Navigating News Programs in Large TV-Streams: A Knowledge-Based Approach

Walid Mahdi, College of Computers and Information Technology, Taif University, Taif, Saudi Arabia
Tarek Zlitni, Higher Institute of Computer Science and Multimedia, University of Sfax, Sfax, Tunisia

ABSTRACT

The different uses of large TV streams have continued to diversify since the appearance of digital TV. For conveniently retrieving and navigating in TV streams, users are often interested in new content-based multimedia applications of high added value such as Interactive TV, Video on Demand (VoD), YouTube or Dailymotion. These applications offer fast and easy access to best explore a particular TV program. Therefore, it is necessary at first, to be able to retrieve a particular program within a large TV stream and secondly segment this program into semantic units related to appropriate retrieval entities. In this paper, the major originality of the authors’ approach is the use of contextual and operational characteristics of TV production/post-production rules as prior knowledge that captures the structure for recurrent TV news program content. The authors validate their approach by experiments conducted using the TRECVID dataset that demonstrate its robustness.

KEYWORDS

Knowledge-Based Video Indexing, Multimedia Applications, TV News Navigating, TV Stream Structuring, Video Grammar

1. INTRODUCTION

Today, the continually increasing volumes of digital video have contributed to conceive new high added value services around television and video platforms, such as Interactive TV and VoD (Video on demand). For example, we notice a rise of Internet Protocol Television (IPTV) and the distribution of multimedia content via the Internet, and especially, a wide availability of services like VoD and catch-up TV. Managing a TV stream that is characterized by both heterogeneous and opaque content is a challenging task that receives significant attention from both the industry of video-sharing platforms and academia (content management systems). This challenge needs several content-based video operations such as representation, segmentation, structuring, indexing and retrieval. A typical scenario consists in identifying particular TV programs from large TV streams and then the segmentation of identified program into consistent and semantic units to be available in a short period (1 to 2 hours) after the satellite broadcasting for usage by VoD or catch-up TV services. The program identification and their semantic and temporal internal segmentation needed by VoD or catch-up TV services that must usually be done in very short period of time.
Video segmentation, structuring, indexing and retrieval can be achieved by techniques that extract semantic and/or structural features used to divide TV streams into distinct programs. The research on this topic covers three fundamental and complementary areas, namely, video analysis, video abstraction, and video retrieval (Souza et al., 2014). Video abstraction, in turn, refers to the representation of visual information, by applying, for instance, key-frame detection and shot clustering techniques. Video analysis addresses the extraction of low-level visual features, such as color, texture, shape and salient points. Finally, video retrieval is based on the extracted features and allows users to query and search the video database. Although many efforts have been devoted into these three areas, the accuracy of the existing systems is still far from satisfactory. Indeed, a thorough study of the state of the art shows that the proposed works are divided into two classes. The works of the first class are interested in locating programs in TV stream (Hu et al., 2011; Manson et al., 2009; Choroś, 2015b). While the works of Abduraman et al. (2011), Goyal et al. (2009), Misra et al. (2010), Fan et al. (2014), Younessian and Rajan (2015) of the second one carry out the internal structuring of TV programs. These works are suitable only for media types known in advance. However, few works start from the phase of inter-segmentation step of programs in long TV streams all the way to the intra-segmentation level.

The rest of the paper is structured as follows. In section 2, we present the related works and the motivation and context. Section 3 introduces the prior knowledge of media production and grammar video concept. In Section 4, we introduce the TV program identification in TV streams. Section 5 presents the topic detection of identified news programs. Experiments and evaluation results are presented in Section 6. We conclude with discussions of the proposed solution and an outline of future work.

2. RELATED WORKS

Intensive research efforts were directed to content-based video indexing (Hu et al. 2011; Choroś, 2015b). The video documents are habitually incorporated in large TV streams. Therefore, efficient indexing of TV programs requires firstly their localization and extraction them from the stream. A class of works focuses on locating programs in TV stream, where as other kind of works is interested on the internal structuring of TV programs. Few efficient contributions have been proposed to structure TV streams. For example, to identify the various programs in TV stream, Naturel and Gros (2008) created hash-table containing key-frame signatures of program references. Then, he used signature similarity between the stream signal and the hash-table elements to locate the programs. The method presented by Manson (2009) aims to detect automatically programs in TV streams. The purpose of its work is to detect the limits of broadcasted programs. The method first detects inter-programs as repeated sequences in the TV stream in order to deduce the programs boundaries. The major drawback of these contributions is that they focus only on programs localization in TV streams without reaching the second level: the internal structuring where we can extract the semantics.

Numerous works have focused on automatic internal structuring of different TV program types. News programs are among the most interesting types of these contributions. According to recent studies, TV news present more than 50% of TV-REPLAY content. Several research teams have been interested in TV news structuring (Abduraman et al., 2011). In general, news programs are produced according to typical production rules that provide important cues for the automatic structuring (Goyal et al., 2009). The majority of the TV news indexing approaches is based on low-level primitives (texture, colors and forms) and/or high-level features such as anchorperson features (Goyal et al., 2009). Misra et al. (2010) segmented TV news into topics by detecting anchorperson shots and text transcripts Fan
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