# MirrorLAB: narrative patterns between collections of antiquities and urban landscapes

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*Abstract* – **The MirrorLAB project, nearing completion, seeks to employ innovative tools to enhance Rome's public museum heritage within aristocratic palaces, focusing on their historical and morphological relationship to the city. The project aims to expose cultural content through inter-scalar, inter-modal ICT, making it homogeneous and operable by comparison and aggregation, using a geodatabase for cognitive data and a technological system for disseminating meaningful data within narratives. The initiative is built on three actions: documentation of aristocratic palaces housing art collections from the 16th to 18th century, prototypical representation of existing or virtually reconstructed palace interiors, and the design of a cultural and touristic circuit of publicly-managed palaces-museums, enhanced with augmented reality technologies. To explore the relationships between buildings and their historical occupants, case studies linking museums to past residences are examined. This includes the Boncompagni Ludovisi collection, selected for its typological eloquence, historical stratification, and relational character.**

## I. INTRODUCTION

The MirrorLAB project, currently in the final stages of completion, aims to provide a series of innovative tools for the enhancement and curation of the public museum heritage of Rome's aristocratic palaces read in their historical and morphological relationship to the city. The prototypical implementation of a Roman public museum network that brings the art collections in tune with the museum architecture and with the peculiar city context required the involvement of scholars working at the museum sites starting from those already involved in the DTC project "Research and development of technologies for the valorisation of the cultural heritage" (Det G02422 of 1/3/2018 of the Lazio Region) entitled "The interactive virtual museum of Renaissance archaeology and art collecting" conceived, promoted and coordinated by the Museo Nazionale Romano - Palazzo Altemps. The project has seen the collaboration of two work units: the DigiLab interdepartmental research centre of Sapienza University of Rome, which has been responsible for the scientific and project management and the development of technological actions, coordinated by Prof. Francesco Freddolini; the Department of Architecture (DArc) of the Roma Tre University, which has participated in the scientific elaboration and project actions, the development of the analysis system, the characterisation and propositional synthesis at the urban and architectural scales, coordinated by Prof. Antonio Pugliano.

## II. CASE STUDY

The focus is on exploring efficient ways of inter-scalar and inter-modal ICT exposure of apparently heterogeneous cultural contents that will be processed, made consistent and operable by comparison and aggregation. The main tools are a geodatabase for the repository and management of cognitive data (training, implementation and maintenance), and a technological system for the dissemination/communication of meaningful data aggregations within narratives to be activated online for the support of the direct and/or indirect fruition of places and attractions. Three actions are implemented in this context:

- the creation of a system that documents and locates the palaces of the great aristocratic families that housed the art collections in the urban context of Rome from the 16th to the 18th century;
- the prototypical representation of interiors of existing or virtually reconstructed palatial environments;
- the design of the cultural and touristic circuit of Roman palaces-museums today under public management, implemented and infrastructured with augmented reality technologies and apps able to offer information and services to the visitor.

In order to reconstruct both the individual interiors of the buildings and the relationships between them and the families who built and inhabited them [1], the team has chosen to take into consideration a number of case studies that link museums to the residences of the past. The Mirror LAB Project therefore develops in-depth studies of a body of case studies selected on the basis of their typological eloquence, the consistency of the process of historical stratification that characterises the places, and the relational character of the works on display: the Boncompagni Ludovisi collection has been taken into consideration for this purpose [2-6].

This important early modern Roman collection of antiquities offers a particularly thematically cohesive corpus of works posing similar problems: a group of antique statues, restored by high-calibre artists, with highlights such as those of Gian Lorenzo Bernini and Alessandro Algardi, and, above all, a conspicuous documentation of these restorations. The antique sculptures in the collection already housed at the Villa Ludovisi therefore lend themselves well to a study of their 17th-century life [7]. This is even more relevant if we add the consideration that the arrangements and movements are documented by a body of inventories that is already largely known and easily verifiable [8], as well as potentially expandable through new transcriptions of documents. The Ludovisi collection thus offers an important case study for the working methodology that the research group intends to experiment with. In addition to the reasons just mentioned, there is also the consideration that the rich archival documentation corresponds not only to a different contemporary location, but above all to the destruction of the original contexts in which the statues were exhibited due to the subdivision of the areas in which the villa with the large garden stood, carried out by Prince Rodolfo Boncompagni Ludovisi [9-12]. The sources, therefore, not only make it possible to fill a gap from a historiographical point of view, but-along with architectural surveys and cartographical sources stratified from the 18th century onwards-allow us to engage in spatialisation work conducted with GIS tools and virtual reconstructions of environments and spatial relations both in the architectural sphere and, widening the lens, in the urban context of the city area in which the villa was located [13-16].

## III. WORKFLOW

For the development of the functional prototype, seven statues were identified in the Ludovisi collection, which provide insight into relationships useful for constructing a narrative framework. The team working at DigiLab Sapienza began the cataloguing of the statues through the retrieval and insertion in the database of the bibliographic, archival and iconographic data of the seven Ludovisi statues under investigation (Ares Ludovisi,

Athena with Serpent, Cupid and Psyche, Dadoforo, Head of Mars Helmeted, Apollo Citaredo 8950 and Apollo Citaredo 8954).

The digital repertory that has been created (and is continuously being updated) is based on the compilation of a card that contains together the basic fields of the ICCD cards RA (archaeological finds) and OA (works of art). In the ICCD catalogue, the statues in question are catalogued with RA cards [17-18]. The creation of 'double' cards seemed necessary because it is true that these are archaeological finds, but they were restored and supplemented in the early modern period by artists such as Gian Lorenzo Bernini, Alessandro Algardi and Ippolito Buzio and thus also took on the value of works of art [19]. In addition to the basic card, a space called 'relation cards' has also been created in the database, a repertory linked to the mother card with the intention of grouping all archival, bibliographical, or iconographic information in order to highlight, through compilation, the critical fortune the statues have had and their role as a source of artistic inspiration over the centuries.

*Architecture*

The contribution made by the DArc of Roma Tre, aimed at the so-called "spatialization" (i.e. the knowledge and reconstruction of some historical exhibition contexts of the selected works) concerned first of all the creation of a basic card, i.e. a register of historical information in a chronological key (in a Microsoft Access environment) with the relative compilation manual (an autonomous re-elaboration based on the ICCD regulations and sheet models suitably revised and implemented in a relational key). The basic card allows the recording of individual pieces of information taken from the scientific literature or from archival and iconographic directories, without any mutation from the original seed, by filing them according to the object to which they refer. As in the ICCD standard, study objects are grouped into the following categories:

- Urban areas (SU, not present in the ICCD index)
- Archaeological sites (SA)
- Archaeological complexes (CA)
- Archaeological monuments (MA)
- Parks and gardens (PG)
- Architectures (A)
- Works of art (OA)
- Archaeological finds (RA)
- Collections (CL, not present in the ICCD repertory)
- Museums (not present in the ICCD repertory)
- Architectural environments (not present in the ICCD repertory)

- Structural systems and architectural components (not present in the ICCD index and mainly based on the cataloguing criteria described in [20]).

The denomination of the objects, for each category, is univocal and provides for the recognition of a corresponding georeferenced cartographic entity. Any other designations under which the object appears in the literature have instead been noted together with the main designation. This allows an orderly and immediate filtering of all information gathered during the investigation. In addition, it is possible to keep a note of any other figures involved in the recorded event (authors, principals, workers). The form includes, at the end, a space for free annotations and, above all, a 'Vocation' field in which it is possible to immediately define the purpose of the information with respect to the elaborations being developed.

For the part relating to the elevations, digital and three-dimensional surveys were carried out at the scales of the detail, the whole and the context In this case, surveys were produced from the sources with some targeted in-depth studies, where possible, correlating the transcription of information in the DB environment (textual data repository) and CAD (vector data repository) in the digital platform (as archiving and correlation of the data). At present, overall volumetric drawings and initial architectural detail drawings of some components of the aforementioned buildings are available. Following the definition of the plots and scripts, in relation to the selected works of art, in-depth studies will be carried out on specific environments to be related to the needs of the narrative. The drafting of this script, coordinated by the DigiLab Sapienza group, is emerging from the data that have already been grouped in the database and whose critical analysis allows the narrative threads to be constructed by extrapolating data from the repository created.

*GIS*

In order to create a cartographic view of the reproductions (in painting, sculpture, derivation and study copies) of the Ares Ludovisi (which would allow the public to see the widespread diffusion of this extraordinary iconographic model), a list of all the elements that have been found in Europe and beyond, with related images and links to the work, was compiled. At this stage, work was done on the construction of the system, database logic and data interchange, in order to operate in a GIS environment. The data collected in a rigorous computerized form organised in the relational DB system were made to dialogue in advance with the precise geographical and cartographic references of Rome in the modern era [cf. 21]. This passes through the recognition of places on georeferenced maps (dressing). From the DB, ideas were gathered for the construction of different digital routes to take visitors to the Altemps-Ludovisi collection. These paths and thematic maps are currently designed to be usable in different ways: on the app through the export in JSON of the spatial queries and through a script full of learned references and cross-references to the world's main collections representing and mentioning the exhibited works. The exposed data will then interface with the ACTUS platform, thus cooperating with the different parts of the research in the creation of the webGIS prototype for the app.

Exemplary in this is the experimental prototyping of the first of the three outputs, the maps of the artistic quotations of the Altemps-Ludovisi works. Over time, each work in the Altemps-Ludovisi collection has generated sheer admiration and willingness of international artists to engage in pictorial or sculptural replicas in various formats and materials of the most important sculptures on display. These copies circulated with the artists, through cartoons, through collectors and in European courts, reaching all over the world. This information was carefully collected and filed in the DB. This gave rise to the idea of creating a series of maps of the 'fortune' that the masterpieces of ancient art in the Altemps-Ludovisi collection had. The environment in which the first information prototype was developed was the Geographic Territorial System organised in QGIS 3.22, to facilitate data interchange and the speed of modification and reproduction of geographical data. Records of the sculpture of Ares Ludovisi were entered in the database to create an initial prototype of a "map of artistic citations" known for the work. This map, having a global scale, was necessarily organised in a 4326 WGS84 world EPSG. The data was drawn from the database by writing a targeted query, the result of which was a .csv file. The .csv was transformed into a geopackage after entering the X Y coordinates of the museums containing the listed works. The geopackage format will be useful for collecting the layer's clothing, labelling and styles. Once the layer was created, it was then exported in JSON format to be sent and shared with the app building group. The JSON format was reviewed and changes were requested in the database structure for better data utilisation and more performant app operation. The changes were then made and the prototyping of the first type of maps, which will feed into the final output of the project, was closed.

From the point of view of GIS support for the rendering of the landscape of Rome in the years of the discovery of the works now in the Altemps-Ludovisi collection, we began to elaborate proposals in 3D, superimposing the IGM cartographic data and the Nolli Nuova Pianta di Roma map of 1748. The 3D map, some views of which are presented here, can be exported in formats compatible with 3D modelling in a CAD or Blender environment.

The 3D rendering was realised through the QGIS plugin called Qgis2threejs, developed by Minoru Akagi, a very

versatile and easy-to-use tool for creating ancient or modern landscapes in the form of a queryable 3D map.

*Application*

The DigiLab team then designed and developed the digital content for museum dissemination with the production of structured data tables containing the basic information about each statue that could be used to set up the basic content of the App. Based on the previous database setup with the art-historical information, the focus was on the design of the digital data display system for user enjoyment. Requirements were defined for data mining (json format) for fast and real-time access to the data via a native mobile app for both ecosystems (Android and Apple). The sources for the two platforms have a common basis (approximately 90%) with platform-specific variations for the two native implementations.

The features and functionality of the App were then designed:

- possibility of geolocalized information on points of interest (POI);
- possibility of receiving information, including multimedia, on the objects of study;
- possibility of exploiting GPS services by relying on the mobile network to update information;
- possibility of viewing POIs in Augmented Reality mode, through the device's video camera (GeoAR through the Wikitude sdk system);
- development of an additional Augmented Reality system (Image Tracking through the Wikitude SDK system) for the enhancement of some works to offer a more complete and comprehensive use, in addition to the multimedia content developed ad hoc;
- possibility of connecting all spatial information to a GIS system;
- synchronisation of the internal DB with the central one so as to have available, even in the absence of an Internet connection, the latest updated information.

With regard to user interaction, a standard design pattern (TabBar and popup) was defined to simplify interaction for all types of users and to organise and subdivide content and navigation. For downloading online content (images, panoramas, maps), the approach used is asynchronous with separate threads to manage loading (so as not to block the interface while downloading the associated files) and caching (for images).

## IV. CONCLUSIONS

Programming of the prototype is currently in progress,

for the development of which the following languages are being used: java/javascript (Android) objective-c/swift (Apple). The basic narrative, which communicates the type, subject, author, commissioning, material, restoration and brief description of the work, is the starting point for the dissemination of content to the public. It is expected that the data to be included in the App will be expanded so that it can be used by different audiences, including, for users who wish to go beyond the basic information, more specific content, such as information on historical and archival sources, bibliography and iconographic reuse in other works.

Following this process, a socio-cultural impact assessment will be carried out, through which, by decostructing the logical framework of the mechanisms to which the intervention proposes to suggest a solution (metrics), the process chain will be set up: resources-activities-quantitative results-impact. At the end, having clarified the output (direct result produced by the activity) and the outcome (change in the conditions of the beneficiary individuals) obtained and validating or not the same on the basis of the metrics established at the beginning of the process, we will proceed with the introduction of the project within wider markets, through a communication of the results obtained to the scientific community of reference and to the world of ICT entrepreneurship.

With this process, MirrorLAB sets itself the challenging goal of reaching the reference entrepreneurial markets, already having clear qualitative and quantitative standards that they will have to guarantee for the pursuit of the project objectives.

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