SEMANTICS AND ONTOLOGIES FOR MULTIMEDIA OBJECTS REPRESENTATION AND METADATA MANAGEMENT IN SOUND ARCHIVES

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ABSTRACT

Sound archives have been massively digitalized in the past twenty years. We are also witnessing that many of them are becoming available on-line. The emergence of the web, and its evolution towards the semantic web opens a new phase for the publication of digital archives. The data and assets they contain can be made available in a structured way, providing more precise, as well as wider querying possibilities. In this paper, we present an ontology for easily publishing and managing digital archives, based on semantic web technologies. An architecture based on the Music Ontology is successfully being used within the EASAIER (Enabling Access to Sound Archives through Integration, Enrichment and Retrieval) European project.

Index Terms— Sound Archives, Multimedia Retrieval, Music Ontology.

1. INTRODUCTION

Ontologies are the backbone of the semantic web in particular, and of modern knowledge representations in general. An ontology provides a way to describe a restricted world we are in a logical language (description logics, and in the semantic web context, OWL (which can be serialized as XML)), allowing automatic reasoning. It is far more than just a metadata scheme (descriptors attached to top-level nodes), as the raw MM file is just an object which has the same relevance as any other objects (such as a particular artist, a particular performance, and so on...). An ontology answers the following use-cases:

- **Automatic reasoning** - An ontology, by being formally specified, allows automatic reasoning on objects in the described domain. For example, It is possible to query an ontology-based system for all recordings involving wind instruments and gain access to those involving flute, oboe and not only the ones directly "tagged" with wind instrument.
- **Cross-Media knowledge management** - Each multimedia object is relevant, and described in a semantic graph. By using an ontology, a user can access both the video of a performance and the related recording, as well as the lyrics.
- **Flexible knowledge representation** - For example, using an ontology, you can perfectly recognise the existence of an object representing a particular performance of a piece, without the related recording. This is impossible with a standard metadata approach.
- **Distributed multimedia repositories** - Using OWL, multimedia files are identified by an URI. It means that files can be on a FTP server, on an HTTP one, accessible through SSH, streamed, or even on a peer-to-peer network. The corresponding URI just has to be resolvable.
- **Exporting multiple metadata standards / MPEG7 link** - By building a particular interpretation of the theory held by the ontology, it is possible to export some knowledge in several metadata standard. From really poorly expressive ones (ID3,...) to highly expressive ones (MPEG7).

2. MUSIC ONTOLOGY

The Music Ontology [1] is built on top of the Timeline ontology [2] and the Event ontology [3], as well as the Functional Requirements for Bibliographic Records ontology (FRBR) [4], mainly used for its concept of **Work** (an abstract, distinct, artistic creation), **Manifestation** (physical embodiment, like a record, for example), and **Item** (a single exemplar of such a manifestation, like a particular vinyl). We also use the Friendof-a-friend ontology (FOAF) [5], and its concepts of **Person** and **Group**. We define a number of music-specific concepts, on top of these three ontologies.

On top of FRBR, we define **MusicalWork**—an abstract musical creation (such as Franz Schubert's Trout quintet), **MusicalManifestation**, which can be a a **Record** or a **Track** among others), and **MusicalItem**, which can be a **Stream**, a particular **CD** or a particular **vinyl**, etc. On top of the FOAF ontology, we define **MusicArtist** and **MusicGroup**.

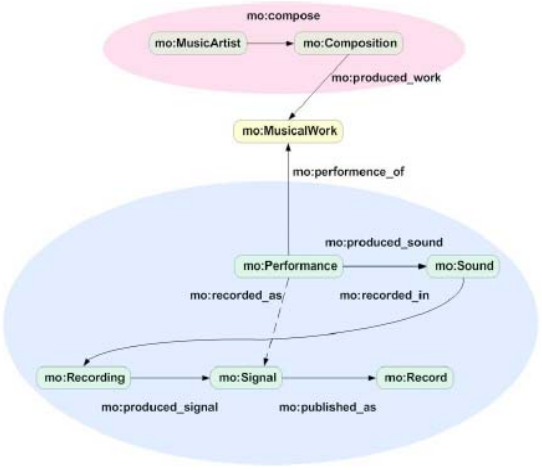

Figure 1. Music Ontology Workflow

On top of the **Event** ontology, we also define a number of concepts, relative to the music creation work flow. **Composition** deals with the creation of a **MusicalWork**. **Arrangement** deals with an arrangement of a **MusicalWork** and can have as a factor a **MusicalWork**, as an agent an **Arranger** and as a product a **Score**. **Performance** denotes a particular Performance, and can have as factors a **MusicalWork** and a **Score**, a number of musical instruments, equipments, and as agents a number of musicians, sound engineers, conductors, listeners, etc. A **Performance** can have as a product another event: **Sound** — a physical sound. This sound may itself be a factor of a **Recording**, which may produce a **Signal**. This **Signal** can then be published as a **MusicalManifestation**. This leads to a work flow depicted in Figure 1.

The feature ontology [6] aims at creating a generic framework for expressing features of audio signals (Mel Frequency Cepstral Coefficients, chromagram, onsets, etc.). It uses the broad definition of the Event concept in order to express an artificial classification of a time region, corresponding to a particular feature. Therefore, it defines a sub class of Event: FeatureEvent, allowing to classify time regions corresponding to features.

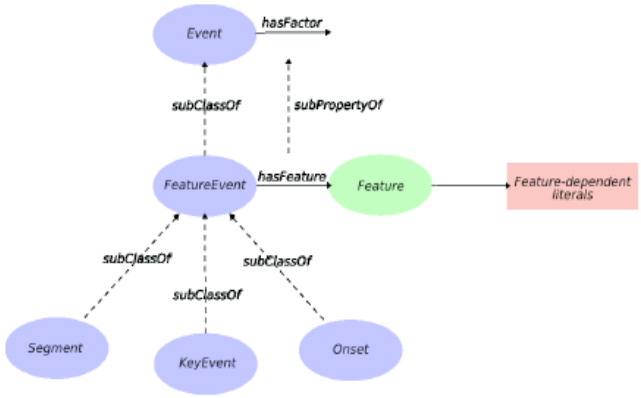

Figure 2. Features Ontology

Feature Event may have a number of Feature factors, representing a particular feature, such as a chromagram or a key (Figure 2)**.**

Linking Open Data on the Semantic Web - As an example of such a linking, we may provide information about a festival happening in Montreal, Canada on 28 June 2007. We can link our Festival instance using the event:place property to its geographical location resource in Geonames. A user agent crawling the web of data can then jump from our knowledge base to the Geonames one, by following this link, and get detailed information about the place where the festival is happening.

3. CONCLUSIONS

The music ontology has a quickly growing users community, and can be considered as the reference ontology for publishing audio archives on the semantic Web. An architecture based around the music ontology that can be reused to integrate sound archives, and with extending the ontologies, to integrate any media archive, and publish its contents on the semantic Web. This gives a powerful tool for archivists willing to exploit the rich knowledge contained in archives, and give access of this knowledge to a wider audience [7],[8].

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