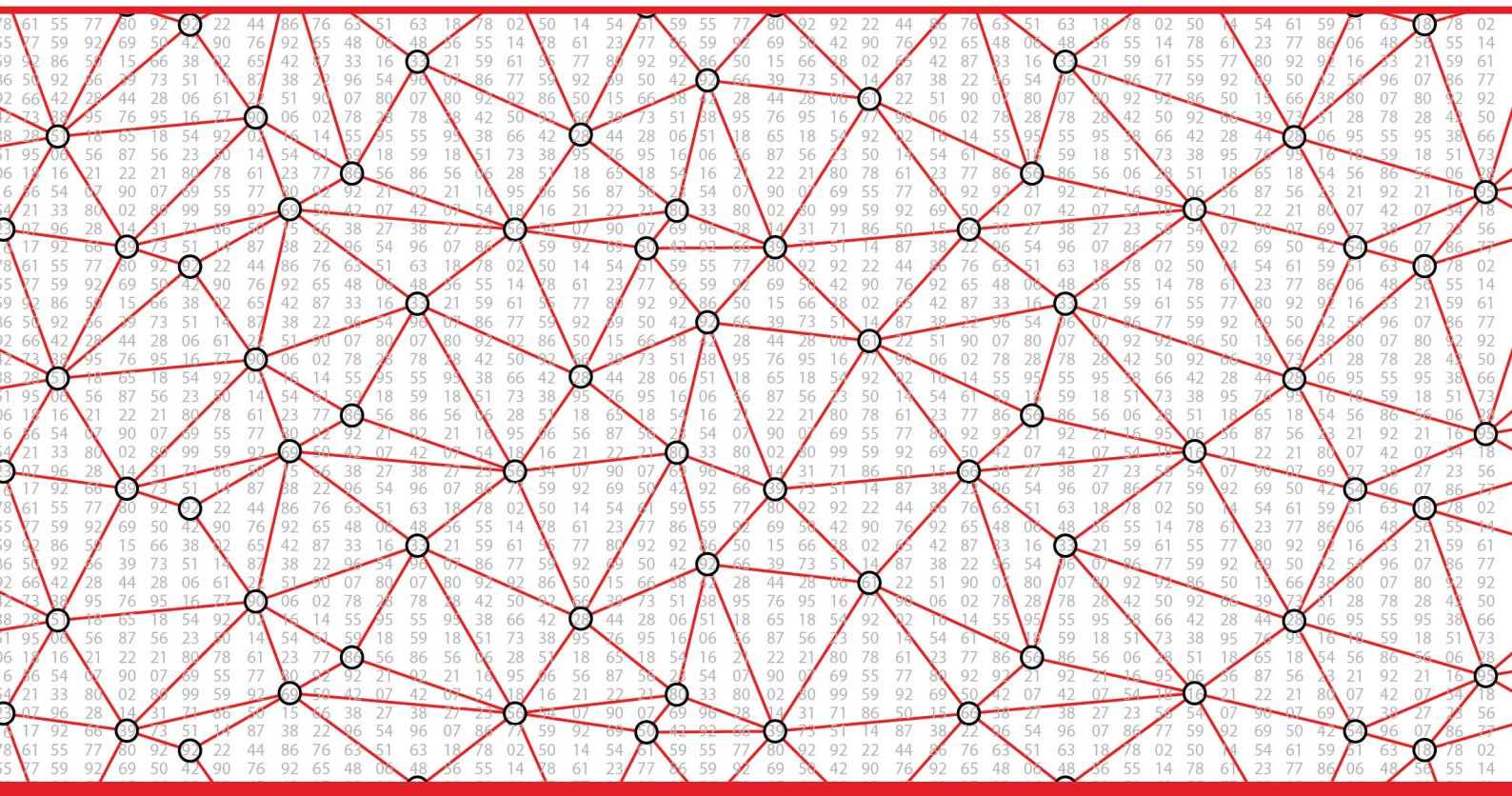
REPRESENTATION CHALLENGES

Augmented Reality and Artificial Intelligence in Cultural Heritage and Innovative Design Domain

edited by

Andrea Giordano
Michele Russo
Roberta Spallone



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Preface

Francesca Fatta

When in January 2020 Roberta Spallone with Andrea Giordano and Michele Russo proposed a seminar with the complex acronym REAACH–ID to involve a larger group of Augmented Reality scholars, I realized that the time had come to define the context of our initiatives on virtual representation, looking also to the sphere of science that deals with Artificial Intelligence. Their proposal did not want to follow the trend, but rather to respond to the need for methodological relationships and cross competences aimed at promoting a dialogue between human and hard sciences.

The starting point consists in the single and shared researches of the scholars involved in the organization of this symposium, they are all teachers of Drawing who have been engaged for years in the creation and analysis of drawings, images and models that represent the evolution of existing realities over time or purely designed entities. Moreover, when the Italian teachers of Drawing reorganized the declaration of the sector (UID May 2021), they agreed that the scope of our SSD (Scientific Disciplinary Sector) research: "[…] therefore concerns the geometric–descriptive–configurative domains, graphic–visual–synaesthetic, informational–computational features, as well as the related historical, epistemological, semantic, technological and applicative aspects. [...] the modeling, including informative modeling, prototyping and visual communication [...]".

The question concerns the definition of the relationships between a physical, real, tangible reality and an intangible spatiality defined with the help of Artificial Intelligence, increasingly able to trigger specific reading processes of complex contexts, which can be represented in a way similar to human thought with amazing space–time simulation effects.

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Mario Rasetti's prestigious speech performed for the opening of REAACH–ID symposium indicated how Artificial Intelligence may show new possibilities in the world of representations, underlining the links between AI and Engineering, Information Technology, Cognitive Sciences and Philosophy.
During the symposium the scholars asserted several times that reality means everything that is concrete and material, therefore something natural and changeable, but the advent of Artificial and Virtual Reality offers a new version of reality in itself. It cannot be considered anymore as pure vision, but as a participation of all the senses, even of the whole body, thanks to effects created by the digital tools which are so likely that they are accepted by an observer as a real experience.
It has been noted that artificial reality is the most advanced form of interaction between man and machine. Inside this deceptive reality everything that is perceived is generated by a computer that responds to our movements with images and sounds designed to give us the illusion of a virtual world that breaks the laws of physics projecting our self in a free space–time. Artificial Reality represents the realization of an invention, a trespassing tool towards a new kind of utopia.
If it is true that Artificial Reality involves all the senses with illusory messages, nevertheless visual messages have the upper hand over all the others; it is precisely for this reason that during the symposium the scholars have exalted the world of Artificial Reality as a real opportunity for exploring and visual communicating. The user, wandering without constraints into a new world, becomes an experimenter of new models of thought and technologies. Furthermore, researchers in our disciplinary sector often study cultural heritage resorting to digital technologies that increase their reading and interpretation in the process of its analysis, design and enhancement. For over fifteen years, the Italian teachers of Drawing have already made use of a fruitful intertwining between Artificial Intelligence and Augmented Reality thanks to the new possibilities of identification and connection between digital products and physical consistencies, in a mix of real and virtual world.
The way of acting, according to the methodological profile of our research, which starts from physical space, has found in the digital world and Artificial Intelligence those tools for expanding the reality (for this reason called "augmented") aiming at redefining the way to share cultural heritage, or the way to enhance it through innovative systems of community participation.
The success of REAACH–ID encouraged Roberta Spallone, Andrea Giordano and Michele Russo to organize a second symposium. For this I feel the need to thank them for the good work produced in this volume, which collects the results of the open discussion and the scholars' research presented during the first symposium, as well as for what they are preparing in the next future meeting.

UID president
July 2021

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Index

7
Francesco Fatta
Preface

9
Andrea Giordano, Michele Russo, Roberta Spallone
Representation Challenges: The Reasons of the Research

AR&AI theoretical concepts

23
Francesco Bergamo
The Role of Drawing in Data Analysis and Data Representation

29
Giorgio Buratti, Sara Conte, Michela Rossi
Artificial Intelligency, Big Data and Cultural Heritage

35
Marco Ferrari, Lodovica Valetti
Virtual Tours and Representations of Cultural Heritage: Ethical Issues

41
Claudio Marchese, Antonino Nastasi
The Magnificent AI & AR Combinations: Limits? Gorgeous Imperfections!

47
Valerio Palma
Data, Models and Computer Vision: Three Hands–on Projects

53
Alberto Sdegno
Drawing Automata

59
Marco Vitali, Giulia Bertola, Fabrizio Natta, Francesca Ronco
AI+AR: Cultural Heritage, Museum Institutions, Plastic Models and Prototyping. A State of Art

AR&AI virtual reconstruction

67
Alessio Bortot
Physical and Digital Pop–Ups. An AR Application in the Treatises on Stereotomy

73
Maurizio Marco Bocconcino, Mariapaola Vozzola
The Value of a Dynamic Memory: from Heritage Conservation in Turin

79
Antonio Calandriello
Augmented Reality and the Enhancement of Cultural Heritage: the Case of Palazzo Mocenigo in Padua

85
Cristina Càndito, Andrea Quartara, Alessandro Meloni
The Appearance of Keplerian Polyhedra in an Illusory Architecture

91
Maria Grazia Cianci, Daniele Calisi, Sara Colaceci, Francesca Paola Mondelli
Digital Tools at the Service of Public Administrations

97
Riccardo Florio, Raffaele Catuogno, Teresa Della Corte, Veronica Marino
Studies for the Virtual Reconstruction of the Terme del Foro of Cumae

103
Maurizio Perticarini, Chiara Callegaro
Making the Invisible Visible: Virtual/Interactive Itineraries in Roman Padua

AR&AI heritage routes

111
Marinella Arena, Gianluca Lax
Saint Nicholas of Myra. Cataloguing, Identification, and Recognition Through AI

117
Stefano Brusaporci, Pamela Maiezza, Alessandra Tata, Fabio Graziosi, Fabio Franchi
Prosthetic Visualizations for a Smart Heritage

123
Gerardo Maria Cennamo
Advanced Practices of Augmented Reality: the Open Air Museum Systems for the Valorisation and Dissemination of Cultural Heritage

129
Serena Fumero, Benedetta Frezzotti
The Use of AR Illustration in the Promotion of Heritage Sites

135
Alessandro Luigini, Stefano Brusaporci, Alessandro Basso, Pamela Maiezza
The Sanctuary BVMA in Pescara: AR Fruition of the Pre–Conciliar Layout

141
Alessandra Pagliano, Greta Attademo, Anna Lisa Pecora
Phygitalarcheology for the Phlegraean Fields

147
Andrea Rolando, Domenico D'Uva, Alessandro Scandiffio
A Technique to Measure the Spatial Quality of Slow Routes in Fragile Territories Using Image Segmentation

153
Giorgio Verdiani, Ylenia Ricci, Andrea Pasquali, Stéphane Giraudeau
When the Real Really Means: VR and AR Experiences in Real Environments

159
Ornella Zerlenga, Vincenzo Cirillo, Massimiliano Masullo, Aniello Pascale, Luigi Maffei
Drawing, Visualization and Augmented Reality of the 1791 Celebration in Naples

AR&AI classification and 3D analysis

167
Marco Giorgio Bevilacqua, Anthony Fedeli, Federico Capriuoli, Antonella Gioli, Cosimo Monteleone, Andrea Piemonte
Immersive Technologies for the Museum of the Charterhouse of Calci

173
Massimiliano Campi, Valeria Cera, Francesco Cutugno, Antonella di Luggo, Domenico Iovane, Antonio Origlia
CHROME Project: Representation and Survey for AI Development

179
Paolo Clini, Roberto Pierdicca, Ramona Quattrini, Emanuele Frontoni, Romina Nespeca
Deep Learning for Point Clouds Classification in the Ducal Palace at Urbino

185
Pierpaolo D'Agostino, Federico Minelli
Automated Modelling of Masonry Walls: a ML and AR Approach

191
Elisabetta Caterina Giovannini
Data Modelling in Architecture: Digital Architectural Representations

197
Marco Limongiello, Lucas Matias Gujski
Image–Based Modelling Restitution: Pipeline for Accuracy Optimisation

203
Federica Maietti, Marco Medici, Ernesto Iadanza
From AI to H–BIM: New Interpretative Scenarios in Data Processing

209
Michele Russo, Eleonora Grilli, Fabio Remondino, Simone Teruggi, Francesco Fassi
Machine Learning for Cultural Heritage Classification

215
Andrea Tomalini, Edoardo Pristeri, Letizia Bergamasco
Photogrammetric Survey for a Fast Construction of Synthetic Dataset

AR&AI urban enhancement

223
Giuseppe Amoruso, Polina Mironenko, Valentina Demarchi
Rebuilding Amatrice. Representation, Experience and Digital Artifice

229
Paolo Belardi, Valeria Menchetelli, Giovanna Ramaccini, Margherita Maria Ristori, Camilla Sorignani
AR+AI = Augmented (Retail + Identity) for Historical Retail Heritage

235
Fabio Bianconi, Marco Filippucci, Marco Seccaroni
New Interpretative Models for the Study of Urban Space

241
Marco Canciani, Giovanna Spadafora, Mauro Saccone, Antonio Camassa
Augmented Reality as a Research Tool, for the Knowledge and Enhancement of Cultural Heritage

247
Alessandra Pagliano
Augmenting Angri: Murals in AR for Urban Regeneration and Historical Memory

253
Caterina Palestini, Alessandro Basso
Evolutionary Time Lines, Hypothesis of an AI+AR–Based Virtual Museum

259
Daniele Rossi, Federico O. Oppedisano
Marche in Tavola. Augmented Board Game for Enogastronomic Promotion

AR&AI museum heritage

267
Massimo Barilla, Daniele Colistra
An Immersive Room Between Scylla and Charybdis

273
Francesco Borella, Isabella Friso, Ludovica Galeazzo, Cosimo Monteleone, Elena Svalduz
New Cultural Interfaces on the Gallerie dell'Accademia in Venice

279
Laura Carlevaris, Marco Fasolo, Flavia Camagni
Wood Inlays and AR: Considerations Regarding Perspective

285
Giuseppe D'Acunto
Augmented Reality and Museum Exhibition. The Case of the Tribuna of Palazzo Grimani in Venice

291
Giuseppe Di Gregorio
The Rock Church of San Micidiario of the Pantalica Site and 3DLAB VR/AR–Project

297
Elena Ippoliti
Understanding to Enhance, Between the Technical and Humanist Approaches

303
Gabriella Liva, Massimiliano Ciammaichella
Illusory Scene and Immersive Space in Tintoretto's Theatre

309
Franco Prampolini, Dina Porpiglia, Antonio Gambino
Medma Touch, Feel, Think: Survey, Catalog and Sensory Limitations

315
Paola Puma, Giuseppe Nicastro
The Emotion Detection Tools in the Museum Education EmoDeM Project

321
Leopoldo Repola, Nicola Scotto di Carlo, Andrea Maioli, Matteo Martignoni
MareXperience. AI/AR for the Recognition and Enhancement of Reality

AR&AI building information modeling and monitoring

329
Vincenzo Bagnolo, Raffaele Argiolas, Nicola Paba
Communicating Architecture. An AR Application in Scan–to–BIM Processes

335
Marcello Balzani, Fabiana Raco, Manlio Montuori
Integrated Technologies for Smart Buildings and PREdictive Maintenance

341
Fabrizio Banfi
Extended Reality (XR) and Cloud–Based BIM Platform Development

347
Carlo Biagini, Ylenia Ricci, Irene Villoresi
H–Bim to Virtual Reality: a New Tool for Historical Heritage

353
Fabio Bianconi, Marco Filippucci, Giulia Pelliccia
Experimental Value of Representative Models in Wooden Constructions

359
Devid Campagnolo, Paolo Borin
Automatic Recognition Through Deep Learning of Standard Forms in Executive Projects

365
Matteo Del Giudice, Daniela De Luca, Anna Osello
Interactive Information Models and Augmented Reality in the Digital Age

371
Marco Filippucci, Fabio Bianconi, Michela Meschini
Survey and BIM for Energy Upgrading. Two Case Study

377
Raissa Garozzo
A Proposal for Masonry Bridge Health Assessment Using AI and Semantics

383
Federico Mario La Russa
AI for AEC: Open Data and VPL Approach for Urban Seismic Vulnerability

389
Assunta Pelliccio, Marco Saccucci
V.A.I. Reality. A Holistic Approach for Industrial Heritage Enhancement

AR&AI education and shape representation

397
Maria Linda Falcidieno, Maria Elisabetta Ruggiero, Ruggero Torti
Visual Languages: On–Board Communication as a Perception of Customercaring

403
Emanuela Lanzara, Mara Capone
Genetic Algorithms for Polycentric Curves Interpretation

409
Anna Lisa Pecora
The Drawn Space for Inclusion and Communicating Space

415
Marta Salvatore, Leonardo Baglioni, Graziano Mario Valenti, Alessandro Martinelli
Forms in Space. AR Experiences for Geometries of Architectural Form

421
Roberta Spallone, Valerio Palma
AR&AI in the Didactics of the Representation Disciplines

427
Alberto Tono, Meher Shashwat Nigam, Stasya Fedorova, Amirhossein Ahmadnia, Cecilia Bolognesi
Limitations and Review of Geometric Deep Learning Algorithms for Monocular 3D Reconstruction in Architecture

Augmented Reality and Museum Exhibition. The Case of the Tribuna of Palazzo Grimani in Venice

Giuseppe D'Acunto

Abstract

The purpose of this research was the exploration of the potential of the combined use of augmented reality and rapid propotyping for the enhancement of Cultural Property. This specific study explored how these innovative methodologies can be effective in the creation of museum exhibitions which are not only able to show the contents of the exhibition itself in an original and captivating way, but also to recover the memory of a place by reconstructing the original position of the surroundings strictly connected to the sculptures they have been deprived of over the centuries.
It is the case of the Tribuna of Palazzo Grimani in Venice and of the statues that used to adorn its walls. The majority of these statues are now preserved in the National Archaeological Museum of Venice in an attempt to reconstruct their original appearance and disposition, and to offer the public a wholesome vision through augmented reality.

Keywords
augmented reality, digital models, digital survey, museum exhibitions.

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Among the various challenges that those who deal with exhibitions have to face every day, one of the most stimulating and insidious at the same time is the representation of the intangible value of the exhibited goods. Representing the intangible stratification of meanings and contents of a fragment of heritage – it being archaeological, architectural, cultural, or of any other nature – is an undertaking not to be taken for granted and is characterised by the need to maintain a continuous equilibrium between scientific rigor and narrative effectiveness. From this point of view, the evolution of the narrative codes and the increasingly widespread and rooted presence of the media have played a fundamental role in, on one hand, enormously enriching the range of solutions available to designers and curators, and, on the other hand, making this field significantly more complicated. Therefore, it is not surprising that, with usable patterns increasingly more shaped by the indissoluble influence of technology and its complicated rules – immediacy, accessibility, superabundance, experientiality – the contamination of the traditional codes with innovative languages and other narrative solutions has become a trend that is as natural as unavoidable and necessary. This is even more evident when museums are concerned, since the quality of an exhibition is determined, among other factors, also by the ability to show the intangible value of the exhibited goods in a tangible, effective and, most importantly, universal way.
The reconstruction of the position of the statues of the Tribuna of Palazzo Grimani in Venice exegetically explained in this essay is an experimentation of a museum exhibition in one of the most iconic places of Venice structured and organised according to the possibilities offered by augmented reality. The purpose is to show the original aspect of this place that has been lost over time.

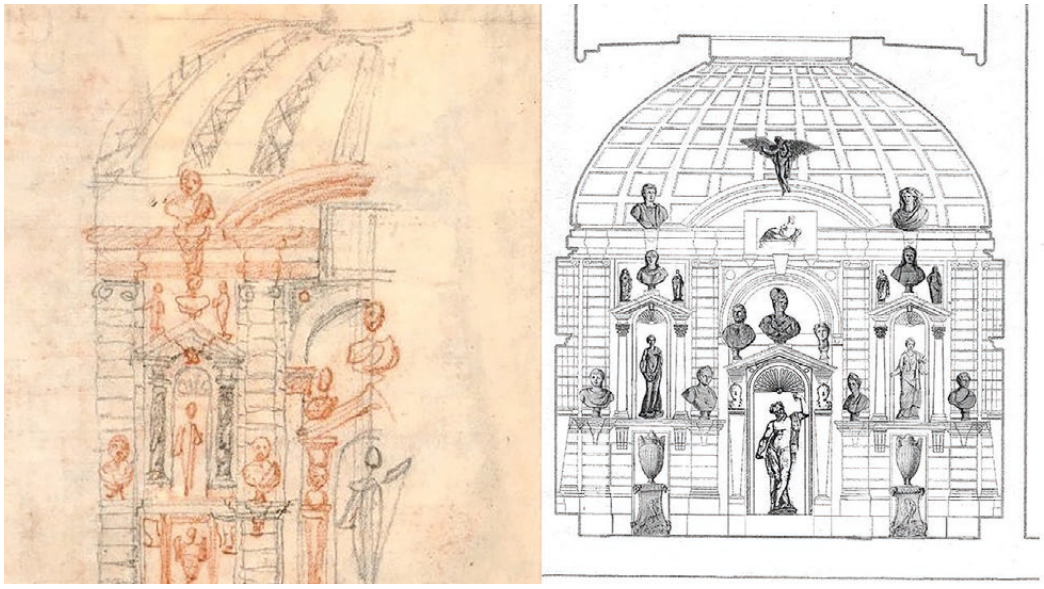

Fig. 1. (left) Reconstruction of a portion of the Tribuna by Federico Zuccari, 1582. British Museum, London. (right) Reconstruction of the wall facing the entrance. Favaretto I., De Paoli M. 2010.

The Tribuna was built in the second half of the 16th century at the will of Giovanni Grimani, patriarch of Aquileia. It was clearly inspired by the Pantheon and illuminated from the above by an opening in the centre of the roof vault. It contained an entire collection of statues in a very scenographic way due to an articulated system of lights and a refined system of niches and shelves. Even though there is no written evidence, it seems that the critics have endorsed the theory according to which Francesco Sansovino curated the architectural project of the Tribuna, as reported for the first time in a small anonymous guide of the end of the 18th century called *Pitture e scolture nel palazzo di casa Grimani a Santa Maria Formosa*. This space was attributed the name '*Tribuna*' only in the descriptions of the guides between the 18th and 19th centuries [1], but it was originally known as Antiquarium (studio of antiquities), as reported by Francesco Sansovino in his famous book *'Venetia città nobilissima et singolare'* dated 1581 [2]. In another passage of this book, there is a detailed narration of the

visit of Henry III, king of France, and Alfonso II, duke of Ferrara, to patriarch Grimani in the autumn of 1574. Sansovino described the amazement of the two illustrious guests towards the wonders that the Venetian Palace and, in particular, the Tribuna – where the entire collection of statues was displayed – offered.
Thus, it can be assumed that the Tribuna was largerly complete between the 60s and 70s of the 16th century, and the fame of its wonders had already spread throughout Europe, even though this setting, as originally organised, survived only less than thirty years. While still alive, Grimani bequeathed the entire collection of statues to the Serenissima Republic of Venice in 1586, with the intention to create a Public Statuary situated in the anteroom of the Marciana Library. According to the chronicles of the time, the transfer of the statues to the Statuary of the Serenissima started in 1593 (the same year in which Grimani died) and ended in 1596. During this operation, the first inventory of the entire collection, known as the Pellegrini Inventory [3], was compiled. This document is still of great importance in the attempt to recreate the historical issues of the Tribuna and it is one of the few written descriptions of the entire collection of statues in the room before their transfer to the Public Statuary. Another fundamental document that gives us the precise idea of the original aspect of the Tribuna in those years is the description dated 1593 that can be found in *'Storia del Friuli'* by Germano de'Vecchi.

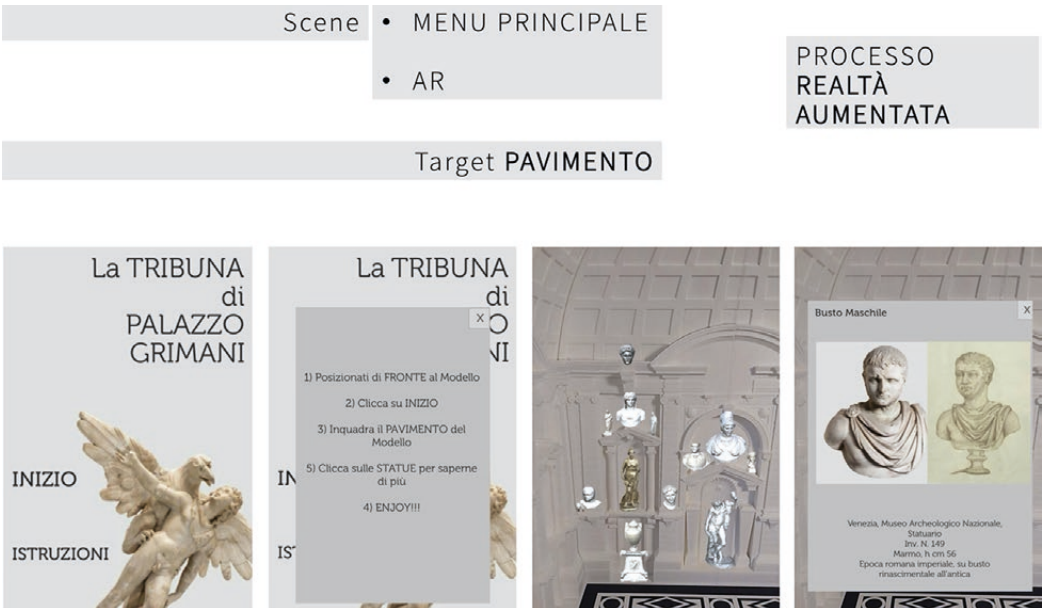

Fig. 2. The screen of the application in augmented reality with an example of multimedia card with the in–depth interactive contents for each individual statue. Digital elaboration by Valeria Sambucini.

As already mentioned before, the descriptions and positions of each statue as reported in the two inventories are incomplete and often approximate and they lack a graphic apparatus able to convey the exhibition in its original aspect with the correspondent disposition of the sculptures in the Tribuna.
Among the various studies about the Tribuna of Palazzo Grimani and its collection of statues, one that is worth to remember is that of the scholar Marilyn Perry [4] who, in 1972, was able to reconstruct the current disposition of the statues as reported in the inventories of Pellegrini and de'Vecchi inside the Archaeological Museum of Venice using also the drawings made by Anton Maria Zanetti 'the Young' in 1736. This contribution is a fundamental stage in the attempt to virtually reconstruct the original exhibition of the Tribuna. Unfortunately, Perry's study did not manage to reconstruct the exact disposition of the statues. A first and plausible hypothesis, then widely supported by critics, can be found instead in the study of the scholar Eva Soccal [5]. In her graduation thesis of 1999, Soccal hypothesised that the inventory of Pellegrini followed a circular trend in the enumeration of the statues, starting from the sculptures situated at the base of the walls and then rising helically upwards. The idea suggested by Soccal became an installation in an exhibition that took place in Bonn

in 2002 and that was dedicated to collectors and Venetian art. The images of the walls of the Tribuna were printed in a 1:1 scale and used as background for some of the original sculptures lent by the Archaeological Museum of Venice. Drawings by Zanetti were instead used as background for the sculptures that were supposedly originally placed in niches and on upper shelves.
It is probably superfluous to point out that this research [6], mainly focused on the digital reconstruction of the Tribuna, had to rely upon reconstructions made by art historians and archaeologists who have received great credit from the scientific community.
Apart from the already mentioned Soccal's study, the other most important research is *'La Tribuna ritrovata. Uno schizzo inedito di Federico Zuccari con l'Antiquario dell'illustrissimo Patriarca Grimani'* by Irene Favaretto and Marcella de Paoli. The work of the two Venetian scholars has been inspired by the finding of a drawing that apparently has nothing to do with the Tribuna of Palazzo Grimani. This drawing by Federico Zuccari is a reproduction of '*The Feast in the House of Simon the Pharisee'* made by Paolo Veronese in 1573 [7] and is preserved in the Department of Prints and Drawings of the British Museum in London. On the back of this drawing there is a freehand sketch made by the author himself which represents an image, although partial, of the Tribuna of Palazzo Grimani when it was full of Greek and Roman statues. The sketch represents the right half of the wall facing the entrance of the Tribuna. Although the drawing is incomplete, Favaretto and de Paoli have tried to reconstruct, even though only on paper, the entire room, hypothesising its organisation in the 80s of the 16th century with the repositioning of about 100 statues. (fig. 1)
Discussing the specifics of the digital reconstruction, after an intense study of the sources with the collaboration of art historians and archaeologists, the first operation carried out was a laser scan survey of the space of the Tribuna and the creation of a physical 3D model. Moreover, once the statues were positioned in their current location, some of them were surveyed using digital photogrammetry, in particular the Hora d'Autunno, which is nowadays preserved in the antitribune hall of Palazzo Grimani. They survey and modelling of all the statues was a long and complex work that involved only a few cases in this first phase, trying to build and explore a methodology that was then completed thanks to the collaboration with the Directorate of Cultural Activities and Sport of the Veneto Region, which lent the models of the missing statues. The data regarding the room and the statue obtained through the photogrammetrical survey were then processed through the software *Agisoft Photoscan*. The elaboration of the room was meant to obtain a three–dimensional model suitable to be then remodelled with a software of digital drawing in order to obtain a printable model. The elaboration of the statues was instead meant to obtain a texturised model that could be used to create the content of the application in augmented reality. The modelling made with the *software Rhinoceros* created a simplification of the digital clone of the room in terms of geometry and decorative details that are believed to be dated after 1582 – the reference year of the hypothetical reconstruction. In particular, the floral decorations at the centre of the ceiling coffers of the vault, the plaster masks placed above the round arches of the main niches and the plaster survey that adorned the mirrors above the arches were removed. In addition, the entrance on the left wall and the window on the right wall were removed for the same reasons and they were replaced with niches.
To enable the view inside the room in the printed physical model, only one half of the room was printed – that is, the one resulting from the division of the room itself by means of a plane perpendicular to the floor and passing through the vertical axis of the left and the right walls. The half that was printed is the one that contains the wall facing the entrance of the Tribuna. The model was subsequently divided into independently printable sections that were then united among themselves with hooks (between the walls, and between the walls and the sections of the vault) made ad hoc or with a glue (between the sections of the vault, and these and the skylight). After the printing phase, an application in augmented reality was created using the Unity and Vuforia *software*. In particular, Unity is a *software* that enables to create a large number of applications such as apps for mobile devices, while *Vuforia* is a kit for the development of applications in augmented reality for mobile devices. The structure of the application includes a simple main menu that introduces the augmented reality

scene and explains to the users how to use it through the 'instructions' command. That same application contains the interactive view of the original position of fourteen statues inside the Tribuna, that is, those relating to two thirds of the wall facing the entrance of the room. (fig. 2) The software Rhinoceros was initially used for the creation of the scene with the digital models of the statues to equalise the scale of the mesh models of the statues and that of the model of the room. Then, the models of the statues were virtually situated inside the Tribuna. Finally, the whole complex of the statues was exported in .obj format and imported into Unity to create the scene. Therefore, by framing the model of the Tribuna with a normal mobile device and thanks to some targets situated in the different support points of the statues, the image of the Tribuna with its statues appears. The next step consists of experimenting this application in the physical space of the Tribuna, considering the excellent functioning of the same on the scale model. The application designed in augmented reality offers interactive in–depth contents too: each statue has a multimedia card, consisting of a panel containing its real image, its representation made by Zanetti in his catalogue of 1736, and a small text with its name, its current location, and some other information. This panel can be activated for each statue by clicking on the statue itself.

Notes

[1] Cf.: Moschini 1815.

[2] Sansovino 1581, pp. 138-139.

[3] Cf.: Inventario Pellegrini, 16 november 1593 (asv, Procuratori de Supra, b. 68, proc. 151, fasc. 3, I, cc. 33-42).

[4] Perry 1972, pp. 75-253.

[5] Soccal E. 1999-2000, La Tribuna di Palazzo Grimani. Ipotesi di ricostruzione di una raccolta d'antichità nella Venezia del XVI secolo, graduation thesis, University of Padua, supervisor Graduate I. Favaretto; Soccal 2002, pp. 447-455.

[6] Part of this work has been developed in the thesis *Nuove Tecnologie per un Exhibit Museale Innovativo*, Graduate Valeria Sambucini, for the II–level Master's degree *MI–Heritage Sistemi Interattivi* e *Digitali per la Restituzione* e *Valorizzazione del patrimonio Culturale* of the Iuav University of Venice, scientific manager Prof. Giuseppe D'Acunto.

[7] For Federico Zuccari, see: Acidini Luchinat 1998 e Acidini Luchinat 2001, pp. 235-240.

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