Chapter 12

Sports Video Analysis

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ABSTRACT

The explosive proliferation of multimedia data necessitates the development of automatic systems and tools for content-based multimedia analysis. Recently, sports video analysis has been attracting more and more attention due to the potential commercial benefits, entertaining functionalities and mass audience requirements. Much research on shot classification, highlight extraction and event detection in sports video has been done to provide the general audience interactive video viewing systems for quick browsing, indexing and summarization. More keenly than ever, the audience desire professional insights into the games. The coach and the players demand automatic tactics analysis and performance evaluation with the aid of multimedia information retrieval technologies. It is also a growing trend to provide computer-assisted umpiring in sports games, such as the well-known Hawk eye system used in tennis. Therefore, sports video analysis is certainly a research issue worth investigation. In this chapter, the authors propose to review current research and give an insight into sports video analysis. The discussion on potential applications and encouraging future work is also presented.

1. INTRODUCTION

The advances in video production technology and the consumer demand have led to the ever-increasing volume of multimedia information. The rapid evolution of digital equipments allows the general users to archive multimedia data much easier. The urgent requirements for multimedia applications therefore motivate the researches in various aspects of video analysis for content-based multimedia information retrieval.

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Recently, sports video is attracting considerable attention due to potential commercial benefits and entertaining functionalities. There has been lots of research directed toward automatic indexing and summarization of broadcast sports video. As the pace of life in the information society accelerates, most viewers desire to retrieve the significant events or designated scenes and players, rather than watch a whole game in a sequential way. Various algorithms of shot classification and highlight extraction in sports video have been developed based on the combination of low-level visual/auditory features and game-specific rules. Some research efforts focus on ball/player tracking for event detection, since semantic events are mainly caused by ball-player and player-player interactions.

Most existing works in sports video analysis are audience-oriented. However, more keenly than ever, the audience desire professional insights into the games. The coach and the players demand automatic tactics analysis and performance evaluation with the aid of multimedia information retrieval technologies. Traditional interactive video viewing systems which provide quick browsing, indexing and summarization of sports video no longer fulfill their requirements. The professionals prefer better understanding of the tactic patterns and statistical data so that they are able to improve performance and better adapt the operational policy during the game. To achieve this purpose, the current trend is to employ some personnel for game annotation, match recording, tactics analysis and statistics collection. However, it is obviously time-consuming and labor-intensive. Hence, automatic tactics analysis and statistics collection in sports games via video analysis technology are undoubtedly compelling.

In this chapter, we propose to review current research and take baseball for example to give an insight into sports video analysis. The rest of this chapter is organized as follows. Section 2 reviews the related work on sports video analysis. Section 3 elaborates the baseball video analysis work with applications (Chen et al. 2006b; Chen et al. 2007a). Section 4 gives the further research directions and finally, section 5 concludes this chapter.

2. RELATED WORK ON SPORT VIDEO ANALYSIS

The contents of sports video are well-structured since the broadcasters present the game process in similar ways due to the game rules. Therefore, many domain-specific features and knowledge can be employed and incorporated into sports video analysis. The possible applications have been found in many kinds of sports, e.g., baseball, soccer, tennis, volleyball, etc. The major research issues are described as follows.

**Shot Classification**

In a sports game, the positions of cameras are fixed around the field and each camera has a specific assignment for broadcasting the game. The rules of presenting the game progress are similar in different channels. The broadcasting technique that a few dominant shots constitute most parts of a sports game leads to the requirement of shot classification. Duan et al. (2003 & 2005) employ a supervised learning scheme to perform a top-down shot classification based on mid-level representations, including motion vector field model, color tracking model and shot pace model. Hua et al. (2002) integrate color distribution, edge distribution, camera motion, sound effects and closed captions with maximum entropy scheme to classify baseball scenes. Kumano et al. (2005) divide a frame into blocks and analyze the mean, variance and log variance of the luminosity within each block for pitch scene discrimination. Lu and Tan (2003) propose a recursive peer-group filtering scheme to identify prototypical shots for each dominant