ARCHEOSTORIE[™] JOURNAL of PUBLIC ARCHAEOLOGY

VOLUME 1 / 2017 Topic of the Year: Small but Kind of Mighty

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The Virtual Etruscan Museum of Populonia *Gasparri Collection*: enhancing the visitor's experience

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Abstract

Recent advances in the technologies needed to digitize cultural heritage resources in three dimensions (3D) have led to the development of low-cost pieces of software and hardware for high quality projects aimed to reduce the distance between visitors and the cultural heritage displayed in museums and archaeological sites. Since this new techno-cultural enjoyment can be handled by both computers and mobile devices, its ever-increasing use can enhance the experience of both virtual, long-distance visitors and real visitors. The Etruscan Museum of Populonia Gasparri Collection has launched a project along these lines.

Keywords

S 3D model, Sketchfab, virtual museum, cultural heritage, virtual heritage, techno-cultural enjoyment, Populonia.

History of the Collection

The Etruscan Museum of Populonia *Gasparri Collection* is a private institution mainly displaying artefacts found in Baratti and Populonia (Piombino, LI) during the excavations carried out by the Archaeological Superintendence in the first half of the 20th century (De Agostino 1965).

In order to recover the ancient iron waste, the lands around the gulf rich in minerals that could effectively be used in modern blast furnaces - started to be intensively excavated as early as 1915. In compliance with Italy's cultural heritage legislation (laws n. 364/1909 and n. 1089/1939), in case of discovery of archaeological material on private land, the owner of the land is entitled to a reward that may be paid either in money or through the cession of part of the properties. Tommaso Gasparri and his wife Giulia, owners of the Populonia estate since 1936, were therefore entitled to receive from the Superintendence a large amount of ancient objects, which would become the basis for the Collection.

Giulia and Tommaso immediately decided to set up a small *Antiquarium* of the excavations, conceived as part and parcel of any visit to the necropolis. The chosen locations were a few rooms on the ground floor of their villa, with an entrance opening on Populonia's main street.

When it was time for them to get the artefacts for their collection, Tommaso wrote to Antonio Minto, Superintendent of the Antiquity of Etruria, inviting him to be generous with the rewards (Letter from Tommaso Gasparri to Antonio Minto of 19/02/1937, Ref. n. 77/1935, preserved in the Tuscan Superintendence Archive, Fasc. 9 Livorno 4, 1931-1935, *Scavi di Populonia*). Tommaso was also after the artefacts found in Populonia and preserved in the storage of the Royal Archeological Museum in Florence (Letter from Tommaso Gasparri to Antonio Minto of 07/02/1942, preserved in the Tuscan Superintendence Archive, Fasc. 9 Livorno 4, 1931-1935, *Scavi di Populonia*).

Between August and October 1937, under the direction of the Superintendent Antonio Minto, Giulia Gasparri and Alessandro Salti (chair of the order of the Museums) proceeded to set up the exhibits in the *Antiquarium* (draft of letter from Antonio Minto to Giulia Gasparri of 29/07/1937 and letter from Giulia to Minto of 27/08/1937 and 11/10/1937 preserved in the Tuscan Superintendence Archive, Fasc. 9 Livorno 4, 1931-1935, *Scavi di Populonia*). By October the Museum was almost ready, but the war and the death of Giulia and Tommaso's son Leone interrupted the project.

The Antiquarium was completed in 1942 and inaugurated in the spring of 1943. To the original collection were added the findings discovered during the 1950s governmental excavations and a rather miscellaneous group of artefacts recovered off-site, in the fields and the sea of the Baratti gulf (Figure 1). The Museum was robbed in 1957, 1971 and 1975; all three robberies were most likely commissioned thefts.

In 1988, following a reorganization, the Museum was moved to its present location, the former oil mill of Populonia, built by Curzio Desideri in 1882. For nearly fifty years this small *Antiquarium* has been the only local museum retracing the history of the ancient city of Populonia from the 9th century BC to the Late Imperial period (Figure 2).

The Museum today

Today, some of the major and most visited museums and archaeological parks of the country are spread over the stretch of coast around Populonia known as Val di Cornia. The *Società Parchi Val di Cornia* was started in 1997 and it is now entirely run on public capital (Casini & Zucconi 2003).



Fig. 1, panoramic view of Populonia (photo by Filippo Fior) and 2, former layout of the Etruscan Museum of Populonia.

Its task is that of integrating and managing the natural and cultural heritage, the archaeological areas and the museums of Piombino, Campiglia Marittima, San Vincenzo, Suvereto and Sassetta. The Parks System includes the Archaeominerary Park of San Silvestro (since 1996), the Archaeological Park of Baratti and Populonia (since 1998), the Archaeological Park of the Acropolis (since 2007), the Archaeological Museum of the territory of Populonia, opened in Piombino in 2001, the Museum of the Castle and of the Medieval Pottery completely renovated in 2013, the Museum of the Campiglia Rock (since 2008) and some naturalistic parks (Sbrilli & Luzzati 2009). Every year the Tuscany Region reports on its website the number of admissions in each museum (http://www.regione.toscana. it/-/musei-della-toscana-rapporto-2015).

Museum	Visitors
Archaeological Park of Baratti and Populonia	47627
Archaeominerary Park of San Silvestro	31728
Archaeological Museum of the Territory of Populonia	6140
Museum of the Castle and the Medieval Pottery	3258
Etruscan Museum of Populonia Gasparri Collection	2275
Museum of the Campiglia Rock	1506

Tab.1. Admissions in each museum of Tuscany for year 2014. The latest report refers to the 2014 admissions and its results are listed in Table 1. The attendance numbers of the Etruscan Museum of Populonia (Figure 3, Populonia Museum attendance, data provided by Populonia Servizi sas and Periplo Turismo e Cultura snc) have been clearly declining for several years, but this negative trend does not seem to affect the Populonia hamlet and the Tower, whose average number of visitors per year amounts to about 50,000 (source: Populonia Servizi sas). This difference in attendance can be explained with both external and internal factors. Among the external factors, an important role was certainly played by the transitioning of the Archaeological Park's management from the State to the well structured Società Parchi Val di Cornia. As a matter of fact, if before the transition - occurred in 1998 - a visit to the Etruscan necropolis included also the Populonia Castle and the Museum (both located uphill), the present management of the Archaeological Park offers such a wide and gualified range of activities, educational itineraries and labs, to fill completely and satisfyingly any visitor's expectations and field trip's purposes. To make things even worse for the Museum, there is the fact that while the Archaeological Park is downhill and easy to reach, the street that connects it to the uphill village of Populonia with its Castle and Museum is long, narrow and two-way. This means that big vehicles such as touristic buses must ask ahead of time for a special permission to travel there.

The internal factors that have contributed to the Museum's relative unpopularity can only be explained with a generally poor management of the structure, characterized by an almost do-it-yourself attitude, a very sketchy understanding of strategic planning, no coordination with the territory's rich cultural offer, and a total lack of competitive marketing initiatives. The result has been for a long time an extremely unappealing Museum, managed according to old and completely obsolete museological principles.

Things changed for the better at the end of 2014, when Ottavio Gasparri, manager and owner of the collection, eventually addressed the internal issues by developing a promotional strategy for the Museum: he sponsored its renovation, appointed the author of this article scientific curator, and entrusted the integrated management of Museum and Tower to three archaeologists, members of the *Società Periplo Turismo e Cultura*: Chiara Martinozzi, Laura Peruzzi and Flavio Pucci. The new Museum was inaugurated on 13/06/2015.

The plan behind this overall renovation was that of retracing the history of the territory through artefacts, antique photos and archive documents, stimulating the visitors' interest and giving easy access to information. The main target group was identified in the tourists visiting the hamlet and the medieval tower and wishing to know more about this picturesque corner of Tuscany. The Museum's four rooms do not include artefacts of exceptional value



Fig. 3. Graph showing the number of visitors to the Etruscan Museum of Populonia from 2002 to August 31, 2016 (elaboration by Francesco Ghizzani Marcìa).

(such as the silver amphora of the Piombino Archaeological Museum: De Tommaso 2003); aside for a few items, the *Gasparri Collection* showcases everyday life objects commonly found in local – and more generally Etruscan – digs. The very nature of the collection conveys an experience that crosses the boundary of Antiquity and gets past the inveterate habit to organize archaeological artefacts chronologically and topographically.

Instead, we chose a thematic display backed by multi-media communication. The first room showcases objects unearthed during the governmental excavations carried out in Baratti at the beginning of the 1900s (Fedeli 1983); with the help of a documentary video and a big map, visitors learn about the history of the ancient city of Populonia and its modern discovery. The second room features items unearthed during the excavations that accompanied the urban renewal of Baratti in the 1930s, when a number of aristocratic vacationers had their detached houses built on the gulf. The images and documents on display offer perspectives on the seaside tourism that, from the beginning of the 1900s, has been for Baratti a very strong factor of attraction. The third room focuses on the sea: amphoras, anchor stocks and artefacts recovered underwater are evidence of the key-role played by the sea in the economy of Populonia from antiquity to today. The last room hosts pieces of archaeological evidence of Etruscan funerary practices such as memorial stones and sarcophagi (Fedeli 1983), and everyday life objects found offsite and gathered together - with exquisitely antiguarian taste - in the two cases that close the visit (Figure 4). In order to maintain the antiquarian spirit of the collection, the glass cases are still the original ones from the 1940s, only repainted and internally illuminated; furthermore, the choice of graphics whose colors, font and layout express a warmth from another time suits the exhibit well.

Until 2014, Tower and Museum – located only a few dozen of meters apart from each other – were managed separately in terms of staff, tickets, opening hours and everything else. This contributed to create an imbalance between



Fig. 4. Present layout of the Etruscan Museum of Populonia (designed by architects Agostino Carpo & Erica Foggi).

the two structures: the Tower followed regular opening hours and was indeed visited by more than 50,000 visitors per year, while the average number of admissions to the Museum, with its fluctuating schedule, was in the last few years around 5,000, a mere 10% of the total visitors of the tower. The new integrated management provides instead for consistent and extended opening hours, combo tickets, coordinated promotion, educational labs and special events, and a small store selling educational books and media, museum gifts and one-off pieces of very fine local craftsmanship.

The measures taken to address the internal issues have proved to be an effective solution to the Museum attendance crisis. The first reports have shown an immediate recovery: from 13/06/2015 to the end of December 2015, the Museum visitors have been 13,955 and 14,068 in the first eight months of 2016 (not including free admissions).

Carolina Megale

The Virtual Museum

The new Museum has new scientific and educational purposes, too. Its primary goal is that of reaching wider and new audiences, also attracting the young generations of the digital era.

techniques digital Interactive and technologies are today increasingly used for the preservation, representation and promotion of our cultural heritage. While the costs of digital tech decrease, their quality increases, and they are now an essential tool for the interactive enjoyment of any museum experience. Technology indeed offers the solution to a wide range of problems faced by most museums, such as the limited space of the exhibit halls, the high costs of exhibitions and events, the preservation and management of the artefacts (Sylaiou et al. 2005).

In particular, digital tech and 3D modeling allow visitors to virtually interact with objects in new ways, removing the distance between visitors and exhibits. Digital media turn real objects into their virtual counterparts, so that museums (but also archives and art galleries) offer a more complete and active enjoyment of the items they preserve, engaging visitors (either specialists or simple museum-goers) with more details and more information without damaging the artefacts in the least (Yilmaz et al. 2007; Remondino et al. 2013).

Moving from these assumptions, the Etruscan Museum of Populonia has started a digital tech project aimed not only to enhance the visitor experience, but also to let a selection of exhibits out of the physical spaces of the museum, transcending the rigidity of time and place and (virtually) reaching a potentially unlimited audience.

The project, based on low-cost technologies, consists in the 3D digitalization of the artefacts to be published and shared online on Sketchfab (https://sketchfab.com/).

Sketchfab is an in-browser interactive 3D model viewer where archaeological finds can be organized into a permanent exhibition accessible to everyone. Visualization is hyper-accurate and exhibits can easily be provided

with interactive contextual information and links. Launched in France in 2012, today Sketchfab is the world's largest 3D models and content archive and database, and the leading platform to publish and find VR content. As the slogan underlines, "Sketchfab is for everyone" because its users only need an electronic device and an internet connection to browse shared content in 3D. Furthermore, Sketchfab offers free business licenses to museums and cultural institutions, making their virtual exhibits fully enjoyable by everyone (Krasnodebska 2015).

The cultural heritage preserved in the Populonia Museum is therefore available and accessible to virtual visitors, who can freely interact with the artefacts and improve their historical knowledge using new technological languages.

So far (data retrieved on 20/12/2016), about 200 museums across the world have joined Sketchfab (https://sketchfab.com/ members?segment=organization%2Fmuseum). Among them are art museums, archaeological museums, natural history museums and history museums. Most of the archaeological collections on Sketchfab are in museums located in the US, Spain and England. The virtual museum with the biggest number of followers is the British Museum of London (https://sketchfab.com/britishmuseum)

presently featuring 121 3D models, over 3,592 followers and around 240,000 views. The most active museum is the Royal Museum for Central Africa (https://sketchfab.com/africamuseum) of Tervuren, Belgium, with over 357 3D models published online.

Our case-study can be most effectively compared, in terms of institutions size and targets, to the Spanish museums. Most of them belong to the Catalan Museum System, and almost all of them have joined Sketchfab in the first semester of 2016. The most visited is the Archaeological Museum of Catalonia in Barcelona, with 98 3D models and about 14,300 total views; the smaller museums got a few dozens views in a few months.

Only five Italian museums have joined Sketchfab so far: the Archaeological National Museum of Cagliari, (https://sketchfab. com/museoarcheocagliari, 1 3D model, 11 followers, 24 total views), the Archaeological Museum Antonino Salinas of Palermo (https:// sketchfab.com/museo_archeologico_a.salinas, 3 3D models, 21 followers, 60 total views), the Museo delle Origini de La Sapienza in Rome (https://sketchfab.com/museodelleorigini, 10 3D models, 49 followers, 906 total views) and the Museo Archeologico Nazionale di Napoli (https://sketchfab.com/MANN, 37 3D models, 30 followers, 1,300 total views).

At present, the most active Italian museum on Sketchfab is the Etruscan Museum of Populonia (https://sketchfab.com/museopopulonia), with 40 3D models published from 07/07/2016 to today, 4 collections and more than 2,000 views from both Sketchfab users and virtual visitors. Of course, independent users and cultural organizations can use Sketchfab, too. An enormous amount of 3D models of archaeological finds was indeed uploaded to the platform by independent users through accounts unrelated to the museums were the artefacts are preserved.

The preliminary results of a recent research carried out by the Collections Cubed Survey on the diffusion of 3D technologies into the scientific and cultural heritage sector (Urban 2016), have shown that while the availability and accessibility of 3D technologies has recently recorded a huge increase, cultural institutions are just beginning to explore the enormous potential of digital tech. As a matter of fact, while the quality of digital technologies constantly grows, their costs decrease, and it is expected that in the next five to ten years these technologies will be even more available and affordable; however, a number of important museums are already exploring the many ways in which 3D technologies can broaden access to their collections, and facing the issue of how to best invest limited resources. Furthermore, the rise of other new technologies is confronting the museum professionals with new challenges: constantly evolving hardware and software, lack of a reliable methodology, shortage of qualified professionals. Yet the opportunities offered to document collections for the research, preservation, display and promotion of the scientific and cultural heritage are a powerful boost to continue to explore these new technologies.

Carlo Baione

Museum and Park: Virtual Reconstruction of the Context

The items to be digitized and published on Sketchfab were chosen on the basis of two equally significant criteria: to give visibility to the artefacts that visitors perceive as most valuable, and to bring together all the scattered data and objects pertaining to a given archaeological context in order to recreate it (Pfarr-Harfst 2013). The first group of items includes the so-called masterpieces of the collection, that is, those finds considered unique in their kind (Figure 5) or particularly noteworthy with regards to either local craftsmanship (Figure 6) or Mediterranean imports of Etruscan and Roman period.

On the other side, a full understanding of local archaeological contexts must necessarily include both the grave goods preserved fully or partially in the Populonia museum, and the tombs, today in the Archaeological Park of Baratti and Populonia, where those grave goods were found. To recreate the context means to offer visitors an easy tool capable of putting an object back into its original historical/geographical context, when history or the needs of preservation have removed it, sometimes irreparably.

In this early stage of work, digital technology has been applied to two contexts close to one another in terms of chronology, location and history of excavation (Figure 7): the *Tomb of the Gold Hair Spiral* and the *Aryballoi Tomb*.

The two structures are located less than 20 meters apart from each other on the Poggio della Porcareccia, where they were identified by Antonio Minto in the fall of 1933 after somebody attempted to dig them illegally (Fedeli 1983, pp. 291-294; Minto 1934, pp. 390-397). Minto proceeded therefore to remove the grave goods, while the tombs were covered again following the operations of removal of the ancient iron slags and only brought back to light during the 1956 governmental



Fig. 5 and 6. Testa Gasparri (Gasparri head), 4th-3rd century BC [5], and the etruscan red-figure oinochoe (pitcher) painted by the so called Painter of Populonia (Torcop group), end 4th – early 3rd century BC [6].

excavations carried out by Alfredo De Agostino (De Agostino 1957, pp. 33-35; Figure 8).

They are both 'high *tumulus*' chamber tombs (diameter 7 m), with rectangular plan and walls composed of rows of uneven sandstone slabs.

The Tomb of the Gold Hair Spiral consists of an east-facing *dromos* and a chamber sided by three funerary recesses paved around a central aisle. The grave goods belong altogether to the Gasparri collection and consist of objects dating back to between the last quarter of the 7^{th} to the first quarter of the 6^{th} century BC. They include: some rims of bronze vessels; a bronze head-shaped boundary marker; a bronze top opening of a 'cage vase' (ointment containers in perishable material, such as leather, similar to our pastry bags); three bronze sanguisuga-type fibulae (safety pins), one with lateral buttons, one iron sanguisuga-type fibula and a bronze simple bow fibula; a bronze and two gold hair spirals (from which the name of the tomb derives); a quadrangular gold foil with circular hole; a silver ring; some globular and pear-shaped *alabastra* and *arvballoi* (ointment vessels) in Corinthian and Etrusco-Corinthian pottery; a fragment of black-glazed pottery kylix (cup); impasto spools decorated with impressed twisted rope; an impasto cup and plate; a grey bucchero cup; a red-painted *impasto poculum* (drinking vessel); handles of *bucchero kyathoi* (ladles); a rim of small cup in painted purified clay; a bronze handle and other bronze elements; an iron spear head and fragments of iron spits and tools.

The Aryballoi Tomb is otherwise known as Tomb 'of the propped-up door' due to the presence in situ of a big stone block used to prop up the large slab - also in situ functioning as a door. The tomb consists of a narrow lateral aisle and a big funerary recess filling the whole space of the chamber. Most of the grave goods, dating back to the last quarter of the 7th century, have ended up in the Gasparri collection. The inventory of artefacts made by Minto at the moment of the tomb's discovery (Minto 1934, p. 395) records a few jewellery items that are not included in the collection. It is not clear whether the missing items were never entrusted to the museum - in this case, finding out where they are preserved would be worthwhile - or if they were smuggled away from the museum. However, the Aryballoi Tomb's grave goods preserved in the museum collection are: a goblet-shaped cup in purified clay; some pear-shaped aryballoi (ointment vessels) in Etrusco-Corinthian pottery; a small amphora; an impasto cup, a kyathos (ladle) and a poculum (drinking vessel); a grey pottery plate



Fig. 7. Tomb of the Aryballoi and Tomb of the Gold Hair Spiral, Archaeological Park of Baratti, Poggio della Porcareccia.

with inscription on the bottom; the top opening of a bronze *vaso a gabbia* (cage vase); bronze hair spirals, a bronze ring and bronze *sanguisuga*type *fibulae* (safety pins); an *impasto* spindle whorl and *impasto* spools; fragments of small tubes in silver foil; a fragment of hollow ring and a fragment of *bulla* (amulet) in silver foil; an iron knife blades, a spearhead and some fragments of an iron spit.

So far six objects from each of the two tombs were digitized along with the tombs themselves. The selection of the artefacts was based on context-specific properties, such as the choice of the eponymous object for the *Tomb of the Gold Hair Spiral*, as well as external criteria focusing on the visitor or viewer's experience, that must be a satisfying one in terms of variety of models offered and high resolution of 3D scans.

Carolina Megale

The Virtual Collection

The virtual collection of the Etruscan Museum of Populonia on Sketchfab is ordered into thematic folders called 'Collections.' Each 3D model can be contained in multiple folders at once. At the moment the following Collections are available: the *Gasparri collection* featuring the masterpieces, the *Tomb of the Gold Hair Spiral* and the *Aryballoi Tomb*, each including the 3D model of the tomb structure and the aforementioned selection of six burial objects, and the *City of the Living* collection, featuring models realized on the occasion of a temporary



Fig. 8. Governmental excavations of the Tomb of the Aryballoi and of the Tomb of the Gold Hair Spiral, 1956 (picture from the Tuscan Superintendence Archive).

exhibition set up in the Populonia museum during the summer 2016. In this latter case, Sketchfab was used as an archive and a virtual memory for a temporary thematic display.

Each collection is provided with a description introducing the virtual visitor to the general archaeological context; 3D models of either artefacts or architectural structures have informative captions. Further information is provided by the so-called dynamic annotations, succinct tags positioned on the model to highlight details and particulars.

A further easy access to the Sketchfab experience is provided by QR codes linking the museum exhibits with the virtual collections. The display case with the grave goods of the Tomb of the Gold Hair Spiral, for instance, features a QR code linking to the corresponding Sketchfab Collection, where the visitor can find extra information on the artefacts and the 3D model of the tomb (located in the Archaeological Park) in which the grave goods were found. On the other side, a QR code should be soon included in the information panel next to the Poggio della Porcareccia tombs, with a link not only to the virtual model of the architectural structure, but also to the 3D images of the burial objects found inside it.

The 3D model acquisition method

The selected material has been digitized using photogrammetry from images, a low cost 3D modelling method also known as closerange photogrammetry. The method belongs to the wider group of the non-invasive, passive digitization techniques. It is an optics digitizing system that consists in the identification of points of reference in digital images shot from several angles, and in the determination of the relative position of those identified points in a three dimensional space using triangulation (Bennet 2015; Howland et al. 2014, in general about photogrammetry in Cultural Heritage; Bernardini & Rushmeier 2002 for the pipeline; above all Luhmann et al. 2006).

Compared to other methods for 3D digitization of the cultural heritage, such as laser scanning or Reflectance Transformation Imaging (RTI), photogrammetry is quick, effective and, most importantly, low cost. Since all photogrammetry software packages work with digital images, the only equipment required is a good camera (preferably DLSR) and a gaming computer (for system requirements, see http://www.agisoft.com/downloads/systemrequirements/, shared by most pieces of photogrammetry software). Photogrammetry software packages such as the popular Agisoft Photoscan are relatively affordable, but there are also a number of valid open source software packages, such as Visual SFG combined with PMVS2, Python Photogrammetry Toolbox and



Fig. 9. Shooting setup for 3D model of Etruscan skyphos (cup).

Meshlab, also generating high-quality results.

Digital image capturing consists in shooting objects of small and medium dimensions placed on a circular turntable in order to catch their every side and angle. The digital camera (for this project, a Canon EOS600D) is put on a tripod in order to provide stability and maximize sharpness (Figure 9). Targets added to the shooting setup provide the software with reference information to determine the exact geometry of the object and, later, scale it down. The background behind the object must be of a uniform color in contrast with that of the object's surface.

For every object must be taken two or more sets of images at no less than three different heights. The camera, equipped with a polarizing filter, must capture every side of the object in order to generate an accurate digital threedimensional copy.

The color temperature of light in the shooting setup must be of 6,500k; light diffusion must be very even and illuminate the object with no shadows or highlights in order to record its real color. The average number of pictures required to generate a 3D model is 60, although this number can vary depending on



Fig. 10. Shooting setup for 3D model of Etruscan sarcophagus lid.

the complexity, shape and dimensions of the object. Also, a 60-70% overlap between photos is needed for the software to identify the same points in different photos.

The use of a softbox to shoot small items and shiny surfaces (for example black-slip ware or metals) helps the artificial light to spread more evenly on the object's surface.

Images of bigger objects or museum artefacts that cannot be moved from their display location - such as the Etruscan sarcophagus lid (Figure 10) - must be shot with no tripod and, possibly, no artificial light. Targets are in this case positioned all around the object.

Once the pictures are taken, it is possible to proceed with the creation of the 3D model (Porter et al. 2016). After removing the background with masking, images are processed to generate a 3D digital model. The software we chose for this stage of our project is Agisoft Photoscan, that automatically aligns images on the basis of the identification of their common points. Photoscan offers the possibility of splitting the workspace in several chunks. Batch processing can be applied to all chunks, thus saving a lot of processing time. The choice of chunk alignment setting mostly depends on the object selected for digitization: high quality software can capture a higher level of details and implement color management, and should therefore be employed, for instance, to digitize a painted vessel.

As a result a sparse point cloud and a set of camera positions are formed. The next stage consists in the creation of the dense cloud, a point cloud based on the camera positions and on the pictures themselves. A dense point cloud enables us to apply different methods to create the final 3D model ready to be uploaded on Sketchfab. If the object features photographic details, we will build texture; if untextured model is sufficient as the final result, as in the case of a sculpted stone sarcophagus lid, we will proceed to extract a textured mesh from the dense point cloud using Meshlab.

The two dense clouds are clean, aligned, and merged into a point cloud containing surface normal infos and color data.

The dense cloud is then scaled and exported in an extension (.ply, or .obj in this project) that can be read by pieces of software such as Meshlab, used to create and manage the mesh (that is, the real surface of the object). Mesh uploading in Sketchfab must respect certain size limits: for this project we chose a range of min 10,000 - max 75,000 fps. The last stage is the creation of the photorealistic texture, basically a patchwork of all the pictures used superimposed on the mesh, the three dimensional surface previously obtained. Both Meshlab and Photoscan provide image blending filters to build texture for painted or minutely detailed objects; less sophisticated objects, instead, are textured by extracting color from the points of the dense cloud as explained above. Eventually, the 3D model is exported in a format that can be read by all the most common 3D modelling software packages (in this case .obj or .3ds), ready to be published online on Sketchfab.

The entire process, starting with the acquisition of images and ending with the realization of a digital model, can be completed in four working hours on average. More or less time may be required according to the number of images taken and the surface's complexity.

Sketchfab provides a range of built-in postprocessing tools that enhance the quality and interaction properties of the final digital product: rotation axis for 3D models, base color adjusting and lighting set up, to mention a few examples. Eventually, after adding tags the model can be published.

Carlo Baione

The free flow of images and the Art Bonus (almost) revolution

As a marginal note to the present paper, it is expedient to underline that the ever-increasing online presence of images depicting cultural heritage/museum artefacts, particularly on social media, and the resulting enormous benefit to the cultural development of our society, is due to the so-called Art Bonus deregulation. The conversion into law of Law Decree No. 83 of 31/05/2014, in fact, repealed the prohibition of taking pictures in

Italian museums and libraries, and partially liberalized the online, non-profit reproduction of national cultural heritage. Today, eventually, both scholars and visitors can bring home the memory of what they saw in a museum, to broaden their knowledge of the artworks or simply show them to friends and relatives. The free, shared knowledge of the cultural heritage preserved in museums, libraries and archives is a powerful tool to implement the democratization of culture in liberal societies, that is, the right to participate in the cultural life of the community enjoying the cultural heritage (Modolo & Tumicelli 2016), as established by Articles 9 and 33 of the Italian Constitution and by the more recent Framework Convention on the Value of Cultural Heritage for Society, also known as Faro Convention (https://goo.gl/ zb5tWv), which Italy will hopefully ratify soon.

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