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Exploring the Visualization of Concepts, Objects, Places, Time and Activities

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Abstract

The present study aims at exploring the possible ways of achieving correlated informational types that interlock and compile mind maps interconnecting people, places, time, objects, texts, documents, techniques and activities. Ontologies, geospatial attributes, vocabularies, description standards and linked data are part of this trial. As the core concept of the experiment the plant decoration of prehistoric vases was chosen.

Whilst the theoretical framework of the study lays upon the information standards and the role of semantics in managing knowledge, the study also looks at the reinterpretations of users, and their needs for information with wholeness and expanding mechanisms. Furthermore, the persistence of the core concept is regarded as its continuous life in time and space. The example of the plant decoration has its roots in archaeological findings and incorporates several scientific aspects (art, botany, history, archaeology, geography, geology, chemistry) and it is used here as a tester for exploring the informational capability of mind maps within the digital environment.

Methodology follows the systematic review paradigm and includes the development of a protocol for the following elements: protocol for the inclusion of different types of entities. Protocol for the ways of standard use and expansion, in this case CIDOC CRM augmented by TNG and AAT vocabularies. Protocol for the description of entities within the ontological framework and finally a set of rules for the selection of vocabularies and authority tools.

Literature search will be conducted grouped in units to the corresponding protocols and likewise research results will be tested per protocol.

CCS Concepts

• Human-centered computing • Visualization

Keywords: Metadata, Description standards, Controlled vocabularies, Information science

1.1 Framework of the study

The way we perceive cultural information today, or for that matter information in general, tends to come in whole units within context, not differentiating its place of storage such library, archives or museums, information centers or governmental organizations, art places or street art. Furthermore, we do not like barriers in its form or substrate, medium of dissemination or even making the distinction between tangible and intangible. All we look now for is the wholeness of information and the possibilities of building upon it in order to create more information and knowledge. Technology has been investing on replicating human mind's correlational capabilities and AI has focused on semantics as the means of achieving it.

Key role has been played by standards as they were the vehicle through which interoperability and codification could be implemented. Description standards traditionally in libraries, archives and museums as well as other information organizations have been pioneering in connecting described items and their counterparts. Whilst description standards such as Dublin Core (DCMI, 2020 https://www.dublincore.org/specifications/dublin-core/) connected items through relations (Relation http://purl.org/dc/terms/relation) CIDOC CRM was the first standard that actually changed the data structure by implementing a formal ontology, and emphasized the integration of data from multiple sources in a software and in an agnostic fashion schema. (CIDOC CRM, 2020 http://www.cidoc-crm.org/).

1.2 Scope, aims and definitions

The present study is focusing on exploring the possible ways of achieving the correlation of diverse informational types that can interlock forming rich informational units including concepts, people, places, time, objects, texts, documents, techniques and activities. The main system studied here is an ontology of the concept of plant decoration whilst each one of the forming entities are looked at as subsystems of the ontology. Within this framework the study explores how these correlations endure or disjoint themselves from the main concept within time and space. CIDOC CRM offers a great tool for the representation of these correlations and in this study, which builds upon CIDOC CRM the emphasis is on achieving the grouping of information in concrete units. It also aims at studying the visualization of the endurance of concepts through time and their manifestations in different places.

The structure of an ontology in the OWL-Protégé environment includes mainly:
Classes which are defined as: categories of specific items of the same type
Individuals defined as: specific items, which are members of one or more classes
Object properties defined as: relations between individuals of the same or different classes
Datatype properties: Properties or characteristics of individuals belonging to one or more classes

Plant decoration was the core concept of the experiment. For the purposes of this study plant decoration is defined as the depiction of plant motifs (foliation, flower and tree) on all art forms and techniques (such as ceramics, frescoes, sculpture, embroidery, seal rings and moldings) that can be found across different eras and places. For the purposes of this ontology place is considered to be confined within the Mediterranean basin whilst there is not time restriction. Quite the contrary, an effort was made to follow the motifs and their transformations in time and art form.

2 Methodology

A Literature search was conducted focusing initially on CIDOC CRM and its theoretical framework and works published on its implementation and design. In addition, the concepts of presenting time and spatial information and relevant standards, ontologies and thesauri were also taken into account.

In forming the ontology the protégé 4.3 software was used, which allowed us to move around elements, combine properties and connect to external sources, create link data and attach documents, images and other items. To construct the ontology and its parameters the methodology of the systematic review paradigm [1] or middle range theory was followed. The systematic review allowed us to study the ontology as a closed system with its own parameters and focus on the development of relevant protocols for its functioning.

It should be noted that systematic review or middle range theory [2] was also used by anthropologists who placed the study of artefacts within time, space and cultural context [3]. The use of a common methodology for both the cultural and informational study allowed us to crosscheck the construction of the ontology. Furthermore, the process has guided us to develop guidelines and procedures for developing protocols for the incorporation within the ontology for the following elements: protocol for the inclusion of different types of entities. Protocol for the ways of standard use and expansion, in this case CIDOC CRM augmented by TGN, AAT vocabularies and verified historical periods from the PeriodO data source. Protocol for the description of entities within the ontological framework and finally a set of rules for the selection of vocabularies and authority tools.

3Plant Decoration Ontology

The basic idea behind the organization of this ontology is the presentation of the 'substantiation' of concepts within space and time through the study of the continuity of cultural concepts in the form of various materialized instances. CIDOC CRM has produced a tool and a paradigm in configuring events as time instances [4]. Combining places, time and concepts was the step taken in this study.

We selected as working context, the plant decorations, which have been used as cultural expressions in many historical phases of the human civilization, spread in a plethora of places. In order to be able to follow exact motifs and their transformations and / or replications acrosstime periods and places within the Mediterranean basin, the "palm tree" decoration motif was chosen. Palm tree depictions are easily recognizable in diverse art forms as their shape and greenery is very indicative. Furthermore, it is a decorative motif that manifests itself throughout human history.

A series of artefacts were allocated and documented and these were the core individuals of the ontology. Their descriptive elements and informational carriers were the key concepts that guided us in forming the entities of the ontology. It has to be noted that in order to locate and gather information about the cultural artifacts, organize and structure the ontology, an interdisciplinary cooperation involving a computer scientist, an information scientist and an archaeologist/ museologist took place. Artefacts were tabulated and motifs were identified and verified in terms of particular designs. Materials, techniques, styles and artists were also recorded. Hosting museums and cultural institutions, relevant links and images were allocated and incorporated as well.

In this frame we designed and implemented an hierarchical ontological scheme, where we included conceptual elements on the one hand and spatio-temporal elements on the other hand.

Technically speaking, the main (first level) classes of the ontology are the 'Conceptual object' (type: E28 Conceptual objects), the 'Place' elements (type: E53Place) and the 'Time' element (type: E4 Time). 'Conceptual object' class includes 'Design elements' class, which includes 'Motifs' class, which is subdivided into 'Flower patterns' class, 'Foliation patterns' class and "Tree patterns" class. The latter contains the subclass for our ontology "Palm tree motif". 'Conceptual object' class includes also 'Actors' class (type: E39 actor) with the creators of the artifacts (conceptual objects). 'Actors' class is subdivided into 'Decorative painters', potters, Painters and 'Embroiderers' class. It also includes "Activity (type: E7 Activity) with the actual activities taking place for the creation of the artefact. "Activity" is subdivided into Painting, Embroidery, Mosaic making and Pottery. 'Place' class is subdivided into geographic areas: 'Aegean' class, Ravenna, Euboia and 'Crete' class, an indication of the places where the motifs of plant decoration were found through time in a variety of artefact manifestations such as pottery work, mosaics, embroidered works and modern painting. The above mentioned geographic places contain subclasses such as Eretria as a subclass of Euboia, etc. 'Time' class is subdivided indicatively into "Early Minoan" class, "Classical period" class, "6th century" class and "20th century" class. Then we inserted specific individuals in the actors' classes and the motifs classes adding within the ontology system the exact objects manifesting plant decoration within time and space.

Lastly we defined the heart of the ontology, the object properties namely the relations between individuals. The defined relations are: ‘creates’ (a certain creator who creates a certain artifact), ‘is taking place at’ (a certain artifact is met in a certain place) and ‘it occurred’ (a certain artifact has been created in a certain temporal unit).

Apart from the object properties (relations), we have also defined datatype properties (properties) concerning the individuals of certain classes. For example, ‘image’ consists of the actual image of the object and “url” of the url where the conceptual object can be found.

For the creation of the ontology the software “protégé 4.3” (https://protege.stanford.edu/) was used. Diagrams were produced by the same software. Ontology guidelines and parameters were followed.

The following diagram presents the concept of “plant decoration” ontology:

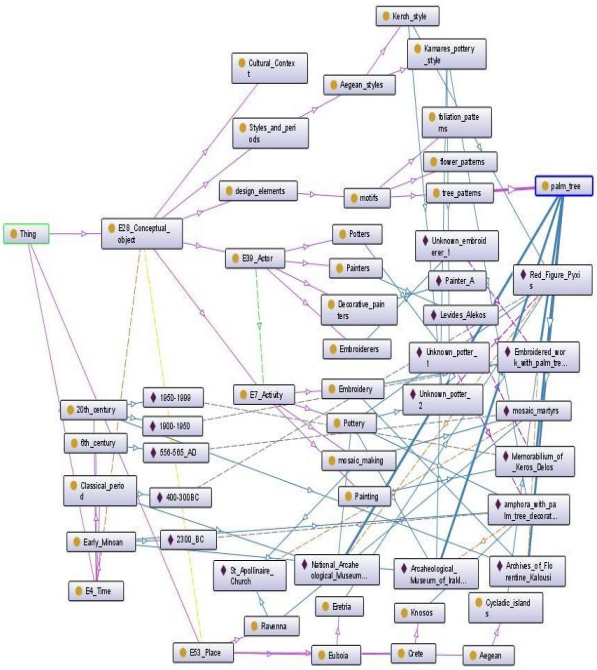

Figure 1: Diagram of plant decoration ontology

Conceptual object is unfolding into design elements and motifs, yet having as subclasses foliation patterns, flower patterns and tree patterns reaching the lower level of palm tree patterns. From “palm tree motif” subclass a series of relevant individuals depicting palm tree motifs deriving from a variety of activities such as painting, mosaic making, pottery and embroidery and created by different actors are drawn.

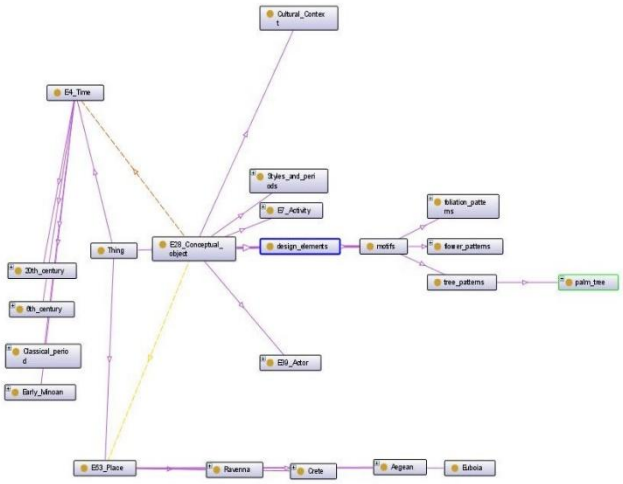

Figure 2: Diagram of palm tree motif through time and space instances

Figure 2 presents the axes of time and space and how the conceptual object, relates to these two elements. Namely, palm tree motif can be found across time and spaces and Figure 2 offers us a visualization of how the specific plant decoration element endures through time and travels through space.

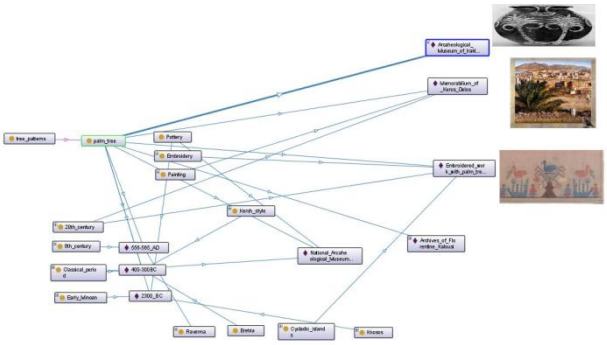

Figure 3: Diagram of palm tree motif with individuals

Figure 3 presents the "palm tree motif" subclass within time and place along with the correlated individuals (i.e. the artefacts) entered in the ontology structure as "images" data property. Data properties also include urls, thus creating linked data.

In working with the ontology, the need for standardization and compatibility with relevant works was of essence. As a result the following protocols were defined:

A. for the inclusion of entities CIDOC CRM [5] was used as the master standard and all included classes of the first level have the corresponding number of CIDOC CRM. Attributes and CIDOC guidelines were followed. Same holds for the object properties.

B. In using standardized terminology was also of essence for achieving interoperability and compatibility with cultural institutions. The need for using scientific terminology was also of essence. Hence, the need for the use of controlled vocabularies was essential. Terminology was verified against AAT Vocabulary [6] and the relevant uris provided through the "semantic view" were assigned to each class entry. This secured interoperability.

C. Same holds for Geographic Place names where the Getty TGN online [7] tool was used. The same procedure of assigning the allocated uris secured not only interoperability but also the completeness of the geographic name entry as it provided complete geospatial information and procured valid name authority as well.

D. Historical periods and their use were also verified against Periodo Data Source tool [8]. This secured standardized use of the historical term and again compatibility.

E. In the case of names of physical persons the name authorities of the Greek National Library were used.
G. Regarding the specific ways and forms of entering names and or titles of ontology "individuals" the RDA guidelines were used.

4 Conclusion

The concept of "plant decoration" along with its subclasses, properties and ontological individuals have been presented here as materialized instances within space and time. The graphs are presenting the endurance of the concept in time and its manifestations in different places. The identification of specific design (palm tree motif) in a variety of artefacts as products of diverse cultural activities are depicted and correlated offering a portrayal of how concepts can be intertemporal and interspatial. The paradigm presented in this study can be used for the representation of a variety of concepts in art and be a tool for the study of the transmission and correspondences of cultural notions and cultural information. Manifestations of specific concepts and/ or notions can be visualized and be followed as trans temporal and trans spatial information carriers.

This work can be also used as a paradigm for cooperation between humanities and computational semantics, since there are a lot of available techniques that can enrich the information research and retrieval in

digital humanities repositories, leading to the emergence of 'hidden' treasures in contexts not studied and exploited yet.

Furthermore, in building the ontology an interdisciplinary collaboration took place and in assessing the outcome of the study, this was also of importance: not only the cooperation across disciplines was of importance, but also the communication mechanisms that lead to the implementation of a tool that can be used for facilitating digital humanities' projects.

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