Alessandro Luigini   *Editor*

Proceedings of the 1st International and Interdisciplinary Conference on Digital Environments for Education, Arts and Heritage

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Editor
Alessandro Luigini
Free University of Bozen
Bressanone, Italy

Preface

The book presents the proceedings of the homonymous conference organized at the Free University of Bozen-Bolzano on 5 and 6 July 2018. A few months before, in October 2017 a conference entitled *Ambienti digitali per l'educazione all'arte e al patrimonio*[1], organized at the Faculty of Education of Bressanone of the Free University of Bozen-Bolzano, anticipated what is documented here, laying the foundations for a long-term scientific and cultural project that is symmetrical to the interdisciplinary research *VAR.HEE. Virtual and Augmented Reality for Heritage Education in school and museum Experience* which will end in 2021. The main aim of the project as a whole is the strengthening and structuring of interdisciplinary links between scholars interested in heritage education.

In fact, on the one hand the scholars of graphic representation, which have always been largely involved in the documentation, survey and enhancement of heritage, and on the other hand the scholars of the art education and museum didactics seem to forge two sides of the same coin: the safeguarding of the value of the arts and of the heritage for the formation of individuals and, therefore, of a society able to develop itself starting from the memory of its own expressive capacity in the history.

In particular, it is a technology that seems to be the "mirror" in which scholars of representation and pedagogists reflect, look at each other and look alike: digital technology applied to the arts and heritage. In fact, the environments described in the volume are digital, and the experiences that a prevalent part of Western society makes every day become digital. We draw information, we build relationships, we buy services or products, and we spend our free time and leave a trace of our existence in digital environments, whether they are contained in a mobile device or in the physical space in which we find ourselves. In this context, where the individual is formed, acts and relates to the world, a primacy of representation emerges, which from digital technologies has received a significant increase in possible declinations. We speak through the representation of our voice and our interlocutor

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[1]Conference proceedings are available in open access here: http://ojs.francoangeli.it/_omp/index. php/oa/catalog/book/334.

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on the phone, we watch entertainment contents via digital devices, we interact via social networks, we buy in online stores, and this list could be expanded to include a significant range, quantity and quality, of more or less daily activities.

The support for the interdisciplinary exchange has been favored not only by the meeting of scholars of representation and pedagogy of art, but also by the contribution, fundamental for us, of two other areas of research that greatly affect the good result of the practices that here propose: cognitive psychology, which shows us how our mind and our brain react and elaborate the experiences with art and heritage in digital environments, and the economy of culture, which shows us how the museum models have presented new paradigms able to fostering the flourishing of good practices in the art world.

Categorizing the contributions in this book is not simple due to the marked interdisciplinarity that most of the contributions pursue. However, as a result of the submission phase, we have been able to identify some sub-themes that would allow for the creation of environments for the discussion as homogeneous as possible. The ten sessions were: visual heritage, digital heritage 1 and 2, augmented reality, immersive, education, archaeology, territory and maps, museum ideas and museum life. All the contributions were selected through a double-blind peer review.

The International Scientific Committee followed and evaluated all parallel sessions, and awarded three prizes as Best Paper Award: one for senior section and two for junior section. The senior section consists of scholars from Italian and foreign universities or research centres. The junior section consists of grant researcher, Ph. D., Ph.D. students, and freelance researcher. Each member of the International Scientific Committee expressed a preference for each section.

For the senior section:

Fabrizio Gay, Irene Cazzaro, Università Iuav di Venezia
Venetian perspective boxes: when the images become environments. Low-tech, high-knowledge media for teaching the historical heritage of the interior/exterior environments.

For the junior section:

Silvia Calegari, Matteo Dominoni, Università di Milano-Bicocca
The Pollicina Project. A collaborative and educational social suite to build cultural itineraries.

Ramona Feriozzi e Alessandro Olivieri, Università di Camerino
Video game for learning the projective geometry. Analysis of virtual spaces through discipline of representation.

About 100 submissions, over 80 speeches, 10 keynote speakers in 2 plenary sessions, 34 members of the scientific committee, over 50 reviewers are the numbers that tell the conference. Thanks to all those who have allowed the proper development from preparation to the holding of the conference.

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When the Future Is the Past. Digital Databases for the Virtualization of Museum Collection

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Abstract. The paper through an excursus on the technological development of virtual fruition systems, intends to reflect on the methods of communication and dissemination of cultural heritage, taking as a reference part of the results of research recently conducted on some case studies. The museum, configured in its new immaterial form and no longer as an exclusively physical place, amplifies the availability of space open to visitors, revolutionizing its role as cultural mediator in the extension of a potential connective that increases the dynamics of social development. The present research was aimed at programming a methodological protocol for the documentation and the virtualization of museum assets, collections and architectural heritage of tourist interest, based on a new approach to fruition of the space and the work of art in it contained.

Keywords: Digital survey · 3D database management · VR and AR systems · Virtual museum · Native Americans handicraft

1 Real-Virtual: A New Approach to the Documentation Process[1]

"…*Painful as it may be sometimes, the reality remains the only place to eat a good meal. Because the reality is real. Can you follow me?…*" *Steven Spielberg, Ready Player One*[2]

There is no future without a past: "planning" always involves comparing the experiences in progress with those already experienced, as well as the evaluation of behavioral models in order to undertake some fundamental procedural choices. In this way "the virtual" means how much more it does not exist and what can not be

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[1] The Section 1 entitled "Real-Virtual: a new approach to the documentation process" and Section 4 Conclusions is edited by Sandro Parrinello, of Section 2 entitled "The use of digital technologies in the CH: the tools and the production of digital databases for the virtual" is edited by Francesca Picchio and Section 3 entitled "Content Virtualization and Museum Container: case studies compared" is edited by Anna Dell'Amico.

[2] The quote from the 2017 film refers to "*It's not that i'm going crazy about reality, but it's still the only place to eat a decent meal*" by G. Marx.

described precisely because, if described, if it is harnessed in an image, if represented, it will cease to be virtual, acquiring its own identity within what we consider "real", that is in all that it can be somehow perceived by a community of individuals.

The architect's profession deals with the transformation of virtual images into real images and how ideas can be made, based on experience, to become figures in the mind and finally a critical experience represented: in a few words Drawing.

Today the virtual can be associated with a second meaning, more commonly used, which more specifically relates to the experience of life in the digital world, simulated through specific interactions with what the digital graphic expression is able to recur in the real world (Levy 1997).

This creates a parallelism between real-material and virtual-digital, within which human experience is inserted to give life to new design scenarios. The implementation of meanings in the virtual context of digital expression implies giving a second life to the dimension of places, whose laws are dictated by computer science. This implementation of meanings also implies a substantial simplification of the complexities characterizing the real space, so that the process of image construction is able to replicate in all and for all the action of "drawing" and the elaborate products become tools from which he deduces simplified and critically interpreted information of what has been specifically described. Being a digital life experience, the interaction with these drawings or representations, in any case, involves the generation of a new awareness and, consequently, a new logic of learning. In this sense, living and enjoying the virtual means interconnecting data, explaining actions and designing analyzes and knowledge that, even at the unconscious level, qualify the understanding of a given phenomenon. It is well known that the image is entrusted with the task of adding the word within the narrative systems to allow a more effective projection and virtualization of the imaginative identity of what is narrated. The imaginative projection of one's own virtual identity and, at the same time, of the community and the community contextualizes the identity necessary to inhabit a place and live a certain environment.

The process of virtualization of history, which originates with the story, expresses this condition well, and it is easy to imagine what emotional tensions support the story that the Neolithic community, gathered around the hearth, received from the elderly about the events of the origins of the community itself. This story, which represents the origin of civilization and virtualization of a bygone era, was also proposed to us, as children, to educate the imagination and memory through the narration of stories.

This is why talking about the future necessarily involves talking about the past, qualifying it and reproducing it through virtual images, especially when the processes for their production are addressed, as then, to the teaching and dissemination of information.

The technological revolution and the dissemination of information started with the digital age has progressively transferred the sphere of drawing and representation towards an almost totally immaterial communication system, able to propose, through virtual images, an idealized future or a glorious past, as a witness to landscapes in continuous transformation. (Parrinello and Picchio 2017). The image is entrusted with the task of reproducing the characteristics of a given context by implementing its contents and meanings in the virtual dimension, often modifying the concept of reality in favor of greater emotional involvement on the part of the user. To the multiple utopian images associated with the "real", research in the field of drawing and representation is

increasingly turning towards the development of new expressive systems, capable not only of telling the complexities of contemporary spaces but also of actively involving the viewer in the learning and dissemination of information collected. Within this field of technological experimentation and communication development, which includes contemporary cinematography, *serious games*, and *educational entertainment*, in recent years the museum spaces and the works that are part of the collections inside have also found their place also in favor of the promotion of a system of fruition of the culture increasingly projected towards sharing and global fruition.

2   The Use of Digital Technologies in the CH: The Tools and the Production of Digital Databases for the Virtual

In the definition "Virtual is a new form of reality that allows us to understand the real best" by the philosopher Philippe Queau, the link between virtual and image is clear, underlined by the use of the word form. (Queau 1993). The virtual we refer to today, 3D models, VR and AR applications, are the outcome of the technological development of a representative system, of how our ordering of space refers to computational models and how, despite the change in the medium, the unchanged remains the purpose of representing, of communicating, of transmitting knowledge effectively, which today corresponds to the qualities of speed and immediacy. On the basis of these reflections, the technological development of "representing" has gradually led to the elimination of barriers and distances between the user and the object used, making the virtual experience ever closer and more likely than the real one. The escape from the real took place through drawing and the use of the graphic sign as a total form of abstraction that allowed the user to immerse himself in idealized imaginations of the unrepresentable (an example is the first depictions of the amanuensis monks, combined with the texts of books sacred), from the mid-nineteenth century, following the construction of the first devices of "escape" from the real through systems for image amplification (among the first instruments are the stereoscope, the Kaiserpanorama[3] of Fuhrmann più the Kaiserpanorama of Fuhrmann and the more recent Tru-Vue e View Master[4]), is the tool to become a point of contact between virtual reality and the real world, establishing a new connection with the user by the amplification of the two-dimensional drawing (Fig. 1).

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[3] Conceived by August Fuhrmann, in 1890 the Kaiserpanorama was an optical device that exploited the technology of the stereoscope, a machine around which could seat about twenty people and simultaneously view different stereo photography. Taken from the website: http://www.kabarett.it/kaiserpanorama-visore-stereoscopico-tra-divertimento-e-propaganda/.

[4] True-Vue, a Rock Island company founded in 1931, became famous for the production of the stereoscopic viewer by David Brewster. In 1951 it was then incorporated by the rival company Sawyer's owner of View-Master. Taken from the site: http://www.wikiwand.com/it/Stereoscopi_del_XX_secolo.

Fig. 1. From the left: a depiction of the Kaiserpanorama of Fuhrmann, and the two viewers systems in the center the Tru-Vue and to the right the View-Master.

From these types of instruments, ancestors of our viewers, to the first experiments of dynamic virtualization of the second half of the twentieth century with Ivan Sutherland and his "Sword of Damocles"[5] and the creation of the first interactive digital management system with the project by Andrew Lippman the Aspen Movie Map, anticipating 30 years of Google Street View, the interactive map of Google. (Biocca and Delaney 1995) In the '80s and '90s, some laboratories were set up to research and develop new technologies for virtual reality, creating new products such as Dataglove, NASA VIEW, Nintendo Power Glove, Virtuality 1000CS, SEGAVR, Nintendo Virtual Boy and many other fruition systems that have followed one another every year with the fast pace of an ever increasing vertiginous technological revolution that has led to the production of the current viewers on the market like Oculus Rift and HTC Vive.

Despite the change and the evolution of the medium, the goal remains to simplify the understanding of the user: technological development contributes decisively to the increase in user involvement through immersive systems, thanks to which the user it can interact and discover a certain place through different levels of interaction. These systems become necessary means for the communication and dissemination of culture and the use of spaces within a click; this is why the tendency, in the field of drawing and representation, is to increase project towards the development of new expressive systems capable not only of telling the complexities of contemporary spaces but also of actively involving the viewer in learning and disseminating the information collected. (Gerosa and Pfeffer 2006). The development of utopian virtuality has also been applied to museum spaces through descriptive systems for the works and collections contained in them. This configuration of the digital message shows its usefulness when it ascends to a communicative level that is not affected by cultural constraints but is often in line with the promotion of a system of fruition of the culture increasingly projected towards

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[5] The Sutherland experiment, built in 1968, was the first prototype of augmented reality. Taken from the website: https://www.tomshw.it/storia-realta-virtuale-75901.

sharing and global fruition. In this cultural context, images take on a precise role in the development of learning, becoming the language we use to communicate information, mainly visual, and to establish the ways in which such information can be conveyed to be transposed to different areas. In this way, digital end up attributing to the images a new cultural dimension and unexpected perspectives of development, new cultural products that condition the type of experience, new meanings and different ways of constructing knowledge. Our society at *once and immediately*, built on ever more dynamic times and expectations reduced to a minimum, is necessarily forced to update its expectations and its communication needs, transferring training in information so that each individual can perceive the complexity of the real through direct channels.

The applications of virtual reality go to stimulate the curiosity and the attraction towards the discovery for the "new": they awaken emotions and sensations able to reach and activate our neurons and generate physical sensations that predispose to listening and reading more engaging and participatory.

It must be recognized how the advent of new digital media forces a change of perspective not only in the modes of communication but also in how those same contents, vehicles of information, are produced (Fig. 2).

Fig. 2. Access to the use of interactive virtual visits is necessarily conveyed by a material carrier, such as the viewer Oculus Rift, link between real and virtual space. These applications can be navigated through AR and VR visualization systems in situ and not, which allow to place and display information about the object, thus enriching the experience of visiting the museum.

The systems of production and use of this information make use of applications for virtual reality, augmented and mixed reality. Their accessibility is now within reach of the new generations of users, who are now increasingly young, growing in close

contact with this type of reality, accustomed since childhood to immerse themselves in the virtual through digital devices and interactive platforms, catapulting themselves into scenarios and stories of the "cyber society"; a generation, belonging to a virtual context, which we can define as "digital native". Our whole existence is developing within digital environments, both to communicate information and to share and establish new "virtual" connections between individuals. Thus, part of our life is carried out only virtually, through our configuration as entities existing on social networks or on digital platforms, producing a cultural misunderstanding between what is imagined in the solitude of one's real experience, compared to what is communally transmitted as information.

The tool of digital models for the study and the thematic deepening, and therefore the creation of virtual spaces where to use the most varied information, goes to enhance the means of cultural diffusion through what is called *ubiquitous learning*[6] e *discovery-based learning*.[7] Elements that distinguish these new types of smart learning are the permanence of information, collected and always available thanks to the accessibility of digital databases, the ease and speed with which the user can access the various information data in any place through the digital network and the possibility of doing structured research based on the specific needs of the user: thanks to the interactivity of the tool, it is possible to outline the thematic analyzes based on the different user profiles, adapting the knowledge path to their learning needs. (Ogata and Yano 2004).

On the basis of these key points, even the museum complexes are opening the doors to new digital experiences trying to expand their spaces, no longer confined to the physical container detectable in the museum walls, but open their contents to new digital spaces, through virtualization of their collections.

The interaction with the virtual space, with the object or with the collection, transforms the drawing into a computational act that reaches its maximum programmatic expression with the awareness of the interaction between the various databases. Reproducing virtually every object and museum complex in a model involves defining "synthesis" strategies to organize the perceived and measured place semantically. To these 3d models, designed and complete with geometric and material information, it is possible to add further information, qualifying a metadata structure. From hypertext formats to further models, each digitized element is usable and able to interact with the user and with the context, real or virtual, in which it is placed.

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[6] *Ubiquitous learning* is defined as a daily learning environment supported by the use of the pc and is intended to provide students with content and interaction anytime and anywhere. The learning process takes place through the virtual medium. The direct access to information always, in any place, and with any type of device is the characterizing element of a new generation of information systems identified with the term Ubiquitous Computing. In 1988 Mark Weiser coined this term, imagining computers placed in walls and in any other object of daily use (Hwang et al. 2008).

[7] *Discovered based learning*, a 21st-century experiential learning technique based on the study of theorists and psychologists Jean Piaget, Jerome Bruner, and Seymour Papert (Mayer 2004).

3   Content Virtualization and Museum Container: Case Studies Compared

The theme of digitization of public information and cultural heritage is, today, one of the priority themes of the European Digital Agenda[8] that encourages public administrations to invest in the potential of information. However, to date, some "homogeneous" museum policies that favor the integration of heritage and digital technologies are missing. Analyzing the statistical data[9] relating to the flow of museum visits in 2017, no Italian museum at international level is ranked among the top ten most visited museums in the world.

Among the first three are the Louvre museum, with 8.1 million visitors, the National Museum of China, with 8 million visitors and the MET in New York, followed by the Vatican Museums, the British Museum, and the Tate Modern. In the Italian scene, the recent data collected by the Mibact[10] statistical office record an increase in visits compared to 2017 and see the Colosseum among the first three most visited sites, with about 7 million visitors, the archaeological site of Pompeii and the gallery of the Uffizi.

Analyzing the largest museums in the world ranking, it can be observed that not by chance, are those who have already started to open their archives in digital mode is the example of THE MET that has networked the cataloging of 375,000 free photos from rights, and the British Museum that, in collaboration with Google Art Project, has designed an accessible virtual timeline of the works inside the museum.

The diffusion of digital technologies has led to a profound change in the use of art, which in addition to the static approach also includes personalized interactive, the museums while preserving their tradition of place for the protection and conservation of works with the advent technology are populated with new ways of learning and awareness to bring the user closer to the art and it does so through digital that today is the fastest way to get there.

This trend has allowed the development of museums that find their construction only in the digital world.

An example is the French project UMA (Universal Art Museum): officially inaugurated on December 5, 2017, the system works in all respects as a museum with temporary exhibitions, designed and organized by a real curator, in the idea of collecting, in a unique digital space, all the works of the world. And here the technology comes to their aid, giving the possibility to create a totally new, imaginary design environment, modifiable according to the organized exhibitions.

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[8] The digital agenda presented by the European Commission in Brussels in 2010 sets targets to be achieved by 2020, aimed at boosting productivity and technological development and supporting social cohesion in the European Union (EU).

[9] Data taken from the world ranking compiled by the Giornale dell'Arte with The Art Newspaper.

[10] Data published on the website http://www.beniculturali.it/mibac/export/MiBAC/sito-MiBAC/Contenuti/visualizza_asset.html_249254064.html. Source: Mibact-Statistics Office, 2018 - provisional data subject to change.

Another similar experience is proposed by the "Virtual Museum of Iraq" which, however, does not claim to be a reconstruction of the Royal Museum of Baghdad, remembered for the events of 2003, which saw him victim of several looting during the Iraqi conflict, but it is rather a reinterpretation of the real museum presenting only a selection of the most significant works with 3D reconstructions offering an interactive, sound, visual approach and learning to the works.

This opens the reflection on the fact that in Italy there is still a lot of work to do to reach the world standard because today's museum is not just a container of collections.

In order to combine information systems capable of describing the museum spaces, within the research activities carried out by the Experimental Laboratory of Didactics and Research DAda-Lab of the University of Pavia, have been developed some projects that have had as their object the digitization of the heritage and museum collections for the production of 3D databases and interactive modes of use associated with them.

The activities of the laboratory are concentrating both towards the realization of a methodological process of digitization of the museum space (container) towards innovative forms of use of the museum space, and towards the study of a methodological process of acquisition of the museum collections (content) generating new experiences of visiting the digitized space and encouraging renewed systems of interaction between real and virtual with the aim of creating information systems in which the content is directly connected to its container. Through digital detection and the use of specific data management and processing software, databases have been produced organized according to different levels, dimensions, and data complexity, in which it was possible to collect all the data acquired to allow the extraction of a useful information. In particular, the digital survey produces point clouds that can be converted into models in which spatiality is re-proposed in its three dimensions (Parrinello and Picchio 2017) (Fig. 3).

Regarding the collections, a first case study saw the experimentation of Native American craftsmanship[11] carried out on a widespread heritage. The research has been involved in the production of highly reliable models from which to develop useful considerations for the construction of information systems and digital databases for collections that unlike others are not collected in a single museum structure, but diffused among the various private collectors and not Americans and Europeans, and therefore the creation of a virtual museum system that allows to organize databases to try to gather such widespread heritage in a complex information system (Parrinello and Dell'Amico 2018). The aim is to preserve the specific qualities of each material, deformations, alterations and imperfections, working on the geometry of the polygonal mesh in order to decimate as much as possible the number of triangles without altering the functional qualities to achieve the objectives for the investigation.

The models thus obtained, reliable and complete, can be used to define an information database on the morphological qualities of each work. With this in mind, the database becomes a sample of technical sheets describing craftsmanship through a census that links qualitative information to models that describe "quantitatively" in terms of measurement, the specifics of each work.

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[11] The collection referred to is a private collection by Sergio Susani, an expert in the culture and art of Native American manufacturing.
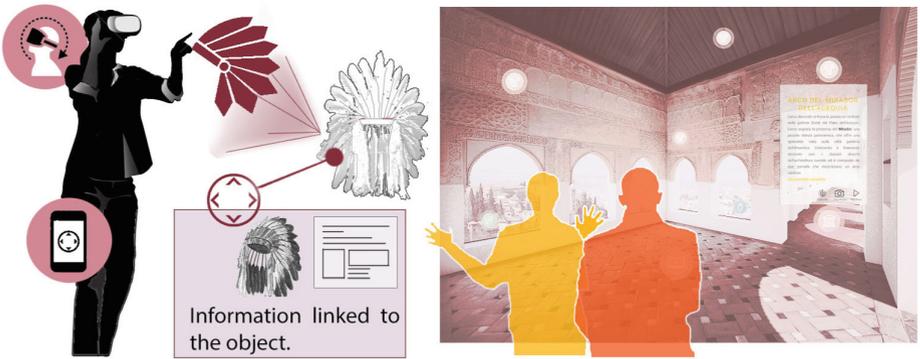
Fig. 3. The digital model can be used to connect information, which can be viewed through mobile devices and interactive digital platforms.

The set of database information describes a digital archive that offers various development possibilities for the enhancement of the collection as well as for the management of the phenomenon (crafts of the natives) as a whole. A possible development for the use of the collection began with the design of a virtual museum on the natives, an all-digital architectural space that collects the different collections (Fig. 4).
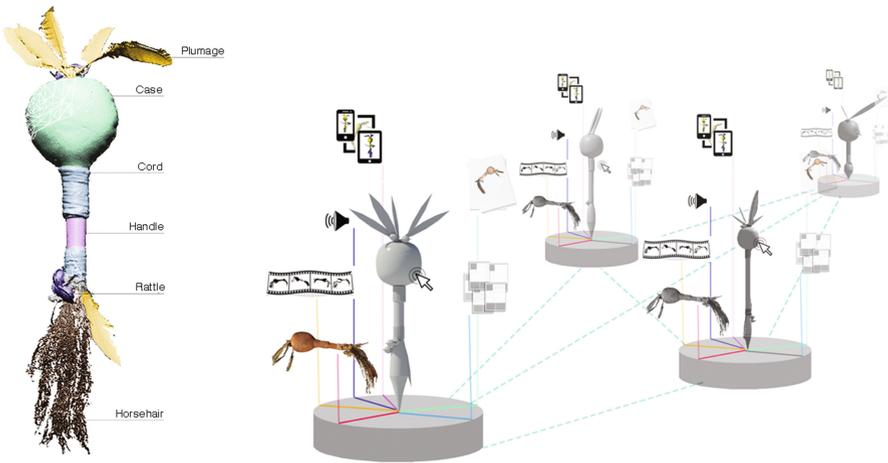
Fig. 4. The management of a database composed of a very large number of elements through a virtual stereotype to which multimedia files and information cards can be associated, in addition to the relative mesh model from which to be able to uniquely identify the work with all its formal characteristics three-dimensional.

A second case study is being developed within the laboratory hours of the court of Drawings Foundations and graphic documentation[12] held by prof. S. Parrinello and Dr. D. Bontempi: the course was aimed at experimenting with a photogrammetric survey for the design and the digitization of artifacts and works with historical-artistic value developing actions for the enhancement and conservation of cultural heritage, in detail addressed to museum collections and valuable exhibits belonging to the museum structures of the University itself, specifically saw the survey of a series of musical instruments belonging to the collection of the Department of Musicology of Cremona. The digital reconstruction of musical instruments, and scientific and technical instruments and their components, with the aim of obtaining two-dimensional drawings and detailed 3D models associated with a database of technical data sheets describing technical and historical information, conservation status and guidelines for the programmed management and restoration of the artifacts. Use of the archive material produced in a questionable database and with the possibility of updating data, through which to start initiatives and projects to enhance the objects of the various collections.

4 Conclusions

The research activities promote the creation of a heterogeneous data archive, updated with new information and accessible through virtual platforms. Localization systems refer the work to the container exhibition system while allowing a cultural connection with keywords and links that, through various access channels, animate the experience of remote use. This study is a reflection on the museum management systems in which space and artwork coexist within their virtual, dynamic transposition.

A database, in order to preserve the historical memory of the museum complex and of the cultural system that can become both an instrument for the management of the asset in terms of planning short, medium and long-term interventions and an enhancement tool. We could talk about databases for the planned exploitation where the use of immersive reality systems and digitalized space gives rise to a system of information that amplifies the potential and connections of 3D databases with different types of formats and information systems. Through digital if on the one hand problems of accessibility and diffusion of good are resolved, on the other hand the same work of art takes on a new expressive value, capable of renewing the glorious past through dynamic, audio aspects and explanatory contents aimed at enriching its identity and making it reacquire that original dignity too often hidden behind a closed glass case.

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[12] The course is part of the educational didactics offer of the single cycle degree course in Conservation and Restoration of Cultural Heritage (class LMR/02) a.a 2017/2018.

References

Biocca F, Delaney B (1995) Immersive virtual reality technology. In: Biocca F, Levy M (eds) Communication in the age of virtual reality. Lawrence Erlbaum Associates Publishers, Hillsdale

Gerosa M, Pfeffer A (2006) Mondi virtuali: benvenuti nel futuro dell'umanità. Castelvecchi editore, Roma

Hwang G-J, Tsai C-C, Yang SJH (2008) Criteria, strategies and research issues of context-aware ubiquitous learning. Educ Technol Soc 11(2):81–91

Lèvy P (1997) Il virtuale. Raffaello Cortina editore, Milano

Mayer R (2004) Should there be a three-strikes rule against pure discovery learning? the case for guided methods of instruction. Am Psychol 59(1):14–19

Ogata H, Yano Y (2004) Context-aware support for computer-supported ubiquitous learning. In: Proceedings of the 2nd IEEE international workshop on wireless and mobile technologies in education, pp 27–34

Parrinello S, Dell'Amico A (2018) The traditional crafts of the native Americans Procedures of survey and documentation for the creation of informative systems 3D. In: Proceedings of the conference 3D modeling and BIM, pp 394–409. Nuove frontiere, DEI Tipografia del genio civile, Roma

Parrinello S, Picchio F (2017) Databases and complexity. Remote use of the data in the virtual space of reliable 3D models. Archit Eng 2:27–36

Queau P (1993) Le virtuel: Vertus et vertige. Champ Vallon Editions, Ceyzérieu

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