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Beyond the Standards: Combine Different Metadata Schemas for a Versatile Museum Repository Development

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Abstract. As cultural heritage evolves in the digital age, museums face three primary objectives. Firstly, they must revise their collection management philosophy to include the new possibilities that derive from the technological progress[1]. Secondly, they must integrate data infrastructures and schemas that are user-friendly for museum staff and researchers alike [2]. Thirdly, they must start thinking of collaborative ways of managing their data, something that will add informational value to their artefacts, as well as, contribute to saving costs and time. To achieve these goals, a well-defined metadata structure for curating cultural content is essential. Implementing an ontology-based metadata policy is crucial for museums aiming to enhance digital access to their collections strategically[3]. Additionally, it's vital to test the sustainability of proposed metadata schemas in practical applications, ensuring they effectively describe artefacts or collections [4]. Subsequently, the need strives towards the selection of multi-functional and flexible repositories platforms providing poly-semantic documentation of artefacts.

In this paper, we propose and implement a holistic ontology-based metadata grid combining descriptive, reputation, conservation, and indoor navigation fields for a full documentation of artefacts and collections. One step further, the proposed metadata schema is adopted and implemented in Reasonable Graph. A platform capable of enhancing semantic intercorrelation between artefacts and collections using a diversity of thematic entities, such as geographical locations, historical periods, persons, events, and ethnographical labelling. The versatile folklore collections of Museum of Modern Greek Culture in Athens are used as testbed to assess the proposed schema and platform practicability to describe and semantically correlate the available artefacts.

To this end, the paper generally contributes to the understanding of the evolving challenges faced by museums in the digital age by proposing solutions to address these challenges and highlighting how an ontology-based schema gives a dynamic perspective on metadata management.

Keywords: Ontologies, Cultural heritage, Digital repositories, Metadata, Interoperability, Open Science

1 Introduction

Cultural heritage is a crucial field in implementing new technologies. As societies are gradually transforming their infrastructures into digital ones, cultural institutions investigate and develop their own ways to follow this trend. Especially, museums are facing the challenge of becoming more functional, more visible, more cooperative and more attractive to their visitors by incorporating digital technologies into their daily routines, not only as individual applications but also as a holistic approach to operation [5].

Considering the specific needs of managing, documenting, preserving and exhibiting objects of cultural heritage, we introduce some of the basic features of the Reasonable Graph repository platform, as a single tool for managing and presenting metadata related to cultural objects at any stage of their processing. An ontology-based approach for cultural collection management is proposed as the conceptual model of this project.

The ReasonableGraph platform has already been installed and is fully functional in many Greek institutions, which manage digital collections, however, in this context, we focus on a new innovative digital space that has been developed and prototyped for the Museum of Modern Greek Culture (MNEP) in Athens, as a case-study for the project MELTOPENLAB.

2 Research Project MeltOpenLab: case-study “Museum of Modern Greek Culture (MNEP) in Athens”

The MELTOPENLAB [6] (Museum Experience with Location Tracking Ontologies and Open Laboratories) project, addresses the aforementioned issues in a holistic manner, by developing and pilot-operating an advanced and cost-effective integrated information system for exhibition facilities, such as Museums, Multi-Cultural spaces, and Open Labs. On one hand, the project focuses on the digital documentation of exhibits/objects of modern cultural heritage and methods of their restoration/conservation and presentation. On the other hand, the project focuses on developing an advanced information system for capturing visitor movement in near real-time (in both eponymous and anonymous mode) and analyzing collected data. The system is designed in a cost-effective approach, i.e., employing technologies that are both available and energy-efficient, and is used as a platform, upon which innovative applications provide a personalized presentation and learning/entertainment experience, record and evaluate visitor interest, behavior, and satisfaction.

The Information System and Applications that have been developed and prototyped, are pilot-applied to the artefacts and exhibition collections spaces and archival material, documentation/maintenance/restoration procedures in selected exhibits (simple and complex concepts) of the Museum of Modern Greek Culture (MNEP) in Athens[7], Greece. MNEP is the only public museum dealing with the tangible and intangible modern Greek cultural heritage. For more than 100 years, it has been rescuing, studying, and highlighting everyday life and ritual symbols and objects, information on morals and customs, traditional arts, and techniques, which make up the modern Greek reality. Introducing new technologies in order to support its operation, MNEP aims to be transformed from a space of stored cultural memory and presentation, to a space of active knowledge and experience for the visitors, providing, at the same time, to the employees new tools for managing the collections.

The project currently performs Pilot Operations, validating functionalities and evaluating tools and applications for visitors and museum administrators. Preliminary results are analyzed and documented.

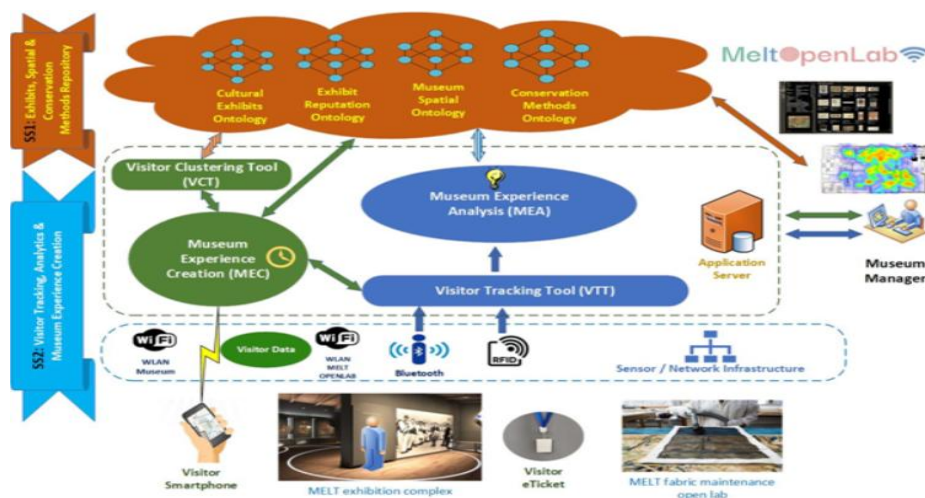


Fig. 1. Operational Architecture of High Level MeltOpenLab

3 ReasonableGraph platform

The ReasonableGraph platform (RG) is an open-source information system for managing physical and digital collections and their metadata, using ontologies and semantic schemas. RG is based on widespread open-source software technologies (Linux, PHP, PostgreSQL, Apache, Laravel, Drupal, SOLR, Nodejs). Inherently manages ontologies, specified on a scientific field or based on prototypes (e.g. FRBR-FRAD-

FRSAD/FRBR LRM, BIB-FRAME, FRBR-OO, etc), and also, offers the ability for the management of an organization collection directly as a semantic and linked open data set. In parallel, it supports cataloguing, archiving, and documenting for many different types of physical or digital items (such as books, journals, newspapers, correspondence, posters, 3D-objects, etc.) and formats (such as pdf, epub, images, wav, mp3, mp4, etc.).

The representation of the data inside the system is modeled as a graph. This graph represents a dynamic and interconnected set of data which is constantly enriched and extended while the user adds information, using the suitable data form according to the material type that he/she describes. These digital forms are either standardized or can be customized by the user to satisfy special needs. At the front edge, the external users can easily navigate or search the platform in order to explore its content.

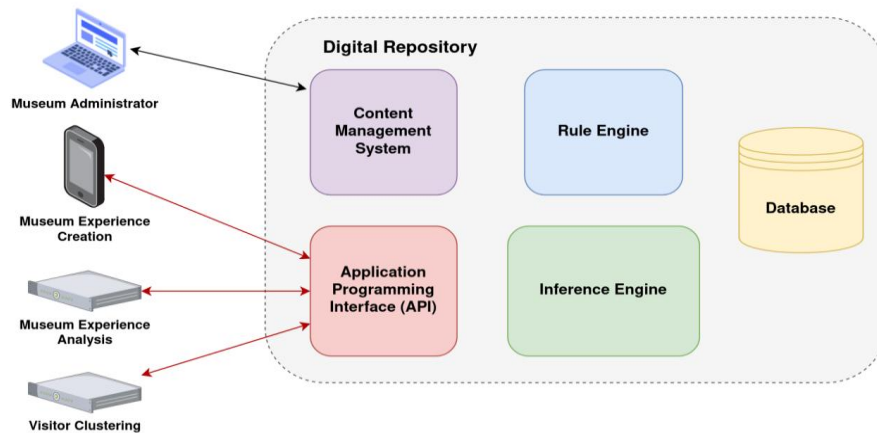


Fig. 2. RG System architecture for MNEP

4 MeltOpenLab Repository

The information system that has been developed for the Museum of Modern Greek Culture through the MeltOpenLab project, is called MeltOpenLab Repository. ReasonableGraph platform provides the digital environment for implementing the project, while it supports the creation of the proposed ontology.



Fig. 3. MeltOpenLab Repository – Main Page

4.1 Ontology of Cultural Exhibits

The operational role of the ontologies is to determine the specific conceptual context in which the museum's objects documentation is taking place [9]. Ontologies, although locally developed, should be consistent with interoperability standards in order to ensure semantic communication with other systems.

In MeltOpenLab Repository has been developed a core ontology of cultural exhibits (CEO), divided into four individual ones from different scientific fields (museology, ethnology, conservation etc):

- **Semantic Description Ontology (SDO):** hosted in the MeltOpenLab Repository in which the cultural objects of the museum are organized semantically, the SDO proposed by MELTOPENLAB combines different metadata standards for artefact documentation. It is structured on five basic elements: geographical space, historical period, historical person, historical event and ethnological determination.
- **Museum Spatial Ontology (MSO):** floor plans with exhibit allocation and coverage areas (cells) of installed sensors in the museum spaces, are integrated into the MeltOpenLab Repository overall system, providing support to both MEC (visitor experience) and MEA (visitor statistics) services. The ontology represents the building structure of the museum and the relations between its parts, starting with the separation in buildings and ending at the showcases, where the objects are located.
- **Exhibits Reputation Ontology (ERO):** hosted in the MeltOpenLab Repository in which visitors' ratings of exhibits provided during physical visits, as well as metrics/indicators evaluating their popularity based on visitor behavior, are accumulated.
- **Conservation Methods Ontology (CMO):** hosted in the MeltOpenLab Repository, complements CEO, providing documentation on methods used for conservation / preservation and restoration of artefacts. The ontology was developed in collaboration with the employees of the related department of MNEP. Part of it is physically demonstrated in the Open Lab implemented in the context of the project, in MNEP premises.

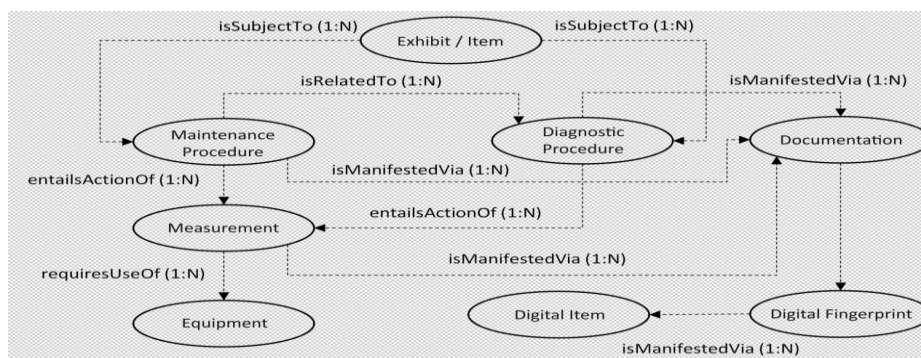


Fig. 4. Conservation Methods Ontology (CMO)

The entities of these ontologies belong to widespread international standards, such as FRBR[10], Core Categories for Visual Resources Association (VRA)[11], CIDOC-CRM[12], OntoNav and iLOC. The semantic interoperability between MeltOpenLabRepository and other systems has been ensured by following these standards.

Taking into consideration that MNEP already had an existing repository platform (MuseumPlus), a process of data migration had to be performed. Transferring the data from the old system to the new one, the developed ontology was applied on the process. Furthermore, the system, as well as the ontology, is designed to accept data entries by humans, in an easy and friendly way, without requiring specialized experience.

The basic structure of the proposed ontology along with its sub-ontologies appears in Figure 5.

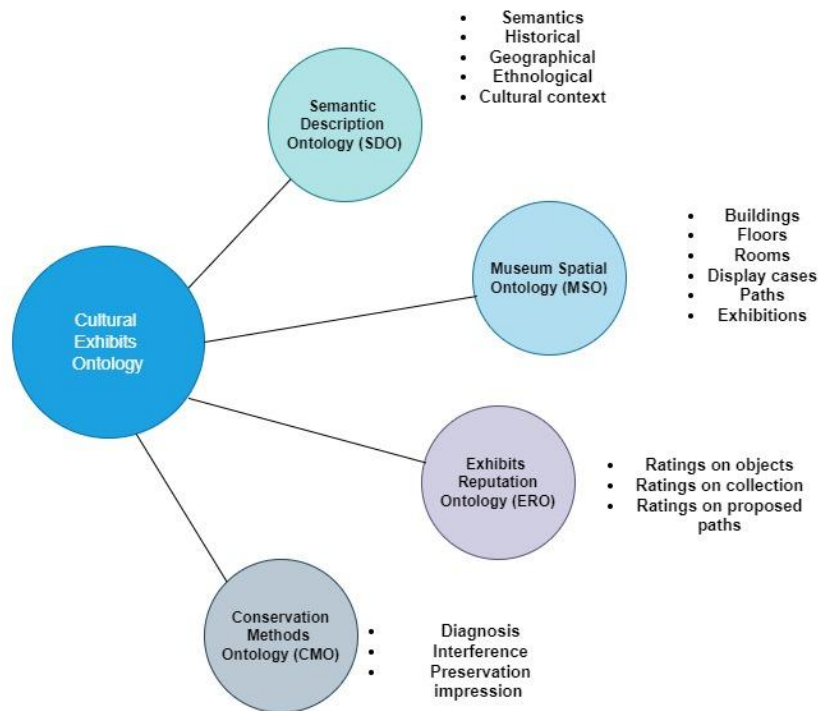


Fig. 5. Proposed Ontology for MNEP

RG platform provides the mechanism to combine all the above ontologies in order to document every cultural object in the museum’s collections. Each specific ontology reflects a different view of a cultural object: its descriptive information along with its scientific data, its location, the opinion of the visitors about it and its conservation/preservation status. Scientists from different fields could use that information for their specific needs. Developing extra sub-ontologies, even more aspects of a cultural object could emerge. In that way, the whole infrastructure has, a dynamic perspective in managing cultural objects.

In addition, the graph-based structure of the system contributes to giving prominence to the relations among the information data, which results in an augmented informational value of the collections. Inter-connected informational data can be realized both on an internal level of the system and on an external level. The objects of the museum communicate among themselves by having many descriptive entities in common, such as type, place of origin, showcase, or the same rating, but they also can be connected to entities, existing outside of the museum, using the technologies of linked data and opened data.

Another important feature of the ontology-based application is that it allows and also supports the collaboration of scientists who are involved in managing a cultural collection. They can all have access to the same information about objects, and document or comment on them, according to their work. For example, they would all be informed about when an object is in its showcase or has been moved for conservation reasons. Moreover, they can know who has added a specific kind of information which is ambiguous or incorrect. They can, also, combine the information to create new one, as in the case that they want to define new visitor paths in the museum.

These features resulted as an implementation of an ontology-oriented approach to cultural collection management. One step beyond, this approach could be expanded to support a network of cultural institutions, that are sharing the same technical infrastructure, ReasonableGraph platform in this case. Developing ontologies in common, cultural institutions around similar scientific areas, could work collaboratively to manage their collections and add informational value to their content.

5 Conclusion

Semantics, in the field of cultural heritage, as expressed through ontologies, have a very strong impact [13]. Cultural objects carry of huge amount of information during their long route in time and a plain descriptive recording of their characteristics does not meet the interests, not only of museum visitors, but also of the museum staff. The cultural objects should be interpreted alongside with their relation to other objects inside a semantic context that gives them the opportunity to export all their informational content. Cultural institutions should advance their management perspectives, aiming to succeed all the above by introducing new technologies that support this holistic approach of operation.

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