Interactive Broadcasting Contents Authoring and Searching system

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ABSTRACT

In recent years, we have seen a vast increase in interactive broadcasting contents researches based on MPEG-4 and multimedia content description researches based on MPEG-7 standard. Also, there is a rising research area to compromise between the MPEG-4 and the MPEG-7 standard for a new application domain such as the interactive broadcasting server, and so on. Especially, MPEG-4 and MPEG-7 based interactive contents allow a user to watch preferred broadcasting programs by using retrieval functionalities. In this paper, we present the first result of the MPEG-7 over MPEG-4 research and introduce the prototype of interactive broadcasting contents authoring and searching system using the MPEG-7 over MPEG-4 scheme.

1. INTRODUCTION

The emerging research area of broadcasting is how to construct the digital broadcasting infrastructure. Especially, the development and management of digital broadcasting contents are more important than the development and propagation of digital broadcasting equipments to attract users’ attention. There are requirements for digital broadcasting contents, and the one important requirement is to provide interactivity in contents, which called the interactive broadcasting content. To represent and use the interactive broadcasting content, MPEG-4 and MPEG-7 standard are considered as more suitable than other methods [1].

The MPEG-4 [2] and MPEG-7 [3] standard provide new ways for representing and using the interactive broadcasting content. While the MPEG-4 is the first standard supporting interactive and complex multimedia presentations, MPEG-7 is targeted at standardizing the metadata description for any kinds of media data and contents in more natural manner. More details about two standards are following.

The main design goal of MPEG-4 can be summarized as follows: to provide a corpus of technology to be used by various types of multimedia services and networks including interactive, broadcast, and conversational models, to provide audiovisual content with the same kind of interactivity that can be found on the WWW, and to integrate rich media content in a unique framework so that it can be seamlessly manipulated by the content authors as well as by the end users. Following these design goals, the MPEG-4 standard has been developed on the concept of audiovisual scenes make of audiovisual objects composed together according to a scene description. This concept of audiovisual scene allows: interaction with elements with is the audiovisual content, named audiovisual objects, adaptation of the coding scheme on a per-audiovisual object basis and easy reuse and customization of audiovisual content. Thus, for the advanced interactive multimedia applications such as home shopping, interactive TV, remote education, virtual reality and interactive entertainment, the MPEG-4 standard is expected to be a core technology [4].

The MPEG-7 standard, called “Multimedia Content Description Interface,” standardized the description of multimedia content supporting a wide range of applications. Multimedia search and retrieval has become a very active research field because of the increasing amount of audiovisual data that is becoming available, and the growing difficulty to search, filter or manage such data. Furthermore, many new practical applications such as large-scale multimedia search engines on the Web, media asset management system in corporations, AV broadcast servers, and personal media servers form consumers are about to be widely available. This context has led to the development of efficient processing tools that are able to create the description audiovisual material or to support the identification or retrieval of audiovisual documents. Besides the research activity on processing tool, the need for interoperability between devices has also been recognized and several standardization activities have been launched. MPEG-7 standardization activities do not focus so much on processing tools but concentrate on the selection of features that have to be described, and on the way to structure and instantiate them with a common language. Simply, the MPEG-7 technology covers the most recent developments in multimedia search and retrieval [5] [13].

Both standards are used to develop each application area: MEPG-4 standard used in digital television, interactive graphics applications and interactive multimedia and MPEG-7 standard used in broadcast media selection, Multimedia directory service and digital libraries.

As developing each application, there is created the need to compromise between the MPEG-4 and the MPEG-7 standard. For example, when some people want to develop a broadcast server this contains interactive multimedia contents the server should include querying, searching and selecting functions. Therefore, we focus on the research area to compromising the MPEG-4 and the MPEG-7 standard. For the first step of this research initiative, we have developed the MPEG-7 over MPEG-4 scheme. The main objective of MPEG-7 over MPEG-4 scheme is the development of an operational prototype.
allowing the creation of MPEG-4 content, which includes MPEG-7 descriptions.

The organization of this paper is as follow. Section 2 introduces the motivation and background of proposed system. Section 3 gives details of implementation are described, and then the result from our implementation is shown in Section 4. Finally, Section 5 presents conclusion.

2. BACKGROUND AND MOTIVATIONS

As described in previous section, there is the need to compromise between the MPEG-4 and the MPEG-7 standard for new kinds of applications. In this section, we introduce some results of the harmonization research done by other groups, and present our approach to the harmonization research. There are different approaches to compromise between the MPEG-4 and the MPEG-7 standard.

The first approach [6] is that MPEG-7 is used for the querying/browsing/searching and MPEG-4 is used for compressing any transmitted content. In this approach, MPEG-7 color, motion and shape descriptors are extracted and attached to a content description and the content is encoded using MPEG-4. However, when a user wants to search MPEG-4 contents this approach has several restrictions. This is because the approach separately saves MPEG-7 features file and corresponding MPEG-4 content. Therefore, if there didn’t exist MPEG-7 feature file, searching MPEG-4 content is not possible.

The second approach [7] is that MPEG-7 is used for synthesizing content and MPEG-4 is used for representing content. In this approach, MPEG-7 description described content is generated by MPEG-7 description tool and the generated MPEG-7 description is transformed to MPEG-4 Textual format (XMT) by MPEG-7 to MPEG-4 Transcoder. Still, this approach has problems. There is limitation to translate MPEG-7 descriptions into MPEG-4 contents. For example, interactivity of MPEG-4 content can’t translate from MPEG-7 description.

In our approach, we extend the MPEG-4 textual format (XMT) and MP4 format, which include MPEG-7 description in itself. MPEG-4 is consisted of three main features such as visual, audio and system part. How to encode visual and audio streams are addressed in the visual and audio part, respectively. MPEG-4 system part takes a scene into account of a combination of individual objects that can be specified interactivity. In order to composite a scene, MPEG-4 defines two formats: the MPEG-4 file format (MP4) and the Extensible MPEG-4 textual format (XMT)[9][10]. Since a scene is considered as a combination of individual objects, it is possible to retrieve or search broadcasting contents in terms of the properties of their component objects. Some of the properties of objects in a scene are just textual metadata such as keyword, creation date, creator, language etc. In order to provide richer information of the properties, MPEG-7 specification can be considered. As described previous section, the purpose of MPEG-7 is to provide the methods of retrieving multimedia data by standardized metadata. MPEG-7 provides not only textual metadata, but also audio-visual characteristics of objects such as color, texture, shape etc. Therefore, it is possible to more precisely and diversely retrieve or search broadcasting contents by using MPEG-7 standard.

Consequently, we have used two methods to harmonize MPEG-4 and MPEG-7 standard without loosing their advantages. The first method is to add MPEG-7 description stream as Elementary Stream (ES) as other media data like Figure 1. The other method is to define new elements and attributes for MPEG-7 description in ES_Descriptor like Figure 2. In our system, we have implemented both of methods.

As shown in Figure 1, each media object in MPEG-4 content is described as Object Descriptor, and this Object Descriptor can contain information such as decoding parameters, the type of decoder, elementary stream descriptors, the location of elementary stream, etc. In this case, we appended the MPEG-7 elementary stream into Object Descriptor as a kind of elementary stream. Figure 2 shows the schema diagram for the ES_Descriptor in XMT format. The solid line of square means an essential element, and the dotted line of square means an optional element in XML format. The new attributes are inserted in DecoderConfigDescriptor, which is the child of ES_Descriptor. This new attributes contains MPEG-7 Descriptions. In this proposed scheme, MPEG-4 contents include MPEG-7 description in itself. Thus, user can search MPEG-4 contents without redefining MPEG-7 description, and also MPEG-4 contents have full interactivities without limitation.

3. IMPLEMENTATION

3.1 The Proposed System

For the harmonization between MPEG-7 and MPEG-4, we choose the method extending MPEG-4 formats both textual and MP4 format. Furthermore, we have designed to be able to embed the MPEG-4 authoring
system, which we developed.

As shown in Figure 3, the prototype consists of four software modules: Interactive Contents Authoring Tool, MPEG-7 Description Generator, Interactive Contents Retrieval Module, and Interactive Content Player.

3.2 Interactive Broadcasting Contents Authoring Tool

We had developed Interactive Rich-media Authoring tool [8], which is based on MPEG-4 systems specification. The authoring tool provides a powerful graphic user interface and produces broadcasting contents in the form of MP4, an efficient binary format for storage or transmission, and/or XMT, a convenient textual format for later modification or editing.

3.3 MPEG-7 Description Generator

The present implementation of the MPEG-7 Description Generator supports the scalable color and homogeneous texture feature descriptors. While user creates an interactive broadcasting content through the authoring tool, the MPEG-7 description of media object is loaded and parsed by Data Access API module. The referenced MPEG-7 description is existed as files and generated by MPEG-7 Description Generator, before referencing. The MPEG-7 Description Generator is an independent module of Interactive Rich-media Authoring Tool.

3.4 Interactive Contents Retrieval Module

We have implemented the Interactive Contents Retrieval Module as part of Interactive Content Player and designed to use query by example.

Whenever a user queries through the retrieval browser in the Content Player, the Content Retrieval Module extracts parameters from the user query. Then, Content retrieval Module parses targeted MP4 files and extracts values of MPEG-7 features. Finally, the module calculates the similarity between features from targeted MP4 files and the user query. The Content Retrieval module shows results of the calculation as the list of targeted MP4 files, which sorted by distance value and the sorted list is returned to the Retrieval Browser.

4. RESULT

To search interactive broadcasting contents from database or file storage, the function flow is shown in Figure 4.

Step 1: Retrieving step

Through the retrieval browser in the Interactive Content Player, user queries what user wants to find by example image. Then the Content Retrieval Module extracts MPEG-7 feature descriptors from the query image and compares between descriptors from the query and from target files. The result of retrieving step is the list of target files, which sorted by the distance value and the sorted list is returned to the Retrieval Browser. Figure 5 shows the retrieving step in User Interface.
Step 2: Browsing step

The result of retrieving step is listed in the User Interface of Retrieval Browser, and then user chooses the interactive content which contains the similar MPEG-7 features to user query. Figure 6 shows the Browsing step in User Interface.

![Figure 6 Browsing step in User Interface](image68x477to268x724)

Step 3: Playing step

After user selects the content, the Content Player is asked to load the corresponding content and play the content. Figure 7 shows the Playing step in Interactive Content Player.

![Figure 7 Playing step in Interactive Content Player](image54x185to281x386)

5. CONCLUSION

As construction of the digital broadcasting infrastructure is becoming more and more important, the development and management of digital broadcasting contents are also becoming more important. One of the most expecting features in digital broadcasting contents is the interactivity in contents, which not only delivers additional information, but also allows a viewer pass his preference to contents. To represent the interactive broadcasting content, MPEG-4 and MPEG-7 standard are considered as efficient means. However two standards are used in different way to represent interactive broadcasting contents. While the MPEG-4 standard is supporting interactive and complex multimedia presentations, MPEG-7 standard is providing the metadata description for any kinds of media data and contents.

Both standards are used to develop each application area. As developing each application, there is created the need to compromise between the MPEG-4 and MPEG-7 standard. Therefore, we focus on the research to harmonize both standards in an efficient way.

In this paper, we have proposed the MPEG-7 over MPEG-4 scheme and developed the prototype system applied the proposed scheme. We explained details through the section II and the section V. Consequently, MPEG-4 and MPEG-7 based interactive broadcasting contents allow a viewer to watch preferred broadcasting programs by using retrieval functionalities, access their component objects possibly in their favorite scene composition, and obtain their detailed information. Especially, in T-commerce (E-commerce carried our by utilizing TV) environments, a viewer can have all the needed information products and do shopping while he/she is watching broadcasting program.

6. REFERENCES