

Detection of corner event in soccer video

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Abstract. A corner event detection method based on HMM (Hidden Markov Model) in soccer videos. Through analysis of the semantic structure of corner events, define and extract six multi-modal semantic clues to describe shot sequences, which constitute observation sequences as the HMM model input. By the iterative training of the HMM model and the continuous optimization of model parameters, construct the HMM model of corner events. From two aspects of audio and video, dig the inherent pattern of corner events and realize corner events

Keywords: Video semantic analysis, Audio and video features

1 Introduction

With the application and wide spread of sport videos, the automatic detection of highlight in those videos has become an important branch in the field of sport video retrieval area, receiving much attention from numerous researchers. In order to implement automatic detection of some specified events, scholars both home and abroad conducted intensive and systematical studies by applying extensively plenty of machine learning models. So far there're methods like dynamic Bayesian Network (DBN) [1-2], Bayesian Belief Network and Hidden Markov Model (HMM) [3]. HMM joins Markov chain model of temporal evolution and probability model of Bayesian network [4-5]. It's a broadly used statistical model. It's able to express the inherent uncertainties of observations in video episodes, which is more accordant with the temporal features of videos [6-7]. Also, it has effective expression form of video events and parameter learning algorithm [8-9]. The method based on HMM has been one of the most extensively discussed methods in the field of detecting sport video semantic events [10-11].

2 Retrieval of semantic clues of corner kick episodes in football videos

In order to describe comprehensively and clearly corner kick episodes in football videos [12], according to the semantic content information covered by various shots of those episodes, we extract audio/video features from key frames of shots as to discover automatically from different aspects the inherent laws of the episodes, better depicting characteristics of different shots there. Hence it's necessary to use effective feature retrieval technique for the goal.

Here we use HIS color model and cylindrical distance measure for field area segmentations. Make FR the field rate and Green Ratio (GR) the rate of green color in image frames. The quantitative rule is shown as (1):

$$FR = \begin{cases} 1 & GR(i) = \frac{D(i)}{\frac{2}{3} \times p \times q} > T_d \\ 0 & \text{else} \end{cases} \quad (1)$$

$GR(i)$ is grass green ratio of the frame i in camera. GR_{\max} is the maximum ratio of the grass green. Figure 1 gives the field shot and non-field shot frames based on FR partition. In figure 1 (a) and figure 1 (b), GR value is large, said rate of the grass green is the larger. The FR=1 field shot, figure1(c) is a non-field shot.



(a) field shot GR = 68.01% (b) field shot GR = 73.93% (c) (a) non-field shot GR = 8.74%

Fig. 1. Semantic shot frame based on FR partition

3 Detection of corner kick episodes in football videos based on HMM

The HMM model for corner ball episodes is designed to decide the structure of it, i.e. the Markov chain shape of such episodes and the relationship between elements in videos and the model.

In sport videos, typical episodes occur by certain lens changing rules. To be specific, corner kick episodes contain local shots which show one player serves a ball in CA and global shots showing both players competing in the goal area. Learning that several scenes exist when a corner kick episode is happening, we get lens conversion way to which such an episode relates, and then determine and depict Markov link shape of the episode. Fig. 5 gives the conversions chart.

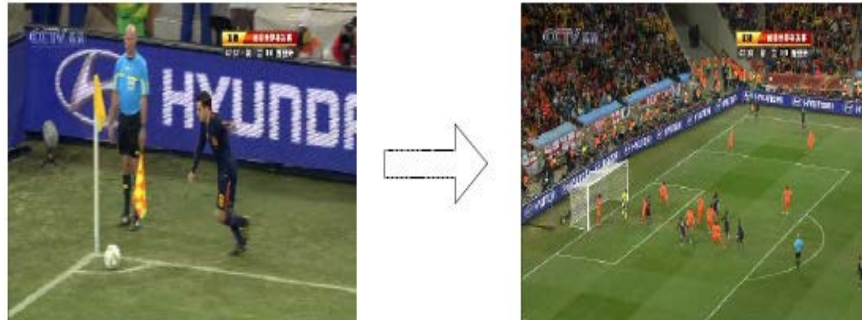


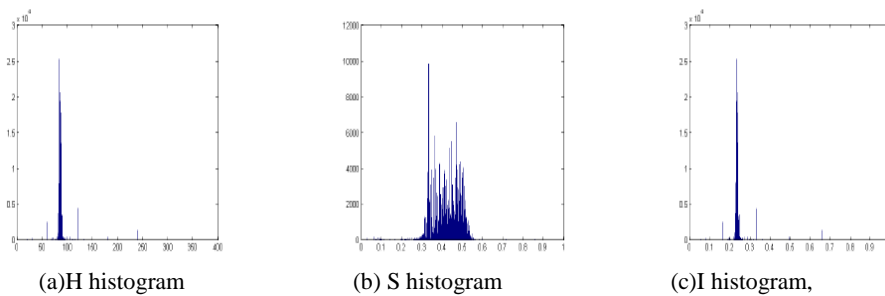
Fig. 5. Transition diagram of corner event shot

The detection of corner kick episodes is consisted of two parts:

Regarding corner ball episodes, the HMM model is created, that is, to select enough video training samples for it. According to those samples, we can decide type of state, number contained episodes; and sketch relative Markov chains. After pre-processing of samples in the training set, we determine the state descriptive method and complete the training process of HMM parameters.

4 Experiment Design and Discussion

Fig. 1(a)(b)(c) is HIS histogram of training image and calculation results of the main color H_{mean} , S_{mean} and I_{mean} . Fig. 1(g) also shows the results of segmenting the main color of video frame images by the cylindrical distance measure. Obviously, we realized well the separation of field and audience area, retained more detailed information and removed some pixel dots close to the main color in the audience area by filtering, such as crowds in green clothes and green flags which have impacts on feature extraction, avoiding incorrect and over segmentations. Table1 gives the retrieval results of green field rate, which reveal that it realized effectively the extraction of field rate features, both recall and precision ratio reaching 100%.





(e) original image frame (f) interception of part image (g) main color segment results

Fig. 1. The segmentation results of main color and HSI histogram of training images

5 Conclusion

This paper presents a method for the detection of soccer video corner event based on HMM. Firstly, analyzed semantic structure of soccer video corner segment; secondly, on every shot key frame extracted six multimodal semantic cue. Audio and video features are fused, the description of the video shot, constitutes the observation value sequence.

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