MONDIS: Using Ontologies for Monument Damage Descriptions

Petr Křemen, Miroslav Blaško, Marek Šmíd, Zdeněk Kouba, Martin Ledvinka,
and Bogdan Kostov

Czech Technical University in Prague, Czech Republic

Abstract. The MONDIS project is aimed at knowledge management
in the field of monument conservation, monument damages and related
interventions. The IT platform developed within the project is to be used
by conservators, monument owners and other stakeholders to share their
terminology, contextual knowledge, as well as experience about existing
damages and their interventions.

1 Project Overview

1.1 Main Goals

The project is aimed at developing ontology-based information system for sharing knowledge between various stakeholders in the cultural heritage preservation domain, including conservators, monument owners, academics, and other. Currently, no integrated knowledge about monument damage is available to the stakeholders in the domain. Thus, the project focuses on:

- documentation of damages and failures of cultural heritage objects,
- analysis of dependencies between failures and their causes,
- damage mitigation measures and intervention plans,
- risk factors of failure occurrence and their prevention.

1.2 Basic Facts

MONDIS is a 5-year project funded in years 2011-2015 by the Ministry of Culture of the Czech Republic with budget over 20 mil. CZK. The project consortium consists of two partners

FEE Faculty of Electrical Engineering, Czech Technical University in Prague, responsible for designing the IT stack based on requirements formulated by ITAM.

ITAM Institute of Theoretical and Applied Mechanics, Academy of Sciences of the Czech Republic, responsible for defining business cases, developing terminological knowledge and testing developed tools.

Details about the MONDIS project are already publicly available at the project web site[1].

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[1] http://www.mondis.cz, cit. 18.6.2014

2 MONDIS Information System

The IT platform developed within the project is depicted in Fig.1. The knowledge structure managed by the project IT stack is defined in the Monument Damage Ontology [1]. To efficiently create the representative damage records for ontology developement, we designed OntoMind [2], an ontology-driven mindmapping tool.

In the core of the platform is the MONDIS server that provides various web services for other components of the system as well as access to the data in the OWLIM semantic repository. MONDIS Mobile is a mobile application for creating damage records according to various damage record templates. MONDIS web application serves for visualization, management and approval of the damage records. Its component for semantic comparison of different damage cases is currently under development. Terminology Editor is used to manage the terminology in the monument damage domain and to extend the Monument Damage Ontology. The relationships between different characteristics of the domain terms are visualized by means of the knowledge matrix tool.
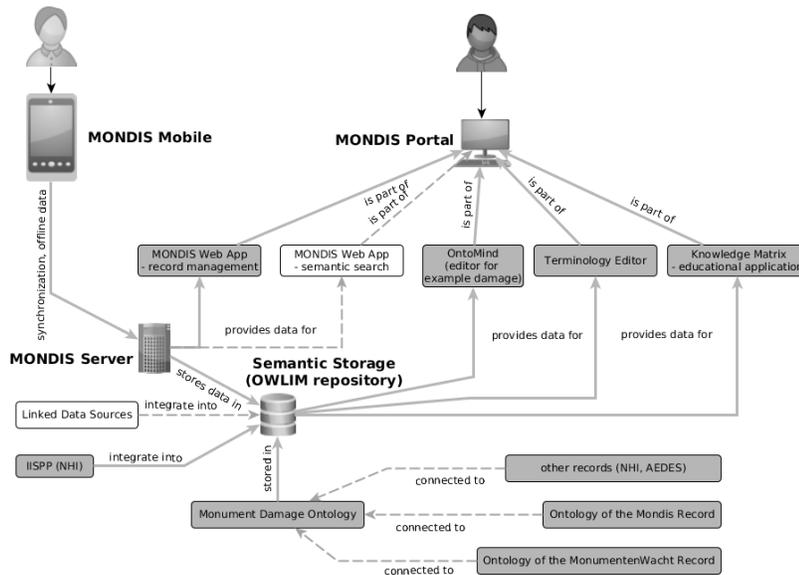

Fig. 1. MONDIS system. White boxes/dashed lines show modules under development.

2.1 Monument Damage Ontology

Monument Damage Ontology (MDO) is a domain OWL 2 ontology [3]. The ontology describes Cultural Heritage objects together with their components

and used materials. For each component its damages are represented together with damage mechanisms and agents. Damages are connected to interventions used for repairing the damage. The aim of the monument damage ontology is to cover the most important relationships in the domain together with deep concept taxonomies (e.g. materials, components, interventions) for contextual search in the MONDIS tools. See http://www.mondis.cz/en/web/portal/tools for more details.

2.2 OntoMind

Ontomind is an ontology-driven mind-mapping tool used to create mind maps with the guidance of an OWL 2 Ontology. The tool itself is domain-independent – the domain knowledge is represented purely by the ontology. During mind map creation, the user is offered ontological classes/properties according to the current context to annotate the current mind map concept ontologically. Mind maps created by the tool are exported in the form of OWL ontologies to the OWLIM storage. See http://www.mondis.cz/en/web/portal/ontomind for more details.

2.3 MONDIS Mobile and MONDIS Web Application

MONDIS Mobile is an Android/IOS mobile application for creating monument damage records on site. There are implemented several methodologies for monument damage description (Mondis Record, MonumentenWacht card [2], and other, see Fig. 1). The records can be spatially identified by PaGIS points[3], address or GPS position. Each record consists of a tree-shaped structure of various criteria. Each criterion can be classified (e.g. *Roof Damage Extent* criterion with level *Large*), as well as equipped with textual description and photo documentation.

The records created by MONDIS Mobile are sent to the MONDIS Server and stored within the semantic repository. Each record can be viewed by means of the MONDIS Web Application that allows to review the record, modify it and approve it for publication. The published records are available using MONDIS web site at http://www.mondis.cz/en/web/portal/mondis-explorer.

2.4 Terminology Editor

Terminology editor is a tool for management of domain terminology and taxonomies. While the core ontological structure of the Monument Damage Ontology is fixed, the terminological editor allows creating and annotating the taxonomies and refine existing terminology to support multilinguality, term definitions, or term photodocumentation.

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[2] see Art Nouveau training materials at http://www.artnouveau-net.eu, cit. 19.6.2014
[3] http://gis.up.npu.cz/, cit. 19.6.2014

2.5 Knowledge Matrix

Knowledge Matrix is a web application that allows the user to investigate and comprehend relationships among selected concepts of targeted OWL 2 ontology. It deals both with particular existing as well as possibly existing relationships. The visible part of the application is a web component representing a tabular view on the relationships. It represents a matrix with specific concepts assigned to each of its two dimensions that represent navigable taxonomies. Selection of a concept in the hierarchy results in filtering the content of matrix cells.

One of MONDIS scenarios aims at investigation of possible interventions associated with a manifestation of damage with respect to various mechanisms (e.g. corrosion), and agents (e.g. humidity) activating the respective mechanism. For details see http://www.mondis.cz/en/web/portal/knowledge-matrix.

3 Conclusions

Within the MONDIS project, unique cooperation between IT specialists and domain experts is mediated. The gained experience showed us the necessity to use agile ontology and SW development techniques. By now, one and half year before the end of the project, prototypes of most of the software stack components were released. Besides MDO, Mondis Mobile/Server stack presents one of the most promising result. Currently, possible commercial deployment is discussed with two european monument preservation organizations.

Yet, some goals are still to be completed within the remaining part of the project. First, transformation between damage records made by the mobile application according to different methodologies and the MDO is required. Second, semantic search in the damage records is to be done. Third, testing of the current software stack on the real-world examples of monument damages is necessary.

References

1. Blaško, M., Cacciotti, R., Křemen, P., Kouba, Z.: Monument Damage Ontology. In: Ioannides, M., Fritsch, D., Leissner, J., Davies, R., Remondino, F., Caffo, R. (eds.) Progress in Cultural Heritage Preservation, Lecture Notes in Computer Science, vol. 7616, pp. 221–230. Springer Berlin Heidelberg (2012)
2. Křemen, P., Mička, P., Blaško, M., Šmíd, M.: Ontology-driven Mindmapping. In: Proceedings of the 8th International Conference on Semantic Systems. pp. 125–132. I-SEMANTICS '12, ACM, New York, NY, USA (2012), http://doi.acm.org/10.1145/2362499.2362517
3. Motik, B., Parsia, B., Patel-Schneider, P.F.: OWL 2 Web Ontology Language Structural Specification and Functional-Style Syntax. W3C recommendation, W3C (Oct 2009), http://www.w3.org/TR/2009/REC-owl2-syntax-20091027/