

D5.5 Three Documented 3D/VR Case Studies

CASE STUDY 3: Maltese Prehistoric Sites and Collections



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Abstract

Created in 2002, Heritage Malta is the national agency for museums, conservation practice and cultural heritage. As reflected in its mission statement, the responsibility of Heritage Malta is to ensure that all the aspects of cultural heritage entrusted to it are protected and made accessible to the general public. This translates to a multitude of functions in real life which include research, management, conservation, interpretation, marketing, education and dissemination.

The rapid advance of technology over the last few decades has completely changed the way we interact with information and gain knowledge. From searching online to social networking, technology and the Internet have become an important element in many aspects of our lives, not the least of which are research and education. This has prompted Heritage Malta to invest in the digitisation of the historical sites and items under its care, both to create high quality records of their current state for posterity as well as creating a tool for research, management and public dissemination.

In order to make these resources more accessible, Heritage Malta joined the Best Practice Network CARARE in 2009 which is a dedicated group of universities and heritage institutions that are working towards adding records on the archaeological and architectural heritage of Europe to the online digital library, Europeana. To the visitor, Europeana has given access to a repository of over 20 million object records, ranging from images to ancient texts, audio and video files, from 34 countries. To the heritage institution, Europeana has become a gateway to reaching millions of visitors across the world. Already in the first nine months of 2012, the site has registered over 3.5 million visits (Europeana 2012), making it an ideal dissemination tool.

Heritage Malta has been using 3D scanning since 2005 to record its megalithic temples, which are World Heritage sites, and will make these available as 3D PDFs through the technology options offered by the CARARE Project. In addition, 7,000 digital records of various archaeological objects are also being made available to Europeana through CARARE.

Keywords: Neolithic, Bronze age, megalithic temples, World Heritage Sites, 3D models.

1. Introduction – Malta’s prehistoric cultural heritage

In spite of its small size, the Maltese archipelago has a rich and varied history. Archaeologically, it is probably best known for the imposing remains of megalithic structures dating back to the Neolithic period of Maltese prehistory. These structures are dated to between c. 3600 BC and 2500 BC, a period which became commonly known as the Temple Period. Some of these structures were reused in the subsequent Bronze Age period (2400 to 700 BC). These free-standing structures, with their characteristic D-shaped rooms flanking an open central space, were constructed from massive limestone blocks. In most structures, well-dressed blocks form a concave monumental facade overlooking a level forecourt whilst a large external wall delimits the structures. Considering that they were built in a period when technology was limited to wood, stone and bone tools and society was based on agriculture and animal rearing, it is no wonder that six of these structures have been inscribed in the UNESCO World Heritage List since 1992 as the most characteristic examples of a major cultural, artistic and technological development. These sites are the Megalithic Temples of Malta, namely Hagar Qim, Mnajdra, Tarxien, Ggantija, Ta' Hagra and Skorba Temples. (Figure 1).

Also from the same period, with its own inscription in the UNESCO World Heritage List since 1980, is another unique site, the Hal Saflieni Hypogeum. Carved into the soft limestone bedrock of the modern-day town of Paola, this underground site consists of three distinct layers of chambers which were used for burial during the Maltese Neolithic period. Carved features, which mimic elements from the contemporaneous above ground Temple sites, and red ochre paintings on the rock walls which have survived over 4000 years, give evidence to the artistic heritage of the people who built and used the Hypogeum. (Figure 2) .

The excavation of these and similar sites have also produced a rich and varied collection of prehistoric artefacts which range from finely carved statuettes depicting obese human figures to decorated pottery, stone jewellery and metal implements from the Bronze Age.



Figure 1: The Hagar Qim Temples
(Photo: Heritage Malta)



Figure 2: The chamber within the Hal Saflieni Hypogeum known as the Holy of Holies
(Photo: Heritage Malta)



2. Heritage Malta's data

Over the past decade, these sites have played a major role in Heritage Malta's digitisation efforts. The archaeological collection, consisting of thousands of artefacts, is in the process of being catalogued and photographed. Of these, approximately 6,000 records of artefacts span Maltese pre-history from its earliest days in the Neolithic period up to Punic, Roman and Medieval times.

The approach adopted towards the architectural remains, the Megalithic Temples, had to account for the complexity of the structure and its surfaces, some of which are decorated. It is for this reason that, back in 2005, the first tests were made on the use of laser scanners for accurate three dimensional recording at the Ggantija Temples in Gozo. Between 2006 and 2011, with the help of European funds, Heritage Malta has created a 3D record for all the World Heritage Sites under its care. Whenever possible, similar technology is now also being utilised for the documentation of artefacts.

These models are currently being prepared for inclusion in Europeana through the CARARE project as part of its efforts to include three-dimensional records into the digital library. However, the combination of very complex structures, uneven surfaces and the use of high resolution laser scanners has created models with some very particular issues. The biggest challenge is the sheer size of the models with the high density of points recorded and the high resolution texture. This makes it difficult to view, navigate and certainly far too large to upload onto the internet. The older models, carried out between 2005-2008 when the technology and its application in such sites was still developing, also present an additional challenge in the form of gaps in the model caused by lack of data.

3. Preparation of the models for CARARE and Europeana

Work to date on preparation of the 3D models for CARARE and Europeana has focused mainly on addressing two challenges: improving the model aesthetically and reducing its size for online publication. Several meetings with Work Package leader, Daniel Pletinckx, have helped identify a possible solution to the first issue which consists of utilising alternative methods of recording in 3D, such as the image-based modelling for cultural heritage developed by the EU-funded EPOCH project, to create point clouds for the areas where data is missing and then merging the two. The point cloud was created using aerial images taken from the maintenance walkway which forms part of the protective shelter over Hagar Qim during a visit by Dr. Pletinckx. With help and guidance of specialists from the University of Malta, namely Mr. Sandro Spina and Dr. Suzanne Psaila, this merge was tested with promising results for one of the apses/rooms of the Hagar Qim Temples.

Although the image-based point cloud is of lower quality when compared to the high resolution, highly accurate laser scan clouds, in most areas the merge of the two point clouds fit well enough to make an acceptable model for public presentation (Figures 3 and 4). Once testing is complete, this process will be applied to the Hagar Qim and Mnajdra Temples models.



Figure 3: High resolution three dimensional model of the Hagar Qim Temples.
Image showing part of the external wall.

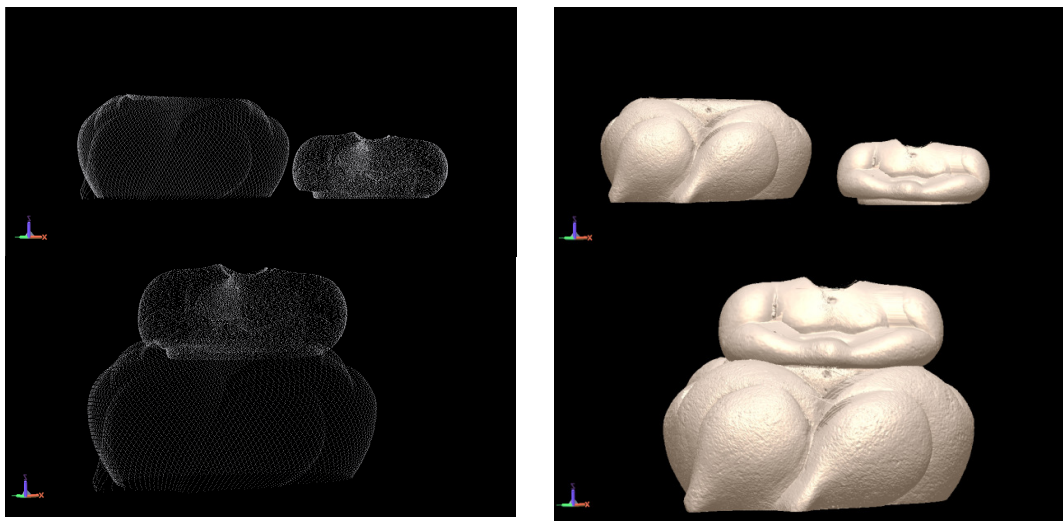


Figure 4: Merging of laser-scan based and image-based point clouds. Initial test carried out by Dr. Suzanne Psaila. (Images: Dr. S. Psaila)

The second challenge, reducing the file size of these models to enable online publication, is also being addressed. Again, on Dr Pletinckx's and Mr Spina's suggestion, a simplification of the mesh has been tested on the latest of the models to be produced, the Tarxien Temples model. This has already been successfully reduced from 760Mb to a mere 69Mb. A loss in resolution is unavoidable but acceptable for its intended end use. However, although the reduction in size is remarkable, further experiments will be carried out to try to reduce it further as the model is still too large for online use.

A back-up solution, which consists of breaking up the model into smaller pieces such as a set of rooms instead of a whole site, was also identified in case any of the preferred solutions failed for one or more of the models.

4. Publishing the models as 3D PDF

The chosen vehicle for the online publication of these models for Europeana is 3D PDF, primarily because it is accessible to all through a free viewer, it is easy to use and offers a number of convenient functions such as having named views, linking certain viewpoints to the descriptive text and allowing full 3D navigation.

Until the tests are completed on the reduction in size, efforts have concentrated on creating 3D PDF models which contain at least one part of a site model. The 3D models within the document would therefore be illustrating highlights of the site rather than allowing the user to see the site as a whole.

One example, “HM 3D-PDF-Tarxien temples Earliest remains.pdf” (5.83MB), is the model of the earliest of the four Megalithic Temples which make up the Tarxien Temples complex. The document contains a brief introduction to the site, a description of the remains, a plan of the site which indicates the location of the area being described and the 3D model itself. The preparation of the 3D PDF document required: segmentation of the model; simplification of the mesh reducing its size to 25% of the original; conversion into U3D format; and finally, the assembly of the document using Adobe Acrobat 9 Pro Extended.

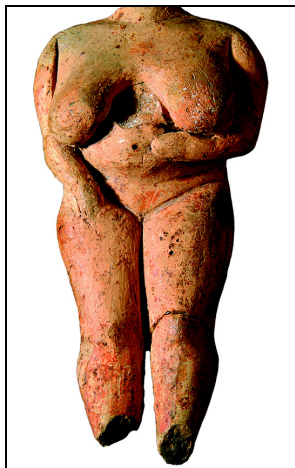


Figure 5: The Venus of Malta

A second example, “HM 3D-PDF-Venus of Malta.pdf” (1.65 MB), shows one of the iconic stone figurines originally discovered at Hagar Qim and which now forms part of the national collection and is on display at the National Museum of Archaeology. The layout of the document is similar except for the site plan which has been replaced by an image of the original.

One particular site however presents a different challenge with regards to its online publication. This is the model of the Hal Saflieni Hypogeum. Apart from the size of the model, the very fact that the site is underground requires a different form of interaction from the user - particularly when it comes to navigation. The tool used to publish such a model needs to be able to stop the user from navigating through the rock walls as this would only make the experience confusing and unrealistic. Upon Dr Pletinckx's suggestion, several solutions for this are being considered including the use of a simple virtual reality environment where such constraints can be enforced. However, a final decision has not yet been made.

5. Digital Library Mapping

Heritage Malta has over 7,000 records with images of archaeological objects within its digital asset management system. All the images and metadata of these sites and artefacts, ranging from megalithic structures (such as the "Mnajdra Temples"), to figurines (such as the "Sleeping Lady" and "The Venus of Malta", [Figure 5]) and tools (such as "Bone Borers"), will be ingested in the CARARE MORE repository. Figure 6 shows some of the images related to the records that will be ingested.



Figure 6. Bone Borer, Sleeping Lady

6. Conclusion

The final step of the process is the publication through Europeana which will bring many benefits. It will increase the awareness of the rich and varied archaeological and architectural heritage of Europe and in particular, Malta. It will enable and encourage users to explore this heritage and to learn in a controlled environment with information produced by specialists in the field. And, addition of 3D capabilities to Europeana and the inclusion of three dimensional models will give users a very different perception, or mental image, of what a site - especially ones as complex as the Megalithic Temples of Malta - is like, giving them a completely new experience. After all, in 2012, technology and new media have been an important part of everyday life for most people.

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