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Research on the analytical method of video of athletic contest

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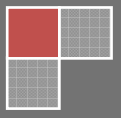
ABSTRACT

During the fast development of computer technology, multimedia technology and network technique, there are huge of video information. However how to extract meaningful information from them is a complex question. Modern big sports events cannot without the video technique, the current method is to analyze and search the video and apply the processing techniques and analysis techniques of computer to establish a full set of index structure of video in athletic contest which is convenient for users. The analysis techniques of sports video have importance and valued application whose key part is to analyze semantic event and mutual relation. Firstly, the thesis explains the research background of analytical method of video content of athletic contest. And then, it introduces the research status, the structure of video, semantic analysis and current technical question and so on. It also proposes analytical methods based on rule and statistics and detection method of replaying the wonderful event. It states the process of extracting wonderful event in video content of athletic contest and analytical rule of sports game video. Finally, the thesis analyzes and compares the statistic model through the test scheme and testifies whether they can successfully resolve the semantic event in sports game video and look far ahead into the future of athletic contest.

KEYWORDS

Athletic contest; Video analysis; Semantic event; Based on rules and statistics; Wonderful events.



INTRODUCTION

The main goal of analysis techniques of sports video is conducive to clients searching for useful information as much as possible with the help of the processing techniques and analysis techniques of computer. The video of athletic contest has very specific definition of semantic event which is a key distinction from other kinds of video. And video of athletic contest also has special structure and rule which is easy for analyzing and labeling video of athletic contest[1]. The specific event detection, state inspection of contest and specific target tracking, analysis of strategies and other contents are now the main part of high level semantic analysis of video of athletic contest[2]. At present, the more matured analysis techniques in video of athletic contest includes Hidden Markov Model and dynamic planning in football match video, labeling of playing tennis using contour feature of people[4], detection and recognition of wonderful event in ball match such as football, basketball and golf etc. through hurrah and applause[5].

ANALYSIS TECHNIQUES OF VIDEO OF ATHLETIC CONTEST

Key content

Now, there are three levels of research on video of athletic contest: scene classification[6], extracting wonderful events, and event detection. There are details:

1) Scene classification: The primary functions of video analysis which can divide the video of athletic contest into proceed and pause and user can directly skip the pause part.
2) Extracting wonderful events: recognizing and extracting the wonderful part effectively and forms the collection.
3) Event detection: Detecting the repeated emerging semantic events (movement of diving, shoot at the basket and shoot at the goal) in independent fields. And label and organize them that are conducive to effectively searching.

Problem to be solved

Analysis and process techniques of video has tens experiences and in terms of video analysis and searching gains good results. But these methods generally cope with low-level feature, and understanding and analyzing high-level semantics need a long-term to reach the goal. Now, the problem to be solved is following:

1) There is lack of study about relations among semantic events. Because the semantic events during the contest are not independent and relates to each other more or less. It need comprehensively analyze their relations, and make the content more valued and accurate.
2) The effective multi-mode of analyzing method is less, and now audio features, motion features, text message of comprehensive sports video are important to enhancing the accuracy of excluding image feature.
3) The frame structure of analysis of video of athletic contest is disorderly and has no unified standard. Though the detection and reorganization of special event has started in some certain contests, there are difficulties in widely generalizing this method in the common athletic contest. This includes the effectiveness and openness of analytical framework of video of athletic contest which is important to improve the development of this field.

THE SPECIFIC CONTENT OF ANALYTICAL METHOD IN CONTENT OF VIDEO OF ATHLETIC CONTEST

Extracting wonderful event

Generally athletic contest has more than one hour in which has time of pause and relaxes. So the video would be long and audients really focus on the wonderful events such as the key shoot in football finals. The former methods were realized by hand, and the process was complex. But now the video storage is completed by digitized methods. So the task of automatically completing the extracting wonderful event is meaningful which an important study is for worker of video analysis and searching. Then it deals with the semantic event and mutual relations of video of athletic contest with the help of principle of management of semantic events and solving thought. And it talks about the analytical method of video of athletic contest based on the rule and statistics gains innovative product on the foundations above.

Besides, as for video coding and transmission automatically, completing the extracting wonderful event has profound influences which are shown in certain bandwidth. When the automatic work is finished, it can complete the later work by the allocation of dynamic code rate[7] which means that the high bit rate is provide to wonderful events and other parts adopt low bit rate. Figure 1 and 2 are curve charts of dynamic code rate and frame rate changing with the bandwidth.

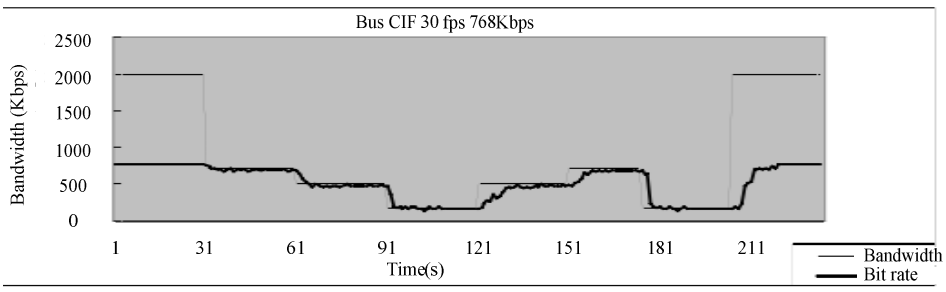


Figure 1 : Code rate change with bandwidth

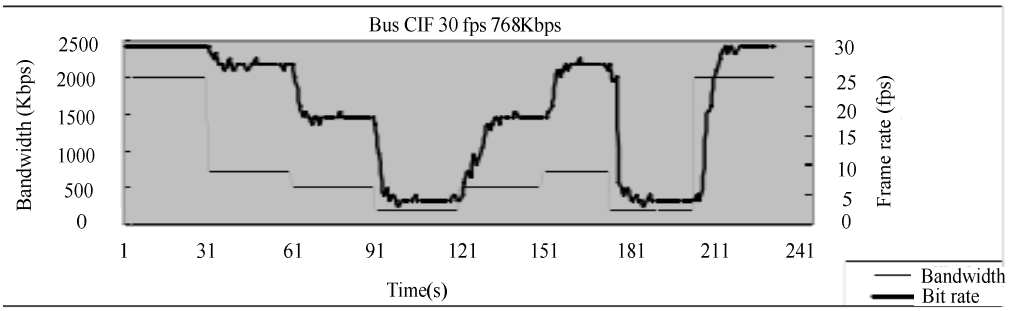


Figure 2 : Frame rate change with bandwidth

Now, there are following methods extracting theoretical research in wonderful event in sports video: Ma and other people propose that establishing user's attention model analyzing the wonderful video in athletic contest which integrates the vision, hearing of people and textual characteristics and finally extract them through image detection; Rui adopts the methods of voice recognition; Hanjalic tests intensity of sports, audio energy etc. and measuring function of exciting program to complete the extracting.

Here, according to the case of diving contests, there are related extracting settings. Firstly, the wonderful events generally would be replayed several times. And the repeated parts come from the same camera. In this way, the natural picture and repeated part can be treated as the wonderful contents shown in Figure 3. This means that this structure is also frequent in other sports.

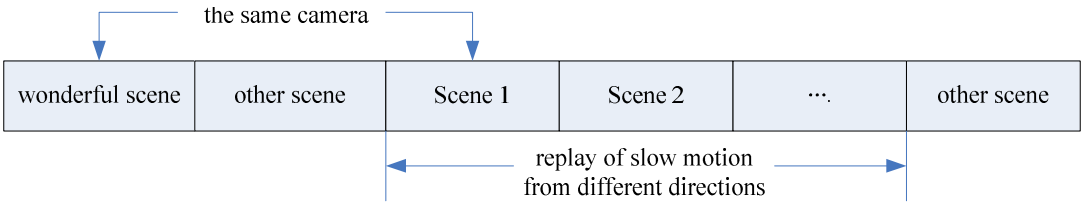


Figure 3 : The basic structure of wonderful parts in the diving video

Based on the setting above, Figure 4 gives the related flow chart of extracting algorithm.

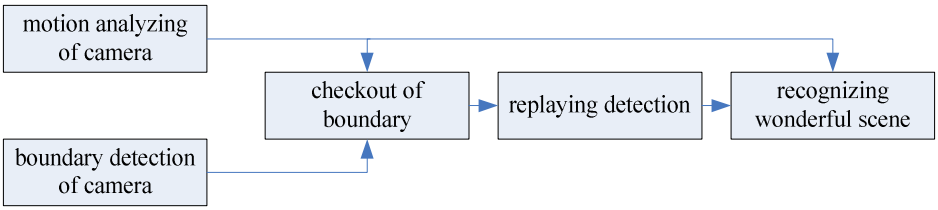


Figure 4 : Extracting of wonderful parts

Boundary detection and checkout of camera

The following work is boundary detection and checkout of camera[8] and the lens are actually a set of frame sequence taken by camera and the smallest structure unit in video. If you want to complete the extracting of wonderful scene, you just need divide the scene required which is boundary of detection of camera. The normal changing-over of lens would create a process of gradual change such as fade-in and fade-out and so on. But it is very difficult to detect the gradual change. Fast change is a kind of lens boundary in sports contests and the gradual change is seldom. The difficulty is that there are so many kinds of sport in video in athletic contest that causes many faults in boundary detection.

As for the boundary detection and checkout of camera, the main segmentation is realized by double compare of color histogram which is effective in detection of gradual change and fast change and is also simple. But the data of experiment shows that there are many cameras moving in the video which will cause the wrong judge of gradual change. The Figure 5 shows results of analyzing D value of histogram between frames in a diving video.

It is shown in Figure 5 that there is a lens picture in A; and there is a change caused by camera in B; there is a gradual change C. But the D-value tells us that it is difficult to distinguish B and C. In order to solve this question, it needs

judge the gradual change is caused by moving or not and is generally judged by movement characteristic order $\{C_i\}$. If it exceeds half, it judges the movement.

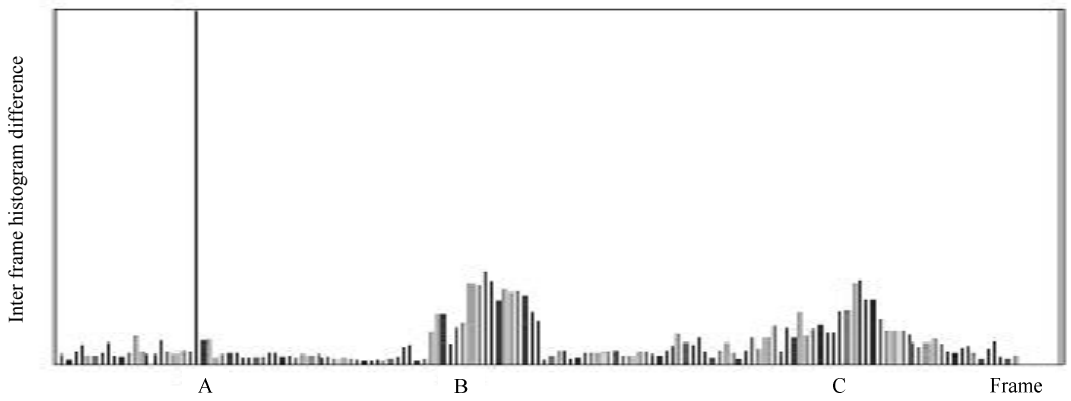


Figure 5 : Analysis of D-value of histogram between frames

Through some algorithm the system of wonderful event in diving video is realized by JAVA. And a video of 3minuts and 20 seconds are treated as a test data and threshold are determined. And the results are shown in TABLE 1.

TABLE 1 : Extracting results of wonderful segments

	A	B	C	D	Total
The whole length	0:3:18	0:35:08	0:47:43	0:47:52	2:44:01
Right segment	0:12:02	0:13:23	0:18:45	0:18:45	1:02:46
Wrong segment	0:02:19	0:00:36	0:01:45	0:00:29	0:05:09
Missing segment	0:00:15	0:00:00	0:00:45	0:00:16	0:01:16
The rate of checking right	83.86%	95.71%	91.40%	97.49%	92.42%
The rate of checking full	97.96%	100%	96.12%	98.60%	98.02%

Though the different contests have different contents and scenes, properties of their algorithm are same shown in TABLE 1. Through the test, the effect of extracting wonderful segments is very good. And the rate of checking right reaches 92.42% and the rate of checking full is 98.02%.

And then the research analyzes the segmentation of lens, semantic labeling[9] and semantic analysis of system. Meanwhile, it comprehensively estimates the performance of system and through lot of data to test and related information of data shown in TABLE 2.

TABLE 2 : The collection of data

	Time	Replayed event	State event	Goal event	Total
A	0:46:54	40	84	40	164
B	0:44:13	40	85	40	165
C	1:09:24	60	125	60	245
D	1:26:43	72	150	72	294
Total	4:07:14	212	444	212	868

Semantic label

Finally the research takes related tests about semantic label mainly involving the rate of checking right and the rate of checking full all events. And through the TABLE 3 the system runs well in testing replayed event and state event but runs ordinarily in testing goal event. The research thinks that the movement of lens mainly causes the change, so the performance of the whole test can be improved by better extracting technique and statistic model of cognition.

Here the research checks the performance of DBN model meets the standard or not by detecting the proceeding and suspending events. If the proceeding and suspending events in football game realizes detection, the automatic forming video abstracts and high level semantic analysis have values. For example, deleting the suspending segments of the game and gaining the simplest video abstract.

TABLE 3 : The results of semantic label

Replayed Event		
	The rate of checking right	**The rate of checking full**
A	40/40=100%	40/40=100%
B	40/40=100%	40/40=100%
C	60/60=100%	60/60=100%
D	71/73=97%	71/72=99%
Total	99%	100%
State event		
	The rate of checking right	**The rate of checking full**
A	78/78=100%	78/84=93%
B	78/78=100%	78/85=92%
C	114/116=99%	114/125=91%
D	118/119=99%	118/150=79%
Total	99%	87%
State event		
	The rate of checking right	**The rate of checking full**
A	30/43=70%	30/40=75%
B	25/34=74%	25/40=63%
C	58/71=82%	58/60=97%
D	58/84=69%	58/72=81%
Total	74%	81%

Firstly, with the help of colors and sports in different modes the research checks the data. Though the colors and sports have small relation with each other, it still has value in the proceeding and suspending events. The methods extracting color is based on the key color. Because the site of video is mostly site of game, the key color represents the site. The shape of site can be shown by geometric moment through set the picture M*N, the definition of moment whose order is (p, q) is formula (1) :

$$m_{pq} = \sum_{y=o}^{N-1} \sum_{x=0}^{M-1} x^p y^q f(\mathrm{x}, \mathrm{y}) \quad \textbf{(1)}$$

Through our experiments, the multilayer DBN model can be tested effectively and meanwhile the integrating of multi model of information can be tested effective or not. Finally, it can compare performances of other integrating. Here, through respective judging of frame and clips, it can gain video analysis data of different model. The sensitiveness of each model on local variation is tested through the performance of frame. In TABLE 4, the color feature can be only shown by HHMM_C that expresses the motion feature. And other model needs two models together. As for the estimation of segment, shown in TABLE 5, the results of judging event segments is right or not which is finally judged by the overlap of event segments and real one in terms of time.

TABLE 4 : Data statistics of experiments based on frame

Model	HHMM_C	HHMM_M	HHMM	FHHMM	CHHMM	PHHMM
Accuracy Rate	78.46	64.07	77.08	81.14	82.60	80.05

TABLE 5 : Results of experiments based on segments

Model	HHMM_C	HHMM_M	HHMM	FHHMM	CHHMM	PHHMM
The rate of checking right	87.61	50.64	69.46	36.09	36.41	73.26
The rate of checking full	71.22	84.40	84.06	100	99.30	90.00
F_value	78.57	63.30	76.07	53.04	53.28	80.77

CONCLUSION

In order to acquire the information from the huge of the video of athletic contest, it needs powerful video analysis and searching techniques. The research makes a comprehensive analysis through the features of structures of video of athletic contest. It determines the complete video analysis method through the dealing, analyzing and understanding of computer. From the point of application, it owns good theoretical meaning and application value. Specifically, through the study of specific semantic event, that is how to effectively extract the wonderful event and applying the analytical method based on rule and statistics, it completes related analysis and research. Of course, there are so many problems in the study that need to be resolved. And at present, accuracy of video searching does not have the practical application ability. From the development tendency and prospect of video analysis techniques of video of athletic contest, through the hard study combining the practical application, it is not difficult to see that the development of it will be better and better.

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