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A. Bucciero, B. Fanini, H. Graf, S. Pescarin, and S. Rizvic (Editors)

Poster

Digitisation of temporary exhibitions: the Aldrovandi case

S. Barzaghi[1], F. Collina[1], F. Fabbri[1], F. Giacomini[1], A. Bordignon[1], R. Balzani[1], G. Bitelli[1], F. Bonifazi[1], L. Cipriani[1], S. Colitti[1], M. Daquino[1], B. Fanini[2], F. Fantini[1], D. Ferdani[2], G. Fiorini[1], E. Formia[1], A. Forte[1], V. A. Girelli[1], B. Gualandi[1], I. Heibi[1], A. Iannucci[1], R. Manganelli del Fà[2], A. Massari[1], A., Moretti[1], S. Peroni[1], S. Pescarin[2], G. Renda[1], D. Ronchi[2], M. Sullini[1], M. A. Tini[1], F. Tomasi[1], L. Travaglini[1], L. Vittuari[1]

[1]University of Bologna
[2]CNR ISPC

Abstract

Temporary exhibitions in the cultural heritage system have become diffused. They are tools to enhance cultural heritage and to gather, in the same context, cultural goods that otherwise would never be exposed together. Their temporal limitation gives them the uniqueness of an event that will not be repeated. The exhibition "The Other Renaissance: Ulisse Aldrovandi and the Wonders of the World" was created to offer visitors a tour of an exceptional legacy of objects, some of which have never been exhibited before, combined with objects, works of art from several Italian museums, and digital installations that together tell the story of how the first generation of naturalists took their first steps into science as we know it today. To store this exhibition a photogrammetric and structured light scanner survey campaign was launched to acquire 3D objects. By leveraging a combination of 3D, LOD, and Semantic Web technologies, we propose to create a digital twin (intended as an aggregation of different information about real-world heritage objects) of Aldrovandi exhibitions, to create a new digital tool differentiated from the physical exhibition, but that could store all the information and objects exposed together physically.

CCS Concepts
• ***Human-centered computing*** → *User interface design, Scenario-based design, HCI theory, concepts and models.*

1. Short introduction

Among the NPRR's Mission 4 - Education and Research is the project CHANGES (Cultural Heritage Active Innovation for Sustainable Society) [MUR23] promotes the development of solutions based on digital and ecological transitions, it is organised in nine Spokes; Spoke 4 is focuses on virtual technologies for museums and the impact of digital cultural heritage (DCH to the narrative and valorisation of cultural heritage collections). The work described is set in this context.

The exhibition "The Other Renaissance: Ulisse Aldrovandi and the wonders of the world" was conceived and organised by Roberto Balzani, President of the Museum of the University of Bologna, with the curatorship of the science and heritage communication expert Giovanni Carrada, to offer visitors a tour of those collections linked to the bequest of naturalist Ulisse Aldrovandi and preserved to this day by the University of Bologna [Reb18]. A veritable collection of 'jewels', most of which have never been exhibited before, combined with objects, works of art from other Italian museums, and digital installations that together tell the story of how the first generation of naturalists, and in particular Aldrovandi, took their first steps into science as we know it today [Hax16].

2. Research questions

Temporary exhibitions are one of the most spread methods to enhance cultural heritage. They link heritage goods that otherwise would not be able to be enjoyed together physically. Their transience makes them unique since they exist for a limited period. The use of digital tools, and the creation of virtual museums in that context, have given a considerable research drive. Digital media allow crystallizing the temporality, creating museums and collections that physically do not exist.

Digital technologies redefine the time and space of exhibitions and the relationship with the audience. The predisposition of the user (or visitor) is different between a physical or digital visit, considering that, also the communication system must change in the two contexts. The use of technology in museum contexts, also regarding virtual museums, assumes the necessity of creating meaningful experiences for the user. The provision of multiple narratives can meet various user needs, personalising the user experience and increasing the accessibility of museum information.

Virtual exhibitions and virtual museums allow enjoying cultural goods that otherwise, for different reasons, could not be enjoyed together. The reflections that emerge from the described project should therefore be taken into consideration in the virtual recon-

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struction of a temporary event, particularly in the case of the exhibition "The Other Renaissance: Ulisse Aldrovandi and the wonders of the world". The study of this case will attempt to answer the questions: what happens to an exhibition when it closes, and what can be done to preserve it beyond the printed catalogue? How can an exhibition be translated in a virtual context where the user expectations are different?

3. Innovation

A digital twin is a virtual representation of a physical object or system that contains all the relevant information and data needed to simulate its real-world characteristics and behaviour in a digital environment [VM21]. The concept of digital twin, originally developed in the manufacturing industry, has evolved and been applied in a variety of different fields [TXQ*22].

Concerning the Cultural Heritage domain, digital twin technologies have been combined with other emerging approaches and technologies, such as Heritage Building Information Modelling (HBIM) [JH19], Linked Open Data (LOD) [NFH22], and the Semantic Web [GGDL*23], to adequately represent the complex information that characterizes objects in this domain. They still present major challenges in terms of both technical aspects - such as data collection, storage, and performance [CM22] - as well as epistemological ones, such as the difficult harmonisation between cultural heritage - which should undergo as few changes as possible- and digital twins - which, by definition, include a flow of information that constantly updates them and the objects they replicate. In this respect, a particularly interesting approach is illustrated in [NMT*23], which draws a clear distinction between the simulation aspect of the digital twin and the way its data is organised, thus providing a definition that, on the one hand, is closer to the idea of Digital Model, and on the other, opens up for the possibility of future integrations with simulation functionalities and other processes that require continuous, out-and-out data flows.

4. Methods and Results

Modelling the workflow process of 3D digitisation of a collection of cultural heritage objects involves identifying the main stages and activities involved and representing them in a structured and systematic way. Its goal is to provide a clear understanding of the steps involved in 3D digitisation and to ensure that the process is repeatable, efficient, and consistent.

Concerning Aldrovandi's exhibition, digitisation activities were carried out over several weeks by the project participants themselves, divided into groups according to their respective institutions. Each group was assigned specific works based on the available timing and equipment.

A vast and heterogeneous corpus like the one shown in the Aldrovandi exhibition requires applying established techniques. Therefore, the acquisition process is based on remote-sensing technologies that have been widely tested in the cultural heritage field, such as 3D structured light scanning and digital photogrammetry [AFGG21]. The choice of the most appropriate technique depends primarily on the characteristics of the object to acquire, both in terms of geometry and shape, as well as materials and surface quality [PSHLBL21]. Despite the high cost of structured light projection scanning equipment, these instruments can provide high acquisition rates by projecting a light pattern onto the objects' surface which is detected and processed to calculate the points 3D coordinates in real time; in fact, these scanners are often used in their handheld configuration, which makes the operational phase of scan acquisition more practical [GIV10] [MPK*16]. Although these range-based systems allow for the rapid and accurate acquisition of a large amount of data, the use of image-based techniques can also offer certain advantages. Digital photogrammetry, for example, can be valid where operational conditions do not allow the object to move, making the 3D scanning complicated [MRMTSA22]. It is also a methodology that can be easily adapted to items of various sizes, particularly effective in capturing irregularly shaped objects [Rem11]. One of the first aspects to address was the organisation of the acquisition work, which aimed to digitise all the objects exhibited in the museum. As a first result of this work, the acquisition of over 200 objects was achieved, not counting the surveying of environments and furnishings. These objects have very different characteristics, both in terms of geometric shape and surface properties. It was necessary to digitize paper materials such as volumes, manuscripts, watercolours, nautical maps, ancient codes, as well as oil paintings, sculptures, such as the marble bust of Ulisse Aldrovandi, woodblock prints, plaster casts, technical instruments, zoological specimens, and taxidermied animal models. Room number 5 alone houses a vast and diverse collection of natural artifacts, of various sizes and materials, including large marine turtle shells, various amphibian and cartilaginous fish specimens, as well as numerous other geo-paleontological artifacts such as fossils and microfossils, rocks, and minerals. Characteristics such as material reflectance, size, placement, and geometric complexity influenced the choice of acquisition technique. Photogrammetry proved suitable for surveying objects characterised by irregular shapes for example, the jagged edges and sharp details of many zoological specimens; moreover, the latter often have dark and highly reflective surfaces. In order to ensure their preservation, these specimens were treated with various substances such as shellac, and the organic tissues they are composed of are often mixed with fibrous materials to mend any damaged parts [Reg22]. To ensure homogeneous lighting, lightboxes were used, while the photographs were taken with an SRL camera and X-Rite ColorChecker Passport Photo (CCP) for colour calibration; the models were then placed on a rotating base with coded targets and measured. The data processing involved the processing of raw files, which were then aligned and scaled in dedicated software such as Metashape and 3DZephir. Regarding the use of structured light scanners, they proved to be extremely useful for the acquisition of small-sized objects, such as the numerous artifacts in room 5. The use of precision tools like the Artec Spider, in particular, allowed for speeding up the work while achieving a high degree of accuracy.

The project groups were assigned the task of collecting workflow metadata and inputting it into a shared spreadsheet document that was stored on a cloud platform. The use of this platform allowed for real-time distribution, peer-to-peer control, and the open exchange of information among multiple individuals. The metadata that was collected included a plethora of details related to the digitisation

process, such as institutional information, participant details, used techniques and tools, and activity duration. From the data that was collected in the spreadsheet, a data model was designed based on the CIDOC Conceptual Reference Model (CIDOC CRM) and its extension CRM Digital (CRMdig) to standardise the semantics of the data and promote its interoperability.

Additionally, the project team collected descriptive data about the objects from the museum catalogue and organised it in a separate spreadsheet. This information included data related to the object's title, description, author, date of creation, and other characteristics. Another data model based on CIDOC CRM was constructed from this spreadsheet data to describe the object's characteristics and contextual information.

The next step is to convert the two sets of data into a set of RDF statements and integrate them into a comprehensive knowledge base, which would provide a detailed record of the exhibition, including information on the digitised objects, their characteristics, the digitisation process, and the individuals and institutions involved. The knowledge base and digital twins of both the exhibition and the single objects could be utilised as a valuable resource for researchers and cultural heritage professionals and a flexible framework that could be adapted to meet the specific needs of different stakeholders in the cultural heritage domain.

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