POLITECNICO DI TORINO
Repository ISTITUZIONALE

Augmented Reality Experience for Inaccessible Areas in Museums

Original
Augmented Reality Experience for Inaccessible Areas in Museums / Germak, C., DI SALVO, A., Abbate, L.. - ELETTRONICO. - (2021), pp. 39-45. (AI and the Arts: Artificial Imagination London - (online) July) [10.14236/ewic/EVA2021.7].

Availability:
This version is available at: 11583/2911078 since: 2023-03-27T11:59:25Z

Publisher:
BCS Learning and Development Ltd

Published
DOI:10.14236/ewic/EVA2021.7

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

(Article begins on next page)

14 September 2026

EVA London 2021
Proceedings of EVA London 2021

BCS London

2021

Editors:

Jon Weinel
Jonathan P. Bowen
Ann Borda
Graham Diprose

Preface

The *Electronic Visualisation and the Arts* London 2021 Conference (EVA London 2021) is co-sponsored by the Computer Arts Society (CAS) and BCS, the Chartered Institute for IT, of which the CAS is a Specialist Group.

Of course, this is a difficult time for all conferences, with the Covid-19 pandemic. As a result, the EVA London 2021 Conference is an online conference, as it was in the previous year as well. We continue with publishing the proceedings, both online, with open access via ScienceOpen, and also in our traditional printed form.

Over recent decades, the EVA London Conference on *Electronic Visualisation and the Arts* has established itself as one of the United Kingdom's most innovative and interdisciplinary conferences. It brings together a wide range of research domains to celebrate a diverse set of interests, with a specialised focus on visualisation.

The long and short papers in this volume cover varied topics concerning the arts, visualisations, and IT, including 3D graphics, animation, artificial intelligence, creativity, culture, design, digital art, ethics, heritage, literature, museums, music, philosophy, politics, publishing, social media, and virtual reality, as well as other related interdisciplinary areas.

The EVA London 2021 proceedings presents a wide spectrum of papers, demonstrations, Research Workshop contributions, other workshops, and for the sixth year, the EVA London Symposium, in the form of an evening panel session with invited contributors. The conference includes a number of other associated online evening events including ones organised by the Computer Arts Society, Art in Flux, and the Lumen Prize.

A feature of EVA London, started in 2018, has been a *Research in Education Day*, immediately after the main conference, bringing together students and associated staff from universities in the London area to enable presentations and networking. In the circumstances, we now aim to hold this in conjunction with EVA London 2022.

As in previous years, there are Research Workshop contributions in this proceedings, aimed at encouraging participation by postgraduate students and early-career artists, accepted either through the peer-review process or directly by the Research Workshop chair. The Research Workshop contributors are offered bursaries to aid participation. In particular, EVA London liaises with Art in Flux, a London-based group of digital artists.

The EVA London 2021 proceedings includes long papers and short "poster" papers from international researchers inside and outside academia, from graduate artists, PhD students, industry professionals, established scholars, and senior researchers, who value EVA London for its interdisciplinary community. The conference also features keynote talks.

This publication has resulted from a selective peer review process, fitting as many excellent submissions as possible into the proceedings. This year, submission numbers were lower than previous years, mostly likely due to the pandemic forcing the conference online. It is still pleasing to have so many good proposals from which to select the papers that have been included.

EVA London is part of a larger network of EVA international conferences. EVA events have been held in Athens, Beijing, Berlin, Brussels, California, Cambridge (both UK and USA), Canberra, Copenhagen, Dallas, Delhi, Edinburgh, Florence, Gifu (Japan), Glasgow, Harvard, Jerusalem, Kiev, Laval, London, Madrid, Montreal, Moscow, New York, Paris, Prague, St Petersburg, Thessaloniki, and Warsaw. Further venues for EVA conferences are very much encouraged by the EVA community.

As noted earlier, this proceedings is a record of accepted submissions to EVA London 2021. We plan for associated online presentations to be recorded and made available online after the conference.

Acknowledgements

EVA London 2021 gratefully acknowledges:

- **BCS, The Chartered Institute for IT** for hosting EVA London online using Zoom, and the BCS **Computer Arts Society** (CAS) Specialist Group for providing bursaries. Special thanks go to Kerry Wear at the BCS, for help with budgeting, registration, and other organisational arrangements, as well as Becky Youe, Florence Leroy, and Ian Borthwick of the BCS Electronic Workshops in Computing (eWiC) series, for support with the printed and online conference proceedings.
- **The Anthill Social** and Tom Keene for website hosting and support.

Thank you to staff at the BCS Swindon office for help with administrative and IT support.

Thanks to all the contributors for making EVA London a continuing success.

Committee

- **EVA London 2021 Conference Chair:** Graham Diprose
- **BCS CAS Chair:** Nick Lambert
- **EVA London 2021 Programme Co-Chairs:** Jon Weinel
  Jonathan P. Bowen
  Ann Borda
  Graham Diprose
- **EVA London 2021 Symposium Co-Chairs:** Tula Giannini
  Jonathan P. Bowen
- **EVA London 2021 Research Workshop Chair:** Graham Diprose
- **EVA London 2021 Workshop Co-Chairs:** Nick Lambert
  Carl Smith
- **EVA London 2021 Publicity:** Sarah McDaid
- **EVA London 2021 Bursaries:** Graham Diprose
- **EVA London 2021 Website:** Jonathan P. Bowen
- **EVA London 2021 Technical Support:** BCS, The Chartered Institute for IT
- **EVA International Liaison:** Terry Trickett
- **EVA London Honorary Chair:** James Hemsley
- **EVA London Honorary Committee Member:** George Mallen

- **EVA London 2021 Organising/Advisory Committee Members :**

Ann Borda	The University of Melbourne
Jonathan P. Bowen	London South Bank University
Sean Clark	Interact Digital Arts
Graham Diprose	Independent
Tula Giannini	Pratt Institute, New York
Christina Hemsley	Independent
James Hemsley	Birkbeck College
Maureen Kendal	Dreamstudio.io
Nick Lambert	Ravensbourne University London
Sarah McDaid	London South Bank University
Gareth Polmeer	Royal College of Art
Aphra Shemza	Art in FLUX
Carl Smith	Ravensbourne University London
Terry Trickett	Trickett Associates
Jon Weinel	London South Bank University

List of Reviewers

The people listed below reviewed submissions for the EVA London 2021 Conference and the Organising Committee is very grateful for their voluntary help in the selection process.

- **EVA London 2021 Programme Committee:**

Otniel Altamirano
Doron Altaratz
Xavier Aure
Christin Bolewski
Ann Borda
Karen Bosy

Jonathan P. Bowen
Beatrice Bretherton
Daniel Buzzo
Kristin Carlson
Elisavet Christou
Sean Clark
Richard Collmann
Ed Cookson
Greg Corness
Stuart Cunningham
Antonio D'Amato
Laura Dekker
Daniela de Paulis
Florent Di Bartolo
J C Diaz
Graham Diprose
Alan Dunning
Eva Emenlauer-Bloemers
Huan Fan
Kenneth Feinstein
Raffaella Folgieri
Francesca Franco
Giuliano Gaia

Philip Galanter
Jānis Garančs
Tula Giannini
David Gibson
Oliver Gingrich
Eunice Gonçalves Duarte

Oana Gui
Kelly Hamilton
Susan Hazan
María Hidalgo Urbaneja
Richard Hoadley
J. Kirk Irwin
Yi Ji
Maria Kallionpää
Maureen Kendal
Eugenia Kim
Jinhee Kim
Nick Lambert
Kyungho Lee
Dominik Lengyel
Michael Lesk
Susan Liggett
Ziva Ljubec
Andy Lomas

Lindsay MacDonald
Jon Malis
Sarah McDaid
Murray McKeich
Lila Moore

Verda Munir
Rebecca Norris
Irida Ntalla
Teresa Numerico
Paul O'Dowd
Jeremy Pilcher

Gareth Polmeer
Cristina Portugal
Sabrina Recoules Quang
Luísa Ribas
Vasileios Routsis
Benjamin Seide
Aphra Shemza
Anna Shvets
Rita Silva
James Simpson
Carl Smith
Lydia Smolin
Agata Marta Soccini
Terry Trickett
Athanasios Velios
Jon Weinel
Ian Willcock
Ross Williams

Ron Yakir
Jing Zhou
Rehan Zia
Tobias Ziegler

Papers:

Keynotes & Symposium

Jonathan P. Bowen, Camille Baker, Ghislaine Boddington, Ernest Edmonds, Merel van Helsdingen & Terrence Masson EVA London 2021: Keynote summaries
http://dx.doi.org/10.14236/ewic/EVA2021.1

Jonathan P. Bowen, Tula Giannini, Rachel Falconer, Michael Takeo Magruder & Emanuele MarconiBeyond Human: Arts and identity between reality and virtuality in a post-Covid-19 world http://dx.doi.org/10.14236/ewic/EVA2021.2

Digital Culture and Museums

Jonathan P. Bowen & Tula Giannini Digitality: A reality check
http://dx.doi.org/10.14236/ewic/EVA2021.3

Ann Borda & Jonathan P. Bowen The Rise of Digital Citizenship and the Participatory Museum http://dx.doi.org/10.14236/ewic/EVA2021.4

Aila Regina da Silva & Gabriele Mauany Ferreira Alencar Sharing Impressions: An investigation about participatory museums and UX design
http://dx.doi.org/10.14236/ewic/EVA2021.5

Alexandra Orlova Digitizing Art or How to Broaden the Viewer's Experience
http://dx.doi.org/10.14236/ewic/EVA2021.6

Claudio Germak, Andrea Di Salvo & Lorenza Abbate Augmented Reality Experience for Inaccessible Areas in Museums http://dx.doi.org/10.14236/ewic/EVA2021.7

Digital Heritage

Dominik Lengyel & Catherine Toulouse Visual Mediation of Unique Construction and Access Principles of the Amphitheatre of Durrës http://dx.doi.org/10.14236/ewic/EVA2021.8

Kristin Carlson, Lucy Gill, Zahra Irranezhad, Amal Abdalla, Annie Sungkajun, Sam Bruner & Ella Jahraus Uncharted Territories: Developing digital experiences for anthropological and archaeological exploration http://dx.doi.org/10.14236/ewic/EVA2021.9

Sophie Dixon Grace: A virtual recreation of the Grace Darling story
http://dx.doi.org/10.14236/ewic/EVA2021.10

Benjamin Seide & Benjamin Slater Performance Capture for Virtual Heritage: Virtual re-enactment for the lost film Pontianak http://dx.doi.org/10.14236/ewic/EVA2021.11

Amalia Foka Computer Vision Applications for Art History: Reflections and paradigms for future research http://dx.doi.org/10.14236/ewic/EVA2021.12

Oliver M. Gingrich, Eike Falk Anderson, Alain Renaud, Evgenia Emets, David Negrao & Deborah Tchoudjinoff New Heritage: New media art between cultural heritage experience and artefact http://dx.doi.org/10.14236/ewic/EVA2021.13

Adventures in Sound and Image

Jonathan Weinel Worship the Penguin: Adventures with sprites, chiptunes, and lasers http://dx.doi.org/10.14236/ewic/EVA2021.14

Anna Shvets & Samer Darkazanli Conditional GAN for Diatonic Harmonic Sequences Generation in a VR Context http://dx.doi.org/10.14236/ewic/EVA2021.15

Kyoko Hidaka Ubiquitous Lighting: The Third Color Digital Art × Lighting Symposium and Workshop http://dx.doi.org/10.14236/ewic/EVA2021.16

James Simpson Live and Life in Virtual Theatre: Adapting traditional theatre processes to engage creatives in digital immersive technologies http://dx.doi.org/10.14236/ewic/EVA2021.17

Camille Baker, Maf'j Alverez, Bushra Burge, Kat Austen & Sarah Büttner INTER/her: An immersive journey inside the female body – VR experience demo http://dx.doi.org/10.14236/ewic/EVA2021.18

Leslie Deere Experimental Affect: Gesture controlled audio-visual performance in VR http://dx.doi.org/10.14236/ewic/EVA2021.19

Annie Sungkajun & Jinsil Huaryoung Seo Though Miles Apart http://dx.doi.org/10.14236/ewic/EVA2021.20

Ziwei Wu, Shuai Xu & Yingyi Wang Invisible War: An audio visual installation with laser light and Twitter API data http://dx.doi.org/10.14236/ewic/EVA2021.21

Artistic Communities & Education

Bao Han & Jonathan P. Bowen The Weiguan Culture Phenomenon in Chinese Online Activism http://dx.doi.org/10.14236/ewic/EVA2021.22

Sonja Pedell & Ann Borda Social Prescribing the Smart City http://dx.doi.org/10.14236/ewic/EVA2021.23

Maureen Kendal, Fion Gunn, Nazia Parvez, Chen Mei-Tsen, Terri M. Broughton & Cleon Grant The Evolving Collaboration – AMazed! The A-Maze artists investigate immersive technology to create imagination and artifice http://dx.doi.org/10.14236/ewic/EVA2021.24

Oliver M. Gingrich GENDER*UCK: Reframing gender & media art http://dx.doi.org/10.14236/ewic/EVA2021.25

Aphra Shemza & Stuart Faromarz Batchelor SHEMZA.DIGITAL: Participatory art as a catalyst for social change http://dx.doi.org/10.14236/ewic/EVA2021.26

Olaoluwa Oyedokun, Kristin Carlson & Annie Sungkajun Embraced Separation: Exploring methods of breath attunement in speculative infant swings http://dx.doi.org/10.14236/ewic/EVA2021.27

Cristina Portugal, Mônica Moura & Márcio Guimaraes Design in Times of Pandemics: Accessible literature to people with visual impairment http://dx.doi.org/10.14236/ewic/EVA2021.28

Sandra Woolley & Tim Collins Art for Computer Scientists: Processing as an open-source art medium for computer science Undergraduates
http://dx.doi.org/10.14236/ewic/EVA2021.29

Carinna Parraman, Fabio D'Agnano & Wuon-Gean Ho The Craftsperson, Tacit Knowledge, and Digital Embodiment http://dx.doi.org/10.14236/ewic/EVA2021.30

Artificial Intelligence

Dongyuan Liu machinesMemory: Malleability of AI technique, the data generated by machine learning algorithms http://dx.doi.org/10.14236/ewic/EVA2021.31

Regula Valérie Burri, Merle Richter & Laura Sigrüner Artificial Futures: Imagining AI through art http://dx.doi.org/10.14236/ewic/EVA2021.32

Konstantina Karterouli & Yota Batsaki AI and Cultural Heritage Image Collections: Opportunities and challenges http://dx.doi.org/10.14236/ewic/EVA2021.33

Graham Wakefield & Haru Hyunkyung JiCreative Artificial Intelligence within the Artificial Life Installation "Infranet" http://dx.doi.org/10.14236/ewic/EVA2021.34

Ozan Yavuz Novel Paradigm of Cameraless Photography: Methodology of AI-generated photographs http://dx.doi.org/10.14236/ewic/EVA2021.35

Imaging and Data Visualisation

Megan L. Smith & Yujie Gao All The Stars We Cannot See: A deep look into real-time satellite traffic http://dx.doi.org/10.14236/ewic/EVA2021.36

Daniel Buzzo Art as Data Set, Data Set as Art: Training machine vision systems to see as artists http://dx.doi.org/10.14236/ewic/EVA2021.37

Ian Willcock Crowdsourcing: Using real-time social media data to repopulate the socially distanced world http://dx.doi.org/10.14236/ewic/EVA2021.38

Rehan Zia Documenting Digital Creative Practice
http://dx.doi.org/10.14236/ewic/EVA2021.39

Ashley Buchanan & Ron Snyder Plant Humanities Lab: Planting the seeds for creative data visualisation http://dx.doi.org/10.14236/ewic/EVA2021.40

Digital Consciousness & Ecology

Terry Trickett New Media Art as a Vehicle for Research and Innovation
http://dx.doi.org/10.14236/ewic/EVA2021.41

Lila Moore & Owen Fender Sentient: A social media environment as a conscious living system http://dx.doi.org/10.14236/ewic/EVA2021.42

Kenneth Feinstein The Uncanny As a Sense of Presence in MX
http://dx.doi.org/10.14236/ewic/EVA2021.43

Carl Hayden Smith An Ecology for the Re-Enchantment of Life
http://dx.doi.org/10.14236/ewic/EVA2021.44

Batuhan Bintas Imaginatrix: School of Cyber Wizardry
http://dx.doi.org/10.14236/ewic/EVA2021.45

Research Workshop

Graham Diprose, Frances Liddell, Marco Pini, Sarah Vollmer & Racelar Ho Research Workshop Collected Paper: Explorations in concepts and the visual arts
http://dx.doi.org/10.14236/ewic/EVA2021.46
Joskaudė Pakalkaitė Development of Noise-free Digital Interfaces: Hand-drawn interfaces for consumer wellbeing http://dx.doi.org/10.14236/ewic/EVA2021.47

Anton Dragan Maslic & Eugenia S. Kim An Epistemological Misalignment of Cogs in the AI-Art-Making Machine http://dx.doi.org/10.14236/ewic/EVA2021.48

Tyler H. McIntosh Exploring the Relationship Between Music and Emotions with Machine Learning http://dx.doi.org/10.14236/ewic/EVA2021.49

Peirui Yang Archaeology and Contemporary Art: An experiment of virtual stratigraphy
http://dx.doi.org/10.14236/ewic/EVA2021.50

Workshops

Carl Hayden Smith, Daniel Buzzo & Eyal Gruss EVA London 2021 Workshops
http://dx.doi.org/10.14236/ewic/EVA2021.51

In a Space Out of Time

Sean Clark & Geoff Davis Revisiting and Re-presenting 1980s Micro Computer Art
http://dx.doi.org/10.14236/ewic/EVA2021.52

Luciana Haill & Nick Lambert Synthesis: Making magic with GenieMo
http://dx.doi.org/10.14236/ewic/EVA2021.53

Gretchen Andrew What if We Educated AI Based on the World We Want Instead of the World We Have? http://dx.doi.org/10.14236/ewic/EVA2021.54

http://dx.doi.org/10.14236/ewic/EVA2021.7

Augmented Reality Experience for Inaccessible Areas in Museums

Claudio Germak
Politecnico di Torino
Italy
claudio.germak@polito.it

Andrea Di Salvo
Politecnico di Torino
Italy
andrea.disalvo@polito.it

Lorenza Abbate
Politecnico di Torino
Italy
lorenza.abbate@polito.it

In recent years, new innovations have been introduced into the cultural heritage sector, aimed at offering more engaging and accessible tours to the public. The article discusses the development process of the VirgilTell project, for the visit of inaccessible places in the Racconigi Castle, one of the Savoy residences in Piedmont (Italy), by the UXD Team of Politecnico di Torino. The places assigned to the project are being restored and therefore excluded from the tour. The VirgilTell experience aims to include and make them accessible to visitors, through a virtual tour including multimedia content for the entertainment and involvement of the users. The visit has been realised through mixed techniques between VR and AR for the narration of the spaces in which the user takes part in a journey made of narratives by characters from the past and objects that no longer exist. The VirgilTell visit was also created with the aim of anticipating, in promotional terms, the physical visit to the museum spaces undergoing restoration, so as to attract visitors back inside once the work is finished.

Design for heritage. Augmented reality. Human centered design. User experience design. Digital storytelling.

1. INTRODUCTION

The introduction of digital technologies into cultural heritage is witnessing a significant paradigm shift in museology: from a model with conservation purposes, where works were simply physically displayed, to one that allows for a mixed-use offer, both in presence and at a remote location (Kargas, Karitsioti & Loumos 2020). Museum institutions are investing in cultural heritage mediated by digital technologies to establish a new dialogue between visitors, with evolving needs, and the spaces they visit. The aim is to create storytelling experiences that make spaces engaging, immersive and interactive.

The technologies allow different levels of immersion in the new realities, digitally mediated and replicated, depending on the perceptual involvement that is intended to be achieved by the users, the characteristics of the activity to be included in the context and consequently the device to be adopted (Koslow 2019).

In this evolving scenario, it is crucial to ensure that accessibility to cultural heritage, both tangible and intangible, can be provided to all visitors, regardless of their physical/cognitive abilities. The concept of accessibility is a key element to take into account when approaching the design of activities aimed at the use of museum spaces; in fact, institutions and research are moving in this direction, trying to respond to the different needs of users through a design-for-all approach.

Therefore, factors that may affect accessibility in museums should be considered, so that they can be overcome through the use of digital technology. Among these factors we find non-compliance with the regulations of the places, architectural barriers, restoration works, the existence of collections of goods not yet ready for display, cognitive and cultural barriers. In this sense, digital technologies can be a key tool in promoting standards of inclusion, if contextualised in a conscious way, for the enjoyment of cultural heritage (Chung et al. 2017). Through the combination of innovative forms of edutainment and experiential learning, we arrive at the creation of experiences for visitors, which allow for a fruition of content, even of a technical nature, in a simplified and informative mode with new forms of "reality" (Tscheu & Buhalis 2016).

Among the growing technologies applied to the museum sector are Virtual Reality and Augmented Reality, whose features allow total visitor immersion and provide entertainment experiences, which facilitate a new museology based on personalisation and customised experience (Southall, Marmion & Davies 2019). VR and AR

© Germak et al. Published by
BCS Learning and Development Ltd.

aim to support the acquisition of knowledge through concrete experimentation, reflection and abstraction, which are generally difficult to acquire when viewing environments and artefacts from the past (Bekele et al. 2018). Visitors have the opportunity to get in touch with the past, with all their senses, experiencing places and objects through their own gestures. By exploiting the potential offered by these technologies it is possible to implement and improve the communication of cultural heritage by making the offer more attractive and accessible to different groups of users.

The VirgilTell project was born with the aim of allowing the public to enjoy temporarily inaccessible museum spaces, in order to create a visit model scalable in other similar contexts, considering that the topic is substantial enough on the Italian scene. In fact, in terms of accessibility, the Italian museum heritage still presents physical and sensory barriers that prevent people with disabilities from fully accessing the available cultural resources. Only half of the Italian museums (53%) are equipped to guarantee the accessibility of the spaces and the usability of the collections to users with disabilities (Istat 2019).

2. RELATED WORK

Since the early 2000s, immersive augmented, virtual and mixed reality technologies have become part of the museum offer, providing a sensory experience to visitors through combinations of real and digital content. Users have the possibility to experience cultural artefacts in a completely new way.

The contamination of technologies within the museum context led the user to get involve in different levels of experience, combining the dimension of traditional cultural models with that of unusual and evolving experiences (Pine & Gilmour, 1998). The disruptive power of new technologies redesigned the museum offer and its services, enhancing the figure of the visitor who becomes the protagonist and proactive explorer of his/her visit. Access to heritage, preservation and enhancement through technological advances are topics in continuous evolution and experimentation that are beginning to open up in collaborations between different disciplines. Even in Italy, the scenarios of the application of these immersive technologies are starting to open up more and more, especially in an area where heritage museums contribute to the education and cultural, ethical and civil formation of individuals and society as a whole (Sacco et al., 2013).

Through experimentation with VR and AR, museum visitors are introduced to exciting immersive and interactive experiences. These experiences transport audiences into a world where they are able to become part of the environment and access simplified content, even for the non-expert audience. Museum organisations are investing in the development of VR and AR experiences to be included in their offer, trying to overcome environmental limitations and provide new opportunities for virtualisation, also thanks to the simplicity and flexibility of updating these tools (Schaper et al. 2018). In fact, these new realities allow, in addition to the documentation and cataloguing of assets, different forms of exploration in knowledge enrichment: reconstruction and narration of places, architectures and objects that are no longer there or have never existed, but also, it may seem a paradox, access to places that exist but are inaccessible.

Inaccessibility therefore becomes an opportunity to experiment with new forms of communication, from storytelling to gaming, through the use of VR and AR, optimised in relation to the characteristics of the user groups. These aspects emerge from the different experiences that have been created in the different museums. Among the VR experiences is one presented at the British Museum in 2015 that was created around exploring and describing the Bronze Age to visitors (Rae & Edwards 2016). The virtual reality environment aimed to increase public interest and excitement in the Bronze Age objects being shown and experienced. The creation of a Bronze Age environment allowed the value of VR to be tested to enhance visitors' understanding of a historical collection, where much of the evidence is archaeological. So, the choice of a VR experience was to add value to building knowledge of this period, especially to specific audiences such as schools and families.

The Ara Pacis Museum in Rome introduced new practices of cultural heritage display based on the use of tools including AR and VR, designing the experience "The Ara As It Was". The experience was installed on the monument 'Ara' and was developed in collaboration with an international digital and creative company. The project aimed to create a learning experience for visitors to the museum, bringing the reliefs of the Ara to life, making them regain their original splendour and colours. A project that sought to bring to light the old splendour of monuments worn out by the passage of time and bring them back to life in the present.

ArkaeVision Archeo is a VR experience designed to engage users in a circular and interactive way, where it is possible to virtually visit the temple dedicated to Hera II in Paestum, in the first half of the 5th century BC (Bozzelli et. al 2019). Users are taken on a journey that will lead them on a virtual tour where the beliefs, values and ancient population of the city of Magna Graecia are presented. There

are mainly two modes of exploration: a semi-guided visit by the digital actor, with the possibility to explore; and a free and more didactic one, where events and facts evolve in the plot, capturing their attention and pushing them to follow the path.

3. VIRGILTELL: AR AND VR EXPERIENCE

VirgilTell is a mixed experience, between VR and AR, born within the project Les Ducs des Alpes / I Duchi delle Alpi, financed in the framework of the cross-border cooperation programme between France and Italy ALCOTRA, to increase the tourist attraction of visiting the territories between Piedmont and France, building an itinerary around the historical places of the House of Savoy.

The VirgilTell project was born with the purpose of tackling the issue of accessibility of the temporary closed areas of Racconigi Castle in Piedmont, which cannot be visited by the public, and the subsequent scalability of the experience in the other Savoy residences in order to create a network among them.

VirgilTell comes as a follow-up to the Virgil project (Lupetti, Germak & Giuliano, 2015), a telepresence robot designed for the exploration of inaccessible areas, also inside Racconigi Castle, led by the UXD Polito research team. The robot was designed for some rooms of the castle that are excluded from visits mainly because of their state of preservation, fragility and logistical management. Virgil, driven by a Museum Guide, conducted a tour inside the spaces, sending live images mixed with multimedia compendium on screen to the visitors. In this case the experience is lived by the end users with the contribution of specialised operators. The activity has therefore become more complex both on an experimental level, bringing to light various technological limits, and on an economic and service management level. Other limitations of the telepresence robot within the environments included: the instability of the connection for piloting the robot, particularly in environments bordered by thick walls, the instability of on-board camera, the need for specialised technical assistance to solve accidental problems with the robot, and the level of interaction of the visitor with the robot, assessed through ethnographic tests as "low".

These considerations were instrumental in the development of the VirgilTell experience, focusing on the exploration of other inaccessible places in the Castle through VR and AR. This has made it possible to make accessible places excluded from visits because they have been restored and to give them a new life.

The condition of conservative restoration is common to many museums, which had to close parts of the tours because they were not safe for users. The VirgilTell experience intends to replace only temporarily those areas that cannot be visited by users, providing a different, augmented and interactive experience.

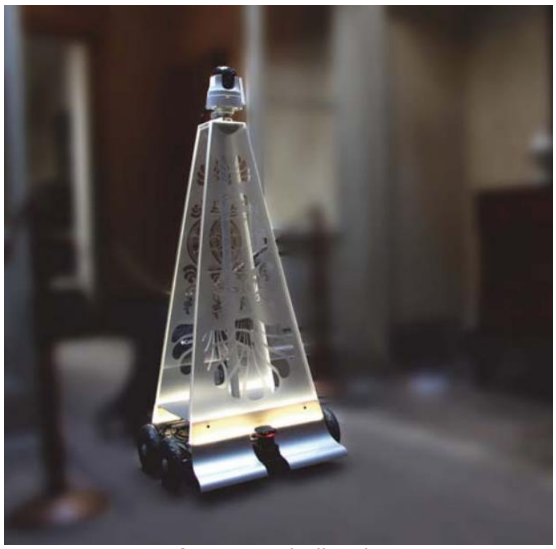

Figure 1: *Virgil Robot*

Unlike robotics, the new solution aims at the ease of scaling up and replicating the experience in a simple and fast way, adapting the contents to other places, without the need to employ significant amounts of resources in terms of money and time. The research team, made up of designers, was supported from the earliest stages of the project by various disciplines including architecture and art history, with the aim of arriving at a product shared and accepted by the users and stakeholders of the system. This strategy was also conceived with a view to showing the rooms before restoration, and then attracting visitors again once the worksite has been completed.

3.1 The Historical Background

Racconigi Castle, located in Piedmont, was built in the 11th century and was one of the residences of the Royal Savoy family. In the 19th century King Carlo Alberto of Savoia-Carignano made substantial changes to the structure that made it a "Royal Holiday Home" (Roggero & Vanelli, 2009). For this occasion, Carlo Alberto called the architect and decorator Pelagio Palagi to the court for the work, in order to assign him the design of the interior furnishings and ornaments in neoclassical style, first only for the areas of the expanding castle, then for all the Savoy residences. The architect Pelagio Palagi was responsible for the design of several rooms, including King Carlo Alberto's thermal baths, a particularly prestigious environment inspired by the Roman thermal baths, where he designed both the frescoes on the walls of the rooms inside, representing classical

mythological scenes, and all the furnishings that had been lost over the years. The thermal baths were later implemented and improved by King Vittorio Emanuele III, who in the early 1900s brought them to new splendour by introducing technological innovations of the time. From that time on, the baths did not undergo any more transformations and restorations and were abandoned for a long time, suffering significant damage caused by the dampness of the rooms.

In 2020, work started on the conservative restoration of the thermal baths of Carlo Alberto, which led to the creation of the VirgilTell project for a virtual visit to the places being restored. This strategy was also conceived with a view to show the rooms before restoration, and then attracting visitors again once the worksite has been completed.

4. VIRGILTELL DEVELOPMENT

The development of VirgilTell's platform for remote access to inaccessible areas involved an initial stage of scenario analysis with the introduction of case studies on Augmented Reality and Virtual Reality applied to cultural heritage.

From the scenario analysis emerged the requirements that guided the development of the project, which has seen the application of a human centered approach, for the understanding of the needs of users and stakeholders involved in the activity, not yet widespread enough in these experiences, which are linked to a technocentric vision (Barbieri, Bruno & Muzzupappa, 2017).

The VirgilTell project had the following objectives: offer the opportunity to visit temporarily inaccessible places, create a scalable model and adopt a digital medium contextual to the message to be transmitted. The experience involved the use of Oculus Quest visors, tools for the reproduction of virtual reality, capable of introducing suggestions that would otherwise be impossible, attracting visitors of all ages and levels of knowledge (technological and historical) and making them experience the atmosphere of the castle. The historical framework of the places to be rendered within the experience was fundamental in the early stages of the project, through textual and iconographic studies of the architecture and customs of the period. To do this, the team used the support of historians, who were able to provide and verify the truthfulness of the information to be included. Once the framework of information was systematised, the contents useful for the narration of the visit experience were selected.

The mixed technique between VR and AR appeared to be the most suitable for the narration of spaces, existing from the architectural point of view, but now devoid of furniture and furnishings. The scenography of the experience is in fact constituted by the images of the rooms in their pre-restoration state, augmented by the introduction of characters, moving machines and objects from the past.

Figure 2: *King Carlo Alberto's thermal baths in pre-restoration phase*

The different steps of the project included a photogrammetric reconstruction of the environments, cleaned of transfigurative and obscuring elements, through 360° images. In the 3D rebuilding operation, the images were superimposed on the meshes of the simplified volumes of the thermal baths of Carlo Alberto. The environments were reconstructed in 3D on the modelling program Blender, and the result obtained was integrated with the elements useful for the scenography: from the lighting, which gives a dark and mysterious photography, to the furniture and objects of the scene. The project attempted to digitally reconstruct the furnishings that were present at the time in those places, now destroyed, through the drawings and inventories of the architect Pelagio Palagi.

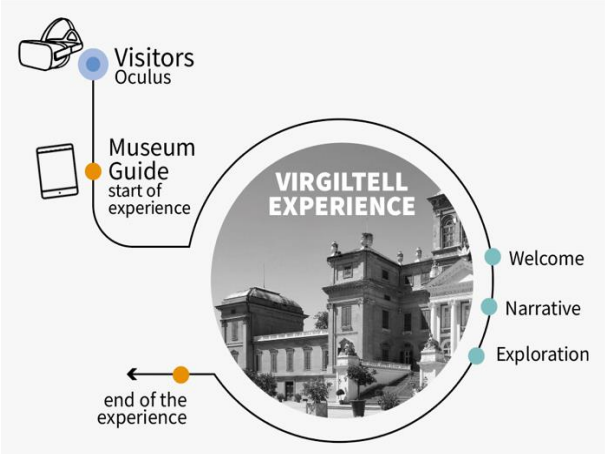

Figure 3: *General schema of VirgilTell experience*

The visiting experience in the virtual space is accompanied by various "ghost" style characters, who stop off in the rooms by appearing from a cloud. The characters appearing in the plot are the ghosts of King Carlo Alberto and King Vittorio Emanuele II, who are among the royal personalities who contributed most to the construction of the thermal flats. They are joined by an entirely imaginary figure, the maid Benedetta, who has

contributed to the informative-didactic and narrative enrichment of the virtual experience, lightening the stories with courtly gossip.

Figure 4: *Green screen shooting of actors in historical dress*

The actors who played these roles shot the various scenes on the green screen, in pre-established positions, following narrative, compositional and functional logics. The characters inserted in post-production in the virtual environments together with the furniture were modified to transform them into the ghosts of the past. The sound element is also important in the experience because it manages to direct the visitor's attention to the precise point where the narration takes place, through the spatialisation of the audio, despite the freedom of exploration.

Figure 5: *VR image of King Carlo Alberto's ghost and furniture*

4.1 Narrative structure

The user who lives the experience is considered as a visitor both in reality and in the virtual world. Wearing the visors, the user finds himself catapulted into the gardens of the Castle, just outside the thermal baths, where, attracted by a voice, that of the ghost of King Carlo Alberto, he is welcomed inside and given some initial indications on how to move and what to expect during his exploration. Visitors will be able to recognise the room they are in by the signs at the foot, where the name will appear. The journey through the different rooms begins in the Ironing Room, a place used by the servants to dry the palace's linen, where the first ghost appears, that of the servant Benedetta and all the furnishings that used to fill the room. Here the life of the court is illustrated and the functioning of one of the machines of the time, still present in the room, is shown in action through an animation. The tour continues in the other rooms, where Benedetta continues with her story, until King Carlo Alberto and then King Vittorio Emanuele III enter on stage. The three timelines on which the narrative unfolds intertwine throughout the experience: the first line is represented by the moment when the visitor participates in the exhibition of the places during the restoration phase; the second, set in 1842, coincides with the appearance of Benedetta and King Carlo Alberto; the last time jump is to 1920, represented by the appearance of King Vittorio Emanuele III, who will take the place of King Carlo Alberto in the last room.

Figure 6: *VR image of King Carlo Alberto's ghost on stage*

The narrative trend curve of the project experience continues slowly, leading the user considered as a hero to meet emblematic figures of increasing importance. Once arrived at the last rooms there are two peaks in the narrative: the first occurs with the appearance of King Carlo Alberto, and the second with the entrance of his twentieth-century successor King Vittorio Emanuele III, who reaches the scene a few moments before the closing of the experience with the wish to meet the visitors again.

The development of the narrative was studied in close correlation with the classic curve of attentional state (which starts very high and then falls after the first few minutes and rises again towards the end of the activity), and the difficulty curve in this case referred to the energies required to process the contents, rather than to an increase in the complexity of interaction with the environment.

It was considered in each room to be visited an extra time at the end of each narrative for free exploration by the visitor of 15 seconds, supported by the textual, iconographic and sound compendium through: descriptions and faithful quotations of the artists who made those rooms and music by composers of the time related to the royal court.

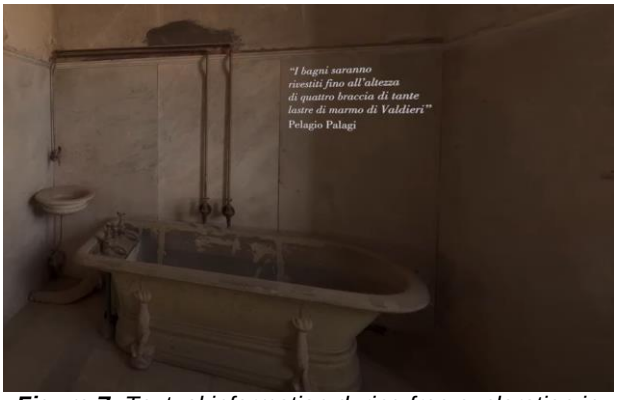

Figure 7: *Textual information during free exploration in VirgilTell*

5. EXPERIENCE MANAGEMENT

The VirgilTell experience is designed to be long enough to present the right amount of information and allow the audience to process the stimulation and maintain a high state of attention. From the moment the playback begins, the experience lasts 10 minutes, and each room visited is alternated with 15 seconds for orbital exploration following the content played in each room.

The experience takes place in spaces adjacent to the restored site, where there are 8 stations set up for the virtual visit using Oculus Quest. During the visit, visitors are seated in swivel chairs that provide the physical support necessary to view the experience without incurring episodes of physical fatigue or disorientation, dizziness or collisions with other members of the group and the surrounding environment.

Figure 8: *Test of VirgilTell experience with museum staff*

Once the visors are seated, the experience will be activated simultaneously in all the visors, by a device controlled by the museum guide, in order to avoid overlapping sounds between the different users. The experience can be interrupted at any time.

In the following phases, the service will be tested with visitors to collect data on the evaluation of the perceived quality and their emotional reaction to the experience.

6. CONCLUSION

The topic of improving and enhancing the enjoyment of cultural heritage through the application of digital technologies is a very recurrent one, especially at a time in history when we are reflecting on new forms of visiting museums. The adoption of technology in museums must be designed as an integral part of the context in which it is used and not considered as an accessory to the visiting experience. Considerations of usability, usefulness, effectiveness and management of the technological tool are necessary for its acceptance. In this sense, in-depth knowledge of the audience is a fundamental element to meet the creation of cultural content that can be enjoyed on a large scale, where the cognitive factor combines with the emotional one (Hassenzahl 2003).

For an ethical approach to the project, the reflection on the opportunities offered by different technologies allows to arrive at an experience that is contextual and appropriate to the message to be conveyed to the public. The visitor is attracted by the ability to tell stories with which they can empathise, where an authentic and unprecedented point of view is presented and where they feel like protagonists of a new reality (Han, tom Dieck & Jung 2017). These reflections supported the evolution of the project from Virgil Robot to VirgilTell, for visiting inaccessible spaces, which placed particular emphasis on aspects relating to the acceptance of technology, both by visitors and museum guides, for the development of the service. It is still evident that the entry of these technologies into museum systems does not take into account the service management of museum guides, who have to interact with complex and cumbersome systems (Shehade & Stylianou-Lambert 2020). Through the VirgilTell experience, an attempt has been made to reduce the responsibility of the museum guide and to make the service easy to manage.

It is evident that technologies such as VR and AR allow not only scalability, but also the continuous possibility to update content and implement the experience. The contribution intends to open a reflection on the impact of innovative elements such as VR and AR combined with the museum context to improve the visitor experience and satisfaction. The VirgilTell project intends to contribute to the debate on the new museology for the creation of methodological models scalable to different realities for the use of evolving museum spaces.

7. REFERENCES

Barbieri, L., Bruno, F., & Muzzupappa, M. (2017) User-centered design of a virtual reality exhibit for archaeological museums. *International Journal on Interactive Design and Manufacturing (IJIDeM), 12*(2), 561-571. doi:10.1007/s12008-017-0414-z

Bekele, M. K., Pierdicca, R., Frontoni, E., Malinverni, E. S., & Gain, J. (2018) A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage. *Journal on Computing and Cultural Heritage, 11*(2), 1-36. doi:10.1145/3145534

Bozzelli, G., Raia, A., Ricciardi, S., Nino, M. D., Barile, N., Perrella, M., Tramontano, M., Pagano, A., Palombini, A. (2019) An integrated VR/AR framework for user-centric interactive experience of cultural heritage: The ArkaeVision project. *Digital Applications in Archaeology and Cultural Heritage, 15*. doi:10.1016/j.daach.2019.e00124

Chung, N., Lee, H., Kim, J., & Koo, C. (2017) The Role of Augmented Reality for Experience-Influenced Environments: The Case of Cultural Heritage Tourism in Korea. *Journal of Travel Research, 57*(5), 627-643. doi:10.1177/0047287517708255

Han, D., Dieck, M. C., & Jung, T. (2017) User experience model for augmented reality applications in urban heritage tourism. *Journal of Heritage Tourism, 13*(1), 46-61. doi:10.1080/1743873x.2016.1251931

Hassenzahl, M. (2003) The thing and I: understanding the relationship between user and product. In M. A. Blythe, K. Overbeeke, A. F. Monk & P. C. Wright (Eds.), Funology (pp. 31–42). Dordrecht: Kluwer Academic Publishers

He, Z., Wu, L., & Li, X. (2018). When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions. *Tourism Management, 68*, 127-139. doi:10.1016/j.tourman.2018.03.003

Istat (2019) L'Italia dei musei, Italy, 23 December, https://www.istat.it/it/archivio/237159

Kargas, A., Karitsioti, N., & Loumos, G. (2020) Reinventing Museums in 21st Century. *Virtual and Augmented Reality in Education, Art, and Museums Advances in Computational Intelligence and Robotics,* 117-138. doi:10.4018/978-1-7998-1796-3.ch007

Koslow, J. (2019) Museums and digital culture: New perspectives and research. *Museum Management and Curatorship, 34*(5), 537-539. doi:10.1080/09647775.2019.1661098

Lee, H., Jung, T. H., Dieck, M. T., & Chung, N. (2020) Experiencing immersive virtual reality in museums. *Information & Management, 57*(5), 103229. doi:10.1016/j.im.2019.103229

Lupetti, M. L., Germak, C., & Giuliano, L. (2015) Robots and Cultural Heritage: New Museum Experiences. doi:10.14236/ewic/eva2015.36

Pine, B. J., & Gilmour, J. H. (n.d.) *The experience economy: Work is theatre & every business a stage*. Harvard Business School Press.

Rae, J, & Edwards, L. (2016) Virtual reality at the British Museum: What is the value of virtual reality environments for learning by children and young people, schools, and families?." *MW2016: Museums and the Web 2016*. Published January 28, 2016. Consulted March 17, 2021

Roggero, C., & Vanelli, A. (2009) *Le residenze Sabaude*. Umberto Allemandi & C.

Sacco, P. L., Ferilli, G., Blessi, G. T., & Nuccio, M. (2013) Culture as an engine of local development processes: System-wide cultural districts I: Theory. Growth and Change, 44(4), 555–570. https://doi.org/10.1111/grow.12020

Schaper, M., Santos, M., Malinverni, L., Berro, J. Z., & Pares, N. (2018) Learning about the past through situatedness, embodied exploration and digital augmentation of cultural heritage sites. *International Journal of Human-Computer Studies, 114*, 36-50. doi:10.1016/j.ijhcs.2018.01.003

Shehade, M., & Stylianou-Lambert, T. (2020) Virtual Reality in Museums: Exploring the Experiences of Museum Professionals. *Applied Sciences, 10*(11), 4031. doi:10.3390/app10114031

Southall, H., Marmion, M., & Davies, A. (2019) Adapting Jake Knapp's Design Sprint Approach for AR/VR Applications in Digital Heritage. *Augmented Reality and Virtual Reality Progress in IS,* 59-70. doi:10.1007/978-3-030-06246-0_5

Trunfio, M., Lucia, M. D., Campana, S., & Magnelli, A. (2021) Innovating the cultural heritage museum service model through virtual reality and augmented reality: The effects on the overall visitor experience and satisfaction. *Journal of Heritage Tourism,* 1-19. doi:10.1080/1743873x.2020.1850742

Tscheu, F., & Buhalis, D. (2016) Augmented reality at cultural heritage sites. In *Information and communication technologies in tourism 2016* (pp. 607–619). Cham: Springer.