

Urban Ink Archive: A Project for Documenting Murals and Street Art in Bologna

Semantic Digital Library, Giovanni Colavizza
Master's program in *Digital Humanities and Digital Knowledge*

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1. Introduction

Urban Ink Archive is a digital project aimed at documenting, preserving, and semantically exploring urban graffiti in the city of Bologna. It focuses on creating a digital catalogue of street art using semantic web technologies and cultural heritage ontologies.

Although the project initially concentrates on murals located in Bologna, its scope could be expanded in future developments to include street art from other contexts. The use of ontologies for conceptual modelling and knowledge graphs for data interconnection enhances adherence to FAIR principles and reproducibility, enabling machine-actionable Linked Open Data (LOD).

The platform supports an accessible web interface, allowing users to filter artworks based on conceptual relationships and view them on an interactive map. This makes the project useful for both experts and non-experts, enhancing the visibility and understanding of street art as a form of contemporary cultural expression.

2. Project Overview

2.1 Project Objectives

The main goals of Urban Ink Archive are:

- To build a digital catalogue of urban graffiti in Bologna.
- To apply semantic web technologies for structured and enhanced data representation.
- To offer a user-friendly interface with semantic filtering and navigation.
- To ensure interoperability through Linked Open Data (LOD) standards.
- To promote public engagement and scholarly research on street art.

2.2 Why Street Art in Bologna

We chose Bologna because it is the city where we live and study. The local street art scene is vibrant and closely tied to its political and cultural context. Despite its cultural relevance, urban art is often under-documented. Our project contributes to recognizing it as part of the city's intangible cultural heritage by providing a structured platform for its exploration.

We selected 12 meaningful street artworks as a starting point. The selection was based on the relevance of the artists and the cultural significance of the works. We focused on murals and included works by 13 artists: ANDRECO, Ericailcane, Bastardilla, Collettivo FX, Orticanoodles, Luis Gutierrez, Honet, Alice Pasquini, Nemo, Etnik, Dado, Mambo, and Blu. We also included a mural by Blu destroyed by the artist himself in 2016, in protest against an exhibition attempting to remove and display parts of his works. Including this piece acknowledges murals that no longer exist, preserving their memory.



figure 1: Mural of Blu in Via Fioravanti 24 (destroyed)

3. The Artworks and Metadata

We curated a selection of murals and defined essential metadata for each item:

- Author
- Location
- Subject
- Theme
- Current condition
- Support
- Creation date
- Descriptive text

Each artwork was given a unique ID and a human-readable label in the format:

“Mural of [Author] in [Street Name] ([title status])”, accounting for the fact that most street art pieces lack formal titles.

4. Knowledge organization and Modeling

4.1 Step 1: Conceptual Map (Natural Language)

We started by visualizing the data as conceptual map in natural language, representing real artwork metadata such as authors, places, and subjects. Color codes were used:

- **Light yellow:** identifier
- **Ochre yellow:** title
- **Pink:** place (street name and coordinates)
- **Green:** author
- **Soft cyan:** subject represented in the artwork
- **Light blue:** theme expressed in the artwork
- **Violet:** date of creation
- **Purple:** description of the artwork
- **Light green:** current state of the artwork
- **Dark green:** support (e.g., wall, gate)

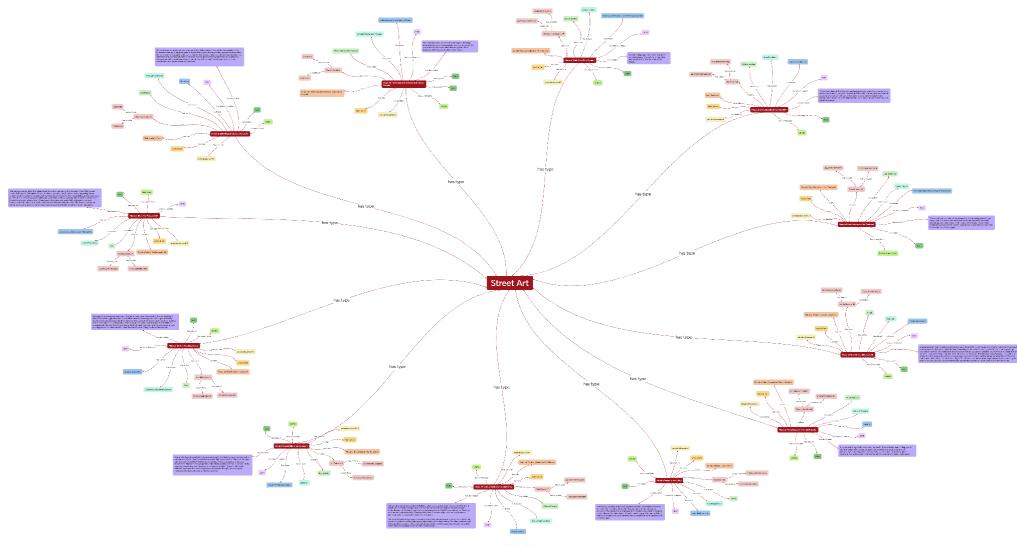


figure 2: Conceptual map

4.2 Step 2: Entity-Relationship (E/R) Model

We translated the conceptual maps into an E/R model, providing a formal schema that defines the entities (e.g., "Artwork", "Place", "Subject") and their relationships. This served as a bridge toward semantic modelling.

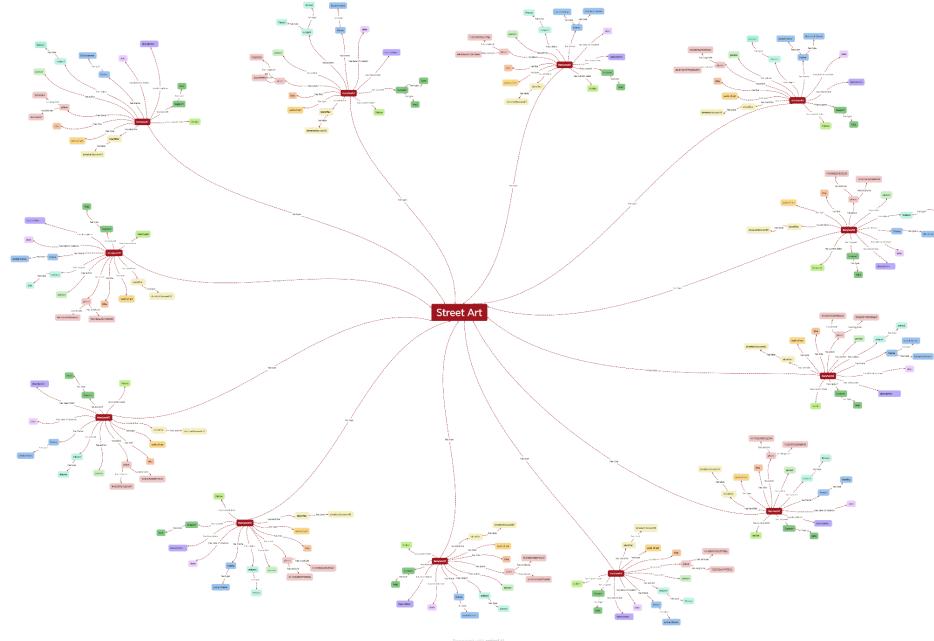


figure 3: E/R model

4.3 Step 3: Ontological Conceptual Model

We adopted a semantic web approach using:

- **CIDOC CRM**: core ontology for cultural heritage data (e.g., E22 Man-Made Object, E53 Place)
- **Getty AAT**: vocabulary for classifying subjects and visual motifs (e.g., “human figure”, “wall painting”)
- **Dublin Core (DC Terms)** and **Schema.org**: for general metadata

We introduced a **custom ontology** called **Strart** (a crasis of *Street Art*) for concepts not covered by existing vocabularies.

We differentiated between:

- **strart:Visual_Subject**: visual elements depicted (e.g., a person, an animal, a symbol).
- **strart:Conceptual_Theme**: the broader concept or message conveyed by the artwork (e.g., social justice, environmental, identity).

Both are subclasses of **crm:E28_Conceptual_Object**.

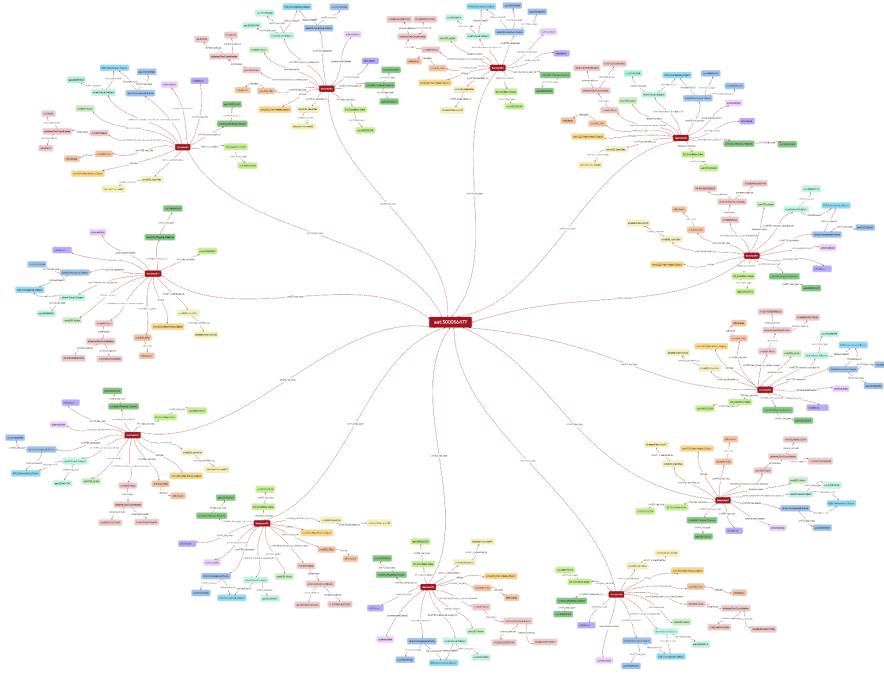


figure 4: Conceptual model

5. Data Conversion and RDF Serialization

Based on the modeling work described above, we created a dataset in CSV format containing the metadata of our objects. This dataset was used for the RDF serialization into a Turtle file.

Using a Python script, we extracted the contents of the CSV files to obtain the subject–predicate–object triples and added them to an internal graph. At the end of the script, the graph is serialized into a Turtle (.ttl) file.

In particular, the Python script reads RDF triples from a CSV file and converts them into an RDF graph using the rdflib library. It defines several namespaces, including Schema.org, CIDOC CRM, Dublin Core, RDFS, and the custom START namespace which is defined by this project, and processes each row in the CSV as a subject-predicate-object triple. The script maps predicate strings to corresponding RDF properties, determines whether the object should be treated as a URI or a literal, and handles different data types such as dates, floats, and strings accordingly. As it iterates through the data, it builds an RDF graph by adding these triples, and finally serializes and exports the graph in Turtle format. This approach enables structured metadata of cultural heritage or street art to be semantically enriched and made interoperable through standardized linked data representation.

6. The Platform

The Urban Ink Archive website acts as both a visual gallery and a semantic interface. It offers a browsable collection of murals that can be semantically filtered, along with an interactive digital map for geolocating each artwork and access to structured data based on ontologies.

All graffiti artworks can be explored in detail, starting from high-resolution images that allow users to appreciate their visual elements and styles. Each image is accompanied by its main data and descriptive metadata, providing insight into the content and context of the work.

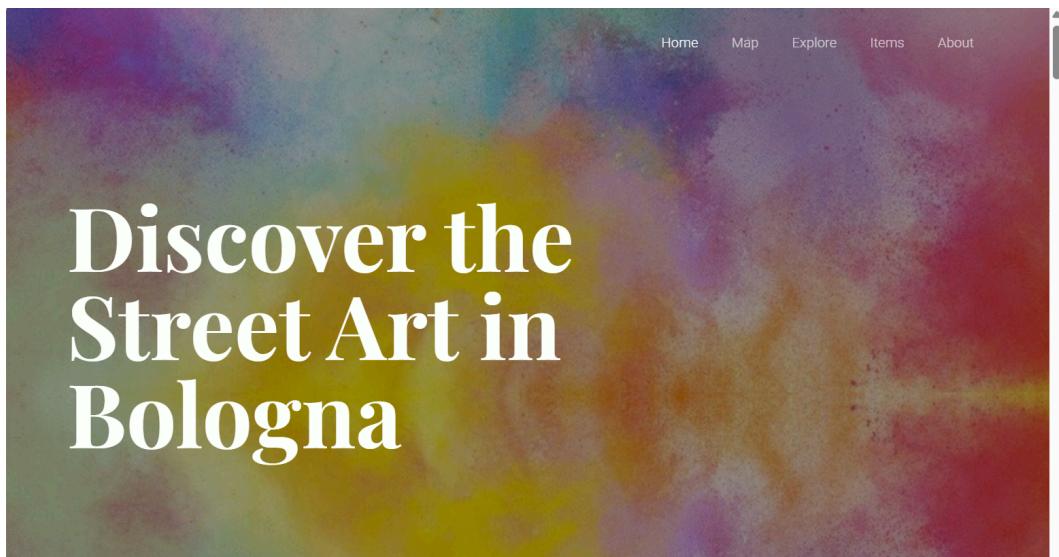


figure 5: The home page

- Catalog Page:

Users can filter to explore relationships among artworks, discovering shared themes or recurring subjects. This functionality enables a deeper and more meaningful navigation of the archive. A dedicated page shows all murals listed and users can apply filters by author, theme, subject, conditions, and support. These metadata elements are shared across all the entries in the archive, allowing users to highlight common aspects between different artworks.

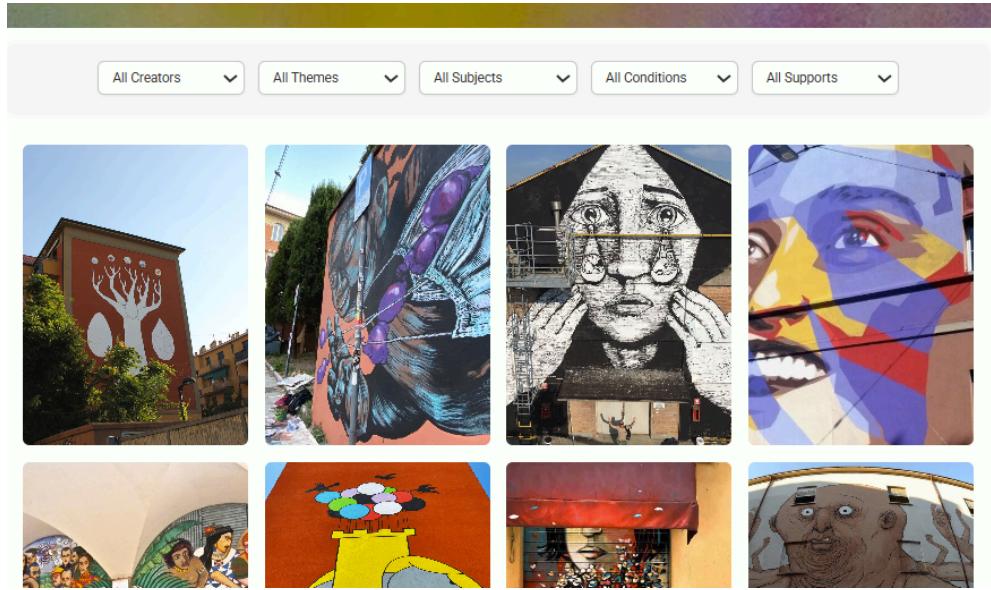


figure 6: Catalogue Page

- **Map Page:**

Thanks to the interactive map, users can explore the exact location of each mural. The use of precise geographic coordinates ensures accurate positioning and reinforces the spatial context of each artwork.

The map is generated using the Turtle serialization of our RDF knowledge graph. All metadata and geographic coordinates are retrieved directly from the TTL file. This approach allows for consistent and flexible updates.

When hovering over a mural, a popup shows the image, key metadata, and a short description—offering an informative preview.

7. Tools used

List of the technical tools used to support the project:

- **XMind:** for creating the maps
- **Python:** for data processing and RDF serialization
- **Bootstrap:** navigation tabs, accordion, carousel, graphics
- **Folium Library:** for creating the map (with different plugins)
- **Leaflet.js:** main library to show the map in browser
- **FontAwesome:** for icons of map markers

8. Future development

This is a project aimed at creating a digital catalog focused on Street Art located in Bologna. However, it has the potential to expand and evolve into a broader archive that documents Street Art globally.

In the future, we envision an open-access online platform where individuals from around the world can contribute to documenting Street Art in their own cities. This would allow both experts and the general public to explore artworks in their actual locations, understand their interconnections, and access detailed metadata.

The implementation of Semantic Web technologies would support this vision by ensuring interoperability and enhancing data quality. The goal is to align the project with the FAIR principles, making cultural heritage data more Findable, Accessible, Interoperable, and Reusable.

9. Conclusion

Urban Ink Archive is a cultural heritage initiative that combines semantic technologies with an accessible digital platform to bring visibility to street art and contribute to its long-term preservation. By using ontologies and structured data, the project offers new ways of engaging with urban visual culture, fostering both scholarly exploration and public appreciation.

The project falls under the "*Design and Specify*" category, as defined by the project guidelines. We developed a prototype of a digital library for street art, integrating semantic web technologies and existing ontologies. The resulting website showcases the design choices and demonstrates how these technologies can enrich digital tools such as catalogs and interactive maps. All elements are thoroughly documented and supported by structured metadata and ontology-based modeling.

Licences and credits

This website is a project developed for the *Semantic Digital Libraries* course, part of the *Digital Humanities and Digital Knowledge* degree program at the University of Bologna, under prof. Giovanni Colavizza.

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