

The Multimedia Metadata Interoperability using MOXMDR+

Ho-Kyun Park¹ and Seok-Jae Moon^{2*}

¹*School of IT Convergence Engineering, Shinhan University, Dongducheon,
Gyeonggi-do, Republic of Korea*

²*Department of Computer Science, Kwangwoon University, Nowon-gu,
Seoul, Republic of Korea*

hkpark@shinhan.ac.kr, msj8086@kw.ac.kr

Abstract

This paper suggested a model of MOXMDR+(Multimedia Ontology based on XMDR+) for interoperability of multimedia contents. In this paper, an XMDR-DAI-based multimedia metadata is defined to describe the application. The model was composed according to rules of ontology concept in the structure of metadata schema like as MDS(Multimedia Description Schema) of MPEG-7. Based on the concept of ontology, the association of multimedia contents data was expanded to enable semantic search.

Keywords: *Multimedia, Content, Ontology, XMDR+, Description Schema*

1. Introduction

Recently, many studies on multimedia contents search in an effective way and its interoperability were performed. Among the studies, several methods of describing metadata of contents were suggested, and thus semantic search of the contents was enabled [1]. Among standards for metadata expression, the representative standards were suggested such as MPEG-7, TV-Anytime, MPEG-21, Cablelabs1.1, DIG35, and Dublin Core; among the standards, MPEG-7 was applied for semantic expression of the multimedia contents instead of expression of the multimedia [2]. However, as contents based on different standards were increased, the semantic search of users for the contents was merely effective. This paper suggested MOXMDR+ model to solve the semantic collision occurred in metadata of the contents. And it suggested rules of the semantic collision to effectively compose associated metadata of the contents.

This paper was structured as follows: This paper is organized with 5 chapters in which Chapter 2 outlines related work and Chapter 3 describes the proposal model. Similarly, Chapter 4 describes implementation and Chapter 5 concludes the paper.

2. Related Work

2.1. MPEG Technology

Regarding MPEG, the standards of MPEG-4 were set for processing interoperable contents with various types of multimedia and the standards of MPEG-7 [2] were set for metadata of the contents; and currently elements of e-commerce technologies for digital contents and integration technologies were standardized as MPEG-21, framework of multimedia. MPEG-7 was related to ‘metadata’, which was expression of the data, instead of data itself [3-4]. The framework standards of MPEG-21 were created with total 7 elements of technologies for applications to create, transmit, and certify data in e-commerce environment through various networks and devices. This study composed

* Corresponding Author

multimedia ontology based on MPEG-7 including the concept of ontology for semantic search of contents, instead of standards of creating multimedia contents among the standards [6- 8].

2.2. XMDR

XMDR (eXtended Metadata Registry) [5, 8] is an agent for preventing data conflicts due to data integration using XMDR which is a concept expanded from MDR and it is the technology to store relational database metadata in object-oriented database. Thus it is a storage where data is integrated by integrating MDR and ontology to solve conflicts between distributed data. Collaboration systems with XMDR-DAI use a single viewer form application to provide data integration service needed in interoperation between local databases. Also it provides integrity and expanded search service by providing related information between data using metadata registry and ontology thesaurus concepts. Also it has the function to map and change between global and local schema in the process of sharing and exchanging data using object schema between local databases, and it provides standards needed in query creation during data interoperation using query based workflow. It also provides copying, moving, and dividing functions that occur often in data transfer situations by providing change mechanism and distributed query-processing module. XMDR is a technology in which data elements, terms and syntactic concepts of metadata are saved and searched for in a semantic sense. XMDR is a standard for information sharing and exchange as suggested in the ISO/IEC 11179, and there are a number of projects underway now in relation to it. Especially, the ISO/IEC 11179-3 sets forth meta models and basic attributes for shared data management. Meta models provide standards and guidelines for syntax of data elements shared by users of information systems in a semantic sense and in the distribution environment. Therefore, this study constructs XMDR as in the following:

- MetaData-Semantic Ontology (MSO): MSO is thesaurus of relation among local schema syntactic and semantic mapping information. MSO is the information necessary for mapping that converts global schema, a standard of schema, to local schema.
- Instance-Semantic Ontology (InSO): InSo is thesaurus of rules and associations among instance values. For example, discrepancies of unit, format (ex: mm → cm, mm/dd/yy → yy-mm-dd, pound → kg) are classified and defined on the basic of collision information classification.
- MetaData-Location (MLoc): MLoc defines physical location and access information of local schema.
- MetaData-Registry (MDR): MDR is engaged in registering and managing individual local schema. It consists of global and local schema domain.

2.3. MOXMDR+

As XMDR+[5] was a roadmap to solve metadata schema, data structure, and semantic collision through integration of data using XMDR, which was an expanded concept of MDR, the technology saved metadata of relational database to object-oriented database. In other words, it was storage integrating data by combining MDR and ontology to solve collision between schema structures and instances of dispersed data. This study composed the association of metadata of multimedia contents with XMDR+ to support data interoperability service for using the multimedia contents effectively. XMDR(eXtended Metadata Registry-Data Access & Integration) [5] was an agent to solve metadata schema and data structure and semantic collision according to data integration using XMDR, which was an extended concept of MDR, saving metadata of relational database to object-oriented database. In other words, it was storage combining MDR with ontology to prevent collision between schema structures of scattered data and instances. The

MOXMDR+ applied collaboration system provided a data integration service for interoperation between local systems using a single view type of application [9]. In addition, it provided association information between the instances using concepts of metadata registry and ontology thesaurus for data integrity and retrieval service. In addition, it had a function of mapping-converting of global schema and local schema in data sharing and exchange using entity schema between local databases, suggested standards required for constructing queries in collaboration using query-based workflow for data interoperation, and provided conversion mechanism and processing module of scattered queries in data migration for functions of replication, alignment, and merging.

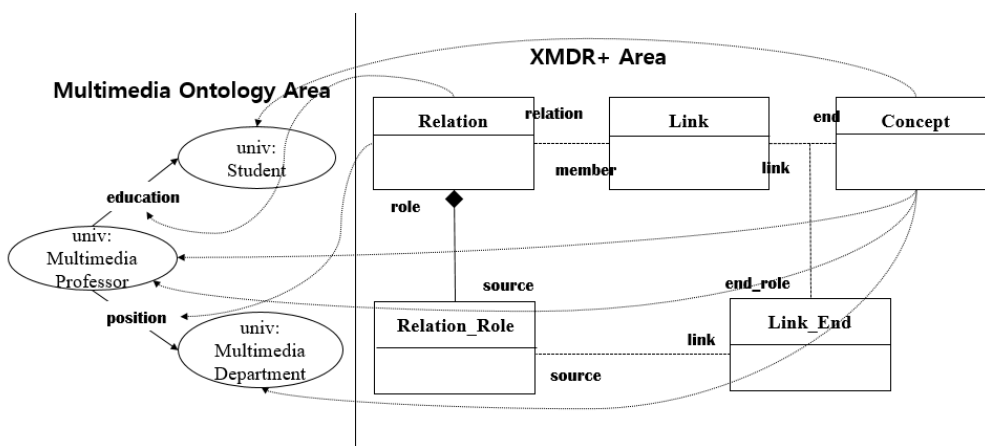


Figure 1. MOXMDR+ Conceptual Model

3. The Proposed Model

3.1. Multimedia Ontology Structure

The structure of multimedia ontology was categorized by contents based on MPEG-7; according to the category, classes were defined to express each object and properties were defined to express the classes. The concepts of the structure were shown in the Figure 1. ellipses were the classes, squares were the properties, straight lines of arrows were sub classes, dotted lines of arrows were domains of the properties, and alternate long and short dash lines were the ranges of properties.

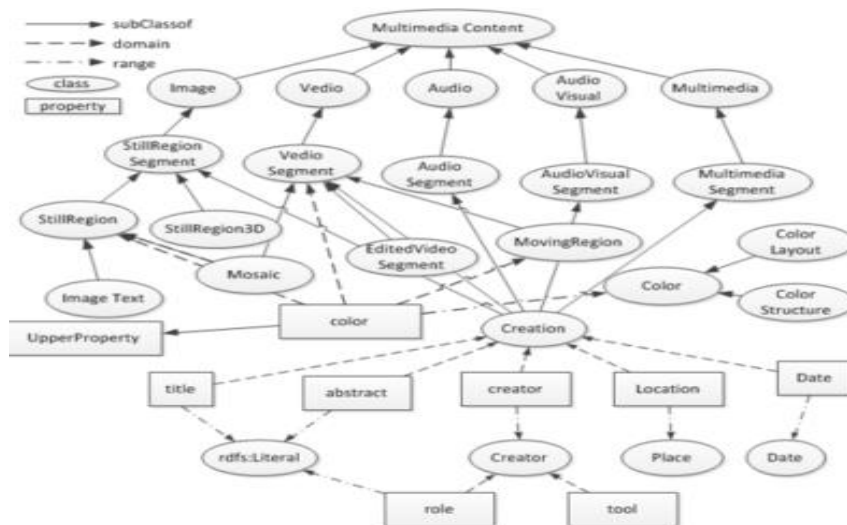


Figure 2. Multimedia Ontology Based on XMDR+ Configuration

In the Figure 2, Creation was a class of the ontology of created multimedia data. The class was a sub class categorizing the contents using the data of the contents, and the necessity properties were title, abstract, creator, location, and date. The title and abstract properties contained the instance of rdfs: Literal. The creator property set tools and rules for creating multimedia through the creator class, and the location and data properties showed necessary information for creating ontology through the class. The classes on the creation class inherited one category of the multimedia data, which was categorized by multimedia ontology. Thus, the created ontology was built through a schema before creating each class.

```
<complexType name="CreationType">
  <complexContent>
    <extension base="mpeg7:DSType">
      <sequence>
        <element name="Title" type="mpeg7:TitleType"/>
        <element name="Abstract" type="mpeg7:TextAnnotationType"/>
        <element name="Creator">
          <complexContent>
            .....
          </complexContent>
        </element>
        <element name="CreationLocation" type="mpeg7:PlaceType"/>
        <element name="CreationDate" type="mpeg7:DateType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

Figure 3. Schema Definition of Creation Class

Figure 3. is the schema designed by ComplexType of Creation class. As the Creation class type of Figure 3, this arranges fields as <element> tags by Creation class type. The name in each element corresponds to the field name, and type means transformation of a field to a technical type. Figure 4. Indicates the attribute and entity defined by Figure 2. as RDF. The examples are color attribute and color class. The attribute describes things with three domains and one scope. Class expresses the identifier and lower class of the corresponding class. Accordingly, ontology has semantic correlation and can solve conflicts between data, and contain following rules for solving each conflict

```
<rdf:Property rdf:ID="color">
  <rdfs:label>color of a video or audio segment</rdfs:label>
  <rdfs:domain rdf="resource="#Mosaic"/>
  <rdfs:domain rdf="resource="#VedoSegment"/>
  <rdfs:domain rdf="resource="#MovingRegion"/>
  <rdfs:range rdf="resource="#Color"/>
</rdf:Property>
<rdfs:Class rdf:ID="Color">
  <rdfs:label>Color</rdfs:label>
  <rdfs:subClassOf rdf="resource="#ColorLayout"/>
  <rdfs:subClassOf rdf="resource="#ColorStructure"/>
</rdfs:Class>
```

Figure 4. RDF Applied Example for Subjected Ontology

- **Rule 1.** Name conflict between entities: Solve conflicts occurring due to the same name between entities.
 - **Rule 2.** Structural conflict between entities: Solve conflicts caused by different structures between classes having correlation.
 - **Rule 3.** Structural conflict between entity and instance: Solve structural conflicts occurring between class and instance.
 - **Rule 4.** Structural conflicts between entity and attribute: Solve structural conflicts occurring between class and attribute.
 - **Rule 5.** Structural conflicts between attribute and instance: Solve structural conflicts occurring between attribute and instance.
 - **Rule 6.** Name conflicts between attributes: Solve conflicts occurring due to differences of names occurring between attributes.
 - **Rule 7.** Structural conflicts between attributes: Solve conflicts occurring due to structural differences existing between attributes.
- Ontology composed in this way can solve correlation and conflicts between classes.

3.2. MOXMDR+(Multimedia Ontology Based on XMDR+) Structure

The concept structure of MOXMDR+ according to metadata was composed based on schema after saving association of contents. This model provided associated information of users with reference to MO upon requests of users, and accordingly the users could search dispersed content resources through mapping based on schema according to the selected association. Figure 5 summarized workflow of the model's structure and elements of the structure. Arrows in the Figure 5 showed interoperation between the elements, and it showed the process of confirmation according to situations of mediator. The functions of each element were as follows:

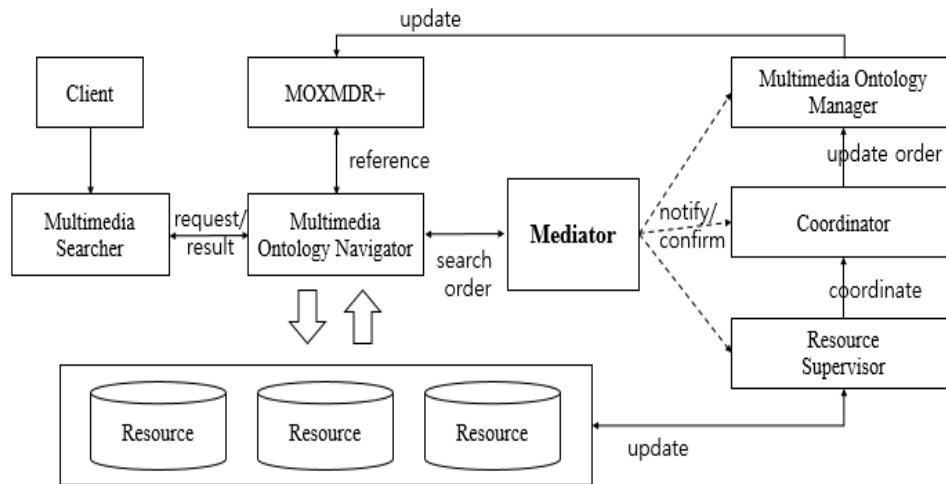


Figure 5. XMDR+ based on Multimedia Ontology Model Proposed

* **Multimedia Search Interface:** This element notices the start of process to mediator according to inputs of users and conveys the behavior of users.

* **Mediator:** It generally operates the system, searches contents data according to conditions of ontology and users, and monitors ontology update.

* **MOXMDR+:** In concept structure based on multimedia metadata, it manages association of contents and processes mapping for semantic collision in application of rules.

* **MONavigator:** With reference to ontology according to demands of users, it extracts and returns relative information.

* **Resource Supervisor:** It checks whether dispersed resources are modified and demands ontology update.

* **Coordinator:** It compares ontology of the mediator and updates information of resource supervisor to adjust ontology.

* **MOManager:** It updates ontology according to coordinator.

Accordingly, MOXMDR+ was updated for the mediator on regular basis to keep the relationship with contents up to date.

3.3. Proposal Model Sequence

Figure 6 shows the performance process of each component of the system. The process is divided into two phases. First, it is the sequences from 1 to 11 as the multi-media contents resource approach through ontology occurring due to user's action. Second, it is the process within ontology update and it corresponds to the sequences from 12 to 23 as the process to confirm the changes of periodical multi-media contents through mediator and renew ontology. Through renewing ontology, the latest condition can be maintained, and through this, ontology evolves [7].

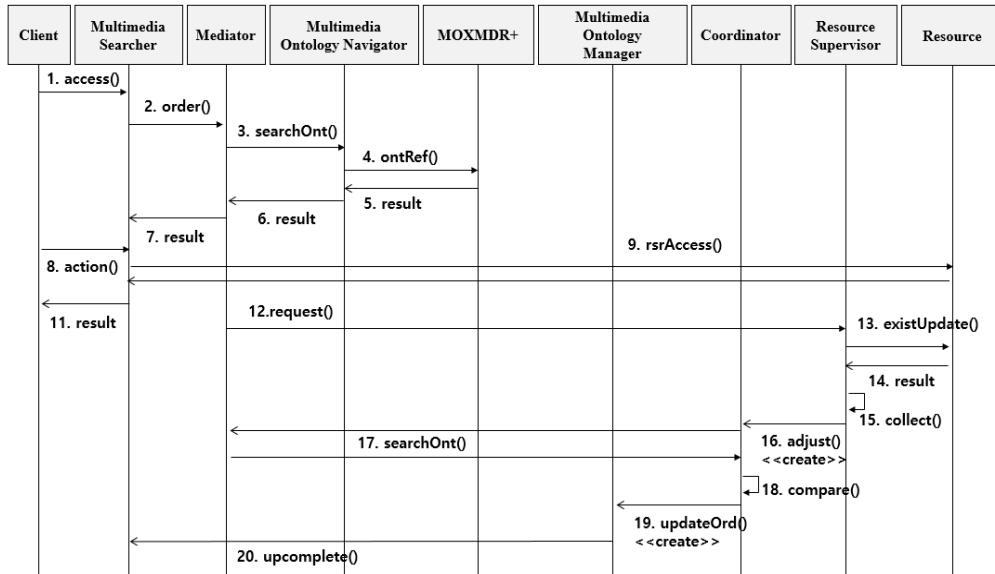


Figure 6. The Multimedia Ontology Based on XMDR+ Sequence Diagram

4. Implementation

This chapter implemented in the way suggested in chapter 3. The search system using MOXMDR+ (Multimedia Ontology based on XMDR+) according to the suggested method as Figure 7. The interface provides correlations such as multi-media category, homonym and synonym by searching for ontology with input conditions selected the user and enables semantic search. The results of search performance according to these conditions are as Figure 8.

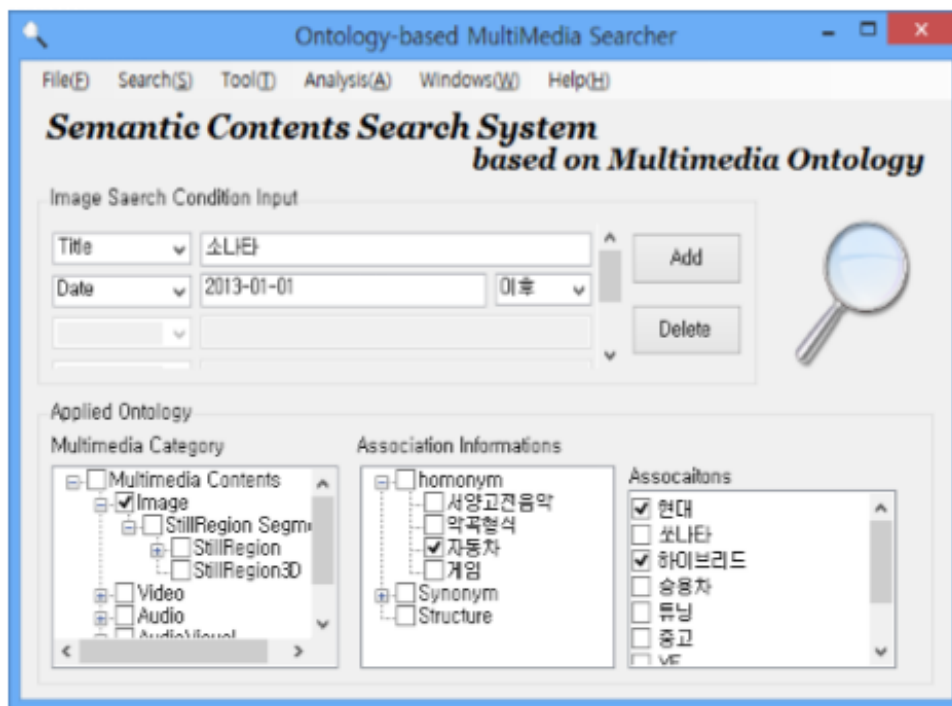


Figure 7. Search Interface Based on Multimedia Ontology

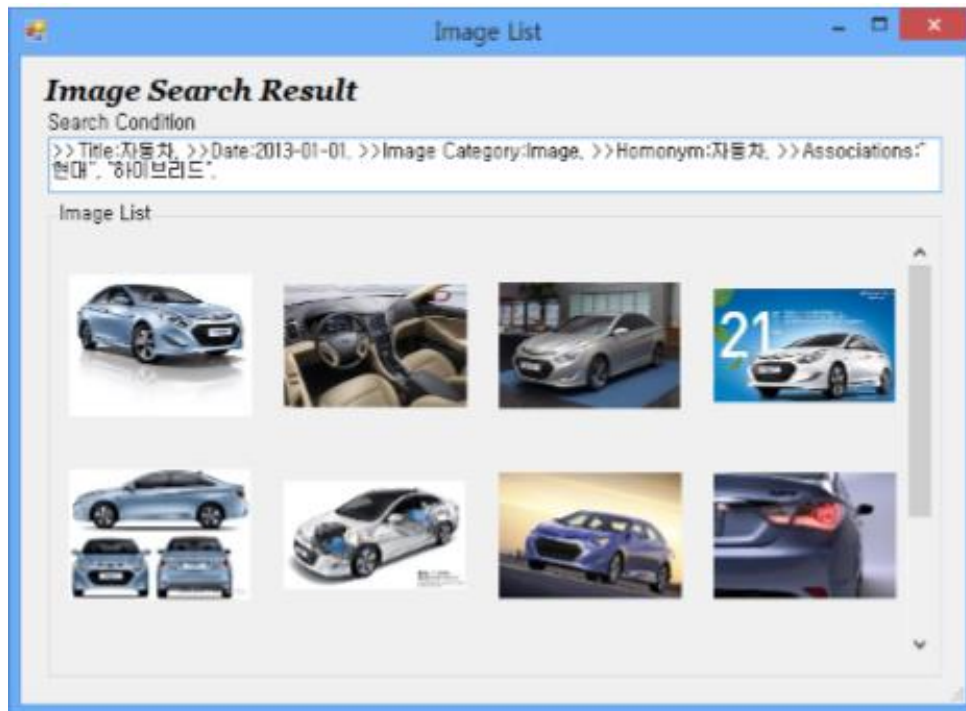


Figure 8. Search Result

In general, evaluation according to the search results reinforced search conditions than image search and caused decrease of search results, but when including the corresponding words occurring in simple keywords, the problem of the subject of search was rather solved. Then, since multi-media ontology provision for search offers information on corresponding keywords to the user, it has a merit to transfer not simple search but knowledge.

5. Conclusion

This study introduced structures of multimedia ontology based on XMDR+ and rules for solving collision for effective search of contents information, and it suggested a system model to search contents accordingly. The model checked a change of data sources and updated ontology on regular basis to develop the ontology. According to the suggestion, a single ontology used relative information of the dispersed contents for search. Recently, studies were performed on integration of the ontology for the dispersed ontology. Accordingly, the integrated ontology would be expanded to use various types of contents; and the suggested rules should be normalized.

Acknowledgments

This article is a revised and expanded version of a paper entitled “Research on Multimedia Ontology based on XMDR+” presented at The 5th International Conference on Information Technology and Computer Science (ITCS 2016) held on July 5-8, 2016 at The Mercure Bali Harvestland Kuta Hotel, Bali, Indonesia.

This work was supported by the Shinhan University Research Fund, 2016.

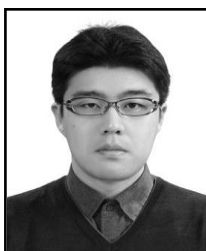
References

- [1] R. Arndt, R. Troncy, S. Staab, L. Hardman, and M. Vacura, "COMM: Designing a Well-Founded Multimedia Ontology for the Web", In Proceedings of the 4th European Semantic Web Conference (ISCW'07), Busan Korea, November, Springer, (2007).
- [2] "MPEG-7 and the Semantic", Web <http://www.w3.org/2005/Incubator/mmsem/XGR-mpeg7/>, (2007).
- [3] S. Philippe and J. R. Smith, "MPEG-7 multimedia description schemes", Circuits and Systems for Video Technology, IEEE Transactions on, vol. 11, no. 6, (2001).
- [4] J. Hunter, "Adding Multimedia to the Semantic Web - Building and Applying an MPEG-7 Ontology", Chapter 3 of "Multimedia Content and the Semantic Web", Eds. Giorgos Stamou and Stefanos Kollias, Wiley, (2005).
- [5] J. D. Kim, J. S. Son and D. K. Baik, "XMDR+: An Extended XMDR Model for Supporting Diverse Ontological Relations", IEICE transactions on information and systems, vol. 94, no. 3, (2011).
- [6] H. Jane, "Adding multimedia to the Semantic Web-Building and applying an MPEG-7 ontology", Wiley, (2005).
- [7] T. Chrisa, P. Polydoros and S. Christodoulakis, "Integration of OWL ontologies in MPEG-7 and TV-Anytime compliant Semantic Indexing", International Conference on Advanced Information Systems Engineering. Springer Berlin Heidelberg, (2004).
- [8] T. Raphaël, "Mpeg-7 based multimedia ontologies: Interoperability support or interoperability issue", 1st international workshop on multimedia annotation and retrieval enabled by Shared Ontologies, (2007).
- [9] T. Raphaël, "Enabling multimedia metadata interoperability by defining formal semantics of MPEG-7 profiles", International Conference on Semantic and Digital Media Technologies. Springer Berlin Heidelberg, (2006).
- [10] H. K. Park and S. J. Moon, "A Study on DBaaS System for the HL7-based Health Information Sharing in the Cloud Environment", ASTL vol. 99, (2015).
- [11] H. K. Park and S. J. Moon, "DBaaS using HL7 based on XMDR-DAI for Medical information Sharing in Cloud", IJMUE vol. 10, no. 9, (2015).

Authors



Ho-Kyun Park, He received his B.S. and M.S. degrees in computer science from Kwangwoon University, Seoul Korea, in 1987 and 1989, respectively. He obtained his Ph.D. in multimedia network from same university, 1998. He is currently a professor with the School of IT Convergence Engineering at the Shinhan University, Korea, since March 1992. His major research interests include network security, smart home-network system, and ubiquitous computing system.



Seok-Jae Moon, He received the B.S. the M.S. and Ph.D. degrees from Kwangwoon University, Seoul Korea, in 2002, 2004, and 2010, all in computer science. He now works as a Principal Research Engineer in the Department of GlobeBit, Seoul, Korea. He is also an adjunct professor in the School of IT Convergence Engineering at the Shinhan University, Korea. His research interests include big data, business process, cloud computing, data interoperability, and cooperation systems.

