

BOEMIE: BOOTSTRAPPING ONTOLOGY EVOLUTION WITH MULTIMEDIA INFORMATION EXTRACTION

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Abstract

The BOEMIE project proposes a bootstrapping approach to knowledge acquisition, which uses multimedia ontologies for fused extraction of semantics from multiple modalities, and feeds back the extracted information, aiming to automate the ontology evolution process.

1 Introduction

The potential in the use of ontologies for extracting semantic information from multimedia content has been highlighted in many recent research articles [1, 2]. However, efficient and effective methodologies for information extraction from multimedia content using ontologies are still missing. Meanwhile, the potential of an iterative approach to ontology evolution, combining information retrieval and extraction techniques for textual content has also been proposed in the literature [3, 4]. On this basis, BOEMIE proposes a specific bootstrapping approach to knowledge acquisition, which uses multimedia ontologies for fused extraction of semantics from multiple modalities, and feeds back the extracted information, aiming to automate the ontology evolution process.

2 BOEMIE methodology

BOEMIE advocates an ontology-driven multimedia content analysis (semantics extraction from images, video, text, audio/speech) through a novel synergistic method that combines multimedia extraction and ontology evolution in a bootstrapping fashion. This method is involving on the one hand, the continuous extraction of knowledge from multimedia content sources in order to populate and enrich the ontologies and, on the other hand, the deployment of these ontologies to enhance the robustness of the multimedia information extraction system. BOEMIE aims to achieve, through this approach, large-scale and precise knowledge acquisition from multimedia content. In order to achieve this, the project proposes the development of innovative methodologies and toolkits in ontology evolution and information extraction. More specifically, on the side of ontology evolution, BOEMIE proposes:

- A unifying representation for multimedia ontologies and related knowledge. This “multimedia semantic model” will link domain-specific ontologies, in which concepts

are represented by domain-specific terms, with multimedia content and descriptor ontologies that represent content structure in multimedia documents and describe characteristics of multimedia objects in terms of low-level features and structural descriptions.

- A methodology for ontology evolution to coordinate the various tools that will use the extracted data to populate and enrich the ontologies.
- A toolkit for ontology evolution which will include tools to support ontology learning, ontology merging and alignment, semantic inference for consistency maintenance, and ontology management.

On the side of information extraction, BOEMIE proposes:

- A methodology and an open architecture for information extraction from multimedia content using data fusion techniques. The proposed methodology will specify how information from the multimedia semantic model can be used to achieve extraction from various media. Additionally, it will combine extracted information from multiple media, using a probabilistic evidence-based framework, to improve the extraction performance.
- A toolkit for semantic extraction from multimedia content. Within the extraction architecture, tools will be developed to support extraction from image, audio, video and text, as well as information fusion.

BOEMIE also proposes an open architecture that integrates the components for ontology evolution and semantics extraction. As it is depicted in Figure 1, the major components of the proposed architecture include:

- The multimedia ontology which will be evolving through the ontology evolution component. An ontology initialization tool will be developed to provide a friendly user interface for the creation of the initial ontology.
- The semantics extraction component which will provide tools for the analysis of single modalities as well as tools for fusing information from multiple media sources. The whole extraction process will be ontology driven in the sense that the ontology will provide the initial knowledge to the extraction process and will also be used to disambiguate the extraction results.
- The ontology evolution component which will use the results of the extraction process to populate and enrich the multimedia ontology, as well as to coordinate the linked ontologies. Special emphasis will be given to the semantic

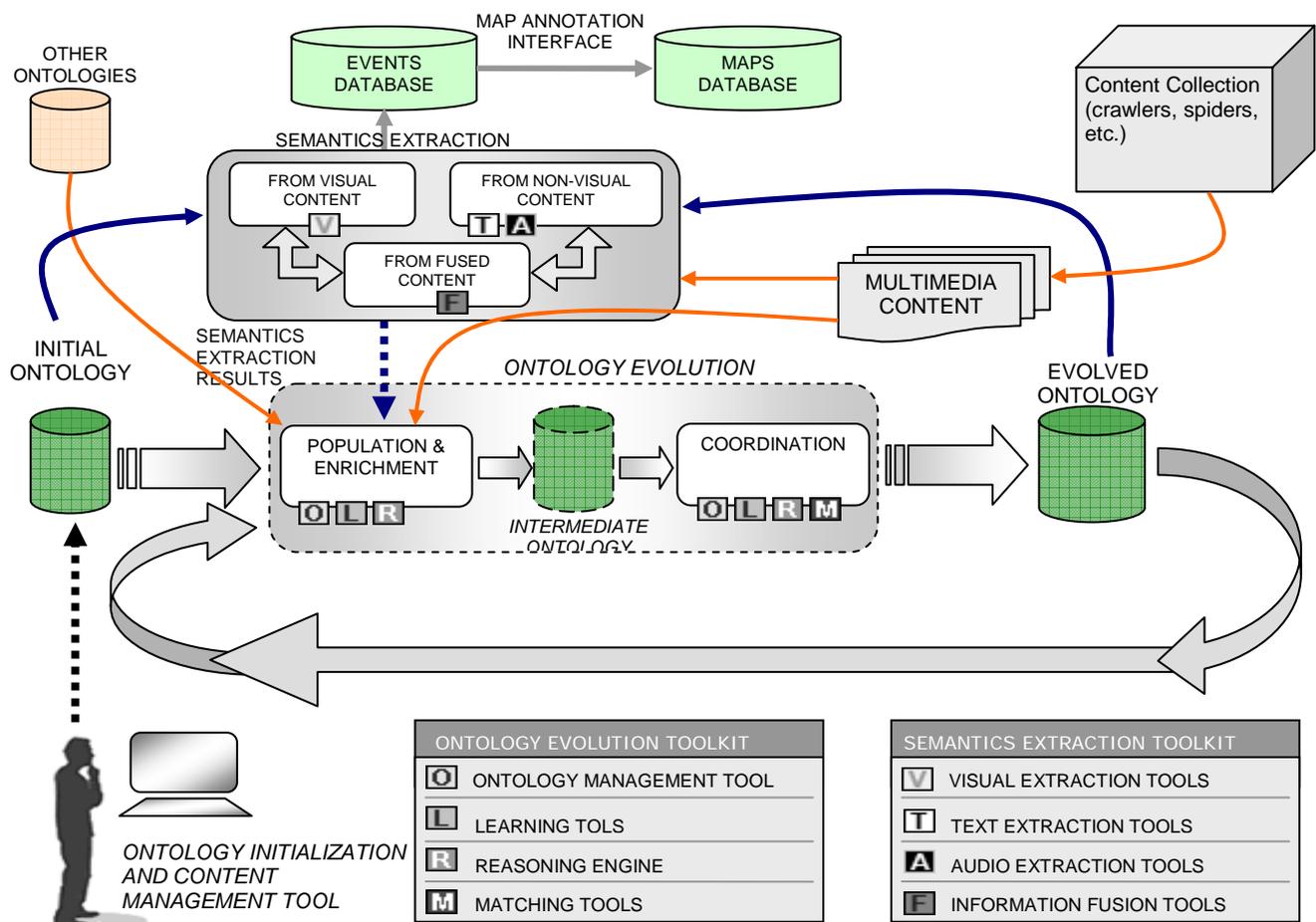


Figure 1. Architecture of the integrated system

consistency maintenance, since any changes may generate inconsistencies in other parts of the same ontology, in the linked ontologies or in the annotated content.

3 Application Scenario

The application we will examine concerns the enrichment of digital maps with semantic information. In other words, the results of the extraction process will be displayed to the end-user, through an interactive digital map. The specific application scenario involves an automatic content collection and annotation service for public events in a number of major cities. The domain of public events includes commercial exhibitions, sport events, concerts etc. This service will continuously collect and annotate large amounts of dynamic content, from the Web and proprietary sources. The results of the annotation process, i.e., the identified entities and their properties, will be linked to geographical locations and stored in a content server. The application can be considered as a monitoring service for public events in a number of big cities. The user will be provided with immediate access to the annotated content base, through the user-friendly interface of digital maps, which will also provide immediate navigation guidance to the place of interest. BOEMIE scenario will focus on exhibitions, although it is easily extensible to other types of public events. Exhibitions are proposed as an application that has significant commercial and social interest, while at the same time it is associated with a wealth of complementary multimedia content that is evolving over time.

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