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# Digital reconstruction of the Arrigo VII funerary complex

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**Abstract**

*The results of a project aimed to the study, reconstruction and presentation to the public of a monument disassembled and dispersed, the mausoleum of the emperor Arrigo VII, are presented here. We used modern 3D graphics for the acquisition of accurate digital models of all the elements of the funerary complex, to draw hypothesis on its original architecture, and finally to present all this knowledge to the museum public. Issues emerged during 3D scanning are discussed. The multimedia museum presentation was implemented with an interactive visualization system, which was extended to manage standard multimedia data together with 3D geometry.*

Categories and Subject Descriptors (according to ACM CCS): I.3 [Computer Graphics]: : I.3.3 Picture/Image Generation - Digitizing and scanning; I.3.8 Applications.

## 1. Introduction

Modern 3D graphics technologies allows us to acquire accurate digital models of works of art and to present them interactively to the public. This paper presents the results of a complex 3D scanning project concerning the digital acquisition of the remains of a late medieval complex, the funerary monument of the emperor Arrigo VII ("Arrigo" is the archaic Italian translation for "Henry"). The Arrigo VII complex was selected as the main assessment case study for an EU project, since it fulfilled various requirements:

- we were looking for a complex case study, consisting of multiple objects (to allow us both to monitor along time the improvement of the tools developed in the project, and to support the setup of virtual expositions). Moreover, each single item should have been of a sufficiently large size and complexity of shape to be considered as a challenge for both scanning and visualization;
- the 3D representation should be useful to provide a better comprehension and presentation of the artworks in the framework of a real museum exposition;
- the set of artworks should be inter-related, a common "story" should exist to support the development of virtual presentations encoding not only shape data but also knowledge (artistic, historical, political).

The Arrigo VII is a very good example, since it is a rich group of statues which have a very peculiar history and an unknown original spatial disposition (see Section 3). The aim of the project was to perform a digital acquisition of the Arrigo VII complex and to design a new approach for its archival, study and presentation, oriented both to experts and to the public (see Section 4). 3D scanning technology has been selected as the technology more adequate to obtain a complete and accurate sampling of the statues. Details on the Arrigo VII's scanning campaign are described in Section 5. On those digital models we have experimented *interactive visualization*, through the use of an easy-to-use and flexible system which presents the 3D data together with multimedia information to locate the statues in their cultural and historical context (see Section 6). The preliminary results of the project are presented to the public with a kiosk installed in the *Museo dell'Opera del Duomo* (Pisa, Italy), directly in the room where a subset of the Arrigo statues is exposed.

**Figure 1:** *The artworks which are recognized to be part of the Arrigo VII's funerary monument, originally located in the apse of the Cathedral of Pisa; it was dismantled and dispersed in the XIV cent.*

## 2. Previous Work

Many previous works concern the use of 3D technology either to reconstruct digital 3D models of Cultural Heritage masterpieces or to present those models through digital media. An exhaustive description of those works goes well beyond the brief overview that we can draw in this section. We prefer to cite here only some seminal papers on the technologies used in the project, i.e. 3D scanning and interactive visualization.

Automatic 3D reconstruction technologies have evolved significantly in the last few years. An overview of 3D scanning systems is presented in [CS00]. Unfortunately, most 3D scanning systems do not produce a final, complete 3D model but a large collection of raw data (*range maps*) which have to be post-processed; the pipeline of post-processing phases is presented in the excellent overview paper by Bernardini and Rushmeier [BR02]. Many significant projects concerning 3D scanning and Cultural Heritage have been presented in the last few years [LPC*00, BRM*02, FGM*02, PGV*01, STH*03].

The high resolution meshes produced with 3D scanning are in general very hard to render with interactive frame rates, due to their excessive complexity. This originated an intense research on: simplification and multiresolution management of huge surface meshes [GH97, Hop99, CMRS03]; and interactive visualization, where both mesh-based [CGG*04] and point-based solutions [RL00, BWK02] have been investigated.

## 3. The Arrigo VII's funerary monument

The Arrigo VII Mausoleum was one of the most famous funerary monuments of the XIV century, perceived as a model by contemporaries. It was carried out by Tino di Camaino, an artist who played a big role in the birth of modern sculpture in Europe. Unfortunately, this masterpiece was dismantled soon after its completion. After almost a century of attempts to reconstruct its original disposal, art historians are now looking with interest to the help offered by new technologies.

**History of the monument.** On August 24th, 1313, the emperor Arrigo VII of Luxemburg died in Tuscany; the utopian vision of a pacification of the Italian cities under the rule of universal monarchy celebrated by Dante died as well. The Ghibelline city of Pisa secured the privilege of hosting the remains of the emperor in its Cathedral. Within two years, the funerary monument was completed by the sculptor Tino di Camaino and located in the most important spot of the cathedral: the apse. What we can still admire in the southern transept of the Cathedral (see the second image from the top in Figure 1) does not correspond, though, to the 14th century monument. Rather, it is the result of a series of shifts and losses of elements from the original complex. This portion of the monument was rebuilt at the beginning of the XX century, following approximately the shape and place it was given when it was removed from the apse in 1494. With the 1494 translation, the artwork lost most of its original structure and some of its elements, while being completed with a base and the fresco decoration of the lunette by the workshop of Domenico Ghirlandaio. In 1727, the sarcophagus with the statue of the reclining emperor was taken apart once more and placed over the door leading to the sacristy. Because of a lack of space, the fifth apostle from the right on the front of the sarcophagus was probably eliminated, to be re-invented and replaced in the 20th-century arrangement of the monument. The eternal sleep of the emperor was disturbed once again in 1829, when the tomb was moved to the western corridor of the Camposanto and flanked by two other statues by Tino, representing the Annunciation. Arrigo VII finally returned to the transept of the Cathedral in 1921, on the occasion of the celebrations of the sixth centenary of Dante Alighieri's death. However, the story of the monument is much more complex, since other groups and fragments of statues have to be considered. At the beginning of the 19th century, five statues were discovered in the gardens that were covering much of the present Piazza dei Miracoli. Soon, they were identified with Arrigo VII and his counsellors (see the third image from the top in Figure 1) and brought to the eastern corridor of the Camposanto in 1825. The head of a fifth figure was added to this group in 1934. Two further elements, two statues representing angels flanking the 15th-century monument of the de'Ricci archbishop in the Cathedral's transept, have been attributed to the imperial tomb due to their stylistic quality and their closeness to works that did certainly belong to the monument. The same is true for a fragment of a twisted ornate column that was rediscovered in the repositories of the Opera Primaziale.

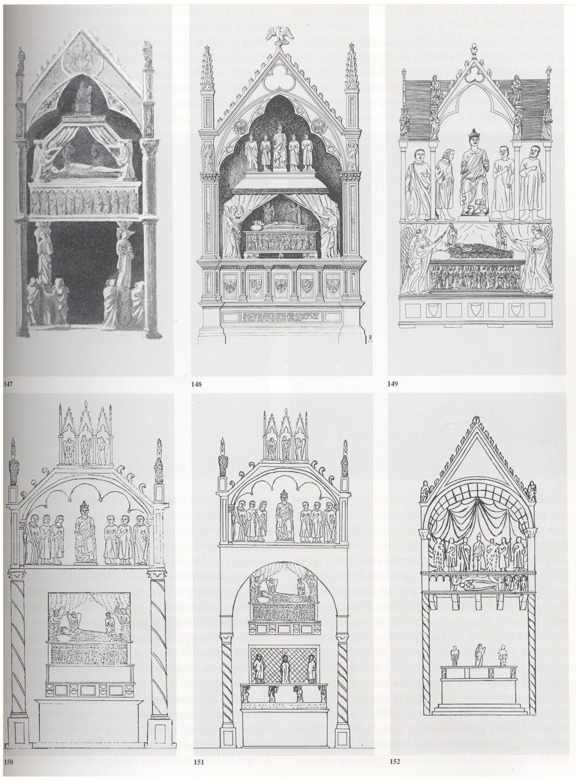

**Figure 2:** *The different hypothesis on the original architecture of the mausoleum produced in previous studies.*

**Reconstruction hypothesis.** Several attempts to reconstrue the original monument are in bibliography, in some cases adding also other elements (Figure 2). These hypothesis do not seem fully convincing nowadays, first of all, since two other elements have been only recently recognized to belong to the complex: the two angels that for centuries had been on the sides of the Cathedral's tympanum (see the first image from the top in Figure 1) hold in hand two scrolls with the emperor's funerary epitaph (LUCEMBURGENSIS SEPTIM(US) HENRICUS) and thus have been recently recognized as part of the complex [Nov95, Mas00]. Another difficulty in reconstructing the original monument stems from the fact that the spatial disposition of the apse in the 14th century was very different from the current status. During a recent restoration of the lower apse, the remains of decorations from the medieval period emerged: fragments of frescoes simulating a curtain and, above them, the remains of a second curtain with the black eagle and the rampant lion, the heraldic symbols of Arrigo VII [NF98]. Furthermore, we know that the apse was originally illuminated by three single lancet windows, subsequently walled in, whose traces have been recognized on the outside wall. Therefore, we have some more elements to draw hypotesis over the original form and placement of the tomb.

## 4. The digital representation - Project goals

The complexity of the problem induced art historian to look around for some help and 3D graphics was perceived as the right tool for finding plausible solutions: the availability of 3D digital models of all the statues (high-fidelity digital copies which can also be easily moved and measured) and of the architecture would in fact help a lot in the evaluation of recomposition hypothesis, offering a realistic perception of reciprocal relations between the elements of the assembly. Moreover, these digital models can also play an important role to let museum and Cathedral's visitors better understand the monument. To meet both objectives, a team of technicians and art historian worked together to build up digital representations and visual presentation applications. The activities of the project can be divided in the following tasks:

- acquisition of 3D models of all the elements of the Arrigo's monument, by adopting high-accuracy 3D scanning;
- post-processing of the raw scanned data, to build up a complete model for each statue and to derive from it optimized 3D representations (different level of details);
- modelling of the Pisa cathedral in its XIV cent. status, by both acquiring the current architecture with a scanning device and re-modeling the lost components with a CAD tool;
- design and implementation of interactive systems to present the models and the associated multimedia data both to ordinary public (museum presentations) and to experts (to support study and analysis of the complex).

## 5. 3D Scanning of the statues

The device used for the digital scan of the Arrigo's statues is a Konica Minolta Vivid 910, a triangulation-based laser scanner. The Arrigo's statues are carved in a material sufficiently cooperative with a laser scanner: an old white marble, mostly uniform and without major veins. The main problems in scanning the statues were: the acquisition had to be done directly in the museum location, by removing the statues one at the time from their pedestals; scanning time should have been as short as possible, to reduce the work of the museum assistants and the overall presence in the museum. Scanning was done during normal visitors access, due to security and administrative reasons. The agreement with museum curators was that the impact on visitors should have been as small as possible. On the other hand, our impression was that our presence in the museum was perceived by visitors as an interesting happening: many questions were raised by visitors (mostly foreigners, since we were scanning in working days) and probably visitors' stay in the Arrigo VII's room was longer and more enjoying than usual.

Each statue has been sampled, in average, with 100-300 range maps (each one covering approximately a region 30*20 cm wide). Scanning has been organized by taking a series of circular strips: the vertical extent of each statue has been covered by a set of circular strips of range maps, with a vertical displacement between strips of around 20 cm and a number of scans per strip depending on the single statue diameter and shape complexity. For each statue, additional range maps were acquired from selected locations to reduce the extent of unsampled surface portions (approximately, 10-20% of the total number of range scans). The technical scanning data are presented in Tables 1 and 2.

### 5.1. Raw scan processing

Scanning any 3D object requires the acquisition of many shots of the artefact taken from different viewpoints, to gather geometry information on all of its shape. This set of range maps has to be processed to convert it into a single, complete, non-redundant and optimal 3D representation. The processing phases (usually supported by standard scanning software tools) are:

- range maps *alignment*, since by definition range map geometry is relative to the current sensor location and has to be transformed into a common coordinate space where all the range maps lie well aligned; after alignment, the sections of the range maps which correspond to the same surface zone will be geometrically overlapping;
- range maps *merge* (or fusion), to build a single, non redundant mesh out of the many, partially overlapping range maps;
- mesh *editing*, to improve (if possible) the quality of the reconstructed mesh;
- mesh *simplification*, to accurately reduce the huge complexity of the model obtained, producing different high quality Level Of Details (LOD) or multiresolution representations.

Processing of the scan set was performed with the ISTI-CNR scanning tools (*MeshAlign*, *MeshMerge*, *MeshSimplify* [CCG*03]), a suite of tools developed in the framework of the EU IST "ViHAP3D" project. In the case of the Arrigo VII project, the main problem was the size of the dataset to be processed: 15 different components, for a total of 3000 range maps (see Tables 1-2). The number of range maps (in average, 200 for each statue) poses strong limitations on the use of commercial tools that are able to manage well just few tens of range maps. Since the scanning was performed in different times during a period of 1.5 years, it gave us also the possibility to evaluate on the field the quality improvement of our post-processing tools.

The final alignment has been performed using *MeshAlign*, obtaining in most cases a maximal error of 0.1 mm. and a much better average error (the alignment tool used, *MeshAlign*, returns numerical data on the accuracy of the registration obtained). The alignment of the last statues processed (e.g. the lying Arrigo or the sepolcro basrelief) has been faster, since we used a new automatic alignment tool which supports the unattended processing of most range maps. This new tool, described in a submitted paper [FPC*04], performs an alignment pre-processing whose results are then passed to *MeshAlign* for further semi-automatic improvement.

The merge of the range map set has been performed with *MeshMerge* [CCG*03], our volumetric reconstruction tool based on a variant of the volumetric approach [CL96]. *MeshMerge* can manage large range map set (many million sample points) on low-cost PC platforms with a very good efficiency. Data fusion is performed by the weighted integration of the range maps, and small holes (region not sampled by the scanner) can be optionally filled. The final models were produced using a voxel size equal or smaller than the intersampling distance used in scanning (0.25 - 0.5 mm). The full resolution models produced are very complex: the smaller one, the "male head", is encoded with 2.3M triangles while the biggest one, the "Sepolcro" statue, is 64M triangles. Most applications require significant complexity reduction in order to manage these models interactively. Two problems arise when we try to simplify such a model with commercial simplification solutions: we need a solution working on external memory to cope with these big models; simplification has to be accurate if we want to obtain high-quality multiresolution models and accurate visualization [CGG*04]. We used the *MeshSimplify* tool [CMRS03], which has no limits in terms of maximal size of the triangle mesh in input and ensures high-quality results, since it is based on edge collapse and takes into account both geometry accuracy and shape curvature [GH97, Hop99].

## 6. Visual presentation of the Arrigo VII complex

Some issues arise from the impressive increase in data complexity (and richness) provided by the evolution of 3D scanning technology: how to manage/visualize those data on commodity computers; how to improve the ease of use of the visualization tools (as potential users are often not expert with interactive graphics); how to support the presentation of other multimedia information together with the visualization of complex 3D geometry. Our *Virtual Inspector* browser has been designed to give a solution to these issues.

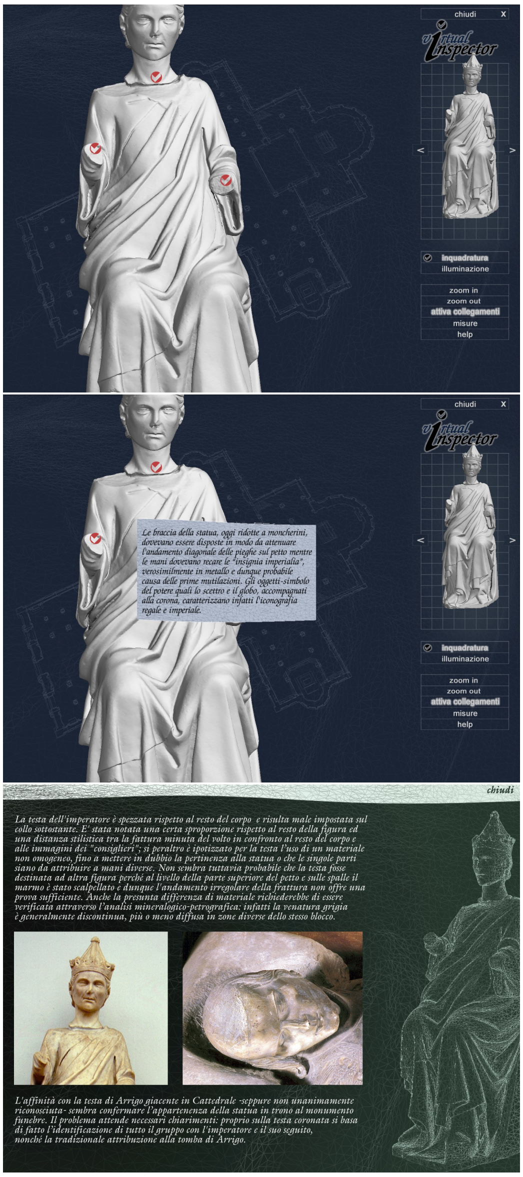


**Figure 3:** *Virtual Inspector: the "Arrigo VII enthroned" statue rendered with active hot spots (top); a short popup panel with a short info, describing the missing hand, appears when the mouse passes over the hotspot (middle); an example of an HTML page activated by clicking the hot spot on the neck (bottom).*

### 6.1. Showing the Arrigo's complex with *Virtual Inspector*

*Virtual Inspector* is a new visualization system that allows naive users to inspect a large complex 3D model at interactive frame rates on standard PC's. This system evolved considerably from the preliminary version presented in [BCS01]; we describe here briefly its new features. To support the efficient manipulation of massive models, *Virtual Inspector* adopts now a multiresolution approach where view-dependent variable resolution representations are extracted on the fly using a new and highly efficient approach [CGG*04]. For each frame, the best-fit *variable resolution* LOD is selected according to the current view frustum and the requested visualization accuracy. LOD selection and rendering are very efficient since we adopt a patch-based representation, where a coarse-grain multiresolution hierarchy is visited on the fly and ready-to-render geometry patches are associated to each logical node of the variable LOD produced. 3D data are therefore not reconstructed on the fly, but efficiently fetched from disk on demand and copied on GPU memory for maximal rendering efficiency.

*Virtual Inspector* is mainly oriented to the visualization of single works of art (sculptures, pottery, architectures, etc.), and adopts a very intuitive approach to guide the virtual manipulation and inspection of the digital replica, based on a straightforward metaphor: we provide a *dummy* representation of the current inspected model on a side of the screen, which can be rotated on its axe; to select any given view the user has just to point with the mouse the corresponding point on the *dummy* (see Figure 5 in the color plates). *Virtual Inspector* supports interactive modification of the lighting, to simulate in real time the "luce radente" (grazing light) effect that is usually used in real inspection to enhance the visualization of small-scale surface detail.

Other important characteristics of *Virtual Inspector* we want to emphasize here are its flexibility and configurability. All main parameters of the system can be easily specified via XML tags contained in a initialization file, such as: which are the 3D models to be rendered (a single mesh or multiple ones, as it is the case of the Arrigo VII complex), the system layout characteristics (i.e. how the different models will be presented on the screen), the rendering modes (e.g. standard Phong-shaded per-vertex colors or BRDF rendering) and the interaction mode (e.g. model manipulation via the standard virtual trackball, the dummy-based "point and click" interaction, or both).
The design of the Arrigo VII installation has been done with the help of a professional graphic designer. Consequently, the layout of the application, all icons and background graphics elements have been completely redesigned with respect to previous incarnations of the *Virtual Inspector* system. This has been done by the easy specification of the new images and location on the screen of all icons and elements of the GUI in the XML initialization file and did not required neither programming nor recompilations of *Virtual Inspector*. It is a task that can be easily assigned to an operator with very limited IT competence.

Finally, while designing the Arrigo VII multimedia presentation we introduced support for *hot-spots* in *Virtual Inspector*. Hot spots are a very handy resource to associate

multimedia data (e.g. html pages) to any point or region of a 3D model. This allows to design interactive presentations where the 3D model is also a natural visual index to historical/artistic information, presented using standard HTML format and browsers (see Figure 3).
The specification of hot spots is extremely easy in *Virtual Inspector*; modifications to the 3D models are not required. We provide a simple 3D browser to the person in charge of the implementation of the multimedia presentation, which allows to query the 3D coordinates of any point on the surface of the artifact (by simply clicking with the mouse on the corresponding point). Then, a new hot spot is specified by introducing a new XML tag in the *Virtual Inspector* specification file. The hot spot XML tag specifies basically the 3D location and the action that has to be triggered when clicking on the hot spot (e.g. the name of the html file, if we want to open a multimedia page). After activation, the control passes to the html browser, while *Virtual Inspector* remains sleeping in the background and regains automatically the control of the interaction whenever the html browser is closed.

The Arrigo VII visual presentation in the museum has been designed with introductory HTML pages, both to present some general artistic/historic information on the Arrigo VII complex, and to provide links to activate *Virtual Inspector* on the different statues (see Figure 5 in the color plates). These introductory/index pages hold also links to time-navigation pages, which present for each sub-set of statues their respective different locations during their seven century life (presented to the user through some precomputed videos).

### 6.2. Usability evaluation of the interactive system

We have planned to run an evaluation of the usability of the interactive system designed with *Virtual Inspector*, based mainly on the scientific observation of final users reaction[†]. This will be implemented both by the setup of a special panel of users, chosen on a statistical base coherent with the museum visitor's profile, and by an on-site analysis of the museum visitors satisfaction while using the interactive kiosk.

## 7. Hypothesis on the original monument architecture

As introduced in Section 3, the Arrigo VII mausoleum was the first and most famous victim of the transformations which took place in the Cathedral since the end of XV century up to the radical innovations of the first decades of the XVII century. Unfortunately, we lack any written or graphic document of the original mausoleum. A complex layout of the monument is indicated by the number, size, and iconography of the sculptures, making it quite different from other contemporary examples of funerary monuments. However, a 100% sure reconstruction of the original asset is almost impossible; many hypothesis have been formulated since the end of the XIX century , but none of them looks really convincing. Moreover, the new elements recently discovered (see Section 3) reopened the debate over the original disposition of the monument, stimulating scholars to formulate new hypothesis. To test *Virtual Inspector* efficiency for the support of academic research we made a new reconstructive attempt using the ViHAP3D technologies. First of all we reconstructed a digital model of the XIV century apse, to put in relationship the reconstructed mausoleum with the building. The reconstruction of the old apse was driven by the documentary and architectonic knowledge (the three windows now visible only from the exterior facade have been restored in the digital model) and by recent discoveries (the fragments of the painted curtain on the apse wall).
The two principal hypothesis for the mausoleum architecture, proposed by well known scholars [Dan83, Kre84] in the form of drawings (see drawings no. 151 and 152 in Figure 2), were verified in the 3D reconstructed apse. Thanks to the new technologies, we easily discovered that many details of these hypothesis were inconsistent both from a dimensional and a structural point of view. Therefore, we tried to devise new reconstruction hypothesis, and tested them with the help of our 3D tools which gave us the possibility to assess easily the consistency of our attempts in terms of reciprocal proportion of the statues, of statues orientation, and of plausible extents of the mausoleum with respect to the apse. The result we obtained is shown in Figure 4 and has been included in the Arrigo's museum installation. Even if it is a work in progress, subjected to further modifications, it appears to be much better than previous attempts, since it is based on the accurate measurements encoded in the 3D models. Unfortunately, the reconstruction proposed cannot give a final answer to many questions (such as, for example, the overall width of the monument) which will remain unsolved for the lack of documentation.

## 8. Further uses of the 3D data

We are planning further utilizations of the raw digital material produced in this project. A first possibility is to produce physical replicas from the digital statues. We are planning to investigate different technologies for the production of high-quality copies, to be sold in the museum shop.

A second application we are planning is the *virtual re-painting* of the statues. There is scientific evidence that these statues were painted (traces of paint have been discovered during the restoration of the Arrigo's grave). Unfortunately, the paint traces are not sufficient to give us complete knowledge of the original decoration. Therefore, further research is needed which will probably lead to multiple potential "col-

[†] The usability evaluation has been commissioned, in the framework of the ViHAP project, to a company specialized in the assessment of museum quality (dott. L. Solima and dott. S. Riolo, Megaride srl, Naples).

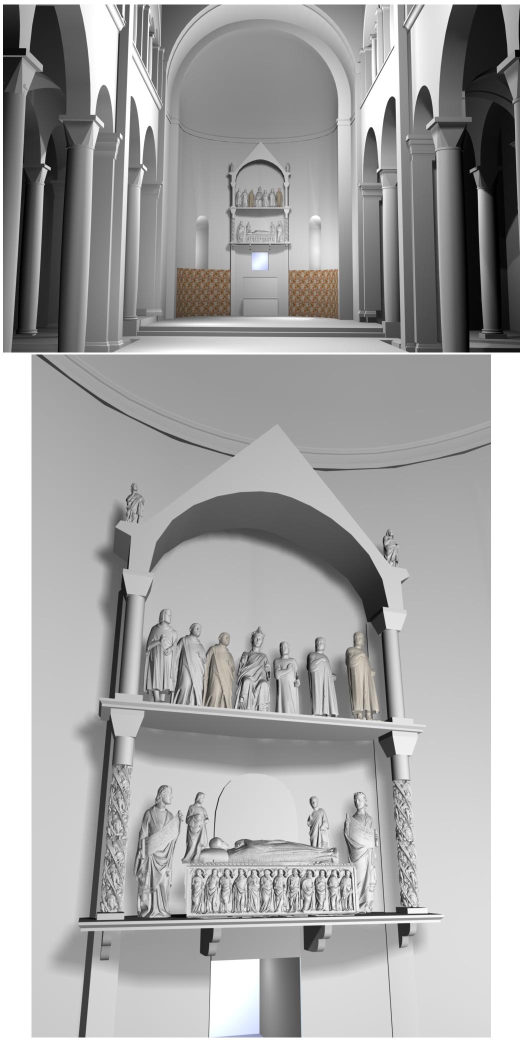

**Figure 4:** *Virtual reconstruction of the hypothetical original architecture of the Arrigo VII monument in the Pisa Cathedral apse.*

orizations" of the statues. Once these reconstructions will be ready, we would like to reproduce them on the surface of the digital replicas and to set up a projection system for dynamically projecting these alternative reconstruction on the real statues in the museum [RWLB01].

Finally, the Arrigo complex can be an ideal test bed for the implementation of an interactive didactic application, which could be proposed to teach medieval sculpture to students and to let them try to reconstruct the original monument from the disassembled components (allowing them to replicate some of the work that the real experts are doing, see Section 7). 3D models might play a major role in education: students can observe a sculpture from every possible point of view, discover disappeared buildings, or be guided to the original locations of artworks inside churches and palaces. Though fascinating, digital 3D models have to be part of an educational plan (produced in strong co-operation by teachers, art-historians and IT experts) to conquer a real and effective impact.
The Superintendency, ISTI-CNR and Opera del Duomo are now setting up an experimental educational program concerning the Arrigo VII monument. First, students are confronted with the history of the Cathedral Square ("Piazza dei Miracoli"), combining together traditional lessons with the use of different multimedia objects, such as Cd-Rom, Internet, and 3D models of the main monuments of the Square. Afterwards, they will be engaged in a virtual journey around and inside the Arrigo VII's Mausoleum: we expect them to become able to read this artwork, finding and interpreting documentary sources, exploring the digital models of the monument' elements, interacting with them and/ or virtually construing by themselves any possible alternative disposition of the statues.

## 9. Conclusions

We have presented the work done to build a digital 3D representation of the Arrigo VII complex. This innovative 3D representation has been of great help in the study of the monument and in setting up an appealing presentation to the museum public. The multimedia kiosk has been installed in the Museo dell'Opera del Duomo on September 22th, and the evaluation of visitors satisfaction in running on.

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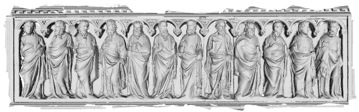
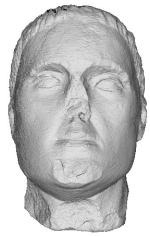


| | **Arrigo VII enthroned** | **Arrigo VII lying on sepolcro** | **Sepolcro's basrelief** |
|---|---|---|---|
| Size: | 170 cm (height) | 188 cm (horiz.lenght) | 222 cm (horiz.lenght) |
| Range maps: | 398 | 176 | 250 |
| Scanning sampling: | 0.4 mm | 0.3 mm | 0.3 mm |
| Scanning time: | 7h | 8h | 8h |
| Align time: | 10 dd | 1 dd | 1 dd |
| Fusion grid size: | 0.5 mm | 0.3 mm | 0.3 mm |
| Model size: | 40 M tr. | 29 M tr. | 35 M tr. |

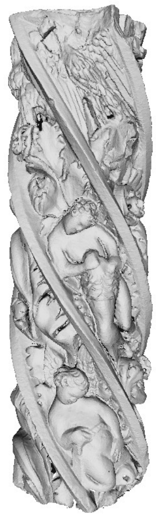


| | **Announcing Angel no. 1** | **Announcing Angel no. 2** | **Virgin Mary** | **Male head** |
|---|---|---|---|---|
| Size (height): | 165 cm | 165 cm | 78 cm | 26 cm |
| Range maps: | 272 | 210 | 97 | 24 |
| Scanning sampling: | 0.5 mm | 0.5 mm | 0.4 mm | 0.4 mm |
| Scanning time: | 8h | 6h | 4h | 1h |
| Align time: | 5 dd | 10 dd | 1 dd | 3h |
| Fusion grid size: | 0.3 mm | 0.5 mm | 0.5 mm | 0.3 mm |
| Model size: | 25 M tr. | 15 M tr. | 6 M tr. | 2.3 M tr. |

**Table 1:** *The set of artifacts scanned is presented, together with some scanning details data (Part 1); the images are not in scale (see respective sizes).*



| | **Announcing Angel no. 3** | **Announcing Angel no. 4** | **Announcing Angel no. 5** | **Column** |
|---|---|---|---|---|
| Size (h*w*d): | 78 cm | 100 cm | 97 cm | 85 cm |
| Range maps: | 94 | 116 | 153 | 115 |
| Scan. sampl.: | 0.35 mm | 0.4 mm | 0.4 mm | 0.4 mm |
| Scan. time: | 4h | 4h | 5h | 4h |
| Align time: | 1 dd | 1 dd | 1 dd | 1 dd |
| Fus. grid: | 0.25 mm | 0.4 mm | 0.4 mm | 0.5 mm |
| Model size: | 6.5 M tr. | 7.1 M tr. | 6.9 M tr. | 12 M tr. |




| | **Counsellor no. 1** | **Counsellor no. 2** | **Counsellor no. 3** | **Counsellor no. 4** |
|---|---|---|---|---|
| Size (height): | 149 cm | 142 cm | 142 cm | 142 cm |
| Range maps: | 253 | 254 | 240 | 310 |
| Scan. sampl.: | 0.5 mm | 0.5 mm | 0.5 mm | 0.5 mm |
| Scan. time: | 1 dd | 1 dd | 1 dd | 1 dd |
| Align time: | 3 dd | 2 dd | 4 dd | 3 dd |
| Fus. grid: | 0.5 mm | 0.5 mm | 0.5 mm | 0.5 mm |
| Model size: | 25 M tr. | 22.7 M tr. | 27 M tr. | 26 M tr. |

**Table 2:** *The set of artifacts scanned is presented, together with some scanning details data (Part 2).*


**Figure 5:** *The initial screen of the multimedia kiosk and one of the following sub-index pages are shown above; to provide access to any statue of the Arrigo VII complex, the statues have been divided in four groups (the second image shows the index page related to the "Arrigo VII enthroned" and counsellors group). Virtual Inspector can be started by clicking on any of the icons of the statues here presented (image top-right). Visualizations of the 3D model of Arrigo VII enthroned are shown below, with two screen shots of the interactive inspection.*