[Proceeding] Robots and Cultural Heritage: New Museum Experiences

Original Citation:

Availability:
This version is available at: http://porto.polito.it/2615179/ since: September 2016

Publisher:
BCS Learning & Development Ltd

Published version:
DOI:http://dx.doi.org/10.14236/ewic/eva2015.36

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ELECTRONIC WORKSHOPS IN COMPUTING (eWiC)

Editors: Kia Ng, Jonathan P. Bowen and Nick Lambert

EVA LONDON 2015
Electronic Visualisation and the Arts

7-9 July 2015
London, UK

www.bcs.org/ewic/eva2015
EVA London
Electronic Visualisation and the Arts
www.eva-london.org

Proceedings of EVA London 2015
BCS London
7–8 July 2015

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www.bcs.org/ewic/eva2015
Acknowledgements

EVA London 2015 gratefully acknowledges:

- BCS, The Chartered Institute for IT for hosting EVA2015 at its London headquarters, and BCS Computer Arts Society (CAS) Specialist Group for providing bursaries. Special thanks go to Kerry Earl at the BCS, for help with venue arrangements, registration, demonstrations and speaker arrangements, and Florence Leroy at the BCS, for support with the conference proceedings.
- The Anthill Social and Tom Keene for website hosting and support.

Thank you to Ashgate for sponsoring the best paper prize and Imperia for sponsoring the best demo prize.

Thanks to all the speakers and participants for making the EVA London conference a continuing success.
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Contents

MONDAY 6th JULY 2015

- V & A Digital Futures meets EVA London
  - "Unheard" Soundscapes
    - Joanne Armitage & Kia Ng
  - Reflections of Essence
    - Steve DiPaola & Sara Saltavant
  - Praximétrie - 11 Datasets You Cannot Believe Just Happened
    - Tom Duval & Mikko Duva
  - Zyrtown: Visualising Human Indoctrine Disaster through Interactive Illustration
    - Hadi Mehriyana, Chris Barker & Mina Braun
  - XV: Reactive Spaces
    - Esteban Garcia Bravo, Jorge A. Garcia & Aaron Zernack
  - Face Value - Augmented Reality Enhanced Photography
    - Eiko E. Rohrbach
  - Images of Protest in Social Media for the Virtual Community
    - Eleanor Linsey & Kristin Forcett
  - Botchery by Light
    - Eric Leskerman & Stephanie Bolt

TUESDAY 7th JULY 2015

Music and Performing Arts

- PULiso 04: Being In the Zone - a Multidisciplinary Body & Digital Media
  - Lorna Moore
- LiveLab: A Multi-Sensory System to Encourage the Awareness of Mindfulness
  - Isabel Bernal, Jeremy Gaede, Thomas Morris, Francois Robson, David Moore & Kia Ng
- Enhancing Global Collaboration through Network-empowered Live Performance
  - James C. Olivero, Angela Sampaio, Chad Jastrow & Atara Yudin
- Keynotes
  - How Songkick is using Technology to Change Live Music
    - Dan Crow (Songkick)
  - Music & Performing Arts II
    - Configuring a Haptic Interface for Music Performance
      - Joanne Armitage & Kia Ng
    - Mapping Motion II: Motion Capture and the Visualisation of Dance
      - Kelly Hamilton
    - Tempo & Autonomic Control of the Head
      - Beatrice Sehertton, Luke Windsor & Kia Ng
  - Music & Performing Arts III
THURSDAY 9th JULY 2015

Cultural Heritage 1

Imaging the Egyptian Obelisk at Kingston Lacy........................................... 252
Lindsay Macdonald, Jane Masefield, Charles Crowther, Ben Allender, Sarah Norford, Andrew Craft & James Grady

iMarch – Tools for Interactive Exhibitions.................................................. 254
Katrin Weill, Estam Abdelrazeq, Yonina Abdelrahman, Thomas Kubitza & Albrecht Schmidt

The Superstar Tech Project: A Reinterpretation of Superstar through New Media Technology................................................ 259
Jinhee Kim

Keynote

Navigating Horizon 2020 Funding................................................................. 267
Christina Miller (UK Research Office, Brussels)

Virtual Tours & Virtual Heritage

New Relations with the Architectural Heritage Education.................................. 278
Carlos Marta Pimentel Reis & Rui de Godao Machado da Silva

A Virtual Tour to the Inscriptions of the UNESCO World Heritage Site St. Michael in Hildesheim................................................ 265
Anna Novoselsky & Julius Panetti

The Prosumer: The Key Player of the Museum of the Future.......................... 291
Valentine Fois

Stemmovation Photowalk Animation for Spatial Immersion in a Remote Cultural Heritage Site....................................................... 298
Scott L. Smith

Innovative, Participatory Listening and Seeing Experiences in Museums................. 305
Tobias Ziegler

Glimpse en Wheels: Incorporating Electronic Interactive Experiences.................. 314
Duc Tran, Andrew Cough, Robert Pickering & J.C. Diaz

Robots and Cultural Heritage: New Museum Experiences.................................. 322
Marta Luce Lupetti, Claudio Germak & Luca Guadagni

Exhibitions at BCS

Sequence......................................................... 367
Anna Diamitri & Alex May

Spiral Dot.................................................. 369
Murray McLeish

Optical Research: A Curated Visual Music Collection....................................... 371
Jonathan Weinert

You, Here, Now.............................................. 373
Ian Welstead

Author Index.................................................. 375
Robots and Cultural Heritage: New Museum Experiences

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The introduction of new technologies to enhance the visiting museum experience is not a novelty. A large variety of interactive systems are nowadays available, including virtual tours, which makes cultural heritage accessible remotely. The theme of increasing accessibility and attractiveness has lately been faced with the employment of the service robotics, covering various types of applications. Unfortunately, many of robotics solutions appear not really successful in terms of usability and availability. On the other hand, the design and use of a robotic system for cultural heritage has been proposed. The project, developed at the royal residence of Caserta, consists of a telepresence robot designed as a tool to explore inaccessible areas of the heritage. The user operated the robot, called Virgil, was expressly designed for the project. The control of the robot was entrusted to the users guiding in order to enhance her work and enrich the cultural storytelling.

1. INTRODUCTION

In the 17th century, the magic lantern technology (a projection system which was the forerunner of the cinema) was used mostly in the earliest forms of museums, the Wunderkammern, to make visits more attractive and engaging.

Nowadays, centuries later, visitors interact with the museums' contents via multimedia systems introducing technology such as interactive games, kiosks, etc. and in a variety of ways (touch, voice), either on-site or remotely (Lupetti, 2011). In the last few years, new technologies as museum, pursuing the Laws and Agreements for Cultural Heritage, as stated by the first declaration of the Italian Franciscan Commission (1957): "The values of conservation, defence and enhancement of cultural heritage are to be found in the function of the social function that is achieved as long as the most extensive public use is guaranteed" (Lupetti, 2011).

An increasing trend in the fruition of museums is, indeed, represented by virtual tours, based on the same concept of wide accessibility. Virtual tours, in fact, aim at making cultural heritage visible for most of the public. Moreover, they give to people the possibility to visit a museum and to experience its contents from the comfort of their own home.

The main popular example is probably the Virtual Museum Project (Proctor, 2011), a sort of repository of digitized masterpieces and museums from all over the world. Through the web, people are able to navigate autonomously in realistic environments that reproduce famous galleries and museums combining 3D modelling and HD pictures. It is also possible to zoom on artworks and observe details undetectable by human eyes. It is possible to recognize different typologies of virtual tour, on the base of the technological orientation, and each one offers a slightly different functionality. The affordability, combined with the effectiveness of the technology adopted, is the main reason of the consequent adoption of the service (Salvini et al. 2010). With regard to this, Sydlo (2010) conducted a Usability Study (Sydlo et al. 2014) of these different typologies evaluating their quality on the base of the indicators of the ISO-9241, which relates to the usability and ergonomic requirements of interfaces (ISO 2011). The evaluation is mainly based on two parameters, namely ease of learning, efficiency of use, ease to remember, few errors production and pleasantness of use. From this analysis arises the fact that the effectiveness of a virtual museum is related to its ability to offer the visitors an experience rich of features, but most of all, insensitivity to usability, interactivity and navigation (Sydlo et al. 2014). People, indeed, largely appreciate the ability to explore virtually the museum, choosing when and where to deepen, whereas a low quality of the displayed environment leads to the disengagement.

2. METHODOLOGY

This paper, therefore, discusses the remote fruition experiences of museums, with particular reference to service robotics for the development of a new museum experience. In particular, the research concern a project developed at the Royal House of Savoy in Piedmont (Italy).

The first part of the research is dedicated to related work, an overview of international case studies analysis assessed by looking at the quality achieved by the design of the service referring to the parameters indicated by the ISO-9241, shown in the introduction. The strengths and weaknesses of the two types of virtual tour, on-site and remote, are evaluated assessing the degree of empathy created between the visitor and the museum. The museum, indeed, is not just a collection of artworks, but rather a physical and emotional context (Sydlo et al. 2006) in which fundamental not to lose the perception of details compared to the whole, of the contrast between light and darkness, of the scent of the materials, of the sounds and the silence. For this reason, the project has been developed in a deep scenario analysis, in which both technological aspects of the context and human activities have been taken into account. From the scenario analysis, with a special focus on ethical aspects, there have been defined requirements on which have been developed the robotic service concept. The project includes also, a product design phase, in which the robot Virgil has been designed.

2.1 Related work

The use of robots in museum context is not a novelty indeed there is a large scientific literature about it. Since now, the robots were used mainly in three categories: museum guide, telepresence and installation.

Museum guide: Definitely, the robotic museum guide category is the most common and includes applications from all over the world. These robots are all characterised by the ability of autonomous navigation, obstacle detection and verbal interaction with visitors to describe the contents of the museum.

Already in 1998, at the Carnegie Museum of Natural History in Pittsburgh, has been introduced the use of a robot, named Chia, at first and Sage later (Houtbrink et al., 1999), to accompany visitors in the Dinosaur Hall and to give them audiovisual information about it (Willekens et al., 2001), provided to the user as a multimedia tour (Houtbrink et al., 1996). Subsequently, in the same museum, were introduced other robots with the same purpose (Willekens et al., 2001).

In the following year, at the Smithsonian’s National Museum of American History has been introduced the robot Minerva, which gave tours to tens of thousands of visitors (Hinm et al., 1999). This robot was equipped with a moving head able to produce facial expressions and communicate its emotional state, defined in accordance with the people’s behaviour. These expressive skills improved the attractiveness of the robot and the effectiveness in the guidance (Thun et al., 1999).

The common and central problem of the effectiveness of speech interaction has been faced in the CoosRobot project, tested at the Archäologisches Museum di Agrigento, in Sicily. In the case the robot, entrusted of the guide activity, allows visitors to make quick reactions in real-time to improve the adaptation of the speech and the coherence of the answer, the robot cognitive architecture has been provided of a semantic module that filters the information received listening visitors’ questions (Mocanu et al. 2005).

In 2003, a group of three different robots have been introduced at the Munich Museum Berlino. Three these robots were entrusted of different duties: instruction, entertainment and education. The instructive robot was, indeed, a museum guide that accompanied visitors in the tour giving explanations about the exhibits. It was able to move the head up and down to indicate which object it was referring to and also it was provided of a screen on which it could show additional contents (Schmitt et al. 2001).

From the engagement and effectiveness points of view, an interesting step forward is represented by Ulysses. This guide robot, equipped with an audio guide, was able to show emotional behaviour (Alvarez et al., 2010), in addition to facial expressions, such behaviour was adapted on the base of the visitor's behaviour, in order to modulate the rhythm with which it gives information, and consists of three main emotional states: happy, curious and surprising (Alvarez et al., 2010).
Recently, the world’s most advanced humanoid robot, Asimo, has been tested at museum guides at the Japan’s National Museum of Emerging Science and Innovation (Falconer 2013). The basic purpose was the same as the previous project, but in this case there was a particular attention to the interaction with group of people. For example, in order to understand, who from the public is asking a question, it suggests people to raise a hand before. Unfortunately this feature, such as others, was still not working as it was supposed to and the overall experience resulted negative from the engagement point of view (Falconer 2013).

Telepresence: The category that, probably, is witnessing the wider expansion is the one of telepresence robots. These consist of robots that, connected to the web, allow visitors to explore the museum remotely. In general, these are all mobile robotic platform equipped with a screen and a camera. The use of this kind of robots is applied with different purposes.

The robot Ciro, for example, has been introduced at the National Museum of Australia, in order to allow people unable to reach the museum, e.g., tourists from rural areas of Australia or the aged in nursing homes, to visit it anyway (CSIRO 2015). The robot Nono, from Droids Company (Droids Company 2015) instead, was designed to allow people with limited mobility, e.g., wheelchair users, to visit a museum, which, otherwise, would result inaccessible for them. The robot was placed, and is still working, at the National Centre for Monuments, Château d’Oiron, France. At the ground floor of the museum is a cockpit from which, through a computer, the visitor can remotely drive the robot located at the first floor (Oiron 2016). Another interesting example is the Alter Dario project, which involved the Tate Britain, in London (Tate 2016). The concept of the project is to allow people to explore the museum rooms during the night, playing with the sense of prohibition and exploiting the alarm that the public assumes during the night. During this experience, available for five nights, in August 2014, some people, chosen randomly, have been connected via internet, to the four robot placed in the museum and drove them via computer (Tate 2015).

Installation: This category is mostly art oriented and the robotic technologies part of it are generally embedded in an artistic or educative setup. One example is the ToshiSopan, an educative installation that enables a group of students, to interact from a space observatory in Ireland to a robotic telescope located in San Francisco, California (Hogan et al. 2015). The installation comprises tangible interfaces and digital displays. The artist-scientist Patrick Tresset, instead, developed a robot art installation called Paul. This installation, exhibited at Tenderpixel Gallery in London for the first time, in 2015, consists of a left hand robotic arm holding a black tile and a pan–tilt camera, both behind a table in front of which is located a chair for visitors (Tresset et al. 2012).

These three types of museum robotic applications have been empirically evaluated on the basis of the parameters indicated by the ISO-9241 (ISO 2011), shown in the introduction. Specifically, these parameters are mean to evaluate the quality of the interaction.

The interaction with guide robots, indeed, appears easy to learn and to remember, due to the fact that it is based on natural interaction modalities, such as speech, facial expressions, gestures and proxemics. On the other hand, this kind of solutions frequently produces errors (Falconer 2013), which, in addition to the low acceptability of the tour, causes a poor experience and, consequently, risk much unpleasantness to use.

Telepresence robot, instead, achieve an higher level of use efficiency and the interaction is easy both to learn and remember, due to the fact that adopt a mediating interface familiar to the users. The robot control, as a matter of fact, occurs through a computer or a tablet, and the control consists of teleoperation, ability that most of people have experienced at least in childhood. These aspects, thus, determine a higher level of use pleasantness.

Regarding the robotic installations category, it is not possible to make absolute considerations. Nevertheless, it is possible to assume that the easiness of use and remembrance are common as well as the pleasantness. The error production and the efficiency, instead, are the most variable aspects from project to project.

From these considerations emerges the fact that, in most of cases, the robotics is employed in museums regardless the evaluation of the physical aspects of the context and the human activities which are carried out there.

3. VIRGIL: NEW ROBOTIC MUSEUM EXPERIENCE

Virgil (German 2015) is a telepresence robot, result of a project for the enhancement of Cultural Heritage and improvement of the fruition experience. This project has been developed for a specific museum context: the royal residence of Roccagionni Castle, in Piedmont, Italy. This castle, called over time as “trials of delights”, was a holiday residence of the Savoy royal family. This residence is a surprising rich context (artworks, furniture, everyday objects, clothing, working machinery etc.) but, simultaneously, extremely delicate. All the Cultural Heritage, indeed, are places to which are entrusted two main activities: the preservation and fruition (Batt et al. 2012). Regrettably, in some cases these two actions are incompatible. For this reason, at Roccagionni, some rooms of the residence are currently excluded from the visit tour, mainly because of the state of conservation, fragility and logistic management of the visit. It has been estimated, indeed, that more than 60% of the residence remains inaccessible to visitors during a standard guided tour.

This phenomenon, in which part of the cultural heritage remains hidden, does not only concern the Roccagionni Castle, but it is diffused throughout Italy. However, in most of cases the main concern is related to the fact that a large amount of artworks and artifacts remains closed in the archives, whereas the problem of areas excluded from the tour route is not widely acknowledged.

For example, many newspapers and journals highlight this issue of hidden archives that would represent an asset to be exploited (Pirelli 2012). This kind of statements are confirmed by the Istituto (National Institute for Statistics) reports in which is shown that the 31.1% of museums expose just around the 50% of the owned goods (Istituto 2013). The delicate nature of the castle influences, further, the visitor tour. The access, indeed, is only organized in groups of maximum 20 people, mandatorily accompanied by a museum guide or a castle guardian. Therefore, the museum guides assume a central role in the experience of museum visit and, as is well known, their competencies have
a strong influence on visitor satisfaction (McDonnell 2001). The storytelling activity performed by the museum guide thus comprises three main aspects: selection, information and interpretation. The last one is the aspect that mostly determines the uniqueness of the experience due to the fact that the museum guide uses the interpretation to create a link between the heritage contents and the visitor culture. An effectively interpretive approach is, instead, what determines the transference of cultural understanding (McDonnell 2001).

Figure 3: New Robotic Museum Experience: general outline of the service

From these considerations, therefore, emerge two requirements: make accessible to visitors areas of the residence excluded from the tour and enhance the activity of the museum guides. The proposed service meets these requirements, extending the museum guide activity through the use of virtual tours made possible by the Virgin robot placed in inaccessible areas. The museum guide assumes a fundamental role since, in addition to the usual accompanying and deepening role in the fruition of the cultural heritage, he is entrusted with the remote control of the robot.

The new robotic service introduces the concept of human-robot collaboration (Epstein 2015). Conversely to many robotic solution applied in museums, as shown in the related work paragraph, the storytelling activity continues to be entrusted to the museum guide and a robot assumes a role of remote collaborator, which explores the areas inaccessible for people. Keen the storytelling activity performed by the museum guide is fundamental due to the fact that only a human can provide the interpretative aspect. The interpretation (McDonnell 2001), as previously explained, is the process in which the museum guide can create links between the visitor culture and the heritage contents. This process allows visitors to develop an empathic relationship with both the museum guide and the cultural heritage itself.

A further consideration has to be addressed in the comparison of this robotic service with other existing technologies, especially virtual tour. As a matter of fact, virtual tours currently seem to be the cheapest and easiest technology available, however involves considerable limitations in terms of realness and immersion. Even if this solution can achieve high level of image quality, the visual result is not realistic due to the fact that navigating through these environments the adaptability of the image and the fluidity of movement are not like the natural. In addition the narrative activity, if entrusted only to multimedia contents, can appear boring, not really adaptable and restricted.

3.1 Robot Design

The robot, designed specifically for the project, consists in a mobile robotic platform equipped with a camera that sends a streaming video displayed to visitors on a dedicated screen or personal devices.

The design process was based on specific requirements, namely the robot should be unobtrusive and homogeneous to the context in which is going to be inserted. This is due to the fact that it is necessary to ensure maximum visibility to the visitor and not to distract him from the heritage. For these reasons, the outer of the robot is made of PMMA (poly-methyl-methacrylate) and is composed in a shape of truncated pyramid, reminding to the similar shape largely diffused in Savoy tradition, used in castles, towers and other architectural elements or furniture. The choice of a transparent material, in fact, was led by willingness to avoid the distraction of the visitors from the cultural goods to the robot and besides to meet a technical requirement of maximum lightness.

This solution, therefore, provides a substantial physical and visual lightness, also in line with the key-finding elements already present in the royal residence. In addition, in the design process has been introduced the concept of customisation based on the context, consisting in a decorative pattern applied on the robot coverage. The pattern represents the Palagiana palm, an already existing decorative motif that can be found in the castle applied in many elements, from the floors to the furniture.

Figure 4: Virgin, interpretation robot at royal residence of Racconigi Castle

3.2 Ethics

From the beginning, this project was developed considering ethical aspects as mandatory. Each design choice was made, not just on the basis of technical feasibility, but rather with the evaluation of the alternatives answering to questions such as: Is it effective to introduce the robot in this way? Is it preferable the use of the robot compared to other technologies? Is the use of a robot fair towards the various stakeholders?

According to this approach, the ethical dimension of project is achieved in the attempt to ensure respect both for the location and the various stakeholders.

From the location point of view, the service proposes a possible solution to the issue of inaccessibility of some castle's areas. The concept of wider the accessibility means is concerned with the management of the visitors' flow, that is to say, the social fruition of cultural heritage have to be guaranteed for the widest possible audience (McDonnell 2001). This is also affirmed by the Decree Law no. 112, which states that a Cultural Heritage have to guarantee the full accessibility, physical and intellectual, of its elements also from the exhibition (D. M. 2001).

From the stakeholders' point of view, the project, brings benefits to all the involved actors. The visitors, benefit from the expanded visiting experience, enriched by the additional knowledge about the robotic solution.

The museum guide, instead, assume a central role in the visiting experience, due to the fact that are entrusted both the cultural storytelling and the robot control. This generates an enhancement of human work and additional professionalisation. This aspect is particularly crucial since it relates to a wider diffusion concern about the introduction of robots. The diffusion of robots in industrial field, indeed, generated a substantial replacement of human work and, consequently, an increase of unemployment (Safotte et al. 2010). The introduction of robotics in other fields rises the concern that the same phenomenon could occur. For this reason, during the design process it is necessary to consider the human work, avoid its replacement and, moreover, enhance it (Blond et al. 2014).

Finally, the institutions, to which is entrusted the Cultural Heritage management, benefit from the improvement of visibility and attractiveness.

4. FUTURE WORK

In the following months, there will be the first experimental phase with visitors, in which the data on the experience by the users will be collected. For this phase, a museum guide will be first trained to drive the robot. This action does not appear easy at first due to the fact that, in the meantime, the guide has to carry on the usual activity of explanation about the museum contents, which includes also a direct interaction with visitors.
5. CONCLUSION

The improvement of Cultural Heritage fruition is a recurrent theme and has been faced with the application of the most diverse technologies. The exemplary case represented by virtual tours, which offers the opportunity of a remote visiting experience, enabled a wide range of new design opportunities. Nevertheless, the limits of this kind of solutions drove to a deep reflection on the effectiveness of a totally virtual experience.

For this reason, the use of Service Robotics in museums is becoming increasingly common. Robots, indeed, represent a bridge between the virtual and the physical world, due to their composite nature. However, the observation of international case studies of museum robotics showed that, since now, many of the proposed solutions were not actually meeting the location and stakeholders’ requirements, which usually vary on the basis of the context.

Based on this consideration, a new robotic museum experience has been designed, with the aim to increase the museum’s attractiveness, offer a more involving experience to the visitors, and enhance museum guides activity. The proposed solution was developed paying particular attention to the ethical aspects and is meant to represent a shifting in the robotic design process. The applications of new robotic solutions, instead, are usually based on the opportunities offered by the technology, whereas this project was developed applying a human centered design approach, which focuses on people instead of technology.

6. ACKNOWLEDGMENT

This project has been developed in collaboration with the Jof CRAB (Connected Robotics Applications) of Telecom Italia and the Terzo dei Savio Association, promoters and manager of cultural activity related to Savoy Cultural Heritage, especially at Rocca di Castiglione.

7. REFERENCES


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ISBN 978-1-78170-316-0