \tag{1}$$

Where,

H (k) is histogram of frames in play field shot,
hi is ith frame histogram,
N is number of frames in the play field shot.

For obtaining the color histogram first play field color shot frames that is RGB images are converted to HSV (Hue Saturation Value). Hue values are threshoulded to specific values to obtain the color histogram. In our experiment we considered eight colors that are white, black, red, green, yellow, magenta, blue, and cyan colors. So we will get eight-channel histogram for any play field frame. For the analysis considered sports videos are lawn tennis tournaments, and soccer. Hence we thresholded the hue values for these colors. With the threshoulded values computed histograms of frame sequence in the shots. Based on obtained histogram and color component values shots are classified into play field color shot and non-play field color shot.

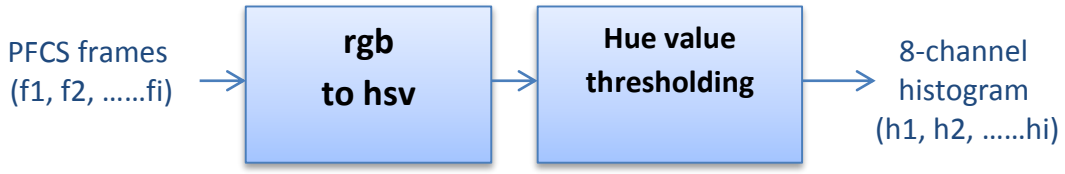


Figure 1 Color histogram of play field color shot's frame sequence.

Frame wise color component values of the shot are used to define mean value of each color component of PFCS. Playfield color shot based sports video summary is potentially effective for browsing the sports video because viewers are interested to look at the events only on the and not on the non-playfield shots.

2.2. Algorithmic Steps

The steps used to extract the dominant colored key frames from play field color shots are as under,
1. Decompose sports video into shots (S1, S2 . . . Sn) using Ulead Video Studio 6.
2. Convert each video shot into frames (f1, f2…fn) using video to JPEG converter.
3. Work out the color histograms of each frame in the play field shot and plot graphs of dominant color of the shot.
4. Plot the graph of frame number verses play field color component distribution in the shots.
5. From the dominant color value in the plot extract corresponding key frame. This frame shows global view of the field and serves as accurate localization of the events on the field.
For the every play field color shot extract the dominant color frame to create sports video summary.

III. EXPERIMENTAL RESULTS

The proposed approach is implemented using MATLAB on a 2.80 GHz Pentium (R) D computer, running Microsoft Windows XP. A video summary is much shorter version than the original video. It is collections of a set of static representative frames.

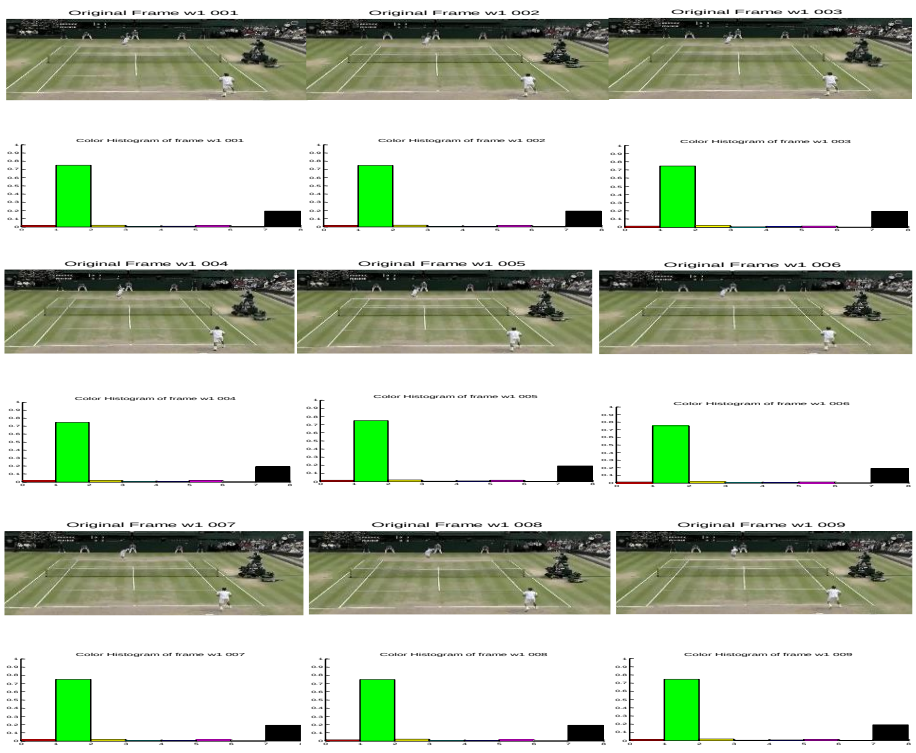


Figure 2 (a) to (f) Sample results of play field color shot frames and their color histograms for Wimbledon shot w1.

The sample results are presented in this section for extraction of dominant color key frame to create video summary of play field color shots Figure 2, figure 5, and figure 8 illustrates sample results of play field color shot frames with their color histograms for Wimbledon, French open and soccer. These histograms show the frame wise dominant color component values which in order to use to define mean value of each color component of play field color shots. Figure 3, figure 6, and figure 9 shows graphs of dominant colors detected for respective labeled sports video play field shots. Furthermore figure 4, figure 7, and figure 10 demonstrates the play field color component distribution in the Wimbledon, French Open and Soccer. Dominant colored frame from each play field color shot have been extracted as one of the key frame for creation of video summary, as illustrated in figure 11.

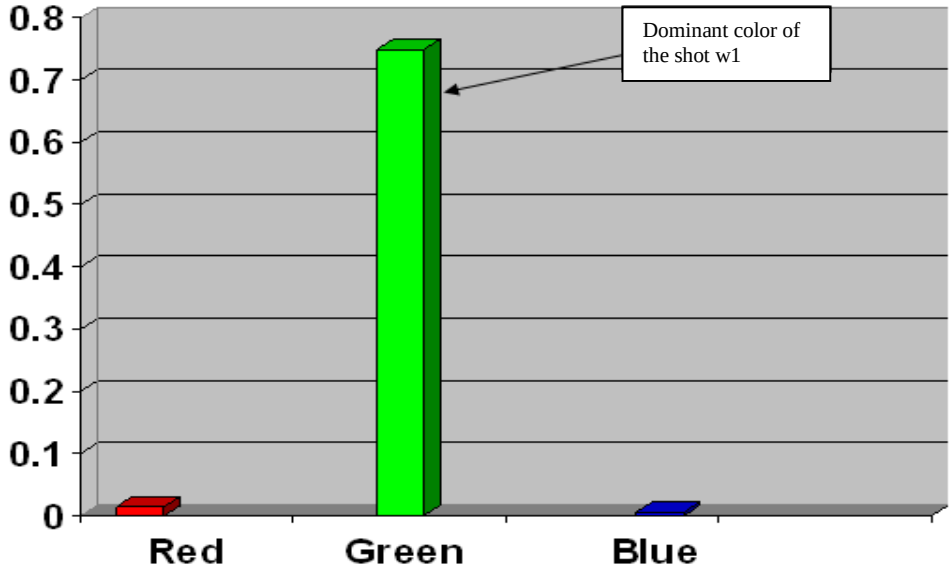


Figure 3 Mean histogram of the sequential frames of shot w1.

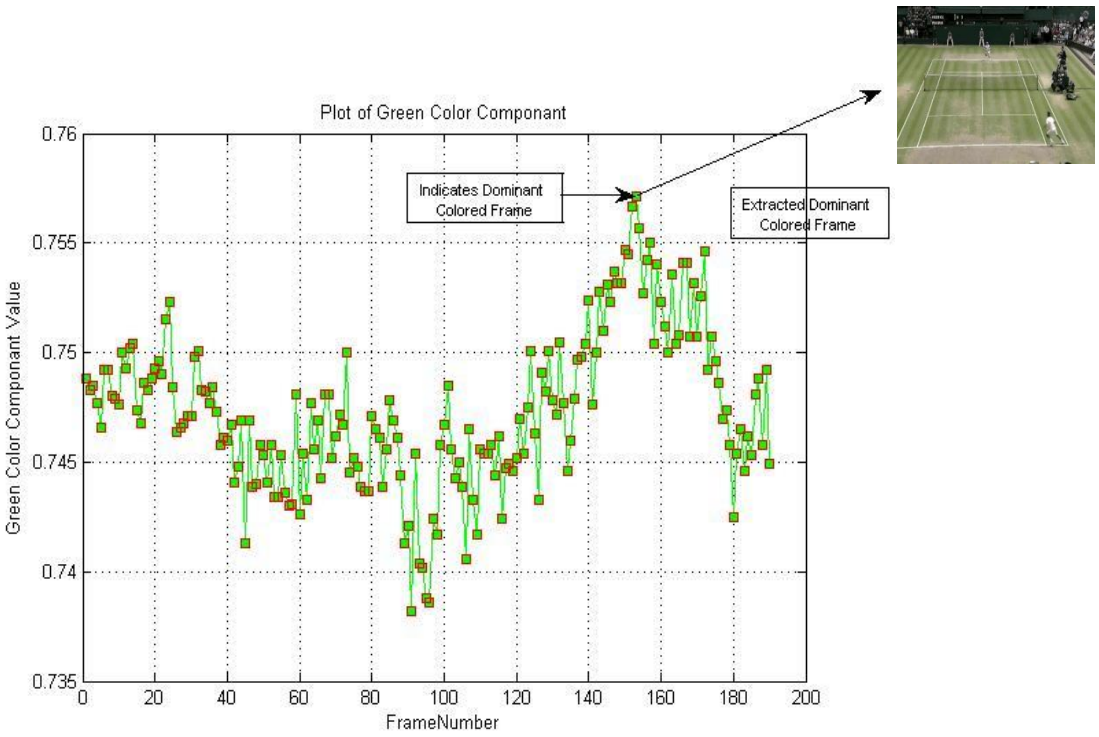


Figure 4 Distribution of green color component and extraction of dominant color frame in shot w1.

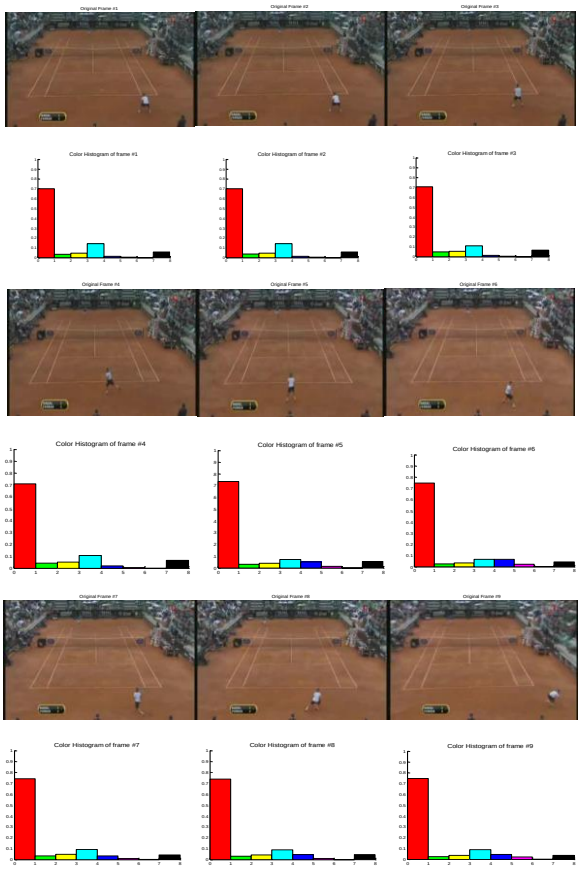


Figure 5 (a) to (f) Sample results of play field color shot frames and their color histograms for French open shot f2.

Figure 6 Graph of dominant color detection of the shot f2

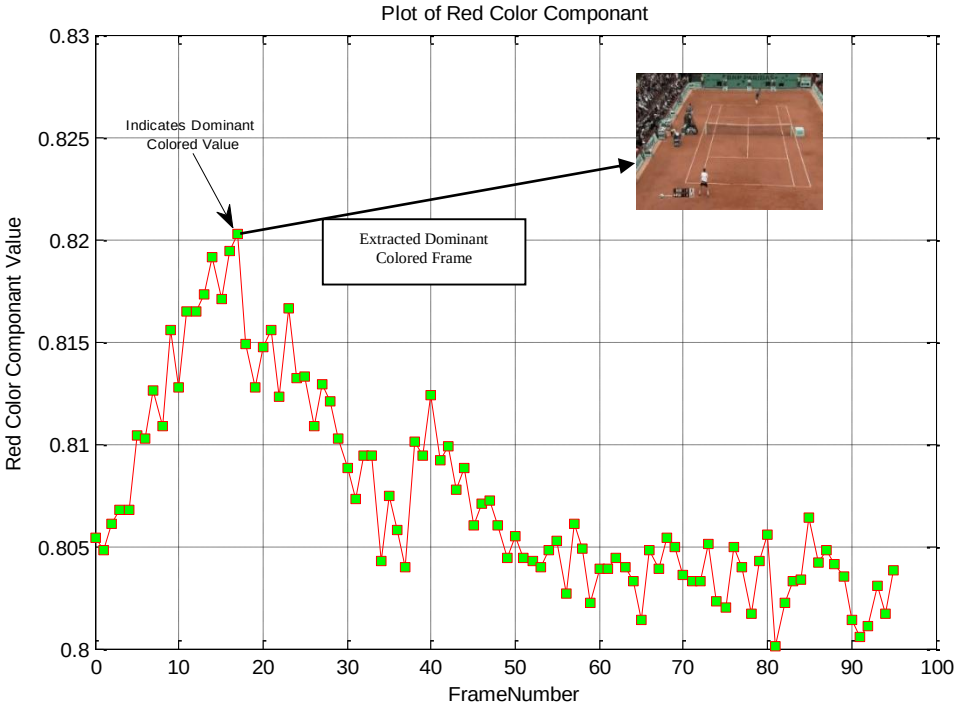


Figure 7 Distribution of red color component and extraction of dominant color frame in shot f2.

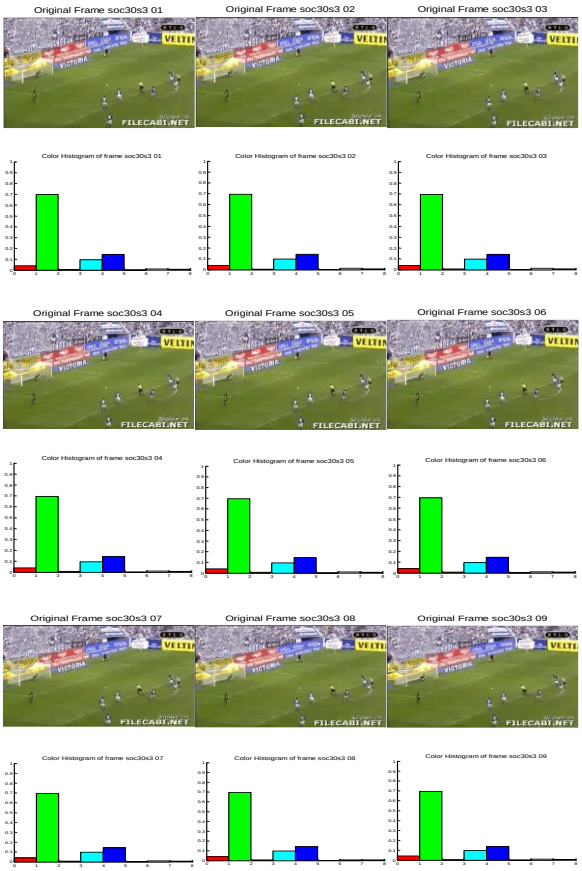


Figure 8 (a) to (f) Sample results of play field color shot frames and their color histograms for soccer shot Soc30s31.

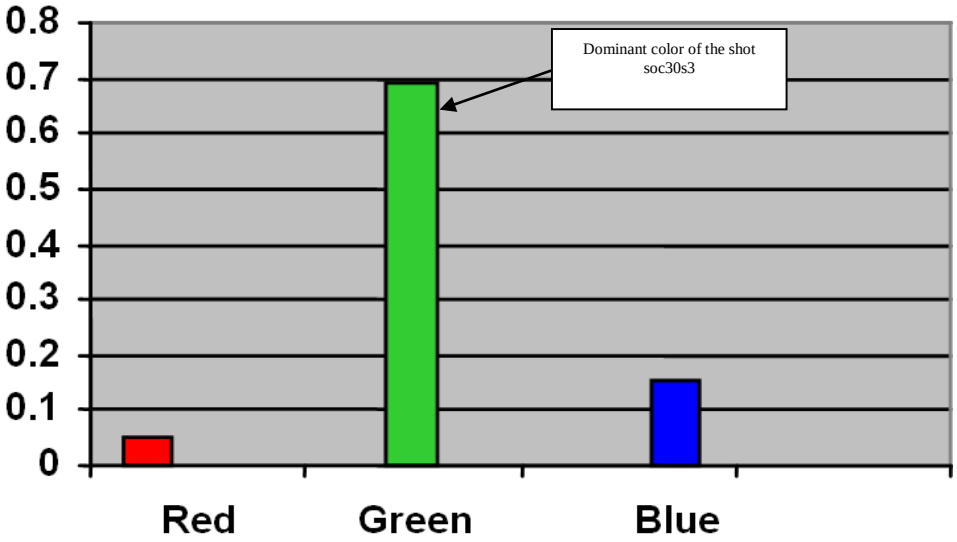


Figure 9 Mean histogram of the sequential frames of shot Soc30s31.

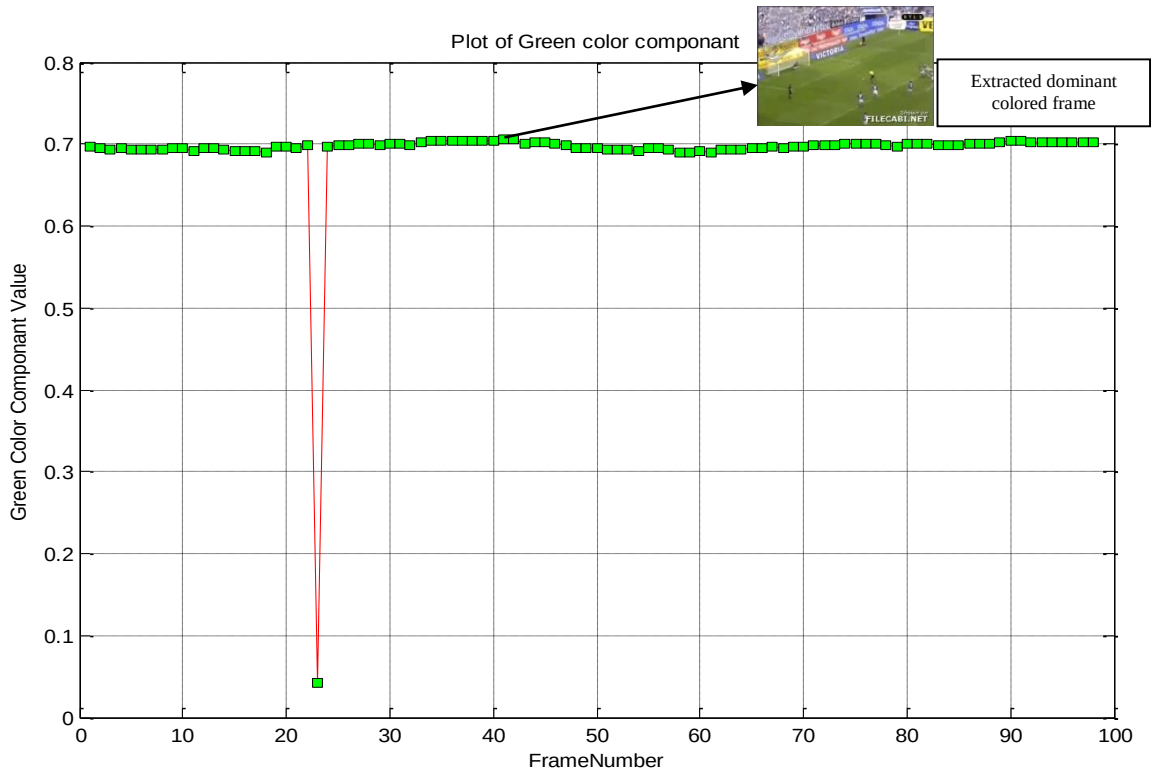
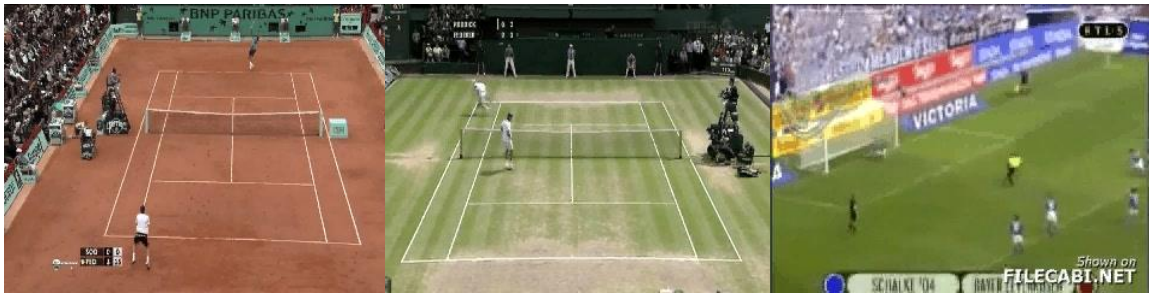


Figure 10 Distribution of green color component and extraction of dominant color frame in shot Soc30s31.



(a) **(b)** **(c)**

Figure 11 Dominant color key frames extracted for play field color shots of Wimbledon shot w1, French open shot f2, and Soccer shot Soc30s31.

IV. CONCLUSIONS AND FUTURE WORK

The color histogram of every frame in the play field color shot has been analysed and used to extract dominant colored frame in the shot. The dominant color based key frame extraction proved to be a practical for Video Summarization. The experimental results reveal the projected scheme is robust and effective to detect most of key events in lawn tennis, and soccer videos in the dataset. It is potentially effective and helpful for sports video fast browsing, retrieving and video summarization.

The main drawback of our approach is that if the same framework is applied for other sports video shots, need to do adjustments in the parameter values such as thresholding of hue values.

As a future work, we will try to apply this approach to more sports video such as basketball, golf and cricket which require different event detection elements. Although our experiment show satisfactory results, additional video features and inclusion of audio and text features will result in better system performance.

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