On Providing 3D Content to Europeana – The case of 'Athena' R.C.

Anestis Koutsoudis
akoutsou@athena-innovation.gr

Institute for Language and Speech Processing, Multimedia Laboratory,
Athena Research and Innovation Centre, PO BOX 159, University Campus,
67100, Xanthi, Greece

Abstract

The CARARE best practice network funded by the European Commission's ICT Policy Support Programme has recently established a methodology for Europeana to provide a point of access to 3D and Virtual Reality content. The proposed pipeline allows bringing to Europeana geo-referenced 3D/VR models. One of the roles of the Athena Research Centre was the provision of cultural heritage 3D content. This paper briefly outlines the content of the 3D model collections that have been published to the broad public through Europeana that is the European Cultural Heritage digital library. It describes the procedures that have being followed in order to prepare the content in the 3D-PDF format. It discusses the approach of handling 3D scenes such as parts of urban areas than contain several cultural heritage entities.

Keywords: 3D content, cultural heritage, 3D-PDF, Europeana, metadata, CARARE, Archaeology, Architecture

1. Introduction

The 3D digitisation of cultural heritage monuments is considered today a common practice [1]. Real time 3D graphics cards in combination with viewpoint aware 3D geometry occlusion algorithms allow the virtual exploration of such high geometric complexity 3D scenes. The presentation and dissemination of our cultural thesaurus are important factors for achieving greater accessibility. 2D digital dissemination media such as sketches, designs, drawings, paintings, photographs and video sequences have already been used for decades. It is a fact that 3D content has become very popular not only due to technological trends (e.g. 3D films, mobile phones and television sets with 3D displays, 3D computer games) but also because it provides a mean for better comprehension and appreciation of the visual content. In general, 3D content is more complex in terms of parsing, visualising and exploring (virtual touring). On the other hand, 3D content is more demanding in terms of processing power, data storage and network bandwidth facilities. In fact, 2D and 3D digitisation are completely different in terms of complexity and potentiality. The latter is actually aims towards the production of complete digital replicas.

As one of the main scopes of 3D digitisation is the dissemination of our cultural thesaurus, several of the produced 3D models have been published on the Internet and thus can be accessed using a Web browser that is equipped with the appropriate plug-ins.

At present, a number of initiatives in the form of research and development projects are focused on enriching the content of cultural heritage digital libraries with 3D digital replicas of monuments, architecturals, urban areas of cultural importance and artefacts. Such an example is the recently initiated *3D-ICONS* project that brings together partners from across Europe with relevant expertise to digitise in 3D architectural and archaeological monuments and buildings identified by UNESCO [2]. Furthermore, the *3D-COFORM* consortium attempts to establish 3D documentation as an affordable, practical and effective mechanism for the cultural heritage domain [3]. The *Sculpteur* project was a three year project that aimed towards the creation of distributed multimedia libraries for storing, searching and retrieving diverse multimedia types with significant support for 3D objects [4]. Moreover, the *CARARE* best practice network brought together heritage agencies and organisation of Europe and established a service that provides 2D/3D digital content to

Europeana [5]. The *CARARE* project belongs to a suite of projects that help in the development of Europeana. It actually builds on the work of earlier projects that have contributed to establish a framework for interoperability in the cultural heritage domain [6].

2. 3D Content Collections

The 3D content provided by Athena R.C. was created mainly for dissemination *over-the-Web* purposes or to be used in stand-alone Virtual Touring applications. For their creation, we have been using multi-image terrestrial photogrammetry, *time-of-flight* 3D laser scanning, topographic designs and empirical measurements. The texture mapping was also performed manually. A number of screenshots of the 3D content is illustrated in Figure 1.

Figure 1. Screenshots from the 3D content provided by Athena R.C.

Some of these 3D models (*A.1-A3* and *C.1*) have been created for *first-person-view* virtual tours only and thus the 3D geometry is restricted to the content visible by the virtual visitor's limited viewpoint. More specifically, the provided content it is organised into three thematic areas. These are the following:

2.1 Urban Areas of Cultural Importance (involves traditional settlements in the cities of Xanthi, Kavala and Drama, Region of Eastern Macedonia and Thrace, Greece)

These 3D reconstructions were implemented within the frame of a low budget project that relied on open source software such as Panorama Tools (ptStereo and PtPicker) [8][9], Blender [10], Hugin [11] and Gimp [12].

***A.1 The old town of Xanthi*:** It is considered as one of the largest traditional settlements of Greece that has the specialty to exhibit mixed traditional Greek, European and Oriental

architectural features. The settlement is characterised by the diversity of architectural types and styles. It is a prime example of local architecture that allows the visitor to discover its eclectic traditional architectural mixture of buildings that are strongly influenced by 19^{th}-20^{th} century European architecture. The 3D model [7] being offered through Europeana covers a small portion of the heart of the settlement.

A.2 The old town of Kavala (or the peninsula of Panagia (Virgin Mary)): The old settlement is located on the peninsula of Panagia. The stone paved streets and the traditional houses are some of the strong characteristics of the area. The 3D model includes a portion of the Imaret complex of buildings, the house of Mohamed (Mehmet / Muhammad) Ali Pasha (1805 – 1848), founder of the last royal dynasty of Egypt, the church of Panagia (Virgin Mary's Assumption) and a small lighthouse located at the edge of the peninsula [13].

A.3 Santa Barbara's springs area in Drama**:** The 3D model covers a small area of the Santa Barbara's springs region that is located in the centre of the modern city. It is considered a trademark for the city of Drama. It is featured among the 60 best parks in Europe. The model depicts the church of Santa Barbara that was built in 1920 and a number of tobacco warehouses located around the lake [13].

2.2 Byzantine Churches in Greece that involve two churches in the area of Mani

The 3D reconstructions include the exterior and the interior of the temples. The 3D models were created using empirical measurements and photogrammetry. The polygonal mesh was manually textured map in Blender using a number of rectified, in terms of perspective and lens distortions, images.

B.1 Church of Ayios Vasilios in the village Kelefa in Mani**:** The church of Ayios Vasilios is located in the large central square of the village Kelefa in western Mani, Peloponnese, Greece. It is an inscribed domed temple with two columns, where the western part of the cross is extended by a pair of pillars. In the west, stands a tall belfry with two bells, which grows in three stages. The temple is built of stones and mortar in its joints. The formation of its facades does not have specific morphological characteristics, except for the stone frames around a few openings [14].

B.2 Church of Episkopi in the Village Of Stavri In Mani**:** The church is situated near the village of Stavri and dates in the Middle Byzantine period. The temple is honoured in the name of Virgin Mary, but seems to have been dedicated to Ayios Georgios (Saint George). It is a two-columned cross-in-square church, with dome and a narthex, which is the most common type of cross-in-square church that one can meet in the region of Mani. The church is built of stone and at various points it has built-in architectural fragments in second use. In the side walls of the narthex there is single-lobe arched window, which is blocked with a relief marble slab. The dome belongs to the *Athenian type*, it is built of limestone and has a cloisonné structure [14][16].

2.2 Byzantine Castles in Eastern Macedonia and Thrace, Greece

Currently it contains a 3D model of the Byzantine castle in the city of Kavala (Greece).The 3D model was digitised using an Optec Ilris 3^6D time-of-flight 3D range scanner [17]. The raw range scan data were imported in Blender and a low- polygon surface mesh was created by manually selecting vertices that depicted sharp corners or edges. Additional, computer graphics techniques such as texture map tile maps and double texturing ambient occlusion shadows were used to create a more realistic result [18].

C.1 The Byzantine Castle of Kavala**:** The Byzantine castles that were located in the area of Macedonia and Thrace had a particular role, that of the defensive *wall* of the Empire. They functioned as the connecting knots of a network in order to protect the capital, Constantinople (Istanbul). The castle of Kavala or Fortress, as the locals use to call it, is located on the peninsula of Panagia (Virgin Mary). The outer walls surround the peninsula by following the coast line on three sides and only a part of them declines [20].

3. 3D Digital Resources Generation Pipeline

In this paragraph, we describe the 3D digital resources generation pipeline. Figure 2 depicts the different stages that are parts of the pipeline being followed.

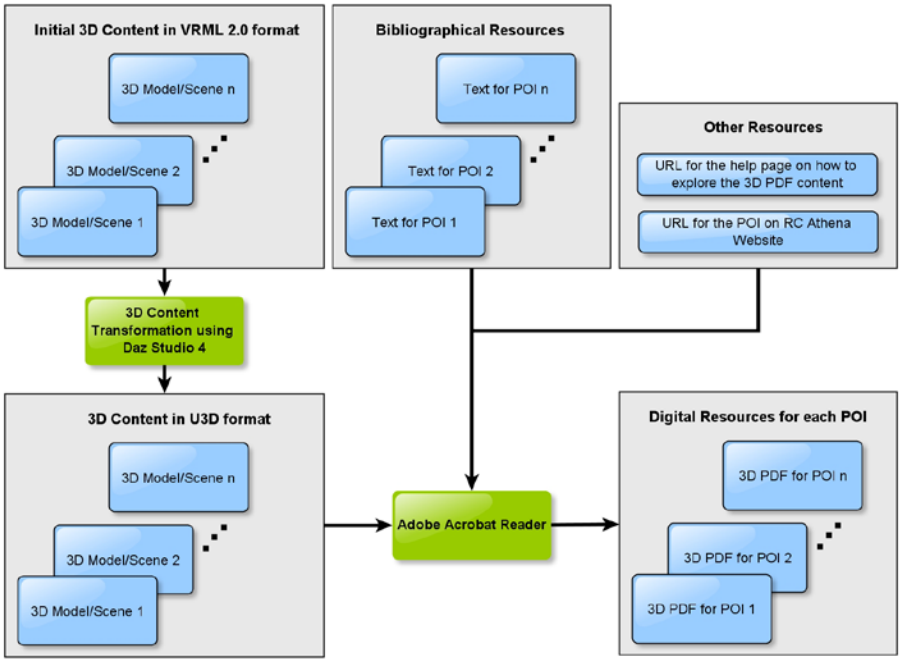

Figure 2. 3D Content Preparation Pipeline

Initially, all the 3D content was stored in the text based VRML 2.0 format [22]. The 3D-PDF file format has been selected as the major solution to provide content to Europeana. The high user-penetration of the Adobe PDF along with the fact that a complete 3D model is stored into a single file (digital resource) are considered some of the key reasons for selecting the current technology. For the creation of the 3D-PDF files, a transformation to the Universal 3D (U3D) [23] file format was a necessity. The U3D standard is natively supported by Adobe Acrobat Reader. This transformation was performed using the free version of DAZ Studio 4 [21]. Then, the U3D files were imported in Adobe Acrobat Reader 9 Professional in order to create a thematic PDF file with 3D content.

The development of the PDF files content was based on the assumption that unlike a 3D digital replica of an artefact, a 3D model of a monument or one of an archaeological site can be considered as a *collection of 3D objects*. Thus, a 3D scene can also be considered as a static database. The entities in these collections need to be described whereas they reflect archaeological, architectural or other important features. In this work, we establish relationships between *Points-of-Interest* (POIs) in the 3D scenes and sets of textual information that add value to the POIs' content by describing historical, archaeological, architectural aspects. According to the proposed annotation approach, entities such as a building, a statue, a monument are considered as POIs as they exhibit aspects in the given context domain. Hence, the procedure of identifying POIs is absolutely interlinked with the content of the 3D scene, the scope of its creation and the information context that can be extracted from it [24].

For each one of the 3D models, a number of POIs were identified. Then with the help of the Cultural Heritage Unit bibliographical resources were identified and informative texts with archaeological, historical and architectural context were prepared in both English and Greek languages. All the textual information that is related to the content of a single 3D scene (e.g. The old town of Xanthi) was organised into a single PDF file along with a set of predefined viewpoints in the 3D content that reflect the POIs. Hence, the end-user is always

offered with a complete documentation of the monument (or the 3D scene) along with the ability to be transferred directly in front of a POI without having to manually explore the model. The complete PDF file was then stored as a number of different file versions. For each file version, the default opening page was set to a different POI.

Furthermore, all POIs were described as different entities using the CARARE schema and thus a different unique digital resource was assigned to them. The provided metadata contained also georeferencing data. Median points and bounding boxes were provided for all POIs using the WGS84 system. Consequently, the end-user will be presented with all the annotated content of the 3D scene as independent options when querying the Europeana's search engine.

Additionally, a Web-based *step-by-step* user guide on how to enable the 3D content of a PDF file along with details on how to explore a 3D scene has been designed in both Greek and English language. A link to this Webpage has been added in each PDF file under each 2D image thumbnail that links to the 3D content. Thus, an efficient method to support users that are not familiar on exploring 3D content has been provided.

Figure 3 depicts an example of a POI in the 3D model of the old town of Xanthi followed by its textual information.

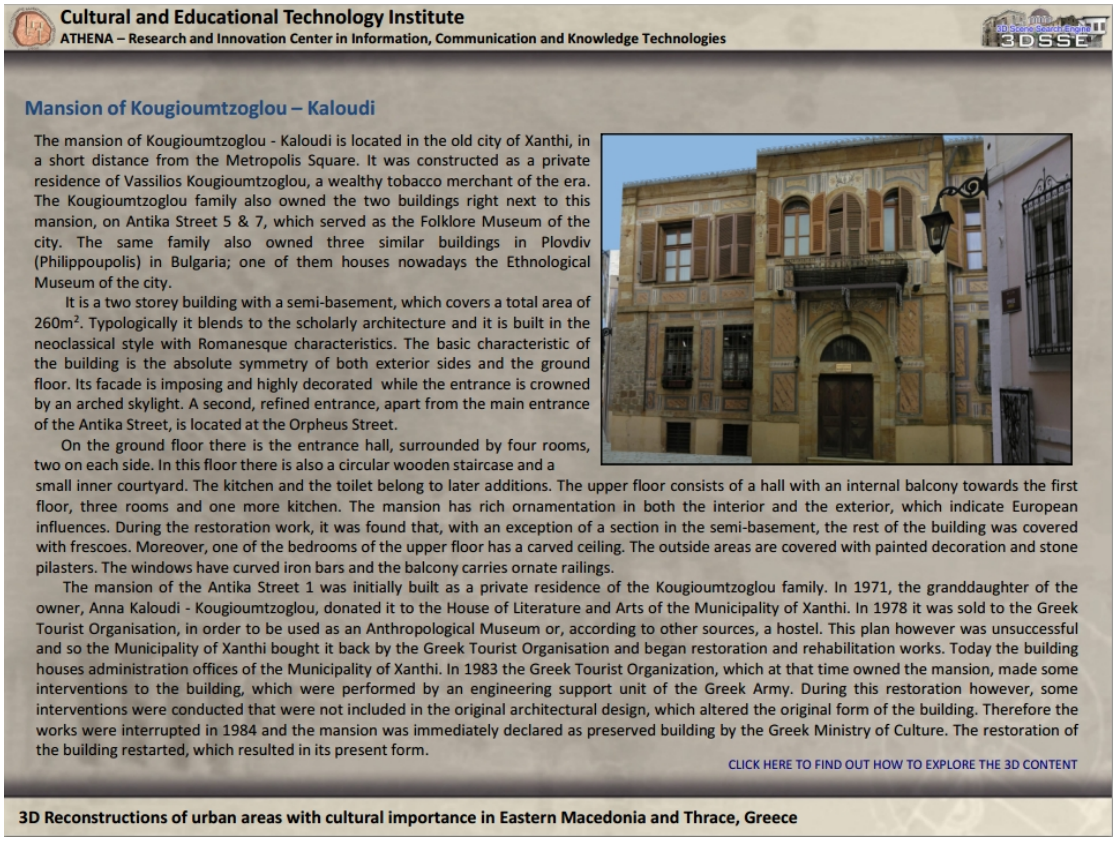

Figure 3. Example of a thematic PDF with 3D content

5. Conclusions

In this paper, we have briefly outlined the procedures being followed to prepare the 3D content that has been provided to Europeana using the pipeline described and established by the CARARE Best Practise Network. The proposed pipeline enables heritage agencies, organisations, museums and research institutions to increase the critical mass of 3D content available to Europeana.

We followed the pipeline by taking under consideration the fact that a complex 3D scene carries a number of entities that have to be visible when querying within Europeana.

We have created different digital resources for each POI within the 3D scenes in order to unburden the user from the time consuming process of manually exploring 3D scenes. Currently, Europeana users can only have access to the English language versions of the 3D-PDF files.

Concluding, a follow up of the CARARE project is the 3D-ICONS project [2]. The two projects share a number of partners that will continue towards the same direction and bring new 3D content to Europeana. More specifically, the 3D-ICONS continues on the work done within the CARARE project frame and brings together partners from across Europe with the relevant expertise to digitise in 3D architectural and archaeological monuments and buildings identified by UNESCO as being of outstanding cultural importance.

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