

3D-ICONS: European project providing 3D models and related digital content to Europeana

A. D'Andrea

Centro Interdipartimentale di Servizi di Archeologia
Università degli Studi di Napoli L'Orientale, Napoli, Italy
dandrea@unior.it

F. Niccolucci

Centro Interdipartimentale di Servizi di Archeologia
Università degli Studi di Napoli L'Orientale, Napoli, Italy
niccolucci@unifi.it

K. Fernie

MDR Partners, London, UK
kate.fernie@mdrpartners.com

Abstract – 3D-ICONS is a European project aimed to enhance the content base available to Europeana users through targeted 3D digitisation of European architectural and archaeological monuments which will be selected through their listing by UNESCO on its World Heritage (WH). The project aims to complement the collections which are being made accessible to Europeana via CARARE, Europeana Local, Athena and other projects which have developed the content base for the cultural heritage. 3D-ICONS is targeted to complement the 3D content brought to Europeana via the CARARE project and to increase the critical mass of this engaging content.

1. INTRODUCTION

The public is becoming increasingly familiar with 3D content through films, TV and games. But the provision of high quality 3D cultural heritage content goes above the current technological trends. It provides a highly attractive format for engaging with the cultural heritage which is increasingly popular with users as it allows better understanding and appreciation of our cultural treasures. However relatively little 3D content has yet made its way to Europeana and the digitisation of Europe's rich cultural heritage in 3D has, as yet, made less progress than the importance of these iconic monuments would suggest. There have been both technological and communication challenges to be addressed when digitising very large and complex objects: technical challenges, to acquire, manage and represent faithfully the complexity of surfaces and volumes; documentation challenges, to capture relations between the components of each monument and to cultural facts; cultural challenges in conveying the significance of the masterpiece; and communication challenges in publishing the results in a way which is understandable, interesting, entertaining and accessible to general Internet users. Previously funded EU research projects ([1], [2], [3], [4]) have solved most of the individual issues quoted above, but still mass digitisation of complex monuments is lacking.

3D-ICONS is a European project, funded by European Commission (CIP 297194), aimed to exploit existing tools and methods and to integrate them in a complete supply chain of 3D digitisation to contribute a significant mass of 3D content to Europeana. This project proposes to digitise a series of architectural and archaeological masterpieces of world and

European cultural significance and provide 3D models and related digital content to Europeana, with the aim of contributing to the critical mass of highly engaging content available to users. 3D-ICONS started on the 1st of February 2012 and will run for three years. More details about the project and its partnership are available on the project web site [5].

2. PROJECT OBJECTIVES

The project focuses on UNESCO World Heritage monuments and other monuments of outstanding value at European level, to illustrate a particular strand of Europe's history. The digital content includes overall 3D models and reconstructions, enlarged models of important details, images, texts, videos. It will also include and re-contextualize in 3D, objects belonging to a monument but presently located elsewhere, for example in museums. The project's activities will include both new digitisation as well as the conversion of some existing 3D data into formats which are accessible for Europeana users. The project's anticipated impact is making accessible through Europeana an unprecedented quantity of high-quality, 3D, well-organized and attractive information about the masterpieces of European architecture and archaeology.

3D-ICONS will enhance the content base available to Europeana users through targeted 3D digitisation of European architectural and archaeological monuments. The project aims to complement the collections which are being made accessible to Europeana via CARARE, Europeana Local, Athena and other projects which have developed the content base for the architectural and archaeological heritage. Most notably, the results of 3D-ICONS will complement the 3D content brought to Europeana via the CARARE project and to increase the critical mass of this engaging content. It is also an important objective of the project to build on the results of previous EU projects most notably on CARARE for the aggregation services and guidelines on the publication of 3D for Europeana, and on 3D- COFORM for the 3D creation, management and visualization tools.

The target users of the 3D-ICONS include:

- members of the general public, tourists and students who wish to be able to explore and enjoy architectural and archaeological masterpieces which are often inaccessible to visitors either as a result of their remote locations or because conservation management restricts access to parts of the monuments.
- Europeana users who wish to access, explore and enjoy 3D models together with the related high-quality information.
- The cultural institutions who are in charge of internationally and nationally important monuments and buildings and who need tried and tested mechanisms to produce high quality 3D documentation and publish the results for Europeana as well as on their own websites.
- UNESCO and cultural institutions wishing to find new ways of delivering their missions to promote understanding and increase the sustainability of world and European heritage.
- Content providers and creative industry SMEs wishing to identify sustainable business models to make

3. CONTENT

The content which will be created by the project includes many of the most famous monuments and buildings in Europe, such as The Royal Site at the Hill of Tara in Ireland; Etruscan necropolises with their painted tombs; the Coliseum with the Roman Fora and other

monuments in Rome and throughout Europe; Pompeii; Greek temples from Greece and Italy; the Italian medieval city of S. Gimignano; the Leaning Tower and the Cathedral of Pisa; the Renaissance Centre of Florence; Versailles; to end with such icons of modernity as the Arc de Triomphe and the Centre Pompidou in Paris. At the end of the project some 60 such iconic monuments and sites will be available on Europeana, incorporating more than 1000 3D models of buildings, more than 4000 3D models of architectural details and related objects and more than 10.000 high-resolution images.

The project will consider a long-term sustainability perspective by developing a business model for monument digitisation, including a detailed cost and potential profit analysis. In general, this envisages balancing the costs of digitisation (as reduced by the rationalization induced by the solutions created by this pilot project) with the exploitation of 3D models for commercial use, in collaboration with the content owners. Since rich 3D models have started to have a market, in the medium term break-even should be reached, although in the beginning some seed money may be required.

The digitisation of archaeological and architectural monuments requires arrangements with the authorities in charge of the monument. For content directly digitized by the project, agreements have been made for provision, re-use, improvement and aggregation with already available content. For future use by others, the project will describe an IPR management model that is acceptable for most European public authorities, according to the very diverse legislations existing in Europe. It envisages free access for personal and “fair” use, such as access through Europeana, but allows IPR protection for commercial use. The tools used in the project will be mainly based on open source technologies and the „production pipeline’ that the project plans to establish will be made publicly available for use by cultural institutions and others. The skills developed by the partners may enable them, individually or collectively, to offer consultancy and expertise services. This may include updating the technology.

4. TECHNICAL SOLUTIONS

The technologies likely to be used by the project include:

Scanning equipment

Many different technologies exist and have reached a sufficient level of stability and effectiveness to be used in standard digitisation campaigns

- short-range scanning based on triangulation,
- long-range scanning based on time-of-flight,
- images-to-3D reconstruction based on different incarnations of stereo-matching and photogrammetry,
- modalities for gathering enhanced 2D media, such as Polynomial Texture Maps (PTM) or very large panoramic image).

3D Data acquisition

The 3D data acquisition process involves technologies for both surveying and modelling (topographic surveying, 3D laser scanning, image-based modelling, etc.). A range of technology solutions are available for the processes and are well known and tested, and the equipment used will be selected case by case according to the features of individual objects.

3D model construction

The technology available for 3D model construction is mature and includes these examples of open source software created within previous EU projects:

- MeshLab, a well-known open-source software also developed within the 3D-COFORM project. MeshLab [6] supports a complete set of instruments for the easy

and complete post-processing of raw data (range maps and point clouds), generating derivative models and so on. It is a very stable and consolidated system, with a wide user community (thousands of users worldwide).

- Blender [7] is a tool for further post-processing of the 3D models.

Creation of 3D models

The project will use procedural modelling for the creation of 3D models, for example in the reconstruction of models of destroyed or transformed structures or for the generation of large-scale 3D models (i.e. in the case of a city). A tool which supports this process is CityEngine, also developed in 3D-COFORM, which is commercially available (a light version is offered at low cost). The free version of SketchUp (the commercial version sells for less than 400 €) provides a tool for rapidly generating good quality content.

Metadata and harvesting

Building on work by the CARARE project, 3D-ICONS will implement tried and tested infrastructure to support interoperability and data exchange with Europeana (DEA) including:

- OAI-PMH compliant repositories. Research on repositories for complex 3D models and their metadata has been carried out within 3D-COFORM and other research projects, producing prototypes that may be useful for 3D-ICONS deployment.
- Metadata Mapping and Ingestion Tool (MINT) developed by the National Technical University of Athens and implemented by CARARE and a number of CIP-ICT-PSP funded Europeana Aggregation Services (including Athena, EU Screen amongst others).
- CARARE repository (MORE), based on the MOPSEUS system developed by the Digital Curation Unit of the Athena Research Centre which is in turn based on the widely used Fedora platform.

Publication

Building on the recommendations made in the CARARE for the publication of 3D models online in formats suitable for access by Europeana users, 3D-ICONS plans to convert complex 3D models to 3D PDF, a format supported by Adobe and which is widely used and fully mature.

3D-ICONS will monitor new open source technologies like WebGL as alternative technical solutions for bringing complex 3D content to popular Web browsers. However these technologies are not yet fully matured and are currently supported by a limited number of web browsers and are not suitable (not capable of) rendering complex 3D models.

Data will also be made accessible to external users in the Portal section of the web site, via dedicated high- quality browsers and visualization tools such as the open source Nexus multi-resolution representation proposed and endorsed by 3D-COFORM [2], availing of the experience of partners on using web-based technology for sharing 3D models over internet (as for example, the SpiderGL library [8] and the existing demos).

5. INNOVATIVE ASPECTS AND COMPARISON WITH EXISTING SOLUTIONS

3D-ICONS will build on the achievements of the CARARE project, which is already providing digital assets about European archaeology and architecture. It uses the CARARE aggregation service and extend CARARE's coverage by digitisation in 3D of monuments and buildings and creating a large number of related digital items such as 3D models, images, texts, and possibly more. Each digital replica will be considered an aggregation in the ORE

OAI sense - that is a conceptual combination of many digital objects pertaining to the same monument in order to capture the cultural complexity of such masterpieces. Content will be published according to the Linked Open Data paradigm, by identifying things with standardized references (URI). This will align with the developments in Europeana (EDM, Danube release), building on the services already provided by CARARE and incorporating results from other Europeana-related projects such as EuropeanaConnect and Linked Heritage, 3D-COFORM, an FP7 Integrated Project on 3D collection formation and others, for example CASPAR (long-term preservation of digital data) [9].

The combination of these existing tools and services, so far tested only on a sample of sites (3D-COFORM), will result into an innovative service scheme addressing all the steps of the production pipeline from data creation/acquisition to publication.

The characteristics of the proposed pipeline are the following:

1. Flexibility in data creation. The project is adopting state-of-the-art, open source software with guaranteed performance and quality results but will use different systems for 3D data acquisition and modelling on different monuments enabling comparison of their relative advantages. An important outcome of the project will be clear guidance for future users in choosing one technology over another.

2. Advanced semantics. Rich metadata will be added to digital content produced by the project in order to comply with Europeana specifications for flawless ingestion. The project will adopt the CARARE schema which is being implemented by projects on the tangible heritage, preparing an extension for 3D capture if needed. Terminology will be based on existing standard thesauri, building among others on those adopted for historical buildings and archaeology by ICCD (IT), English Heritage (UK), Ministère de la Culture (FR), and using widely accepted standard lists such e.g. as VIAF, ULAN, *geonames* for other related information. Standardization will facilitate implementing a Linked Open Data approach. By adopting the aggregation approach proposed by ORE-OAI and creating conceptual objects from the aggregation of others, the complexity and multi-faceted nature of architectural masterpieces will be maintained.

3. Quality outcomes. The project will adopt relevant charters and best practices for the creation of 3D cultural heritage models and their use – mainly the London Charter³ – and thus the methodology proposed by the project will guarantee high-quality results from a cultural perspective. Technological quality (e.g. high resolution) will be incorporated in the models, with provisions for publishing versions to optimize the balance between required bandwidth and high definition.

4. Business considerations for future implementation. The project will develop a business model including:

- Cost analysis of the different solutions for data creation
- IPR management models enabling free access through Europeana and exploitation for commercial use.
- Organizational models proposed to content owners, usually public cultural institutions, and service providers, usually SMEs.

5. Attractiveness and wide interest. The public will appreciate the possibility of accessing so famous European monuments and the related information. Altogether, the sites digitised attract millions of visitors every year, a measure of the interest for the digitised masterpieces. Content owners will have a safe IPR management model and content producers will rely on a tested business model.

6. CONCLUSIONS

The broad context of the 3D-ICONS is the 2020 strategy for Europe and the Digital Agenda for a flourishing digital economy and the standards and increased interoperability needed to support Europeana as a multilingual common access point to millions of objects for all European citizens. By January 2011, Europeana provided access to more than 14 million books, maps, recordings, photographs, archival documents, paintings and films from 1,500 cultural institutions across Europe exceeding the content targets which were set for it by the European Commission. This content begins to illustrate the potential for Europeana to be used in schools and in other services. Yet there is great potential to continue extending and enhancing the content base – this was highlighted in the Comité des Sages' (the EC reflection group) *New Renaissance* Report on Europeana in January 2011. Europeana has itself set out in its Strategic Plan objectives in terms of both extending the content base and in seeking to cultivate new ways for its users to participate in their cultural heritage and to enhance their experience.

3D-ICONS supports these policy objectives by enabling increased access to important cultural heritage sites through an effective use of digital technology. Through 3D models the general public can visit sites which may be in remote locations, fragile and in some cases difficult to understand.

3D-ICONS will both contribute to the expansion of Europeana's content base and also offer enhanced experiences for its users by bringing exciting and engaging content for archaeological monuments and historic buildings. The content will comprise of a range of formats including 3D models, movies, texts and 2D images. More than 1000 3D models of buildings, more than 4000 3D models of architectural details and related objects and more than 10.000 high-resolution images will be brought to Europeana by 3D-ICONS.

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