# Chapter 13
# Ontology Based Multimedia Indexing

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## ABSTRACT

*The chapter goal is to provide responses to the following question: how the ontologies could be used in order to index and manage the multimedia collections? Alongside with reviewing the main standard formats, vocabularies and ontology categories developed especially for multimedia content description, the chapter emphasis the existing techniques for acquiring ontology-based indexing. Since a fully automatic such technique is not possible yet, the chapter also proposes a solution for indexing a multimedia collection by combining technologies from both Semantic Web and multimedia indexation domains. The solution considers the management of multimedia metadata based on two correlated dictionaries: a metadata dictionary centralizes the multimedia metadata obtained through an automatic indexation process, while the visual concepts dictionary identifies the list of visual objects contained in multimedia documents and considered in the ontology-based annotation process. This approach facilitates as well the multimedia retrieval process.*

## INTRODUCTION

The multimedia indexing and management is a very important issue in the actual context where various domains such as news gathering, TV, banks of resources for commercial or consumer applications, collaborative work, video surveillance are flooded by a huge amount of multimedia sources.

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The traditional multimedia indexation techniques are focused on the effective multimedia content processing, being mainly in charge with low-level multimedia features analysis. They could capture some information about the content description (such as shapes or faces recognition), but not in terms of high-level concepts (such as ontology or vocabulary concepts). The chapter is focused on possible solutions for the problem of bridging the "semantic gap" between low-level multimedia

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features and high-level concepts describing the multimedia content, in order to reach a semantically enhanced multimedia indexing.

From the representational point of view, the main goal of transforming multimedia materials into machine-compatible content is ensured both by the Semantic Web activity of the Web Consortium[1], and by the ISO's efforts in the direction of complex media content modeling, in particular the Multimedia Content Description Interface (MPEG-7)[2]. The two directions are syntactically and semantically different, and some solutions to unify them were proposed. Moreover, a set of tools were developed to enable the automatic extraction of the visual features in multimedia materials (as MPEG proposes) and the manual association of them with ontology concepts (as a semantic web approach requires). Efforts were made also towards a multimedia annotation interoperability framework[3] and towards a core ontology for multimedia framework[4], aiming a uniform use of the multimedia ontologies, according to their intended use and context.

In order to capture and express a high-level semantics for multimedia objects, some domain specific vocabularies were established for describing multimedia content, as well as some specialized multimedia ontologies. A quick overview is included in Section 2. Because of the binary character of the multimedia content, the main issue concerning the automatic ontology-based multimedia indexing still remains an unsolved problem. However, some steps were accomplished, and our chapter emphasizes the main such techniques: exploiting the textual descriptions accompanying the multimedia content, using the free tagging community effort, applying multiple automatic indexing techniques (in cascade), combining human and machine efforts.

Focused on the last two technique types, the present chapter proposes a solution for indexing a multimedia collection by combining technologies from both semantic Web and multimedia indexation domains. The solution considers the management of multimedia metadata based on two correlated dictionaries: a metadata dictionary centralizes the multimedia metadata obtained through an automatic indexation process, while the visual concepts dictionary identifies the list of visual objects contained in multimedia documents and considered in the ontology-based annotation process. This architecture facilitates as well the multimedia retrieval process.

The second section presents the state of the art in the domain of developing standard formats, vocabularies and ontologies for being adopted to specify and organize the multimedia metadata, as well as the interoperability problems raised by the heterogeneity of vocabularies. the third section provides an overview of the most important ontology-driven frameworks for multimedia semantic annotation, while the fourth section exposes the semantic multimedia indexation proposed solution. In final, the conclusions and further work directions are presented.

## VOCABULARIES FOR MULTIMEDIA ANNOTATION

In the recent years, multiple standards were developed for storing each type of multimedia content. Among these, the most popular are:

- **Video:** MPEG-1, MPEG-2, MPEG-4, QuickTime, Sony DV, AVI, ASF, RealMedia, etc.
- **Audio:** Raw PCM, WAV, MPEG-1, MP3, GSM, G.723, ADPCM, etc;
- **Image:** JPEG, TIFF, BMP, GIF, etc.;
- **Multimedia presentations:** SMIL, MHEG, SVG.

Alongside with the binary information that constitutes the content itself, some basically metadata (creation date, file size, title, author etc.) are also stored in these formats.

In addition, a lot of multimedia features could be expressed through specialized metadata

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