CAMO: Integration of Linked Open Data for Multimedia Metadata Enrichment

Wei Hu\textsuperscript{1}, Cunxin Jia\textsuperscript{1}, Lei Wan\textsuperscript{2}, Liang He\textsuperscript{2}, Lixia Zhou\textsuperscript{2}, and Yuzhong Qu\textsuperscript{1}

\textsuperscript{1} State Key Laboratory for Novel Software Technology, Nanjing University, China
\{whu, yzqu\}@nju.edu.cn, jiacunxin@smail.nju.edu.cn
\textsuperscript{2} Samsung Electronics (China) R&D Center, China
\{l.wan, jaimely.he, lixia.zhou\}@samsung.com

Abstract. Metadata is a vital factor for effective management, organization and retrieval of multimedia content. In this paper, we introduce CAMO, a new system developed jointly with Samsung to enrich multimedia metadata by integrating Linked Open Data (LOD). Large-scale, heterogeneous LOD sources, e.g., DBpedia, LinkMDB and MusicBrainz, are integrated using ontology matching and instance linkage techniques. A mobile app for Android devices is built on top of the LOD to improve multimedia content browsing. An empirical evaluation is conducted to demonstrate the effectiveness and accuracy of the system in the multimedia domain.

Keywords: Linked Data, multimedia, semantic data integration.

1 Introduction

Multimedia metadata and semantic annotation are vital to improve services on multimedia content \cite{21}. The search, browsing and management of multimedia content become very difficult if no or only limited metadata and annotations are provided. Driven by the Linking Open Data Initiative, plenty of open datasets are published and interlinked, in order to enable users to make use of such rich source of information \cite{22}.

Looking at the existing multimedia metadata models and standards, they do not provide formal semantics and typically focus on a single media type. For example, EXIF is widely used for image description, but it is incompatible with MPEG-7 \cite{21}. In real world, different media types often coexist in a multimedia presentation, where for example a movie may have a theme music and a poster. We believe that a unified, well-defined ontology (with its mappings to others) is needed in many multimedia application scenarios to gain interoperability. Additionally, metadata from diverse data sources can denote the same multimedia content. Linking and integrating these heterogeneous datasets are challenging, especially when meeting legacy data reserved in relational databases (RDBs) or on the Deep Web. Thus, accurate methods are desired to (semi-)automatically link the overlapping parts of the datasets. The integrated metadata can provide benefits to many multimedia applications like mobile devices, whose market is expected to rise to $9.5$ billion by 2014 \cite{7}.
A motivating example. Fig. 1 illustrates a real-world example about the movie Beauty and the Beast. The original video already has a few low-level metadata like runtime and location. By integrating LOD, e.g., LinkedMDB [10] and DBpedia [17], the description of this movie would be enriched significantly. However, LinkedMDB and DBpedia use different but related ontologies for movie description, thus creating mappings between their classes and properties is important for integrating the descriptions into the movie metadata. Additionally, DBpedia and LinkedMDB refer to the same movie by using different instances, e.g., dbpedia:Beauty and the Beast (1991 film) and linkedmdb:330 in this example. But it may not be sufficient and accurate to only match their titles/labels, where for example a music dbpedia:Beauty and the Beast (Soundtrack) with exactly the same label should not be linked.

In this paper, we describe CAMO, a system developed jointly with Samsung for enriching multimedia metadata via integrating LOD. CAMO achieves this by using our ontology matching and instance linkage techniques and adapting them to the multimedia domain. The technical contributions of this paper are threefold: (i) CAMO selects the DBpedia ontology as the mediation model and matches with other ontologies; (ii) CAMO links the instances in DBpedia with other sources and aggregates their descriptions; (iii) CAMO incorporates RDBs with DBpedia to cope with legacy data. We hope that our methods and system can provide reusable experience for applications consuming Linked Data.

We develop a mobile app for browsing and searching multimedia content on Android devices. We perform a user-centered evaluation of CAMO to measure how well it compares with existing apps, in particular with Last.fm, IMDb and Wikipedia mobile apps. We also conduct an experiment on the accuracy of the ontology matching and instance linkage in the multimedia domain. The results demonstrate the advantages of integrating LOD into multimedia metadata for improving the quality of multimedia content services. More information about CAMO is available at http://ws.nju.edu.cn/camo/.