

Chapter 9

Ontology Instance Matching Based MPEG- 7 Resource Integration

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ABSTRACT

Heterogeneous multimedia contents are annotated by a sharable formal conceptualization, often called ontology, and these contents, regardless of their media, become sharable resources/instances. Integration of the sharable resources and acquisition of diverse knowledge is getting researchers' attention at a rapid pace. In this regard, MPEG-7 standard convertible to semantic Resource Description Framework (RDF) evolves for containing structured data and knowledge sources. In this paper, the authors propose an efficient approach to integrate the multimedia resources annotated by the standard of MPEG-7 schema using ontology instance matching techniques. MPEG-7 resources are usually specified explicitly by their surrounding MPEG-7 schema entities, e.g., concepts and properties, in conjunction with other linked resources. Therefore, resource integration needed schema matching as well. In this approach, the authors obtained the schema matching using their scalable ontology alignment algorithm and collected the semantically linked resources, referred to as the Semantic Link Cloud (SLC) collectively for each of the resources. Techniques were addressed to solve several data heterogeneity: value transformation, structural transformation and logical transformation. These experiments show the strength and efficiency of the proposed matching approach.

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INTRODUCTION

The proliferation of heterogeneous digital media contents along with the rapid growth of current World Wide Web endures a formidable task of information integration across media. The digital media is often represented by text, image, audio, video, and graphics and so on. Due to the heterogeneity and availability of large number of digital contents, digital media turns out to become hardly manageable without fine-grained computerized support (Garcia & Celma, 2005). Furthermore, the most of state-of-the-art researches are borne to focus on monotonic digital media, either concentrating on text or image or other media contents independently. Recently a number of structured resource annotation standards are proposed for knowledge acquisition from heterogeneous digital media.

The heterogeneous contents of digital data, regardless of their media, become structured resources containing knowledge source in an interoperable format by means of MPEG-7 (Nack & Lindsay, 1999; Nack, Lindsay, & GMD-IPSI, 1999; Salembier & Smith, 2002), or MPEG-21 (Bormans & Hill, 2002) standards. MPEG-7, formally named *Multimedia Content Description Interface* (Salembier & Smith, 2002), is developed by the Moving Picture Experts Group¹ (MPEG). MPEG-7 is standardized by means of *Descriptors* (Ds), *Description Schemes* (DSs) and the relationships between them. The descriptors correspond either to the low-level data features (e.g., visual texture, camera motion, audio spectrum and so on) or semantic resources (e.g., places, actors, events and objects). The description schemes are used for grouping the descriptors into more abstract description entities. The descriptors, the schemes and their relationships are represented using the *Description Definition Language* (DDL) in W3C XML Schema recommendation². However, XML is a semi-structured context having a little semantic with hardly sharable structure.

The XML schema lacks to express formal semantics. However, an ontology has formal semantic with reusability and is defined as a formal specification of a shared conceptualization (Gruber, 1993). It has capability to alleviate the limitation. An ontology contains sets of concepts, properties, axioms and instances. Furthermore, it contains concept hierarchy and property hierarchy. Several researchers converted MPEG-7 schema into ontologies to enhance the semantic expressiveness using *Web Ontology Language* (OWL) (McGuinness & van Harmelen, 2004).

There are a number of MPEG-7 ontologies. They are *Hunter's ABC ontology*³ (Lagoze & Hunter, 2001) used for digital libraries (Hunter, 2002; Hunter, 2003) and eResearch field (Bloehdorn, et al., 2005), *DS-MIRF*⁴ (Tsinaraki, Polydoros, & Christodoulaki, 2004), (Tsinaraki, Polydoros, & Christodoulakis, 2007), *Rhizomik*⁵ (Garcia & Celma, 2005) and *COMM*⁶ (Arndt, Troncy, Staab, Hardman, & Vacura, 2007). COMM is developed based on their previous work (Troncy, 2003; Isaac & Troncy, 2004). A comprehensive research work compares the ontologies (Troncy, Celma, Little, Garcia, & Tsinaraki, 2007). Moreover, the description of an annotated digital media can be obtained either manually or automatically in XML format. This annotating description can also be converted automatically into RDF description (Garcia & Celma, 2005).

Using MPEG-7 ontologies, multimedia resources are annotated by the concepts, properties and other schema entities of MPEG-7. We can divide the MPEG-7 contents into two parts: schema and resources. The schema entities, often called as terminology, are collectively defined as TBox, assertion for describing a set of concepts and properties in terms of controlled vocabularies of ontologies. On the other hand, the instances of concepts of TBox are collectively called as ABox i.e. assertion of control statements on instances of the concepts. We call the MPEG-7 based instances as multimedia resources. A multimedia resource

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