# It is Unique, It is Fragile, but It is Open to All.
## Virtual 3d Enhancement of The Archaeological Collections of the S. Mark Square, Venice

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*Abstract* — Saint Mark's Square, the heart of Venice, is undoubtedly one of the most visited places in the world. The city welcomes more than 20 million tourists yearly, with intense pressure on the Venetian heritage collections.

Within the EU-Inter-regional Project 'Shared Culture', the Veneto Region has promoted 3-D enhancement of the entire collections of the archaeological museums of St. Mark's Square. Through inexpensive 3-D technologies the project has captured digital representations of the heritage artefacts, transforming them into 3-D virtual objects (VO). The digital copies will be used for broad public access, preservation, restoration and scholarly study. The project has been characterized by a high cost-benefit ratio.

Furthermore, the 3-D VO collection will allow the recreation of the original location of the classical sculptures in the *Tribuna Grimani* and the *Statuario Pubblico della Serenissima*. Virtual visitors will have the opportunity of visiting the collections in their historic displays in an extraordinary museum which no longer exists.

The 3-D VOs are stored in a detailed updated open-access database. They have been integrated into virtual tours available for computer desktop and mobile devices. For the very first time Venice will have a complete, integrated virtual museum.

*Key words* — **Virtual Heritage Conservation, Virtual Museum, 3-D Enhancement, 3-D Virtual Objects, Accessibility/Open Access, Open Data, Cultural Heritage Availability, Heritage at Risk, Heritage Protection, Virtual Restoration Tools, Virtual Museums, Cataloguing.**

## 1. INTRODUCTION

The management processes and enhancement policies of the Venetian cultural heritage could be a controversial and a challenging topic. The enormous artistic value and emotional appeal of the *Serenissima* ensure a continuous increase in the number of the visitors. Venice does not need strategies for the development of tourism: on the contrary, the local institutions and communities need plans for improving the quality of visitors' experiences. A well-informed approach, with high quality services before, during and after visits, seems to be the recipe that the major Venetian museums must adopt in order to maintain the quality of the cultural offer.

'Sustainability' and 'sustainable open access' are the key words which have inspired Work Package No. 4, Italy-Slovenia Inter-regional Programme, of the EU 'Shared Culture' project. The Veneto Region has chosen to support good management practices of the cultural heritage, with particular attention to archaeological material culture. The programme has also funded the complete digitalization of national Archaeological Record forms ([1] RA) for every ancient object exhibited in the archaeological museums of the Venetian Adriatic coastline. This complete digitalization helps museum staff to manage the conservation of ancient objects, but also offers a unique tool for scholars and the public in general for acquiring updated information about the archaeological identity of the region.

These electronic forms, published in the Veneto Regional On-Line Heritage Catalogue [2], have been completed by experienced archaeologists, and checked by the local *Soprintendenza per i Beni Archeologici*. The forms are integrated with new fully accessible high-quality colour photographs.

For the archaeological museums in the heart of the region, those facing Saint Mark's Square, the digital forms have an extra multimedia attachment, represented by 3-D VOs. Through inexpensive 3-D technologies, the project aims to capture digital representations of heritage artefacts. The digital copies will be used for free public access, preservation, restoration, and scholarly study. This project, with the great number of objects digitalized, has a high cost-benefit ratio.

The uniqueness of the programme is in the decision to produce the 3-D VOs for complete collections, rather than only for selected artefacts; making the data suitable for building complete virtual, fully accessible museums.

## 2. THE PUBLIC, ENHANCEMENT AND HERITAGE PROTECTION: VIRTUAL TOOLS

Saint Mark's Square, the heart of Venice, is undoubtedly one of the most visited places in the world. The city welcomes more than 20 million tourists yearly, with intense pressure on the Venetian heritage collections. The National Archaeological Museum and the Treasury of St. Mark's Museum are world-class institutions, and should be visited by the great majority of visitors to Venice. It is clear that this is nearly impossible because of the intrinsic physical limits of the buildings. On peak days the number of visitors makes the visit a frustrating experience. The opulence of the monuments overwhelms the importance of the archaeological objects themselves, and visitors could decide to skip visiting the museums.

The Archaeological Museum represents one of the most important collections of ancient Roman and Greek sculptures in Italy. The Museum is dedicated to the distinctive taste of Venetian collectors. Its origins date back to the bequest by Domenico Grimani in 1523, and the donation by Giovanni Grimani in 1587, who left the bulk of their collections of antique objects to the Republic of Venice.

The extraordinary Grimani collection of antiques was astonishing also at the time when Giovanni, Patriarch of Aquileia, arranged it in his recently restored palace in Venice, in the Santa Maria Formosa area. He conceived the project specifically to better display the ancient statues collected in Rome and Aquileia. Giovanni decided to organize the renovation of the first floor (*piano nobile*) around the *Tribuna Grimani*, a very special room [3]. The *Tribuna* was a real private museum, but was also open to visitors. It represented a sort of classic *Wunderkammer* organized according to the taste for the time of Classical Rome. The *Tribuna* was one of most appreciated artistic material libraries in Europe in the 16th century. Being able to reconstruct the original aspect of the room and the collection is fundamental. It helps to convey to modern visitors the ancient Renaissance elite's taste for Antiquity. The collection was a symbol of the role of Venice as promoter in the revival of the taste for Antiquity.

The ancient statues were located in special niches in the *Tribuna*, individually shaped to house the ancient marbles. The niches and bases were designed to create a sort of mental landscape [4] according to the specific forms of the artefacts.

The *Tribuna* has recently been restored, and it is possible to visit it, but it is almost empty. The statues, in fact, were moved at the end of the 16th century, according to the will of Giovanni Grimani, into the new public collection of the antiquities of the *Serenissima*, the *Statuario Pubblico della Serenissima*. The *Statuario*, a quintessential expression of the Renaissance style, was founded in 1596 by Federico Contarini in the antechamber of the *Libreria di S. Marco*. It was one of the first public national museums of the modern era. The *Statuario* was included among 200 ancient statues. It represented a unique artistic and cultural reference for Venetian and European culture. The collection was dispersed in 1811, and from 1923 the *Statuario* has been housed in the National Archaeological Museum [5, 6, 7, and 8].

Today the antechamber of the Library of Saint Mark hosts a partial reconstruction of the *Statuario*, as displayed in 1990 in a major exhibition [5]. The visitor has the opportunity to imagine the general impression of guests of the Serenissima when they visited the city during the 16th and 17th centuries. "Abundance", "astonishment", and "magnificence" were the terms with which ambassadors and merchants referred to the *Statuario*. This experience of entering an Aladdin's Cave cannot be fully felt by visiting the museum today. The museum is organized in the modern style, with a very accurate philological approach, but it makes less impact on the visitor.

With the project, the 3-D VO collections will allow the re-creation of the original locations of the Classical sculptures in the *Tribuna Grimani* and the *Statuario* [9, 11]. The virtual visitor will be able to move around the original displays of collections of two extraordinary museums of the past which no longer exist, experiencing and sharing the emotions of the visitors of the 16th and 17th centuries.

The virtual museums of the *Statuario* and *Tribuna* will be integrated into a virtual tour of St. Mark's Square itself, where digital visitors will be able to explore the 3-D VO of some very famous archaeological artefacts, such as the Lion of St. Mark, the statue of St. Theodore, the Horses of St. Mark's, the *Carmagnola* Head and the Tetrarchs group. These are celebrated objects, but because of their inaccessibility, it is almost impossible to make a real visit.

Regarding the Byzantine, Medieval and Modern times, with the digitalization of the Treasure of Saint Mark, the virtual visitor will have the opportunity to browse the richness of the Venetian market system, well represented by its ability in acquiring relics or religious objects of priceless value.

The Treasure of St. Mark's consists of nearly 300 pieces in gold, silver, glass and other precious materials from different sites and geographical areas. The most interesting nucleus consists of objects plundered by the Venetians from Constantinople after 1204, during the 4th Crusade. It contains incomparable liturgical chalices, bowls and patens in semi-precious stone mounted on Byzantine enamelled gold-work. It represents the material richness of the *Serenissima* and its role connecting East and West, sacred and profane [11, 12].

The rooms where the Treasure is housed are quite cramped, as they are inside the mediaeval basilica. Accessibility is not easy, and visitors can be overwhelmed by the magnificence of the mosaics. The placing of the objects inside traditional glass windows does not enhance the treasure itself: the chalices, the patens and the vases. In fact, they were designed and decorated in order to create awe among both the priests and the Christian congregation during religious rites. Obviously, the visitor cannot appreciate the complexity of the objects, often decorated over their whole surface; and cannot touch or turn the objects over to inspect the decorations. The chance of examining and virtually 'touching' the objects, given by the 3-D reconstruction, will contribute in recreating an otherwise unattainable emotional experience with the past.

The 3-D VOs will also be tools for virtual restoration, for calculating real restoration costs, and for evaluating the risk and cost of moving the objects for temporary exhibitions. The 3-D would be a tool for obtaining data for the preparation of the cases or bases for the artefacts. 3-D could even be used as a tool for the reconstruction of missing parts. It is important to stress the fact that the 3-D VOs have been stored in a detailed updated open-access database: the 3-D products will always link with high quality reference data.

## 3. VIRTUAL MUSEUM

Many museums have developed a proper virtual museum on line, as virtual replicas of the exhibits [13, 14, and 15]. Nowadays, museums and cultural institutions know the importance of virtual 3-D reality as a tool for experiencing the original. A virtual 3-D museum opens the doors to extraordinary high numbers of visitors from all over the World. The additional value of a virtual 3-D museum is the possibility of rebuilding exhibitions which no longer exist.

The project *Wonders of Venice: Treasures Sacred and Profane in San Marco's Area was* set up starting from this idea. Over the years, the arrangement of the *Grimani Collections* has often been reconsidered, and many hypotheses have been developed about what could have been the original location of each statue, firstly in the *Tribuna*, and then in the *Statuario*. Now, thanks to computer science, we finally have a real way to speculate on what could have been the original layout of the items of the collection in the *Tribuna* of Palazzo Grimani and the *Statuario*.

The project allows the complete reconstruction of the *Statuario*, thanks to the use of the original famous *Sanguigne* ('red' drawings, 1736) by Anton Maria Zanetti il Giovane [5]. Regarding the *Tribuna*, one of the possible original layout of the collection, could be suggested after the drawing of Federico Zuccari dated to the end of the 15th century [10]. Thanks to the insertion of the three-dimensional models of the statues into the 3-D models of the *Statuario* and *Tribuna Grimani*, the digital visitor will be able to see where the statues were originally located. The 3-D model of the *Tribuna Grimani* has recently been completed by the Laboratory of Photogrammetry of the University IUAV of Venice, which has kindly made it available for the project [16].

The *San Marco's Treasure* has been included in the project with the same philosophy. This is a very pioneering operation for this unique collection, which has been studied by scholars from all over the World, but has never been digitally documented.

For the very first time the heart of Venice will have a complete, integrated virtual museum. It will be without entrance fees, or geographical or time limits. Furthermore, as a basic rule in Heritage Protection, "knowing the heritage" means defending the heritage. The first component of an effective presentation of the ancient artefacts is the increase of general shared knowledge.

## 4. OPEN ACCESS

A change has been developing worldwide, and also in Italy, in cultural heritage management over the last few years [20]. Museum institutions and cultural bodies are more and more encouraged to share their collection and their data system with an open access policy on the internet. The EU is actively promoting an open system on data access. On 13th June 2013 the European Parliament voted to agree new rules on open data, effectively making opening up huge amounts of public sector records a reality [21]. The agreement defines the data that public authorities can lawfully reveal, among which there is a huge wealth of information about cultural management. There is an enormous benefit in opening up.

Cities or sites like Venice sit on a gold mine, without knowing it. Open access is a positive policy. Releasing the data, in fact, creates cultural activities and innovative start-ups that generate income (and taxes!) which far exceed revenue from any fees previously charged for the data itself.

The EU has already set up tools on the European scale, such as *Europeana* [22], which already has millions of cultural items digitized and available for all, with metadata, under an open Creative Commons licence [23].

Important American studies show that the cost of managing intellectual property and maintaining payment structures in cultural heritage collections almost always outweighs the traditional revenues (royalties, etc.). When transferred to the world of online digital resources, the cost of intellectual property transactions becomes even more onerous as it requires technical and legal frameworks for rights management that compromise the efficiency of the networked environment. Allowing works in the public domain to circulate freely is the most effective response [24, 25, and 26].

In general terms, the process of digitizing public domain content may not add enough unique creative value to warrant an attempt to copyright such digital representations. Copyright enforcement and monetization may be justified, however, where analysis, interpretation or other editorial content or enhancements have been added.

Italian laws recognize archaeologists or conservators as authors of the images which they usually take in their researches. However, the system requires cultural operators to have an official authorization from the Cultural Ministry, through the *Soprintendenza Archeologica* (Government Department Responsible for Archaeological Heritage management) for publishing the material [27]. This is because the heritage artefacts belong to the nation. Recent experience has shown how it is possible to avoid to pay the fees expected by law [28]. Specific agreements about EU project implementation or management policies allow cultural bodies the use of images without charge.

In this specific project, the Veneto Region and the local Government body for the Venice area have agreed on the general terms on the ethical duty of publishing the 3-D data resulting from a publically-funded EU project. The institutions have fixed terms for the use of the images, sharing the outcomes of the projects, following the principles of the London Charter (p. 6) [31]. In the meantime the Italian and European Parliaments have set the legislation in process, the Veneto Region has already anticipated an open access policy.

## 5. 3-D VIRTUAL OBJECTS

During the preparation of the *Wonders of Venice* project it has been essential to identify the best method to obtain 3-D models of the artefacts. Two parameters have been considered fundamental in attaining a high cost-benefit ratio: firstly the need to distribute data through the World Wide Web with 3-D models, and secondly the large number of artefacts (statues and jewellery) to document.

The choice was to produce VOs made from high-quality photographs, both for the virtual tours (360° tours), and for the digital reproduction of the single VOs.

The project for the implementation of the 3-D VO has raised some difficulties in choosing the best technology. The artefacts are very different from each other. The *Statuario della Serenissima* contains marble-white statues ranging from 10 cm up to 250 cm high. The items belonging to the Saint Mark's Treasure are very varied, and are manufactured of a vast range of materials, such as gold, silver, precious stones and glass.

The display of artefacts in the museums is very uneven, with large variations in accessibility and light conditions. Many of artefacts cannot be moved from their locations.

The project was interested in the recording of more than 500 artefacts, and laser scanning of all of them would have required an impractical schedule. The reconstruction of 3-D VO models obtained from photographic images appeared to be the better choice, also according to recent successful study cases [16, 17, and 19].

As the first aim of the project is to obtain a 3-D model to display the objects, and not for other purposes (restoration or creation of new material copy, or facsimiles), it has been already demonstrated in several studies and research that

images made for the production of a VO are comparable to models obtained from laser scanner data.

Some objects will not be acquired by camera images in their entirety (360°), because of limited accessibility or because they are very fragile. An articulated arm will ensure the shooting of statues located in unattainable niches. Synthetic solutions, however, could be easily obtained, thanks to the data integration functions of image-based and 3-D integration software.

The VO will be loaded into an internet portal, expressly created for the project, and through this all the contents will be accessible to a wide audience. In addition, using HTML 5, all virtual reconstructions will be accessible by Smartphone, tablet and mobile devices. Visitors will also have the opportunity to touch, rotate and explore the objects during the real visit to the museum.

## 6. MANY POSITIVE SIDE EFFECTS

The digitalization and 3-D renderings of the archaeological collection in Saint Mark's Square is producing many positive side effects. The partnership between different cultural bodies demonstrates that inside the umbrella of the EU project it is easy to develop shared policies in terms of accessibility of the data

The 3-D VO realization has, in the meantime, promoted and enhanced the accurate cataloguing activities linked with the archaeological goods.

With a limited expense (around €400-500 for each artefact) it has been possible to highlight priceless archaeological artefacts, with an evident high cost-benefit ratio.

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