

Exploring iconographical and iconological content in semantic data through art historians' interpretations

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ABSTRACT

Iconology and Iconography are branches of art history studies which focus on the recognition and interpretation of the subject matter represented in visual artworks and of the deeper meanings eventually conveyed. Due to its complex and interpretative nature, iconographical and iconological knowledge is usually recorded in catalogue entries in free text fields according to cataloguing standards (e.g. CDWA), making information retrieval challenging. Nevertheless, having such curated data described with the accuracy and flexibility offered by ontologies would allow us not only to newly explore the art history scholarly discourse through quantitative analysis but also to enable a new way to access cultural heritage objects described in the network of Linked Open Data (LOD) through the narratives of experts' interpretations. The current study aims at filling this gap by presenting an RDF dataset on iconographical and iconological interpretations, extracted from the art historian's Erwin Panofsky references and represented according to standards and a new domain ontology. We also present a quantitative analysis and a browsing interface to show the potential of applications for information retrieval and user-centric exploration of curated, domain-specific data.

KEYWORDS

Data exploration, dynamic digital collections, iconography, iconology, art history, art interpretation, Linked Open Data

1. INTRODUCTION AND MOTIVATION

Ontologies are a means for expressing complex semantic relations between objects and creating highly detailed, interconnected digital collections. Therefore, they are a feasible tool for the representation of art historical information about artworks, which often deal with complex information and with art experts' interpretations. In particular, iconographical and iconological content, which concerns the description and interpretation of the subject matter, is characterised by great complexity. In fact, it relates 1) the subjects depicted in a single artwork among each other (e.g. the action of Time who lifts the personification of the Truth), to formal characteristics (e.g. style, perspective), and/or to deeper meanings, 2) the depicted scene to external sources, such as mythological stories or other artworks, 3) the subject with its representative variations of form or meaning over time and place, and 4) the relationship with the context (e.g. religious or cultural practices of the time the artwork was created)[1]. All of these aspects are prone to a degree of subjectivity in the interpretation. Due to its complex nature, iconographical and iconological knowledge in catalogue entries is usually expressed in free text fields according to standards¹, making thematic information retrieval challenging. Nevertheless, having such curated data described with the accuracy and flexibility offered by ontologies would allow us not only to newly explore the art history scholarly discourse through quantitative analysis but also to furnish a new way to access cultural heritage objects described in the network of Linked Open Data (LOD) through the narratives of experts' interpretations. Our research questions can be expressed as follows:

- How can an ontological modelling of iconographical and iconological interpretations represent the domain features to foster the access, analysis and retrieval of iconographical and iconological content?
- What would be the advantages for users of browsing a semantic network of iconographical and iconological interpretations?

To answer these questions, we focused on a case study of a selection of interpretations made by the art historian Erwin Panofsky. Panofsky was chosen as he is a reference point for the theorization of the iconographical and iconological

¹ See CDWA' guidelines for subject matter at https://www.getty.edu/research/publications/electronic_publications/cdwa/18subject.html

interpretation act [10]. Hence, an ontology (ICON²)[20] based on his theory [16] was created, according to which a corpus of interpretations manually extracted from a selection of his books [14, 15, 16, 17] was described in compliance with the RDF standards³. Finally, a web application⁴ presenting an Exploratory Data Analysis and a thematic gallery of artworks was realised.

2. THEORETICAL BACKGROUND

Whereas the term iconography refers to that branch of art history studying the artworks subjects (i.e. iconographies), their attributes, meaning and evolution over time, the current meaning of the term iconology has its roots in the research activity of Aby Warburg [11, 22]. His approach considered the content and forms of the artworks as witnesses of social memory, conducting his analysis in an interdisciplinary way to include religion, culture, and the recurrence of visual patterns through different ages [19, 22]. The first holistic attempt of defining a theory of the iconographical and iconological method was made the Warburg's scholar Erwin Panofsky [11], which remains nowadays a reference point⁵. We refer to [1] for a comparison of Panofsky's theory to the theoretical attempts made by other art historians about the subdivision into levels of the interpretation act.

According to Panofsky, there are different types of meaning that can be interpreted in an artwork, subdivided into three layers. The depth to which the artwork can be understood depends on the background knowledge of the observer, going from a more superficial understanding to a deeper, cultural-related one. In the first level (Pre-iconographical description) natural elements (people, objects, actions) and expressional qualities (emotions) are identified. If the observer has sufficient background knowledge about the subject types and themes that may be represented in the period considered, then he can interpret them as second-level subjects (e.g. a woman is recognised as Venus). Finally, if he/she is aware of the sociocultural context or artist's personality, he can recognise symptoms of such topics in the artwork under examination [16].

3. STATE OF THE ART

Currently, several ontologies, vocabularies and knowledge graphs describing art-related topics are available. Among them, CIDOC-crm is the standard for describing cultural heritage (CH) objects [6]. Since it doesn't address domain-specific modelling, it has been expanded by VIR ontology to include iconographical content, the act of interpretation and additional information about it [3]. A first attempt to extend VIR in order to include iconological interpretations has been conducted by [1]. Other related ontologies are HiCO⁶, allowing express interpretation acts in relation to their context, and Simulation ontology [21], which concerns the description of symbols and their symbolic meanings. Besides ontologies, fundamental for expressing complex relations, controlled vocabularies are essential tools for information retrieval. Getty Vocabularies⁷ (in particular AAT and IA) and Iconclass⁸ provide identifiers for expressing iconographical subjects and terms for describing what is represented by an artwork. The Warburg Institute Iconographic Database is the online resource providing the most complete corpus of images related to the discipline. Although it follows an iconographic index, the categories designed by the historian to classify images often result in blurred groupings that are difficult to understand or replicate without knowing the underlying iconological studies on which they are based.

Among available Knowledge Graphs (KGs), artwork subject matter description is afforded both by domain-specific and generic datasets. [2] Provides an overview of the extent to which iconographical and iconological content is available in RDF datasets accessible through an online SPARQL endpoint, showing that this content is generally poorly represented and limited to a generic subject identification. Another domain KG not included in the study, ArtGraph⁹[4], is in line with the study results. It's also worth mentioning HyperReal[20], a KG expressing an encyclopedic knowledge about symbols and the corresponding symbolical meaning in specific contexts.

The semantic access to online cultural heritage data is a central topic for LOD for CH [7, 8]. As emerges from the literature, the idea of exploiting ontologies to query databases is an established practice [12, 13]. The potential of the application to the cultural heritage domain has been underlined by [22].

Some interesting displays for artwork aggregation were considered also by projects applying Computer Vision (CV) to iconography or feature analysis. Pilka [18] proposes an online tool for creating thematic collections automatically generated

² Documentation available at (link hidden to preserve anonymity).

³ RDF data available at (link hidden to preserve anonymity).

⁴ <https://iconology-dataset.streamlit.app/>

⁵ the main cataloguing standards (CDWA, CCO) for subject matter description in cultural objects refer to this theory.

⁶ <https://marilenadaquino.github.io/hico/>

⁷ <https://www.getty.edu/research/tools/vocabularies/>

⁸ <https://iconclass.org/>

⁹ <https://zenodo.org/record/6337958>

on the basis of the user selection¹⁰, whereas [9] clusters artworks' images according to gesture similarities. Due to the lack of data about iconographical and iconological interpretations, browsing and exploratory functionalities of these themes is, to the best of the authors' knowledge, not available.

4. METHODOLOGY

In order to define the characteristics of the domain, a survey of existing theoretical approaches was conducted, and theories were compared[1]. On the basis of that, a preliminary study on the modelling of 11 case studies grouped in a typological selection from Medieval and Renaissance art was conducted [1]. The study showed that the current ontologies lack means for describing accurately both first-level and deeper meanings of interpretation. This motivated the creation of ICON, an ontology for expressing iconographical and iconological interpretations with a high level of granularity, based on Panofsky's theory of the three-levels interpretation act (cf. section 2) and tested on a corpus of the art historian's interpretations.

The data modelling was realised according to standard ontologies (CIDOC-crm¹¹, CiTO¹², PROV-O¹³) and ICON, following the research questions relevant to the domain defined through a generalization of RQ formulated for the 11 case studies analysed in [1]. The art historian's claims were then described manually according to the model, converted to RDF, and aligned to existing sources.

The identified research questions were used as a guideline to perform exploratory data analysis. As a result, thematic groups of RQs were identified according to the aspect under investigation, namely: cultural phenomena, iconographies and their attributes, symbols, citations of visual motifs, citations of evidence on which the interpretation is based, artwork metadata, different interpretations of the same artwork, and interpretations supporting other ones. The analysis aimed at 1) addressing in a quantitative fashion iconological research questions, and 2) characterising the art historian's approach, examining features of his interpretations, namely: the extent to which a) he makes use of textual sources, b) he describes the artworks at all levels of interpretation, and c) verifying if the complexity of connections embedded in an iconological interpretation emerges from data.

The quantitative overview of the RQs results was, in some cases, integrated with a qualitative insight to allow users to better understand the results and use them as the basis for further research.

5. RESULTS

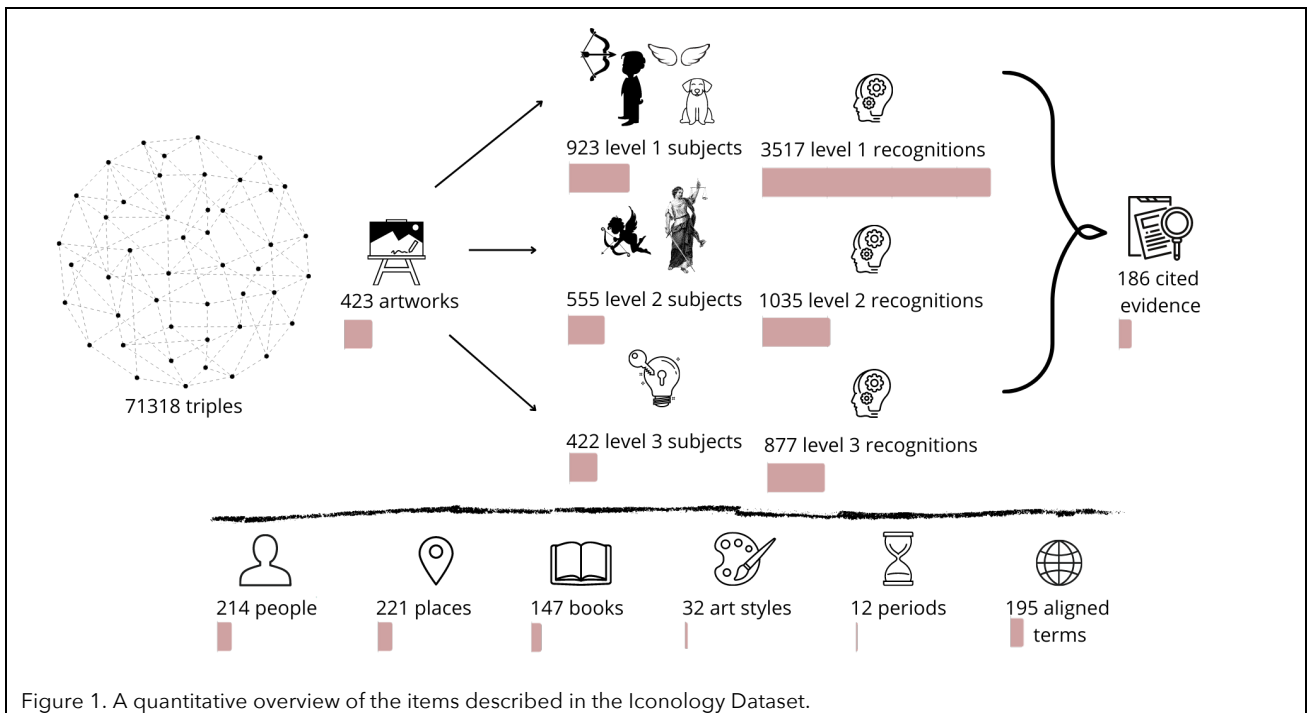
The created dataset contains interpretations about ca. 400 artworks (see Figure 1) mostly from the Middle Ages and Renaissance Western art, mainly interpreted by Panofsky. The interpretations are divided into three levels, from a more superficial understanding to a deeper one, as described by the art historian's theory, and inter-level links among identified subjects are provided. The subject types recorded include natural elements, actions and emotions (level 1), characters, events, places, objects with a specific identity (e.g. the Bible), personifications, symbols, stories and allegories (level 2), concepts, and cultural phenomena (level 3). For each subject identification a provenance of the assertion can be provided, indicating the author, source, and cited evidence, so as to allow the coexistence of multiple (diverging) interpretations.

¹⁰ <https://digitalcurator.art/>

¹¹ <https://www.cidoc-crm.org/>

¹² <https://sparontologies.github.io/cito/current/cito.html>

¹³ <http://www.w3.org/TR/prov-o/>



The data analysis¹⁴ shows that the art historian focuses on the classical themes, as half of the artworks are involved in the cultural phenomenon “*reception of classical antiquity*” and the most frequent level 2 subjects are related to Classical mythology. The most interlinked types of subjects are natural elements, characters, and cultural phenomena. While it was possible to address in a quantitative fashion all the RQs, some of them were only partially addressed due to the lack of data. In detail, diachronic overviews of the evolution of certain subjects showed limited results, since most subjects rarely appear more than once in the dataset and only 68% of artworks described have a date associated.

Unexpected results were retrieved from the analysis of the art historian’s approach. Despite it has been claimed Panofsky’s method highly relies on textual sources, only 27% of his interpretations cite textual evidence. Instead, artworks are the most cited evidence in iconological recognitions, which is also the type of recognition making more use of evidence, in contrast to pre-iconographical and iconographical recognitions, where texts are the most cited sources. In addition, only 9% of recognitions about artworks part of a book (e.g. illuminations) cite the book’s text as evidence.

Only 53% of artworks are described at all levels, while a high number of artworks have only one level described (61 out of 423), i.e. the third level.

The network of iconological recognitions includes links between recognitions supporting each other and artworks cited as evidence, in turn, related to cultural phenomena. The network graph shows the complexity of iconological interpretations and highlights connections between artworks and phenomena that were originally treated in separate books, otherwise difficult to detect without a visual aid.

Access points for browsing are then provided, namely: the variation of iconographies (i.e. from what level 1 subjects is a level 2 subject composed) providing all the artworks showing a certain variation, the comparison between the artworks in which there is a visual motif borrowing and a gallery of artworks that can be filtered according to a selection of subject types in different levels.

6. CONCLUSION AND FUTURE WORK

The presented study provides manually curated domain-specific data based on the authoritative research of the art historian Erwin Panofsky. The data are modelled in the semantic web standard RDF according to ontological standards and a newly created ontology for iconographical and iconological interpretations. As a result, the data provides information about how subjects and meaning are represented in the depicted artworks according to the interpretation, and metadata about the assertion, including evidence, reference, and supportive citations. Therefore, several domain-specific research questions could be answered in a quantitative way. Additionally, information retrieval about iconographies is fostered thanks to their granular description in semantic data and to their linking to controlled vocabularies.

¹⁴ Results and visualisations of the data analysis reported in this section are available at <https://iconology-dataset.streamlit.app/>

The availability of data extracted by the scientific literature of an established art historian fosters the quality of data in the LOD cloud and can be used as a narrative to explore the connected resources in the semantic network. This study is a first case study towards the representation of the scholarly art historian's discourse, currently expressed in natural language in articles and catalogue entries.

Since the dataset includes only the artworks described by the art historian in the selected references, it is not possible to perform a quantitative analysis representative of a certain time period or historical movement. Nevertheless, it can give insights into the art historian's selection and practice. Therefore, future work includes a better alignment with art history KGs representative of the period, such as Zeri&Lode [5], to better study the art historian's personal selection in comparison to the known artworks from a certain period (e.g. Renaissance).

Through the implemented browsing functions, the digital space becomes a dynamic collection of artworks that can be created according to the users' interest in the range of themes and subjects touched by the domain-specific research of iconography and iconology. Future work includes user-centred navigation of the graph, to make the exploration more accessible.

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L'applicazione del riconoscimento testi neurale per la realizzazione di ristampe digitali

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ABSTRACT

Con il miglioramento delle tecnologie per il riconoscimento dei testi, sono finalmente disponibili delle trascrizioni automatiche sempre più accurate. Eppure queste trascrizioni, quando sono trasformate in testo modificabile, richiedono spesso un grandissimo lavoro di post produzione, in particolare per l'identificazione della struttura del testo, i titoli, le note a piè di pagina, o la formattazione speciale dei caratteri, come i corsivi, gli apici, i maiuscolotti. Questi testi, che funzionano abbastanza bene in caso di ricerca full text, non sono invece sufficienti quando lo scopo del riconoscimento è una edizione o una ristampa digitale, in particolare in formato TEI XML.

In questo articolo viene illustrato un workflow sperimentale messo a punto per provare ad ovviare queste limitazioni con l'ausilio del riconoscimento neurale del testo e del layout di pagina attraverso la piattaforma Transkribus, e successivo trattamento del risultato attraverso un processo di sostituzione con espressioni regolari e XSLT, fino alla pubblicazione del risultato sulla piattaforma TEI Publisher per il successivo arricchimento.

PAROLE CHIAVE

Trascrizione neurale; Ristampa digitale; TEI XML; Transkribus

1. 1. INTRODUZIONE

La scansione digitale dei documenti è stata accompagnata già agli inizi del secolo XX da sistemi di conversione dei caratteri, soprattutto ad uso delle persone cieche o con limitazioni alla vista. La tecnologia dell'OCR (Optical Character Recognition) ha ricevuto una spinta avanti molto forte dall'introduzione, alla fine del secolo, di tecnologie open source disponibili nel web, con accuratezza sempre maggiore delle trascrizioni, grazie al miglioramento delle tecniche di digitalizzazione dei documenti e dall'integrazione con vocabolari.

In ambito librario le trascrizioni ottenute dai software di OCR sono utilizzate per fare ricerca a testo intero (per esempio su Google Books), o per fornire versioni PDF ricercabili, dove insieme all'immagine scansionata si trova un livello di testo semplice posizionato secondo le coordinate dei caratteri trascritti, oltre a permettere l'uso di strumenti TTS (Text to Speech) per aumentare l'accessibilità.

Quando però da questo testo riconosciuto vogliamo ricavare una trascrizione da riusare in modo nativamente digitale, per esempio citare un paragrafo all'interno di un saggio senza trascriverlo manualmente, ci accorgiamo subito che, in alcuni casi, la conversione non è ottimizzata: i paragrafi sono spezzati in singole righe, elementi come titoli correnti o numeri di pagina possono essere inseriti all'interno del testo principale. Difficilmente inoltre il testo trascritto conserva correttamente la formattazione dei caratteri, come le parole in corsivo o i riferimenti alle note a piè di pagina in apice. La situazione si complica nel caso in cui, anziché poche righe, andiamo a riprodurre l'intero testo di un libro, in particolare di un libro scientifico con una struttura di paragrafi, sottoparagrafi, note e citazioni nel testo. Se poi consideriamo la trascrizione di testi la cui ortografia non è normalizzata, come il vernacolo italiano, o testi a stampa antichi, con legature, abbreviature, forme alternate come la *f* (s lunga) o font di difficile decodifica come quelli gotici, anche l'accuratezza della trascrizione subisce un sensibile ribasso per l'impossibilità di utilizzare un vocabolario di riferimento.

Questo significa che per una ristampa digitale a partire da scansioni di libri esistenti si rende necessaria non solo una accurata revisione del testo alla ricerca di errori di riconoscimento (per esempio lo scambio del numero 1 con la lettera l o I maiuscola), ma anche una totale ricostruzione della struttura del testo in paragrafi, riconnessione delle note ai rispettivi riferimenti e l'attribuzione degli stili di carattere (o in formato XML dei tag di rendition) corretti. Sebbene esistano dei servizi esterni specializzati, il costo di tale conversione risulta estremamente oneroso sia in termini di costi che di tempo. Questo progetto è un primo tentativo di sfruttare le macchine neurali e creare un flusso di lavoro integrato dal costo limitato e dai risultati configurabili in base all'uso finale del testo [1, 6, 7].

2. IL LIBRO CAMPIONE

Raphael in Early Modern Sources, 1483–1602 di Jonh Shearman [5] è un'opera composta da due volumi per un totale di quasi 1700 pagine di testo, e raccoglie la trascrizione di 1.058 documenti datati tra il 1483 ed il 1602 relativi alla vita e alle