Effective User Interface for Digital Video Library

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ABSTRACT

In this paper, we propose a novel approach of user interface for querying Digital Video Library. Through the proposed user interface, the users can specify the query more easily and precisely for image and video retrieval, resulting in better retrieval accuracy of the system. The prototype of the proposed system allows specification of character, atmosphere, implement, mapping and event for the query. This prototype not only provides users with the convenience of query specification in various aspects, but also can easily be extended to the retrieval systems of various multimedia data.

Keywords *: Multimedia User Interface, Digital Video Library, Image and Video Retrieval.*

1. INTRODUCTION

With the advent of digital television and digital video standards such as MPEG and H.26x, digital video becomes the dominant format of video archiving and sharing. The emerging MPEG7 standard for multimedia content description will further accelerate the availability of video archives and enable large-scale search facilities for video, similar to web search engines for textual documents. Content based text retrieval[13][14] is a long established research field which has developed complex and accurate techniques for matching natural language phrases to natural language documents. For the last few decades, a dramatically increased attention has been paid to the content based retrieval of non-textual data and one of the most important research fields of non-textual data retrieval is the query specification. The characteristics of the non-textual data, specifically visual data, lead the problem of query specification to the problem of user interface design. The user interface should provide users with convenient methods of precisely specifying query image/video. In this paper, we propose a user interface for image/video retrieval system, through which user can conveniently specify the query image, and present a prototype of an effective and accurate video retrieval system adopting the proposed user interface.

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2. RELATED RESEARCH

Usability of a system can be characterized by any aspect of the ways that people interact with the system including installation and maintenance of the system. Nielsen used five attributes of a system's interface usability [1][3] suggesting that these attributes can be evaluated through usability testing relative to certain users and tasks. Kling and Elliott [15] used four of these five attributes and they are listed and discussed below as criteria for measuring the usability of the interface:

1. Learnability: Ease of learning such that how quickly a user can start using the system.
2. Efficiency: The possibility of a user to increase the productivity of using the system.
3. Memorability: The possibility of a user remembering how to use the system after a long period of not using the system.
4. Error: The capability of the system that prevents users from making mistakes and recovers from the user's critical mistakes.

When a query is specified by a user in terms of the features of an actual video content, specialized interfaces compared to those used to capture text-based queries are required. Manually constructed video databases such as VideoSTAR [6] have a text-based query tool where different aspects, which are manually pre-indexed, of the content such as person, events and locations, can be selected from a list to generate the query. When it comes to automatically indexed video collections, VideoQ [7], NeTra-V [8] and MovEase [9] are good

examples of content-based querying interfaces where the user can query either by drawing objects with a certain shapes and specifying the motion of the objects on a colored canvas, or by selecting example video clips from the screen. Specifying motion in a query can be useful when a user is searching for video clips where something is moving from one spatial location to another. In the VideoQ interface, for example, a user can draw a shape and the trajectory of the movement of the shape on the query canvas. The DICEMAN query application [10] is an example of an elaborated query interface for digital video content where the user can compose a query using various elements from pre-defined sets of elements and attributes such as people, overall color, movement, the order of objects appearing in the sequence, and so on [4].

In many information retrieval systems, the facility for refinement of the query based on the current interaction status has become an important element of the interaction as the user keeps on modifying his/her goals as well as information needed while interacting with the systems. In video library systems, early experimentation on systems such as WebSEEk [11] and SWIM [12] provide rudimentary interfaces for query refinement based on initial query results. More recently, the DICEMAN query application [10] provides a query refinement interface, using which an initial visual query is automatically composed on a query panel based on a user's selection of an example clip from the results set, can be further modified for refined subsequent query [4].

3. THE PROPOSED SYSTEM

The proposed system provides several types of tool sets for the convenience and effectiveness of query generation. The provided tool sets include predefined characters, scene types, object samples, and texture tools. Most users of the video archive system try to remember the perception on a video segment when they are asked to formulate a query for the video retrieval. The proposed system tries to capture such a behavior of the users and to provide the tools sets using which the users can represent their perception on the video segment in query. One basic tool to represent the perception of the video is the so-called perceptual edge. The perceptual edge is an edge which may remain strongly in the viewer's perception, among uncountable number of edges. For example, if there is a beach in an image, the viewer may perceive it as a single line, or edge, dividing the land and sea, even if there are numerous other edges present in the image. For matching the perceptual edge represented by the query and the actual edges in the image database, any simple edge detection method can be used.

3.1 Query Formulation

Based on the user's recollection, users can specify the query by drawing freely and by selecting attributes provided by the predefined tool sets. One distinct capability of the proposed user interface is the tool for the character specification. The character specification tool can be used to express one's eyes and gestures. By simply drag-and-dropping the predefined attribute of the given tool and dragging the corner of the dropped object, users can put a feature of a character in the query image and resize it. Users can actually make any shape they want, by using combinations of the predefined tools. The other distinct tool is the scene-type selection tool. Users can use this tool for the representation of the atmosphere of the image/video by selecting attributes such as day, dawn, evening, dusk, weather types. In addition, to represent ambiguous mood of the image, a histogram palette is provided. Using the histogram palette and the spatial selection tool, various color oriented mood can also be expressed in the query.

3.2 Prototypes

Prototypes are the set of predefined tools used in the proposed user interface for query formulation. Each object or scene type is an example of a prototype. The set of prototypes of the proposed user interface, i.e. the predefined tool sets, can be expanded by uploading new prototypes. Any image or texture of certain format acquired through a web search or drawn by drawing applications can be uploaded into the system and used as a prototype. A query formulated using predefined tool sets or drawn using the provided pencil tool can also be saved and used as a prototype. Once the selected prototypes are uploaded into the system, they can be used as other predefined tool sets to formulate a query. The set of tools including the uploaded prototypes can be saved as a new set of tools and reused in future formulation of the query.

4. SIMULATION

The users can easily and conveniently describe the search image with the pro-defined tool set on the screen. As the users draw images, they are represented by several objects and corresponding attribute. For instance, an object is represented by main color and location, texture, and edges. These features are compared with the images in the video library. Figure 1 and Figure 2 show the result of video image retrieval of character oriented image and landscape image respectively. The system shows three of the closest images from the library with the highest on the top.

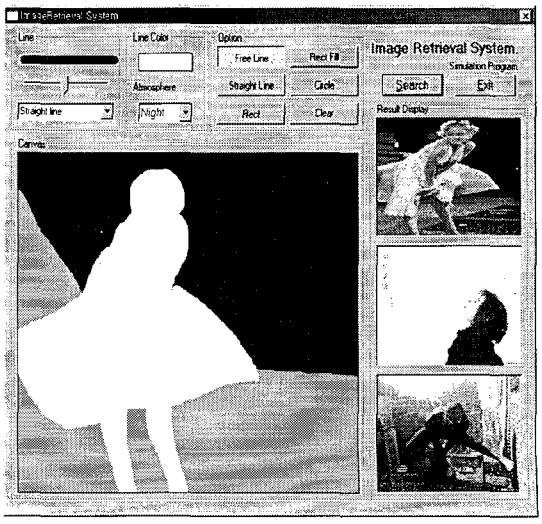

Fig. 1. Character Scene

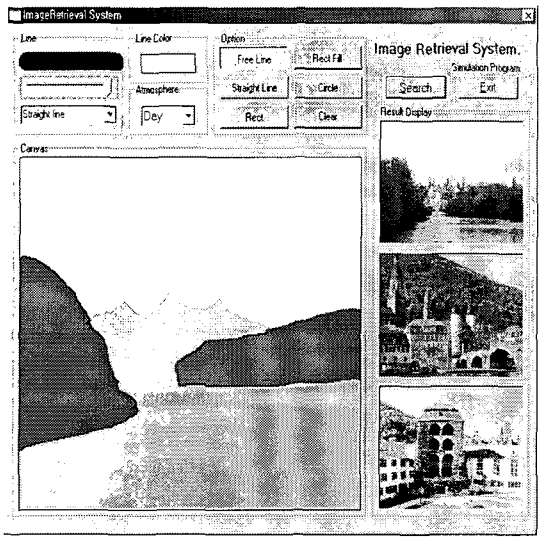

Fig. 2. Landscape Scene

5. CONCLUSION

In this paper, we proposed a novel approach of user interface for querying digital video library and showed the simulation results. Through the proposed user interface, the users can specify the query more easily and precisely for image and video retrieval, resulting in better retrieval accuracy of the system. The prototype of the proposed system allows specification of character, atmosphere, implement, mapping and event for the query. This prototype not only provides users with the convenience of query specification in various aspects, but also can easily be extended to the retrieval systems of various multimedia data.

REFERENCES

[1] Rob Kling and Margaret Elliott. Digital library design for usability: Interface Usability

[2] AXIS communicaton. Compression Techniques: An overview of compression techniques.

[3] Nielsen, J.(1993). Usability Engineering. Boston, MA: Academic Press, Inc.

[4] Hyowon Lee and Alan F. Smeaton. Centre for Digital Video Processing, Dublin City University: Designing the User Interface for the Físchlár Digital Video Library

[5] Lee suck won. Korea Institute of Construction Technology. Digital Image Analysis system's practice

[6] Hjelsvold, R., Lagorgen, S., Midtstraum, R. and Sandsta, O. (1995) "Integrated video archive tools". Proceedings of 3rd ACM International Conference on Multimedia (MM '95), San Francisco, CA, November, pp. 283-293

[7] Chang, S., Chen, W., Meng, H., Sundaram, H. and Zhong, D. (1997) "VideoQ: an automated content based video search system using visual cues". Proceedings of the 5th ACM International Conference on Multimedia (MM '97), Seattle, WA, November, pp. 313-324

[8] Deng, Y., Mukherjee, D. and Manjunath, B. (1998) "NeTra-V: towards an object-based video representation". Proceedings of SPIE, 3312, Storage and Retrieval for Image and Video Databases VI (SPIE: San Jose, CA), pp. 202-213

[9] Ahanger, G., Benson, D. and Little, T. D. C. (1995) "Video query formulation". Proceedings of SPIE, 2420, Storage and Retrieval for Image and Video Databases III (SPIE: San Jose, CA). pp. 280-291

[10] Dunlop, M. and Mc Donald, K. (2000) "Supporting different search strategies in a video query interface". RIAO 2000: Content-Based Multimedia Information Access, Paris, April, pp. 21-31

[11] Smith, J. (1996) "Searching for images and videos on the World-Wide Web". Technical report #459-96-25, Center for Telecommunications Research, Columbia University

[12] Zhang, H., Low, C.,Smoliar, S. and Wu, J. (1995) "Video parsing, retrieval and browsing: an integrated and content-based solution". Proceeding of 3rd ACM International Conference of Multimedia (MM '95), San Francisco, CA, November, pp. 503-512

[13] W.B. Frakes and R. Baeza-Yates (editors), Information Retrieval: Data Structures and Algorithms, Prentice Hall, 1992.

[14] K. Sparck Jones and P. Willett (editors), Readings in Information Retrieval, Morgan Kaufmann,1997

[15] Rob Kling and Margaret Ellitt, Digital Library Design for Usability, pp. 4

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