INTEROPERABILITY BETWEEN MPEG-7 AND LOM USING ONTOLOGY

Hyunjong Choe*

Dept. of Computer Education, Seowon University, Chungju, South Korea

ARTICLE INFO

Corresponding Author:
Hyunjong Choe
Department of computer,
Dept. of Computer Education,
Seowon University, Chungju,
South Korea.
blueland@seowon.ac.kr

Keywords: Ontology; LOM; MPEG-7; Learning resource; LMS

ABSTRACT

As multimedia technology provides e-Learning with a rich paradigm for structuring and delivering multimedia-based learning contents, the study about multimedia and its metadata has widely spread. MPEG-7 is the best practice standard metadata model of multimedia and LOM as Learning Object Metadata is the world-wide standard metadata model of learning resource in e-Learning system. So this study is to analyze these two public metadata standard models and find a way to merge these two different metadata models for sharing, searching, structuring and combining multimedia learning objects that is represented with LOM or MPEG-7 in one e-learning system.

INTRODUCTION

Multimedia technology provides e-Learning with a rich paradigm for producing multimedia-based learning contents. It offers new capabilities for structuring and communicating the subject knowledge within learning contents through the use of digital audio, video, images, graphics and animation. In addition, the potential to re-use multimedia content to create new intellectual property has further accelerated the growth in the size and number of institutional multimedia database. Existing multimedia contents in multimedia database are being combined and reused to generate complex, interactive multimedia, hypermedia, and virtual educational resources. This has led to a demand for systems and tools which can satisfy the more sophisticated requirements for storing, managing, searching, accessing, retrieving, sharing, and tracking complex multimedia contents [1].

Metadata standards enable interoperability and reusability between systems and organizations so that information of metadata can be exchanged and shared. Especially Learning Object Metadata (LOM) model has been developed to define the semantics of learning objects in e-Learning system, and to describe learning objects [2]. And MPEG-7 is a multimedia content description standard, which is an ISO/IEC standard being developed by MPEG [3]. The descriptions of MPEG-7 are based on catalogue (e.g., title, creator, rights), semantic (e.g., who, what, when, where information about objects and events) and structural (e.g., the color histogram) features of the AV content, and uses XML Schema as the language of choice for content description. So it has capability to express lots of information of one whole video and several segments of it in catalog, semantic, and structural features.

The LOM model has general and broad semantic information in the aspect of learning and teaching and the MPEG-7 model has specific and special information of catalogue, semantic, and structural features of multimedia. Hence the key goal of this paper is to analyze each of these two metadata models and to determine a way to merge the two metadata models to generate a standardized model for describing multimedia learning object using ontology.

I. RELATED WORKS

Paolo Boletti, et al. present the architecture of a digital library for enabling the reusing of audio-visual documents in an e-Learning context [4]. Their system is based on MILOS, a general purpose Multimedia Content Management System that created to support design and effective implementation of digital library application. It supports the storage and content based retrieval of any multimedia documents whose description are provided by using metadata models represented in XML. Stephan Repp, et al. describe and evaluate an approach to generate a semantic annotation for multimedia resources, i.e., recorded university lectures [5]. They use the semantic metadata language as OWL. Jobst Loffler, et al. describes the MPEG-7 compliant indexing and retrieval system iFinder based on XML and open source database technology [6]. Abdulmotaleb El Saddik, et al. propose dynamic educational metadata as an extension of IEEE’s Learning Objects metadata to describe multimedia content [7]. Their metadata model can be used to customize the behavior of the multimedia object according to the user's needs. Several researches about system of learning object and MPEG-7 concentrate on the audio and visual contents management and the extension model of LOM.

II. THE LOM AND MPEG-7

LOM is a data model, usually encoded in XML, used to describe a learning object, or similar digital resources used to support e-Learning. The purpose of LOM is to support the reusability of learning objects, to aid discoverability, and to facilitate their interoperability, usually in the context of Learning Management System (LMS). The IEEE 1484.12.1 Standard for LOM is an internationally-recognized open standard for the description of “learning object”. Relevant attributes of learning objects to be described include: type
of object; author; owner; terms of distribution; format; and pedagogical attributes, such as teaching or interaction style. The LOM can be classified into 9 categories:

- The **General** category groups the general information that describes the learning object as a whole.
- The **Lifecycle** category groups the features related to the history and current state of this learning object and those who have affected this learning object during its evolution.
- The **Meta-Metadata** category groups information about the metadata instance itself (rather than the learning object that the metadata instance describes).
- The **Technical** category groups the technical requirements and technical characteristics of the learning object.
- The **Educational** category groups the educational and pedagogic characteristics of the learning object.
- The **Rights** category groups the intellectual property rights and conditions of use for the learning object.
- The **Relation** category groups features that define the relationship between the learning object and other related learning objects.
- The **Annotation** category provides comments on the educational use of the learning object and provides information on when and by whom the comments were created.
- The **Classification** category describes this learning object in relation to a particular classification system.

Figure 1 shows the snapshot of ontology describing the description element of educational category in learning object metadata using a protégé ontology editor.

MPEG-7 is a multimedia content description standard. This description will be associated with the content itself, to allow fast and efficient searching for multimedia material that is of interest to the user. MPEG-7 is formally called Multimedia Content Description Interface. Thus, it is not a standard which deals with the actual encoding of moving pictures and audio, like MPEG-1, MPEG-2 and MPEG-4. It uses XML to store metadata and can be attached to time code in order to tag particular events. It was designed to standardize:

- a set of Description Schemes (short DS in the standard) and Descriptors (short D in the standard)
- a language to specify these schemes, called the Description Definition Language
- a scheme for coding the description

MPEG-7 is intended to provide complementary functionality to the previous MPEG standards. It can be used independently of the other MPEG standards - the description might even be attached to an analog movie. The representation that is defined within MPEG-4, i.e. the representation of audio-visual data in terms of objects, is however very well suited to what will be built on the MPEG-7 standard. This representation is basic to the process of categorization. Figure 2 shows the snapshot of ontology describing the description element of category in MPEG-7 using a protégé ontology editor.
III. INTEROPERABILITY BETWEEN LOM AND MPEG-7

LOM is a metadata about learning objects and MPEG-7 is a metadata about multimedia materials so that these two metadata models have similar meaning and categories of it because many multimedia materials can be used of resources of learning object. A comparison of the LOM and MPEG-7 metadata models reveals that both attributes of metadata models are capable of describing the creation, production and classification information associated with a resource. So merging between these attributes of these two models is possible. Table 1 shows the relation between LOM and MPEG-7.

The LOM model is more focused on describing educational information and the MPEG-7 is more focused on precise, fine-grained content-based descriptions of multimedia content. So if these two models can be combined with each special meaning, educational resources can be described with educational information and multimedia information. Figure 3 shows the snapshot of ontology describing the combination of description elements of categories in LOM and MPEG-7 using a protégé ontology editor.

CONCLUSION

In this paper I have analyzed the LOM and MPEG-7 metadata models in the context of providing educational meaning and multimedia content. Based on this analysis I have described the relation between LOM and MPEG-7 metadata in order to merging two models into one metadata model in e-learning. The outcome metadata model using ontology can be used to provide educational resource metadata and multimedia material metadata. In future research, we will apply this ontology model to the e-learning system, and refine the use of LOM and MPEG-7 metadata ontology.

REFERENCES


TABLE I. RELATION BETWEEN LOM AND MPEG-7

<table>
<thead>
<tr>
<th>Meaning</th>
<th>LOM Models</th>
<th>MPEG-7 Models</th>
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International Multimedia Conference, 2002, pp. 431 - 435


Figure 3. LOM and MPEG-7 merge ontology in a Protégé editor