Discussion Support System for Video-oriented Sports Meetings

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Abstract

Most sports teams have meetings to review and analyze the past games and plays and to discuss tactics and technical issues to improve the performance. Many teams are already introducing video-oriented game analysis such as a simple video recording and replay system or a computerized scorebook system accompanied by annotated digital videos. We propose a novel meeting log system which supports to record the performed discussion systematically associated to the game video log, based on a structural analysis of such meetings. As we look into the structure, they often have meetings in two phases: a leaders meeting and a team member meeting. The team leaders meet and discuss the points of issue for training and tactics in the leaders meeting, and then they bring the conclusion to the member meeting to share the ideas and the plans. Our system provides with a bridge between the meetings to share the discussion of the former meeting in the latter one effectively. We developed a system and evaluated its good performance for a rugby team case.

1. Introduction

We propose a novel meeting log sharing system which supports to share the performed discussion in the sports meetings, which is semantically associated to a captured video log of a sports play. Most sports teams have meetings to review and analyze the games and practices to discuss tactics and technical issues for the improvement of the play performance. A simple video recording and replay and a computerized scorebook are already effectively used by amateur and professional sports teams. Digital videos annotated by the various event tags such as "goal" and "foul" are useful for quick non-linear search and review. Our system integrates such annotated video segments and the essence of the discussion dialog to construct a video-oriented audio-text meeting minute. Such a minute is effectively used to share the conclusion, its rationale options and alternatives discussed in the meeting.

When we look into the structure of the sports meetings, they often have meetings in two phases: a leaders meeting and a team member meeting. The team leaders meet and discuss the points of issue for training and tactics in the leader's meeting, then in the second phase, they bring the conclusion to the team member meeting to share the ideas and the plans. We developed a system and tested it with a university rugby team. The knowledge and experience gap between the leaders and the other team members may introduce conflicts and mis-understanding at the second phase meeting especially when the gap is large. We intend to bridge the gap between the participant groups by the digital minute. This is a good example of group communication gap problems in every hierarchical organization.

In this paper, we first analyze the general sports meeting style. Then, we develop a prototype system for evaluation experiments. The access time for the target play is naturally reduced compared to the linear video search. The recall and precision rates are examined how well the topics are passed between the leaders and the team members by the prototype. A preliminary result shows that at least the precision becomes better when the proposed system is used.

2. Related Works

Meeting capture and its reuse have been investigated by many people. Stiefelhagen et al. [1] developed a meeting capture system with an omni-directional camera and an automatic annotation of the video with attendee's names. Discussion miner [2] captures small group meetings by using multiple cameras and microphones to record video, dialog and

interactions. The dialog and interactions are recorded semi-automatically with the help of human transcript typing. These systems are mostly used to review the meeting by the individual participants. The reuse of the recorded material for further discussion with other people has not been addressed. Text-based groupware for discussion support should be integrated to audio-visual recordings.

Video indexing is also used for sports scene. Searching and summarizing of sports game video are useful for sports funs. Auditory analysis to find an exciting play part is already built in a commercial DVD player. Sports players are more serious to use videos of games and practice to check the techniques and tactics, and video-based support tools have been commercialized [3]. However, they are still focusing on to the editing of video data for review. We focus on the meeting support system such that it produces the video based minute of the meeting and reuses for further meetings.

3. Structure of Sports Meetings

We will discuss and analyze sports meetings taking a rugby team case as an instance, which does not lose the generality of team sports such as football, soccer, American football, etc.

There are two types of sports meetings. One is to share mental matters to motivate the team members for practice and games. The other is to share technical matters such as technical improvement planning, coaching, practice menu development, menu sharing, and tactics planning and sharing. We focus on the latter type: technical meetings.
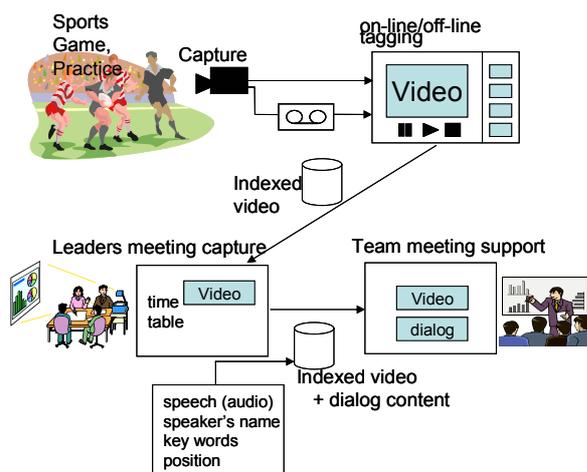

Figure 1 Sports Meeting Support System

3.1 Technical Meeting

A typical technical meeting consists of (i) a capture and selections of the event of interests for discussion, (ii) a leaders meeting for extraction of discussion topics and play analyses, and (iii) a team member meeting to announce and share the conclusion of the leaders meeting as shown in Figure 1. The capturing and the indexing in (i) have been already realized by many works [1][3]. In the leaders meeting, the skillful members of balanced positions attend and discuss the technical issues by referring the video segments. To make the discussion lively and concise, the number of attending members is set as small as possible. In the team member meeting, the conclusion of the leaders meeting is announced to other members of the team. Since these members are often less experienced or skilled, the message passing between the meetings may not be effective enough.

3.2 Use of Video

Video is important and helpful in such sports meetings, because the reviewing of live plays is most effective second to the coaching on the field. Especially, the game such as rugby continues long for an hour or so, and the number of the players is large. Consequently, it is not easy to replay the whole game in brain after that, and some play is not remembered as it happened outside of the player's view. The video recording can provide the facts of the play for the meetings.

The video review has some problem, too. First, it contains too much unnecessary shots. Second, novice and unskilled players often cannot understand the problem even though the video is showing a mistake play. The advices of coach and skilled players are necessary.

3.3 Sharing of Technical Issues

The discussed topics in the meeting are generally memorized by a secretary of the team. The memo and the minute are used for the later meeting. The load of the secretary is, however, heavy. Often, only the issue and the conclusions are memorized and used for the presentation at the team member meeting. However, the members of the meeting may not be skillful to understand the conclusion by such a presentation only. They require the rationale and the trace of discussion for better understanding.

4. Meeting Support System Prototype

We have prototype a meeting support system as illustrated in Figure 1 that can capture the play by video and help indexing on-line/off-line. They are used to memorize the discussion of the leaders meeting and to be utilized for the presentation of the team member meeting. The main purpose of the system is to convey the meeting semantics and content between the meetings. The video segments are used effectively as foci of interests during the meetings.

4.1 Video Indexing Tool

A simple video indexing (tagging) tool was developed. A Digital Video (DV) camera is connected to a PC. Either a live capturing or a video replay is supported by providing a simple user interface to select a named event (play indices) from the menu buttons as shown in Figure 2.

Figure 2 Video Indexing Tool

The indexing must be done in real time. So the simple and fewer buttons are presented in the graphical user interface. The video segments are time-stamped with the name of the tag when the button is pressed. The tag will be used for non-linear access in the following process.

4.2 Discussion Support Tool

The output of the video indexing tool is used by the discussion support tool in the leaders meeting then in the team member meeting. The indexed video segment can be viewed arbitrarily by clicking the list in the GUI time stamps zone (see Figure 3). The leaders investigate and discuss each play, while a member of the secretary role inputs the speaker ID, his position of statement and the keywords spoken during the discussion. There is an audio recording feature to keep records of original spoken dialog, which can be replayed in the team member meeting.

One of the novel features of the tool is that it requires the speakers to identify their positions of comment at the time of speaking loud. The prepared positions list contains "positive", "negative", "subjective", "objective" and "creative". The speaker's

Figure 3 Discussion Support Tool

comment is translated into a keyword by the secretary.

This tool is also used in the team member meeting. The recorded dialog and keywords and the speech are used to explain the transition of discussion when some conclusions are presented to the other team members.

5. Experimental Results

We have conducted the evaluation experiments with the prototyped system. The first experiment was the indexing experiment that was to know the availability of the video indexing tool. We investigated who could use such a tool effectively. The second experiment was to evaluate the interface of the discussion support tool. The position identification and speech recording features were investigated. The third experiment was to evaluate how the discussion support tool could support the conveyance of message of a leader's by using the tool.

5.1 Indexing Experiment

Four male subjects of different carrier are used in the indexing experiment as in Table 1. We conducted the experiment in the following way. A game video was presented to each of the four subjects, who were asked to mark an index at every important play. The importance value varies among each subject based on their backgrounds and experiences. The subjects A and C played in the game of the video content, while B and D didn't play. However, since the game was one year ago, the effect of memory dependence was considered small. The video footage is 28 min. and 41 sec. long.

Table 1 Subjects' profile for Indexing Experiment

Subject	Age	Carrier year	position
A	20's	5	n/a
B	20's	13	Captain
C	20's	15	Ex-captain
D	40's	23	Director

The total numbers of indexed play were 32, 13, 16 and 27 by the subjects A, B, C and D, respectively. Because the subject A was a novice player, it became clear his indices were not correlated to the others' much and were not reliable for the further usage. We then investigated the differences between the subjects B, C and D. The result is shown in Figure 4. The subjects B and C play in different positions. The common selections are indicated by the ellipsoids in the figure. The most of the indices by the subject D (top row) have been also marked by either the subject C (second row) or the subject D (bottom row).

The indices by the subject D is covered by either subject B and C. This means it is better to ask a director to select the important plays for discussion, but if we choose balanced experienced players in a team, we can cover most of the important plays for discussion effectively.

## 5.2 User Interface Experiment

Five leaders of a team were selected as the subjects for this experiment. In this experiment, the subjects were instructed to use the tool to discuss on selected plays from a recorded game. The usability and the time of navigation were investigated. The usability was evaluated with the comments of the subjects. The positive comments were given such as "easy of random and repeated access to the targeted play", "identification of position helps to organize the comment", etc, while the negative comments were also given such as "dialog is not smooth since the system forces the speaking in a sequential order". This should be improved in the future development of the tools.

5.3 Message Conveyance Experiment

The effectiveness of using the discussion support tool was investigated. Eleven subjects of the team members were instructed to note the topic of discussion during the team member meeting. Two cases of with the tool and without the tool were evaluated separating a video footage into two parts. The written topics of importance technical issues and their solutions were checked referring to the topics
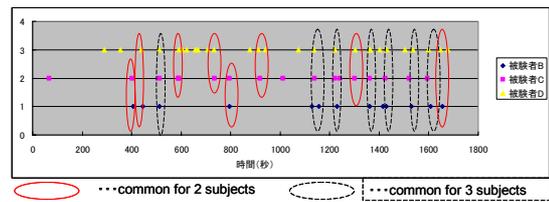
Figure 4 Common Indexing by Subjects B, C, D
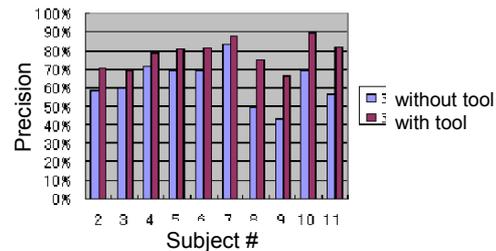
Figure 5 Precision rate of topic conveyance

noted by the presenter. The precision and recall rates were measured and the positive effect was tested by a t-test. The result of precision rate across the subjects is shown in Figure 5. The recall rate didn't improve much but the precision rate was shown statistically improved, which is supported by the t-test.

6. Conclusion

The discussion support system for sports meeting is presented with the description of the prototyped tools and its evaluation with a rugby team. The effect of the structured note of the discussion was confirmed in terms of the precision rate of message passing from the leader presenter to the team members when the proposed system is used.

The user interface of the tools needs to be improved. The evaluation experiment must be conducted with a larger size of games and subjects.

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