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Interoperability Between MPEG-7 and LOM Using Ontology

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Abstract: Multimedia provides e-Learning with a rich paradigm for structuring and delivering learning contents, the study about multimedia and its metadata has widely spread. LOM as learning object metadata and MPEG-7 as multimedia metadata are the best practice model in e-Learning system. So, this study is to analyze these two metadata models and find a way to merge two different metadata models for generating a standardized model to describe multimedia learning contents using ontology.

Key words: Ontology, LOM, MPEG-7, learning resource, LMS

INTRODUCTION

Multimedia provides e-Learning with a rich paradigm for delivering and communicating learning contents. It offers new capabilities for structuring, interpreting and communicating knowledge within learning contents through the use of digital video, audio, 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 objects 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 resources.

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 and MPEG-7 is a multimedia content description standard, which is an ISO/IEC standard being developed by MPEG (Salembier, 2002). These descriptions 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, MEPG-7 has capability to express many 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 study 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.

Related works: Bolettieri *et al.* (2007) present the architecture of a digital library for enabling the reusing of audiovisual documents in an e-Learning context. 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. Repp *et al.* (2007) describe and evaluate an approach to generate a semantic annotation for multimedia resources, i.e., recorded university lectures.

They use the semantic metadata language as OWL. Loffler *et al.* (2002) describes the MPEG-7 compliant indexing and retrieval system iFinder based on XML and open source database technology. Saddik *et al.* (2001, 2000) propose dynamic educational metadata as an extension of IEEE's Learning Objects metadata to describe multimedia content. 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 audio and visual contents management and the extension of LOM.

THE LEARNING OBJECT METADATA AND MPEG-7

Learning Object Metadatais 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 learning object metadata 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 1484.12.1-2002 Standard for learning object metadata 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 learning object metadata 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 protege 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 isnota standard which deals with the actual encoding of moving pictures and audio, like MPEG-1, MPEG-2 and MPEG-4. It uses XMLto 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 (DS) and Descriptors (D)
- A language to specify these schemes, called the Description Definition Language
- A scheme for coding the description

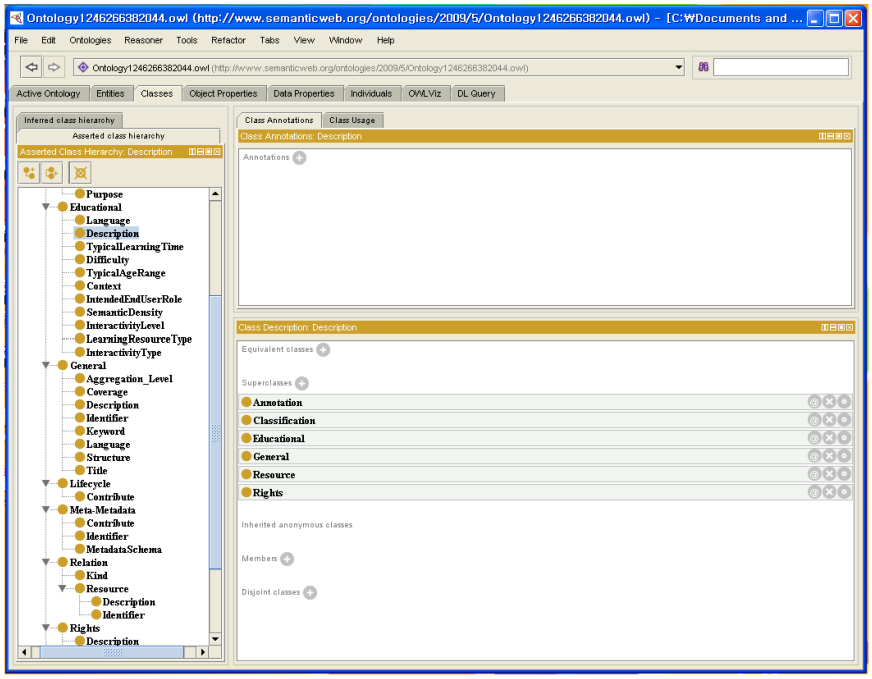

Fig. 1: The snapshot of ontology of educational category in learning object metadata using protege ontology editor

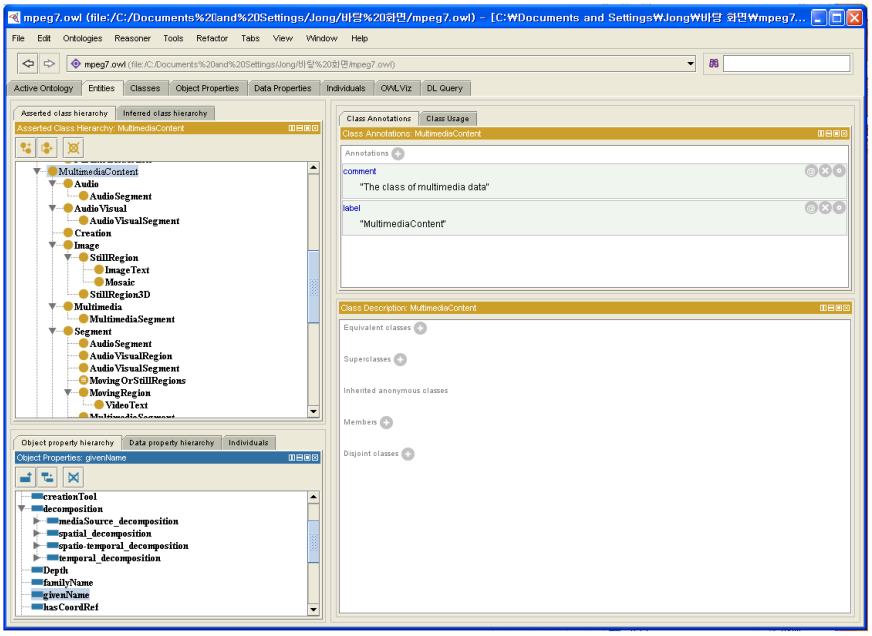

Fig. 2: The snapshot of ontology description category in MPEG-7 using protege ontology editor

Table 1: Relation between LOM and MPEG-7

Meaning	LOM	MPEG-7
Title	General title	Creation information/Creation/Title
Creator	Lifecycle contribute	Creation information/Creation/Creator (Role/Name = Creator)/Agent/Name
Subject		Creation information/Classification/Subject
Description	General description	CreationInformation/Classification/Abstraction
Publisher	Lifecycle contribute	Creation information/Classification/Creator (Role/Name = Publisher)/Agent/Name
Contributor	Lifecycle contribute	Creation information/Creation/Creator (Role/Name = Contributor)/Agent/Name
Date	Lifecycle contribute date	CreationInformation/Creation/Creation Coordinates/Date
Type	Educational learningresource type	CreationInformation/Classification/Genere
Format	Technical format	MedianInformation/MediaProfile/MediaFormat/FileFormat
Identifier	General identifier	MedianInformation/MediaProfile/MediaInstance/MediaLocator/MediaUri
Source	Relation resource	UsageInformation/Availability/Dissemination/Source
Language		CreationInformation/Classification/LanguageCreationInformation/Classification/CaptionLanguage
Relation	Relation kind	CreationInformation/RelatedMaterial/MediaLocator/MediaUri
Rights	Rights description	CreationInformation/Creation/CopyrightString UsageInformation/Right/RightID

MPEG-7 is intended to provide complementary functionality to the previous MPEGstandards. 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 protege ontology editor.

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 are 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

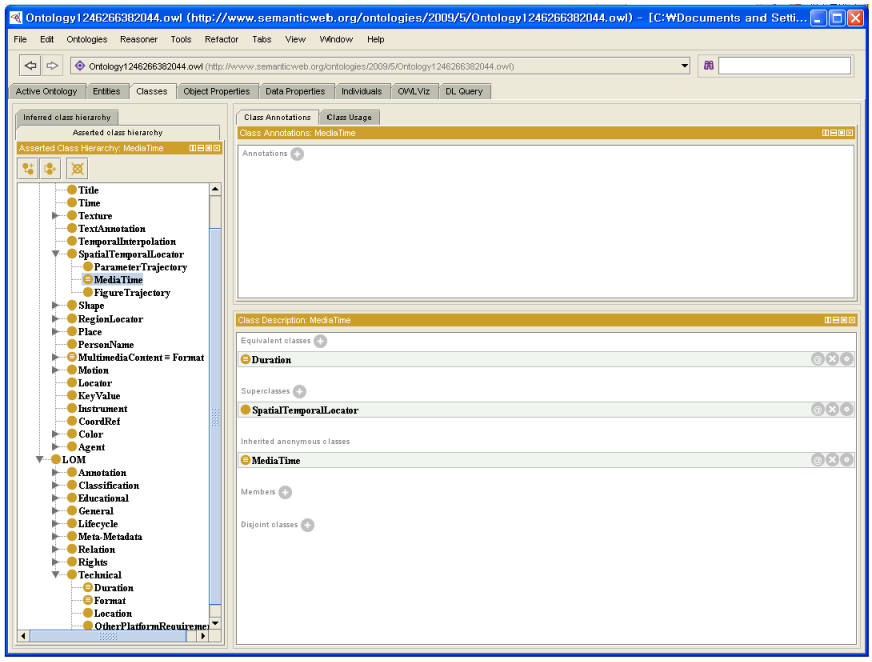

Fig. 3: The snapshot of ontology of description elements of categories in LOM and MPEG-7 using protege ontology editor

of ontology describing the combination of description elements of categories in LOM and MPEG-7 using protege ontology editor.

CONCLUSION

In this study, we have analyzed the LOM and MPEG-7 metadata models in the context of providing educational meaning and multimedia content. Based on this analysis we 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.

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