VIEd'ARTE

A Web Publication Environment for the Digital Dissemination of the Cultural Heritage Knowledge

Andrea Ferrato[1], Antonella Gioli[1], Sonia Lazzari[1], Caterina Romagnoli[1], Elena Scaravella[3], and Andrea Tomasi[2(✉)]

[1] Department of Civilisation and Forms of Knowledge, University of Pisa, Pisa, Italy
antonella.gioli@unipi.it, s.lazzari@live.it, caterina.romagnoli@cfs.unipi.it
[2] Department of Information Engineering, University of Pisa, Pisa, Italy
andrea.tomasi@unipi.it
[3] Cultural Heritage Office of the Diocese of Massa Carrara Pontremoli, Massa, Italy
bbcc.elena@virgilio.it

Abstract. The fruition of the cultural heritage in the pandemic era has been stressed even more towards online and virtual environments. Usually the web site publishing process involves many competences, or the ability of the single cultural operator, which needs to become expert in many complex techniques. In the paper we present the VIEd'ARTE Project, an experience of implementation of a web publication framework supporting the work of cultural operators with tools for the data access to repositories and for the page design of the web applications. An example is shown using the VIEd'ARTE framework for the design of the virtual tour "On the trail of the Renaissance". The publication framework of VIEd'ARTE manages different types of cultural objects and many types of presentations. The front-end side features include templates and predefined layouts, supporting a presentation model for a large public. The back-end side offers access capabilities to SQL databases, in particular to BeWEB archives, which contain data of different types of cultural heritage assets. The metadata layer of the BeWeb Portal allows the integration of the various data fonts. The data access model will move in the next future to allow also no-SQL databases and OAI (Open Archives Initiative) or Linked Open Data protocols to access databases.

Keywords: Cultural heritage fruition · Virtual visit · Data integration · Integrated presentation framework · Online publication schemas

1 Introduction

Since year 2000, with the growing diffusion of digital communication technology in the Internet environment, many projects tried to achieve an effective online dissemination of knowledge about cultural heritage. The knowledge data source are usually contained in many databases, geographically distributed, owned by different proprietary entities. The objects relevant in cultural heritage are of different types (artworks and artistic objects,

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paintings, books and archival documents, historical buildings) and have different models of data description, according with the specific disciplinary standard applied.

The access to heterogeneous, distributed data has to face two main problems: the first at the data level, i.e. the collection of query results over the network, due to the distribution, the second one at the application level, i.e. the specification of the queries and the presentation of the results homogeneously, starting from heterogeneous data.

The main approach adopted in the early 2000s is based on Web Information Systems (WIS) [1], able to expose large amount of data in a well structured, accurate way to an ever increasing community of users. The architecture of a WIS follows the 3-tier model: the front-end or presentation level with the user interface, the functional logic level with the application software and the system processes, the back-end or data level with the data repositories and the Data Base management System (DBMS) functions. One of the main problems to be solved in order to make WIS effective is the development of a suitable model of data representation.

We are not concerned here with the problems related to the distributed system architecture, neither to the goals of performance of the network system or of database management, but only with the aims of integration of data representation: the solution given to such a problem affects the design of applications, in particular in the case of the web publication framework for cultural heritage knowledge. The data dissemination and fruition need in fact two different activities on data: the data access to the distributed data sources and the storytelling to the world of users. The two aspects are strictly related, in order to give to the user a comprehensive and consistent view of all the information pertaining a specific set of knowledge about single cultural heritage objects or about collections.

First of all we discuss in Sect. 1.1 the access to heterogeneous, distributed data, focusing on cultural heritage data and showing the different solution approach of some project to the interoperability or to the integration of data representation. The portal BeWeB, based on the approach of Ecumene Project [2], is briefly presented in Sect. 2 because it constitutes the back-end component of our web publication framework.

The web publication of cultural heritage information is presented in Sect. 1.2. When a cultural operator wishes to publish a web site with the aim of reaching a large public, he can use various tools for the publication, with various degrees of use complexity and different characteristics with respect to the phases of the publishing process: to get the data, to prepare text and images, to design the page layout, and so on. There are many Content Management Systems (CMS) proposal – the most popular being Drupal, Joomla and WordPress - with a lot of extensions for different types of presentations. Moreover there are specific products for particular types of presentations, for example for virtual exhibitions. The available frameworks differ from each other for the characteristics of data access and of metadata supported, or because they focus on the presentation of the web pages leaving to the user the research of data. The approach of the VIEd'ARTE Project offers to the operators a comprehensive framework able to give in the same environment the features of the publication tools and of the data access. The originality of the approach will be discussed in Sect. 3.

1.1 The Data Representation in Case of Heterogeneous, Distributed Data Sources

The data representation has to face the different levels of data repositories:

- The Database level, resident in the peripheral sites. At this level data are constituted by the description of specific types of cultural objects, i.e. artistic objects, like paintings, manufacts and others, archival documents, books, historical buildings and so on; each data type has been defined according to the particular disciplinary sector, either international or national: for example, ISAD (G) - General International Standard Archival Description [3] and ISAAR (CPF) - International Standard Archival Authority Records for Corporate Bodies, Persons and Families [4], or OA form for Art Objects [5] and A form for Architectural heritage [6], defined by ICCD – Istituto Centrale per il Catalogo e la Documentazione.
- The metadata level, implemented at the functional logic level in the Data Access Server. At this level should be implemented the interoperability and/or the integration of the heterogeneous, distributed data sources. The widely used Dublin Core metadata model [7] supports the interoperability of databases of the same type having different implementation details. The metadata are designed to meet the function requirements of different applications, so that Dublin Core model has been enriched by metadata models for specific cultural sectors and for the support of various activities [8]. The interoperability among metadata repositories is achieved by data access protocols such as Z39.50 [9] or by the Open Archives Initiative (OAI) [10]. The use of metadata for integrating heterogeneous data is nevertheless recognized insufficient [11], especially because it can hide semantic aspects of data sources interesting for knowledge dissemination. Hence a way to preserve at most the data semantic value should be found, as it is proposed with the definition of a semantic layer [12].
- The user presentation level. The growing interest for new approaches to cultural heritage fruition starting from the large diffusion of digital data sources enforces the need for a unified data representation and for metadata models allowing the integration of the various representations in a consistent way for the communication and the dissemination. XML [13] has become the data description language more widely adopted for metadata representation. At the presentation level web pages and structured data are all represented with XML, so XML can be seen at the various levels as the standard also for data exchange. XML can support not only interoperability, but also data integration, through mapping functions of the data and metadata representation to XML descriptions.

Many projects has faced the problem of data access in the case of heterogeneous, distributed cultural heritage data sources, with different approaches, stressing more interoperability solutions (Minerva, Aquarell, Perseus, LEAF, DELOS) rather than integration ones (Ecumene).

Minerva Europe Project (2002–2011) [14] was an effort of many public institutions in Europe to establish a network of coordinated initiatives, mainly to support the digitization and quality of web sites through best practices and guidelines, and to perform data access using interoperability tools and standards [15–17].

Ecumene Project (2001–2005) [18–20] chose a different approach, working on an integrated framework for data access and for presentation. The Ecumene approach is significant here because of its conceptual model for metadata, integrating different data sources and preserving their rich semantic (see Sect. 2.1), so we discuss it with more details in Sect. 2.

Other projects focused on specific sectors: Aquarell [21] for museums, which adopted the Z39.50 profile developed by CIMI (Consortium for Computer Interchange of Museum Information) [22], MALVINE and LEAF for documents and libraries, through the collection of authority files [23]. The Project Perseus [24] investigated the field of the so called digital libraries.

The main acquisitions of the projects in that period were the definition of protocols for interoperability based on metadata and the use of XML as the unifying description language, so that some disciplinary description standards mapped on XML, as in the case of EAD (Encoded Archival Description) [25]. Unfortunately some projects did not continue the activities after the deadline and their web sites were abandoned.

1.2 The Web Presentation Framework

The work on data representation and on data access can be seen at now as already established, as stated in the previous section. It constitutes the technological ground for the development of ever more sophisticated presentation tools.

The focus of research studies and of development moves now to the online diffusion of the cultural heritage knowledge to a large public. The audience interested in cultural heritage can access information of any kind and it can visit virtually any museum or gallery over the world. Hence the people may have different knowledge, different cultural bases and different interests towards the fruition. As a consequence, the presentation environment may use different presentation models and it may have different user interfaces according to the target public segmented in groups, having different views and privileges on data. Some basic models can be considered: geographic visiting tours, museum and exhibition visiting tours, virtual exhibitions.

The presentation environment can be structured in three layers:

- the data access layer offers to the application of knowledge dissemination the functions of data access and of mapping of data representation at the database level to the metadata used at the presentation level; as stated, XML is widely used for data description and for mapping;
- the composition layer support the development of the online presentation application; ready-made templates can help the developer and can reduce the effort of designing the pages layout;
- the user interface layer is the front-end application exposing cultural heritage knowledge to the final user with various presentation models.

Each one of the layers corresponds to a phase of the web publishing process, which is supported by many software environments. Usually the web publication software is independent from the particular knowledge content and it can have limitations on the graphical design and on the management of the page layout.

We therefore examine only some products specifically addressed to the web publication of contents related to cultural heritage information. They differ for the destination to the front-end or to the back-end features, the model of metadata supported, the characteristics of the framework for the support of the cultural operators in the work of web publishing. When using a publication framework, the operator should be careful: he should not only examine the characteristics of the framework compared with the publication needs, but he should also evaluate if there is an organization supporting the product for a long time into the future. The verification of the existence of a good staff in charge of maintenance, of technical and user assistance and the availability of satisfying documentation are mandatory to make a successful choice.

The web presentation of collections of data from various sources is the goal of Europeana [26], which includes a portal of cultural heritage objects [27]. Other initiatives focus on specific sectors, as Phaidra for archives [28].

The publication of web sites and online virtual exhibitions for museums and small cultural institution is the target of Movio [29], an open source software distributed by Italian Istituto Centrale per il Catalogo Unico - Central Institute for the Union Catalogue of Italian Libraries and Bibliographic Information (ICCU). All the information published by means of Movio tools must be contained in the inner Content Management System (CMS) of Movio and no access to external data is provided. The project appears to be not updated since a few years.

The lesson of the past experiences shows that the web presentation of a collection of data and the online virtual visits and virtual exhibitions are managed by different sets of framework, whether the cultural operators often need to have both at the same time. This is the aim of VIEd'ARTE, which composes its web publishing framework "on the top" of the BeWeB Portal.

2 The Ecumene Project and the Portal BeWeB.

The Ecumene Project [18, 19] was performed in the context of Parnaso Initiative funded by the Italian Ministry of University and Scientific Research. The aims of the project were the implementation of ICT tools addressing the fruition via Internet of knowledge on cultural heritage objects of different type. The knowledge base was extracted from many existing databases with data about artistic, architectural, bibliographic and archival assets. In particular were referenced the assets owned by entities of the Italian Catholic Church, the main cultural heritage property in Italy. Since 1996 the Italian Catholic Church invested a great effort in a long-term project of inventory and cataloguing of its cultural heritage assets. The Ecumene Project offered the technological ground and tools to the wide fruition online of the collected data. As a result of Ecumene Project it was implemented the BeWeb portal [2, 30, 31].

2.1 The Conceptual Data Model

The services offered by the Ecumene Web Information System strongly rely on the collection of a consistent view of the different objects involved in a particular search. A fundamental step is the design of the conceptual data model: this methodological phase

is often referred to as the definition of the *semantic layer*, emphasizing the importance of semantic interoperability in systems that gather information from heterogeneous sources [12]. In particular, the definition of a *mediated schema* (or *global schema*, i.e. a purely logical schema for the purpose of issuing queries) is the central activity for the data integration within the web information system.

The approach of Ecumene [18, 32, 33] is the adoption of mediated schemas for the generic item representation and the introduction of metadata exploiting the semantic interconnections between the different domains. Metadata model is based on context information, entities and roles. Ecumene makes an extensive use of XML for the data description according to the main standards of sectors: the mediated schema is EAD compliant and XML support the mapping functions between the data source representation and the mediated schema, and between mediated schema and metadata [19].

2.2 The System Architecture

In Fig. 1 it is possible to recognize different system layers, containing the basic functional blocks to manage cultural heritage information.

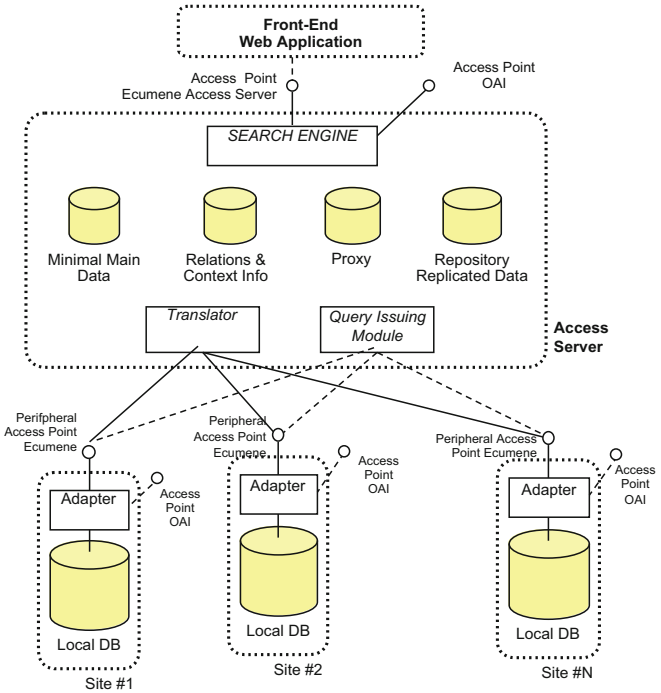

Fig. 1. Overall architecture of the Ecumene system.

The data source layer, the data access layer, and the data presentation layer give access to information with different characteristics, format, and accuracy. Queries can

be issued to each functional block (indicated with a dotted line boundary) through proper endpoints, which are in charge of providing back the retrieved data/metadata. The front-end module constitutes the user interface of the web application, so that most of the usability issues have to be addressed at this level, conforming to quality design issues (see for example the quality recommendations of Minerva project [15, 34]).

2.3 The Beweb Portal

BeWeB Portal allows the web access to the catalogues of the cultural heritage assets of the italian catholic Church [31]. As today, BeWeb data repositories contain the description of 4.135.442 artistic manufacts, 7.084.780 books, 204.242 archival holdings, 66.395 architectural units. Although the user interface of BeWeb allows a lot of cross-queries on data, it should be noted that the cataloging data are often oriented to the fruition from disciplinary experts more than to the large public of people with generic interest in cultural heritage, so that it remains open the need for a web publication environment which makes a "mediation" between the content of data repositories and the web pages presented to the users.

Because of the large amount of heterogeneous data contained and thanks to characteristics of the data access server, BeWeb represents an ideal testbed for the development of an online publication framework supporting various types of dissemination tools on cultural heritage knowledge.

3 The VIEd'ARTE Project

The VIEd'ARTE Project (Virtual Integrated Environment for Arts Routes Territories Exhibitions/Esplorazioni Virtuali Integrate per Arti Rotte Territori Esposizioni) [35] started in 2020. The main goal of the project is the development of a software environment to facilitate the work of cultural operators for web publishing of integrated information about cultural heritage knowledge contained in heterogeneous databases. The publication framework supports different models of presentations, targeting different groups of interest. The presentation models are supported by a set of template layouts, developed according to the advices of the Italian Ministry of Culture on web site quality [36] and on the implementation of virtual exhibitions [37].

The team of the Project is composed by people with complementary competences in the development of the publication environment and in web page publishing, in cultural heritage management and in user oriented storytelling. The expected project results are the assessment of the definition of presentation models suitable for the dissemination of cultural heritage knowledge toward people interested in the sector, although if not skilled, and the implementation of web sites according to such models. The testbed for the assessment of the web publication environment is BeWeb. As stated in 2.3, the availability of a great amount of different data is a good data source for the dissemination. The integrated presentation environment of VIEd'ARTE supports the cultural operators in the access to data and metadata and in the composition of proper web page presentation within the same environment.

The adoption of BeWeB as the back-end data repository of VIEd'ARTE allows to use the data access model of BeWeB as the metadata layer integrating the different types of cultural heritage objects contained in the BeWeB databases. At the same level can be connected further data sources, adding the proper XML mapping functions.

3.1 The Presentation Framework

The page development is based on WordPress [38] extended with ad hoc plugins for data access and layout management. The WordPress CMS contains the pages and the authorization data for the developers. The data repositories are that of BeWeb databases, containing the inventory and cataloging data. During the phase of page composition the operator can store in CMS additional data to adapt the presentation to a wider audience, composed not only by experts, but also by people just curious about.

The published pages are the user interface of various types of applications: virtual geographic tours, virtual exhibitions and virtual museum, web versions of real exhibitions, virtual visit of historic buildings and churches. For each application it is developed a proper set of templates, including optional features for the main layouts of web pages.

The original characteristics of the front-end applications in VIEd'ARTE Project are the access functions to the BeWeB databases included in the presentation framework and the presentation schemas offered by the environment, supporting the cultural operators in the development of their own pages.

3.2 The Presentation Layout

The first presentation schema implemented by VIEd'ARTE is named "Routes" and support virtual geographic tours and physical site visits to cultural heritage assets.

The Route schema is structured in three levels, with three corresponding different page layouts:

- The Home Page includes a general description of the site content and of the presentation aims. The left side menu introduces a set of "Paths" crossing the works and the sites linked by the Route.
- The "Path" page allows a specific knowledge key of interpretation of the Route content. The different views of the presentation can be guided by the historic, artistic, technical characteristics of the asset, or they can give a particular cultural or religious reading. Additional views and further readings can be added to a Route simply inserting a new Path.
- The detail sheets are contained in the third level of the schema. The pages illustrate the data contained in the data repositories, e.g. inventory form of Art Objects or Architectural heritage (OA form or A form) in a way suitable for non-expert users, i.e. adding more information on the history of the heritage asset, of the author or of the content, or substituting the specialistic terms used by the inventory form with a description which uses the current language. The detail sheets can be cross-referenced by each Path. The third level layout can have nested pages of the same type, so that more specification levels can be added.

The work of cultural operators producing the site is supported by the developed publishing environment and by the included templates for the three layouts. A certain degree of customization is allowed to meet specific presentation needs, such as the inserting of image galleries and sliders, tagged maps and tagged images, administrative notices, bibliography sections, and others.

The "Routes" schema is described in Sect. 4 via the case study "On the trail of the Renaissance". The enrichment of the schema with the implementation of "Virtual Tours" allows to enter in a building and to visit its rooms with 360° panoramic views. In Virtual Tours the "Path" schemas may be implemented as sequential visits of the rooms in their physical order or as "Thematic Paths", in which the visit is accomplished following a specific interest. The Virtual Tour feature has been used in the case study of Archbishop's palace of Pisa [39].

4 The Case Study "On the Trail of the Renaissance"

The first step of the VIEd'ARTE Project has been the implementation of the web publication framework and its application to the development of the web site for a tour in the north of Tuscany, named Lunigiana, virtual visiting the places in which are preserved altarpieces of the Renaissance period. In Fig. 2 is shown the Home Page.

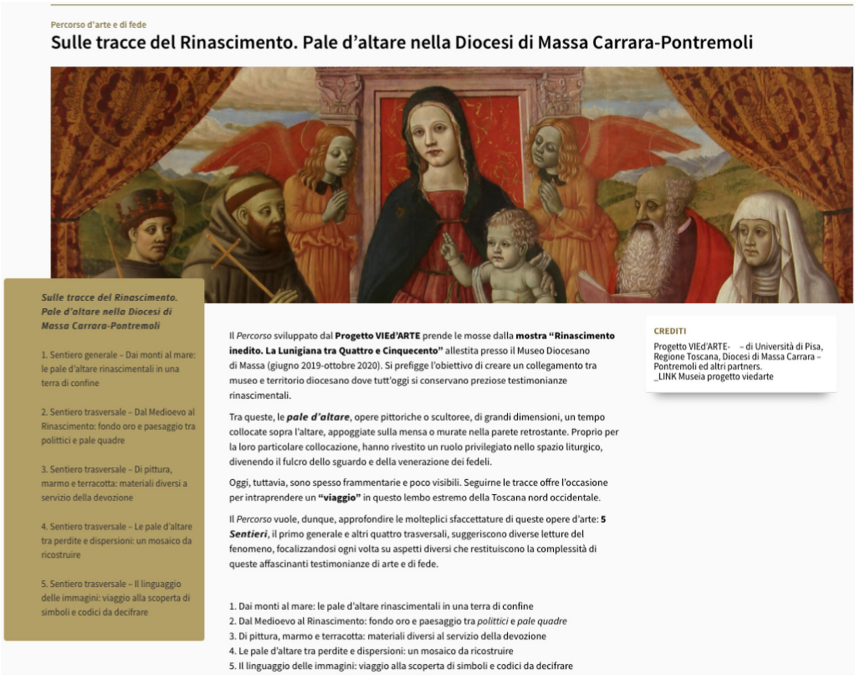

Fig. 2. HomePage of "On the trail of the Renaissance".

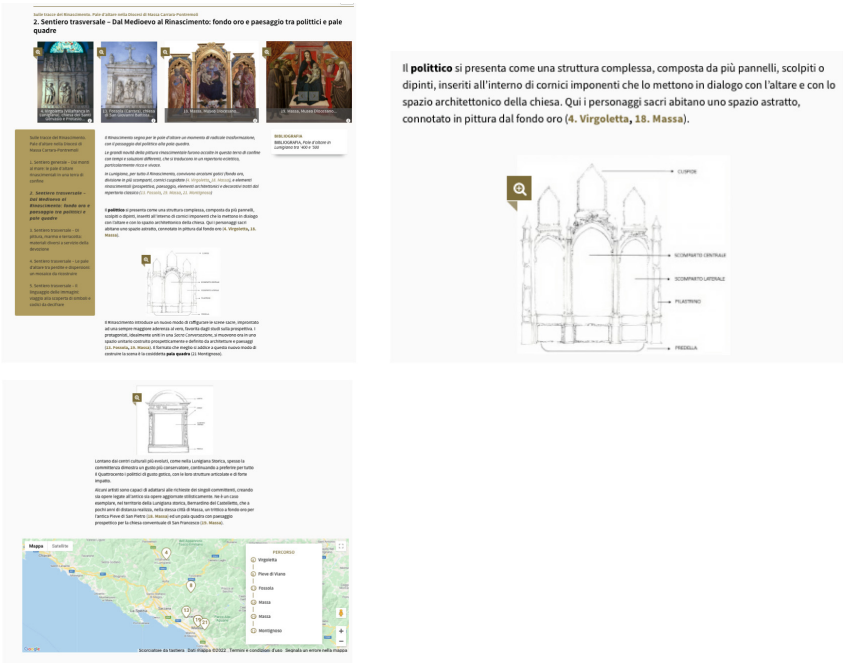

Fig. 3. The path "From the Middle Ages to the Renaissance: gold background and landscape between polyptychs and square blades"

The site contains five paths, structured as in Fig. 3. The body of the page may contains links to the detail sheets. The images in the page can be enlarged, as seen on the right of Fig. 3. An information box can be opened through the tag "i". The map on the low end of the page refers to the sites mentioned in the page.

An example of detail sheet is illustrated in Fig. 4 for a specific paint. The page contains information extracted from catalog card stored in the BeWeb database and enriched with the information added by the operator. The image of the paint enlarged on the bottom of the page has been tagged; tags open information boxes about the figures in the paint. The BeWeB database makes accessible to the experts the OA forms and many searching options, as shown in Fig. 5.

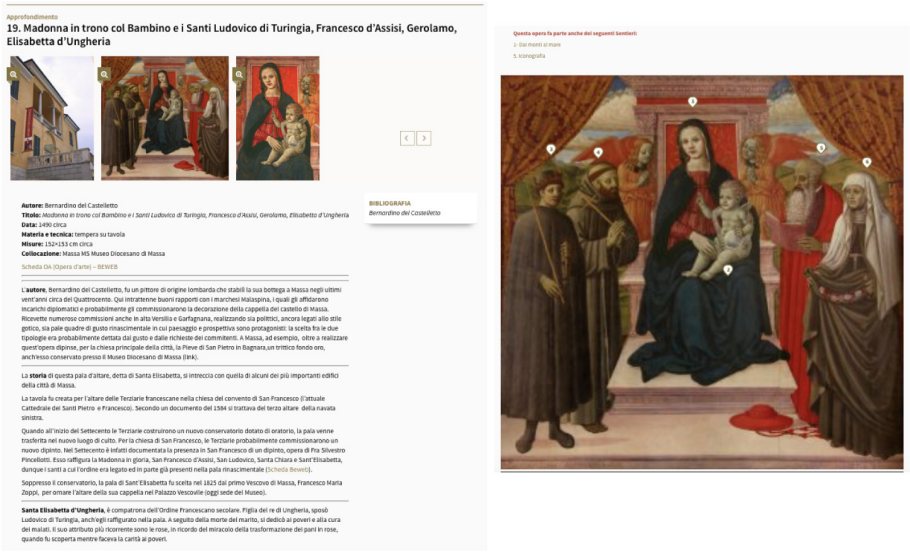

Fig. 4. Detail sheet. On the left is the upper part of the page, the lower on the right.

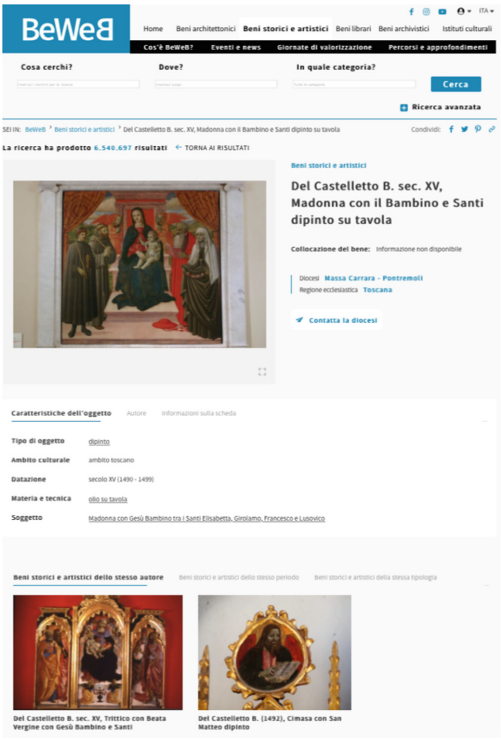

Fig. 5. The OA form and the search engine of BeWeB.

5 Conclusion

The online dissemination of cultural heritage knowledge is a valuable means not only for giving visibility to less known artistic works but also for the increase of touristic flows toward museums, churches and historical sites located outside the mainstream touristic circuits [40].

VIEd'ARTE Project has implemented a framework supporting cultural operators for the web publishing activities. So far it has been implemented the publication framework, extending the Wordpress engine with plugins for the main presentation schemas: Routes through geographic locations and Paths with specific interpretation keys, as discussed in the present work, and Virtual visits of buildings [24]. The Project is now continuing its research and development work on the implementation of data access tools and on the definition of more presentation schemas. The current activities concern the development of further extensions of the basic environment: on the publication side it is under development the application for virtual exhibitions, on the data access side it is being defined the extraction of information from databases compliant with the OAI protocol and with the Linked Open Data (LOD) model.

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