Chapter 5
Navigating through Video Stories Using Clustering Sets

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ABSTRACT

The fast evolution of technology has led to a growing demand for video data, increasing the amount of research into efficient systems to manage those materials. Making efficient use of video information requires that data be accessed in a user-friendly way. Ideally, one would like to perform video search using an intuitive tool. Most of existing browsers for the interactive search of video sequences, however, have employed a too rigid layout to arrange the results, restricting users to explore the results using list- or grid-based layouts. This paper presents a novel approach for the interactive search that displays the result set in a flexible manner. The proposed method is based on a simple and fast algorithm to build video stories and on an effective visual structure to arrange the storyboards, called Clustering Set. It is able to group together videos with similar content and to organize the result set in a well-defined tree. Results from a rigorous empirical comparison with a subjective evaluation show that such a strategy makes the navigation more coherent and engaging to users.

INTRODUCTION

Recent advances in technology have facilitated the creation, storage, and distribution of digital videos. It led to an increase in the amount of video data deployed and used in many applications, such as search engines and digital libraries. This scenario has created a strong requirement for systems that are able to efficiently manage video material (Chang et al., 1998; Hampapur et al., 1997; Snoek et al., 2007).

Making efficient use of video information requires that data to be accessed in a user-friendly way. For this, it is important to provide users
Navigating through Video Stories Using Clustering Sets

with a browsing tool to interactively search for (or query) a video in large collections, without having to look through many possible results at the same time, so that a user can easily find the video in which he/she is interested.

A lot of research has been done in browsing techniques for the interactive search of video sequences (De Rooij et al., 2008; De Rooij & Worring, 2010; Zavesky & Chang, 2008; Zavesky et al., 2008). However, many of those research works have considered a rigid layout to arrange the result set in some default order, typically according to the relevance to the query.

In this paper, we present a novel approach for the interactive search that displays the result set in a more flexible and intuitive way. It relies on two key strategies: (1) storyboard generation and (2) visualization of stories. The former is a simple and fast algorithm to convert videos into storyboards. The speed up of the computation makes our technique suitable for browsing video content in online tasks. The latter is an effective visual structure to organize the video stories in a well-defined tree, called Clustering Set. This innovative framework is significantly different from traditional paradigms, which often limit users to explore the results using list- or grid-based layouts.

Experiments were conducted both for evaluating the layout employed by the proposed method and for comparing it with several visualization techniques. Results from a subjective evaluation with 38 subjects show a clear preference by the display strategy of our approach.

The remainder of this paper is organized as follows. First, we introduce the background of interactive search problems. Next, we present our approach and show how to apply it for browsing a large video collection. After that, we report the results of our experiments and compare our technique with other methods. Finally, we offer our conclusions and directions for future work.

BACKGROUND

The exploration of large collections of video data is non-trivial. When a user requests a search, the query formulation (search criterion) can be quite difficult.

Most of search systems are based on textual metadata, which leads to several problems when searching for visual content. Generally, the user lacks information about which keywords best represent the content in which he/she is interested. In fact, different users tend to use different words to describe a same visual content. The lack of systematization in choosing query words can significantly affect the search results (De Rooij et al., 2008).

Modern systems have addressed those shortcomings by automatically detecting visual concepts derived from visual properties, such as color, texture, and shape. However, a minimum knowledge about the concept vocabulary is needed for performing a query, which is not appropriate for non-expert users (Zavesky & Chang, 2008).

Fully automated approaches have combined descriptors of multiple modalities (textual metadata, visual properties, and visual concepts). In spite of all the advances, the formulation of a query using such features is a difficult task for a human interested in a specific video (De Rooij & Worring, 2010).

Once the search results are returned, we can explore many different directions based on query type and user intention. Several visualization techniques have been proposed to assist users in the exploration of result sets (De Rooij et al., 2008; De Rooij & Worring, 2010; Zavesky & Chang, 2008; Zavesky et al., 2008).

Those methods often employ dimensionality reduction algorithms to map the high-dimensional feature space of visual properties into a fixed display. Afterwards, a display strategy is applied
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