Semantical interoperability with IMAGINATION content using standardized ontologies

Andreas Walter[1], Gabor Nagypal[2]

[1]IPE, FZI Forschungszentrum Informatik, Haid-und-Neu-Straße 10-14, 76131 Karlsruhe
awalter@fzi.de

[2]disy Informationssysteme GmbH, Erbprinzenstraße 4-12, 76133 Karlsruhe
nagypal@disy.net

Abstract: The IMAGINATION project provides image-based navigation for digital cultural and scientific resources. Users can click on parts of an image to find other, interesting images to a given context. The combined application of object detection and identification in images together with text mining techniques exploiting domain specific ontologies will help generate high-quality semantic metadata. We want to share this metadata with other information systems, e.g. in the domain of cultural heritage. This paper describes the requirements of IMAGINATION that must be fulfilled to reach this goal and analyzes CIDOC-CRM, FRBR and MPEG-7 based on these requirements.

1 The IMAGINATION Project

The main objective of IMAGINATION[1] is to bring digital cultural and scientific resources closer to their users. Our aim is to enable image-based navigation for such resources. Users can receive meaningful contextual information about images and image parts, which makes images easier to understand. Moreover, IMAGINATION allows users to navigate to other relevant images and texts in the knowledge repository just by clicking on interesting image parts.

The major instrument to provide context-sensitive, relevant information is the use of semantic metadata. The highest possible quality level of automatically generated metadata is achieved by iteratively combining the results of three processing steps (Figure 1). Step 1 extracts semantic information from the surrounding text and textual metadata of the image (such as its caption) using text mining techniques. In Step 2, object detection algorithms detect faces and objects. Finally in Step 3, the detected objects are identified by using object identification algorithms. All steps exploit an ontology describing the application domains of IMAGINATION – First World War and contemporary European politics (e.g. Person: *Ferdinand Foch*; Profession: *Marshall*; "participates At" Event: *Sign of armistice at Compiegne*). In addition, each

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[1] The IMAGINATION Project – http://www.imagination-project.org

step considers the already available semantic information to improve its results and thus to achieve a synergy effect among the different types of algorithms.

Figure 1 : IMAGINATION technology applied to Wikipedia

2 Our Requirements for semantical interoperability

To enable semantical interoperability with other systems, IMAGINATION needs to exchange technical data, metadata and semantical information.

2.1 Technical information

Technical information needs to be exchanged with other systems to guarantee the correct view of the images. In IMAGINATION, all images are available in digitalized formats (e.g. JPEG) and stored on web-servers. Every image is available in three sizes, a very small one and a medium one for a fast preview of the image and a big size image for commercial usage, e.g. printing. For each image region with interesting content, the coordinates of the corresponding areas are available.

2.2 Textual and semantic metadata

Textual metadata information exchange e.g. text descriptions, the creation date of the image, owner information and usage information, e.g. types of allowed usage. Semantic metadata contain references to instances of the domain ontology of IMAGINATION and information about the relevance of these instances concerning

the whole image or an image region. Especially specifying semantic metadata for image regions is an uncommon requirement that is specific to IMAGINATION.

2.3 Concepts and Instances of the domain specific ontologies

Domain specific ontologies contain concepts, instances and relations. Ontology elements define the possible values for semantic metadata. It is therefore crucial that the ontology contains all information that is needed to (automatically) generate semantic metadata. In our case it is especially includes lots of instances in the WWI and EU politics domains.

3 Using standardised ontologies for semantical interoperability

3.1 CIDOC-CRM

CIDOC-CRM [1] is a conceptual ontology for semantical interoperability. It contains concept and property taxonomies to describe e.g. historical time periods, events, places and persons for the scientific documentation of museum collections. In IMAGINATION, we can use these concepts as a base for our domain specific ontology. Then, we can exchange our concepts based on CIDOC-CRM. CIDOC-CRM does not provide for the semantical interoperability of our technical information because it aims to describe physical objects like paintings or printings in museums and not digitalized images or image regions. Also, we see no possibility to exchange metadata information using CIDOC-CRM.

3.2 FRBR

The scope of FRBR [4] is to exchange data that are recorded in bibliographic records or by national geographic agencies. The integrated entities work, expression, manifestation and items allow the exchange of all required technical information in IMAGINATION except from the definition of image regions. Also, it is possible to exchange metadata. However, the entities are not as powerful as the concepts in CIDOC-CRM. Hence, we would loose a lot of semantical information when exchanging data with FRBR.

3.3 MPEG-7

MPEG-7 [2] provides important functionalities for manipulation and transmission of objects and associated metadata in multimedia content. MPEG-7 allows the definition of all required technical information, including the definition of image regions.

Seungyup et al [5] proposed an extension of the MPEG-7 standard, a description scheme for image content. Using this extension, it is also possible to exchange textual metadata with MPEG-7.

The extraction of semantic descriptions and annotation of the content with the corresponding metadata, though, is out of the scope of the MPEG-7 standard [3]. That means, MPEG-7 does not allow the semantical interoperability based on our own domain specific ontology. This is a missing feature for our requirement to exchange extensive semantical information based on domain specific ontology elements.

4 Conclusions

Our analysis showed that MPEG-7, as an ontology designed for multimedia content, solves two main requirements for the semantical interoperability of IMAGINATION contents. These are the exchange of technical information and metadata.

CIDOC-CRM allows semantical interoperability for ontologies that are aligned with it. Therefore, we aim to use CIDOC-CRM as a basis for our domain specific ontology in IMAGINATION and extend its concepts and properties where needed.

To summarize: the combination of MPEG-7 and its introduced extensions for the description of images for the exchange of technical information with CIDOC-CRM for the exchange of semantical information leads to the highest possible level of semantical interoperability for IMAGINATION content.

References

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