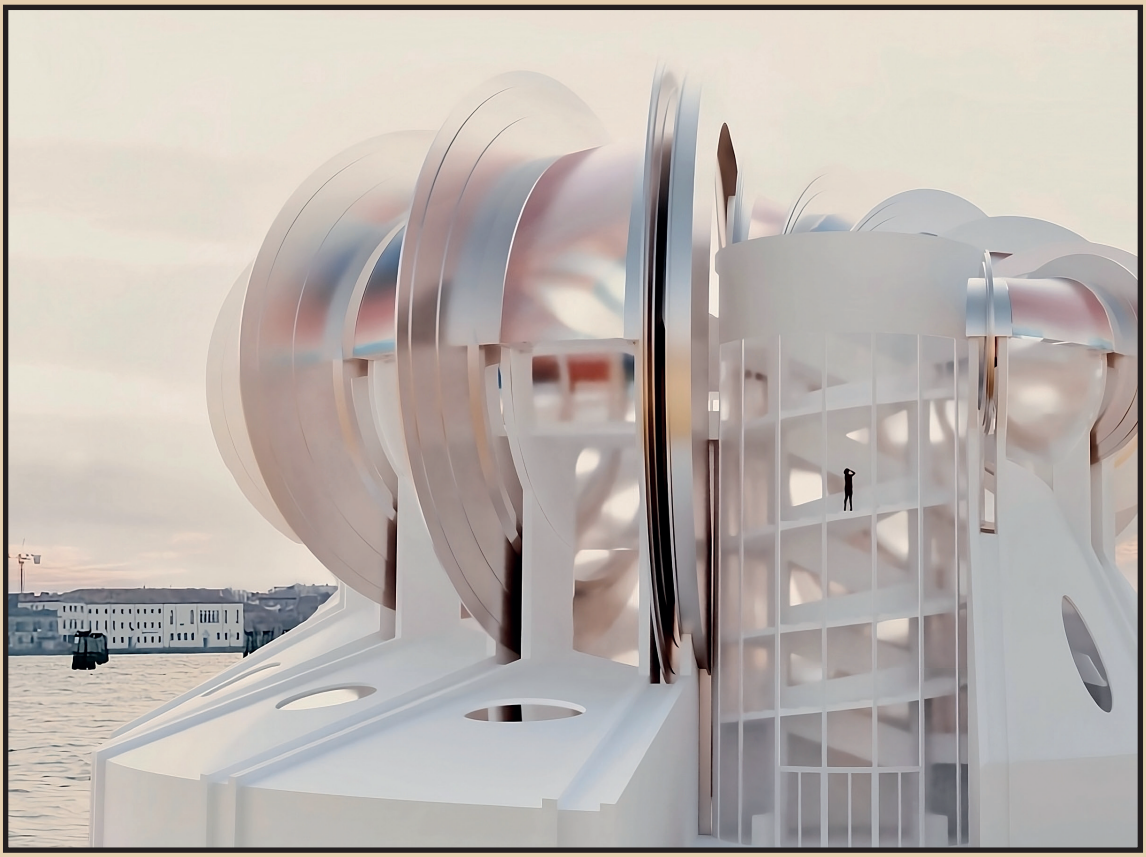
Real Space-Virtual Space

Aesthetics, Architecture, and Immersive Environments

Edited by Fabrizia Bandi and Roberto Paolo Malaspina



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Foreword.
Real Space – Virtual Space: From *Sound Helmets* to VR Headset*

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Can we really make a distinction between real and virtual space? Today, the multitude of digital devices that surround us makes space an increasingly layered and complex dimension to inhabit. In this context, we aim to explore a particular dimension of the experiential space – the architectural and urban one– to better understand how emerging *media* engage with these fields, fostering a productive exchange of ideas and further dissolving the boundaries between them.

Nevertheless, the modification of space through media to alter its aesthetic perception and meaning is not limited to new technologies. One of the primary inspirations for this volume, which also informed the choice of its title, is the seminal work of Italian architect and designer Ugo La Pietra, who curated a part of the XVI Milan Triennale in 1979. The group exhibition, titled *Spazio Reale-Spazio Virtuale. Lo spazio audiovisivo* [*Real Space-Virtual Space. The Audiovisual Space*], explored the intrinsic duality of television through a range of installations. The focus extended beyond the artefactual image and its content – the proto-virtual space transmitted electrically by the device – to encompass the ways in which this space, predominantly situated within the domestic sphere, acquires the capacity to transcend the screen. The need to create alternative, self-contained environments where individuals were exposed to a wide range

* This text was written in the framework of the research project "AN-ICON. An-Iconology: History, Theory, and Practices of Environmental Images." The project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 834033 AN-ICON), and is hosted by the Department of Philosophy "Piero Martinetti" at the University of Milan (Project "Departments of Excellence 2023-2027" awarded by the Italian Ministry of University and Research).

of sensory stimuli and compelled to rethink the conventional perception of space was already evident in the architect's projects between 1967 and 1970, *Le Immersioni* [*The Immersions*]. This series of installations comprised a variety of micro-environments, which visitors were encouraged to enter either with their entire body or just with their head. Even in works that required a high degree of immersion, such as *Uomouovosfera* (1968) and *Immersioni Ambienti Audiovisivi* [*Immersions Audiovisual Environments]* (1969), where participants entered a semi-opaque sphere – the perception of the outside was disrupted and deferred, but never completely eliminated. A similar phenomenon occurred in the most renowned devices of the series, the *Caschi sonori* [*Sound helmets*], created in 1967 for an exhibition at the Galleria Cadario in Milan (subsequently installed as part of *Ambiente Audiovisivo* at the XIV Triennale in 1968).

These works were not merely an exercise in aesthetic experimentation. They also conveyed a compelling social and political message. In the context of the era, this aspect was a crucial driving force behind the creative process. Indeed, certain works, such as *Immersioni nell'acqua* [*Immersions in Water*] (1969), were performed in the streets of the city, directly inviting passers-by to engage with the work and contribute to their own experience of the urban environment. La Pietra's work, which preceded the advent of the technologies we now call "new" or "immersive" media, underscored the spatial, architectural, and urban dimensions of audio-visual forms, thereby establishing theoretical and practical models that redefined the relationship between the virtual and the real.

Inspired by these critical perspectives, this volume aims at investigating how contemporary apparatuses create an artificial space of their own in dialogue with the design and experience of architectural and urban space, fostering productive contaminations and intersections. Of particular note is the impact of virtual reality (VR) technology, which effectively challenges the conventional status of the image, presenting itself as an actual space (Pinotti 2018). Indeed, the image appears as *unframed* and experienced without any form of mediation, in a single word: an *an-icon* (Pinotti, Cavaletti 2020; Pinotti 2021). It occupies the experiencer's entire field of view: thanks to the headset users are totally enclosed in the digital realm, inhabiting images and even interacting with them. The spatial experience created by these devices, as well as the identity and performativity of the participants, must be redefined and negotiated anew (Hofer et al. 2020; Champion 2019).

The crucial feature of VR is that, unlike other kinds of visual representation, it has to do directly with the production and the representation of space in an immersive way. It must be stressed that here the word "space" does not mean just a measurable extension, an aseptic background hosting objects and people. The experience of space claimed by VR is in many ways similar to that of our every-day life, which has also been conceptualized as the primary and paramount dimension of our existence (Merleau-Ponty 1945; Bollnow 1963). In

this light, phenomenology speaks of *lived space* [*Lebensraum*]: the space we "feel" when we enter a room, or when we orient ourselves walking across the streets of a city, or simply when we relate to the objects around us. The space in which we move, interact and have immediate experience of the world. In a way VR too offers this kind of experience, albeit in a digital realm, eliciting in the user a vivid *sense of presence*, yet excluding the body immediately. So, in this light, it is necessary to establish an aesthetics of virtual space (Champion 2021a; Tavinor 2021; Bandi 2021b) in order to undertake an exhaustive investigation of this specific experience.

This potential of VR environments is obviously fundamental for architecture, so much so that these technologies increasingly represent a powerful tool for architects and planners to rethink design in unprecedented perspectives (Bandi 2021a, Parker et al. 2021; Vilar et al. 2022; Vegetti 2022). These devices allow professionals, but also universities and academies, clients and citizens, to *quasi*-live the project, not only visualising it but inhabiting its space. In short, virtual realities change the way we represent and also our relationship with this representation.

Jaron Lanier, one of the pioneering figures in the development of virtual reality, has famously referred to this technology as "a shared dream" (Lanier 2017), underscoring its inherently dreamlike and imaginative dimension (Grossi 2021). This view of virtual reality as a space where the boundaries of the real and the imagined blur offers profound implications, especially when considered in the context of heritage and visionary architecture. Virtual reality can act not only as a medium of creative expression but also as a *poietic collector* – a repository for unrealized, forgotten, or utopian architectural projects. It has the capacity to breathe new life into structures demolished or impossible-to-build, allowing them to "exist" in a virtual world. A fascinating example of this is the project *Dream Builders* by Femme Fatale Studio – which was installed during the conference.[1] It draws inspiration from Étienne-Louis Boullée's *Cenotaph for Newton*. Boullée's 18th-century design for a colossal monument dedicated to Isaac Newton is an iconic unrealized architectural project, a bold expression of Enlightenment thought and a utopian vision of space, scale, and geometry. Femme Fatale Studio has transformed this visionary monument into an immersive experience. Through the lens of virtual reality, the awe-inspiring grandeur of Boullée's cenotaph can be experienced as a shared dream – a virtual environment where users can explore and interact with an architectural masterpiece that only existed on paper.

Projects like this demonstrate the profound capacity of virtual reality to engage with heritage in ways that traditional media cannot. By creating immersive

1 Dream Builders VR: https://www.femmefatale.paris/project/batisseurs-reves-vr (Accessed on: 30.10.2024)

spaces, VR not only preserves historical ideas but also invites a new form of interaction with cultural heritage. It opens a dialogue between past and present, engaging with the architectural avant-garde of bygone eras and allowing these ideas to transcend their temporal and material constraints.

Beyond the headset lies the tangible city, where the physical and virtual worlds are becoming increasingly intertwined. In this evolving landscape, the relationship between the real and the virtual is not merely incremental; rather, it is deeply entangled and reflexive, as observed by Milgram and Kishino (1994). With the advent of augmented reality (AR) and mixed reality (MR) technologies, the boundaries between these two realms are becoming ever more porous. These technologies are capable of embedding digital objects directly into our urban environments, altering how we perceive and interact with the city (Bandi, Pinotti 2023). This fusion serves practical purposes – such as improving route-planning, providing real-time information, or offering enhanced architectural visualization (Duarte and Álvarez 2021; Sharma 2021) – while simultaneously encouraging new forms of artistic and creative expression (Kot 2021; Pirandello 2023; Shokrani et al. 2021).

This transformation not only enhances the utility of urban spaces but also redefines our understanding of them. As Manovich (2006) suggests, augmented reality contributes to the creation of a *new poetics of space* – a digitally infused landscape where physical reality and virtual elements coexist and interact in meaningful ways. In this augmented space, architecture, technology, and human interaction form a dynamic interplay that opens up new possibilities for experience and engagement.

These concepts hold particular significance for the conservation and enhancement of architectural heritage. By leveraging AR and MR, we can create immersive and interactive experiences that breathe new life into historical sites and buildings. For instance, visitors to a monument might encounter digital reconstructions that allow them to see how the site looked in different historical periods (Brusaporci et al. 2017), or interact with virtual elements that create new forms of urban storytelling and cultural memory (Modena, Pirandello, Pinotti 2021), thus enriching their understanding of the site's cultural and historical significance (Champion 2021b). Moreover, these digital interventions contribute to a broader dialogue with theoretical frameworks such as mediascapes (Appadurai 1996; Casetti 2018) and media cities (McQuire 2008). Both of these concepts highlight the intricate relationship between urban landscapes and media technologies, emphasizing that cities are no longer just physical entities but are increasingly shaped by the flow of information, images, and digital experiences (Verhoeff 2012; 2020; Montani et al. 2018) transforming our perceptions of them.

This volume is divided into two sections, *Theory* and *Practice*, on the basis that these are, nevertheless, two aspects of the same entity. Despite this separation, they engage in a dynamic and constructive exchange of ideas.

The *Theory* section opens with an essay by **Scott McQuire** which analyses the ways in which networked digital media are spatially integrated into cities in distinctive historical contexts and how computational processes are reshaping urban space. The media scholar investigates both contemporary practices and the longer history of mediated urban environments in order to identify the continuities and disruptions that are characteristic of the present moment. **Erik Champion**'s contribution analyses the evolution of online 3D technologies over the past three decades, from VRML (Virtual Reality Modeling Language) to the excitement surrounding the "Metaverse" in 2022. The game and media scholar also focuses on how virtual representations of the past connect to the ideas of cultural presence, hermeneutic environments, and immersive literacy, aiming to enhance our understanding of the cultural value of virtual spaces.

In her essay, **Fabrizia Bandi** examines how virtual reality encourages an investigation into the concept of "inhabitation" in relation to spatial experience. She argues that this immersive experience engenders distinctive atmospheres which evoke genuine emotional reactions, thereby challenging the concept of presence in digital environments. The historians of architecture, **Silvia La Placa** and **Massimiliano Savorra,** present an investigation into the potential of digital tools to engage with the history of architecture and the identity of virtual spaces associated with historical monuments. By means of a number of carefully selected case studies, the authors demonstrate the efficacy of digital approaches in the context of cultural heritage research. Furthermore, they address the broader question of how digital humanities and architectural history are advancing this field, discussing key methodologies and practices. The contribution of **Fabrizio Banfi** examines the impact of Building Information Modelling (BIM) technology on our perception of buildings as digital entities comprising all their components and information. This transition from two-dimensional computer-aided design (CAD) drawings to three-dimensional models has facilitated interdisciplinary collaboration and enhanced the sharing of diverse content. BIM is also employed in the context of historic edifices through heritage building information modelling (HBIM), which facilitates novel avenues for disseminating cultural heritage data.

The essay by **Matteo Vegetti**, opening the second section of the volume, *Practices*, bridges the gap between theoretical framework and practice. The philosopher examines the theoretical underpinnings and methodology of an experimental course on the *Phenomenology of space*, specifically designed for architects and interior designers, at SUPSI (University of Applied Sciences and Arts of Southern Switzerland). The course employs virtual reality to facilitate students' immersion in the perceptual and cognitive effects of spatial forms, colours,

materials, and light. The interview with the architect Valentina Temporin, co-founder of **ULTRA**, together with John Volpato, explores the intersection of architecture and virtual reality. Initially used for project presentations, VR soon became central to their work, particularly with *Osaka '70*, a project that reimagines Maurizio Sacripanti's unrealised kinetic architecture. This project, created during the pandemic, evolved into a multi-user experience, enhancing the social and interactive potential of VR. Notably, a dedicated contribution to *Osaka '70* is also included in this volume, highlighting its significance. Finally, the contribution presented by the architect **José Pareja Gómez** outlines the activities of the ZHVR Group, which was established in 2014 as a division of Zaha Hadid Architects. The group's work focuses on the integration of virtual reality in architectural design, with the objective of redefining the conceptualisation and experience of spatial environments.

In conclusion, a close reading of this collection of essays reveals that the hyphen separating "real space" from "virtual space" in the title should not be regarded as a mere hiatus; rather, it serves as a crucial expression of a continuum – a dynamic interplay that reflects an ongoing process of hybridization and fluidification. This relationship signals the emergence of a concept designated as "transarchitecture," previously theorized by Novak (1994), which reconfigures the boundaries between reality and virtuality.

This conference, from which we now present the proceedings, was set in the context of this transformation. It encompassed a diverse range of activities that spanned theoretical investigation from different fields of study and practical experiences in virtual reality. The objective was also to bridge the gap between theory and practice, in order to illuminate the ways in which the convergence of physical and virtual space not only redefines spatial experiences but also challenges traditional notions of presence, perception, and interaction in the built environment. Ultimately, this publication is intended to foster a dialogue that inspires innovative thinking and encourages the creation of spaces that transcend conventional categories, thereby enriching our understanding of both the real and the virtual.

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THEORY

From Restricted to General Augmentation. The Networked Digital City as Augmented Environment

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Abstract

Writing in 1967, on the cusp of the era of widespread digital computation, Marshall McLuhan famously declared that all dominant media constitute an environment. How should we understand this *environmentality* in a present in which networked digital media are not only spatialised throughout cities in historically distinctive ways, but computational processes also offer novel capacities for the *production* of urban space? Drawing on current practices as well a longer history of mediated urban space, I will explore the continuities and ruptures that shape the present moment. Change in the technologies of mediation not only alter how cities look, but recalibrate processes of perception, inhabitation and social encounter.

Keywords: Media Environment; Media City; Light; Immersion.

Abstract

Nel 1967, alla vigilia dell'era della computazione digitale diffusa, Marshall McLuhan affermò che tutti i media dominanti costituiscono un ambiente. Ma come interpretare questa idea oggi, in un contesto in cui i media digitali in rete non solo plasmano le città in modi storicamente nuovi, ma i processi computazionali aprono anche possibilità inedite per la produzione dello spazio urbano? Partendo dalle pratiche contemporanee e da una lunga storia dello spazio urbano mediato, questo articolo indaga le continuità e le trasformazioni che definiscono il nostro presente. Le evoluzioni nelle tecnologie di mediazione non solo influenzano l'aspetto delle città, ma ridefiniscono i processi di percezione, abitazione e interazione sociale.

Parole chiave: Ambiente Mediale; Città Mediale; Luce; Immersione.

Designed by Cass Gilbert and completed in 1913, the Woolworth building in New York was the world's tallest structure until the completion of the Chrysler building in 1930. It was also one of the first buildings to be explicitly designed with electric illumination in mind. The building exterior boasted specially designed terracotta tiles to act as surface reflectors and incorporated external lighting that increased in intensity with height, while its tower was crowned by a constantly rotating lamp.

Significantly, the building's grand opening took place at night. President Woodrow Wilson – who was in Washington – pushed a button to switch on the 80000 interior lights, instantly and dramatically showcasing the thousands of windows that were a key feature of what came to be dubbed the "cathedral of commerce". Wilson baptizes the building – not with water, but with light.

Figure 1. The Woolworth Building at night, New York, between 1910-1920. (US Library of Congress Detroit Publishing Company collection, public domain. LC-DIG-det-4a24623)

I want to use this example to reflect on the new urban environment that was being established at this time. My focus is less the vertical structure of the skyscraper that became the key architectural symbol of the modern city than the new urban atmosphere that electric lighting generated. Light has often been associated with rationality. In English, expressions such as "I see the light" or the cartoon image of the light bulb as a vernacular sign of comprehension connect to the deeper history encapsulated by the term "Enlightenment." But one of the most striking features of the electrical illumination of the modern city has been the way it constantly exceeded any rational agenda. Instead, human experience of the electric city is marked by perceptual overload, which became a common theme for numerous writers and artists in the 1910s and 1920s. One classic formulation comes from the novel *Metropolis* written in 1925 by Thea von Harbou.[1]

> The workman No. 11811, the man who lived in a prison-like house, under the underground railway of Metropolis, who knew no other way than that from the hole in which he slept to the machine and from the machine back to the hole – this man saw, for the first time in his life, the wonder of the world, which was Metropolis: the city, by night shining under millions and millions of lights.
> He saw the ocean of light which filled the endless trails of streets with a silver, flashing luster. He saw the will-o'-the-wisp sparkle of the electric advertisements, lavishing themselves inexhaustibly in an ecstasy of brightness. He saw towers projecting, built up of blocks of light, feeling himself seized, over-powered to a state of complete impotence by this intoxication of light, feeling this sparkling ocean with its hundreds and thousands of spraying waves, to reach out for him, to take the breath from his mouth, to pierce him, suffocate him [...] (von Harbou n.d., 50-51).

von Harbou's prose here is florid and emotive. But you can find many similar pronouncements about the *excessive* impact of electric lighting from a virtual who's who of the modernist *avant-garde*, including Futurists such as Marinetti and Boccioni, Soviet luminaries such as Majyakovsky and Eisenstein and poets such as Ezra Pound. When Maxim Gorky visited Luna Park at New York's Coney Island in 1913 he was so moved that he proclaimed:

> Thousands of ruddy sparks glimmer in the darkness, limning in fine, sensitive outline on the black background of the sky shapely towers of miraculous castles, palaces and temples. [...] Fabulous beyond conceiving, ineffably beautiful, is this fiery scintillation (Quoted in Koolhaas 1994, 29).

1 von Harbou was Fritz Lang's creative partner on nine films produced between 1924 and 1933. As a married couple, they formed a pioneering multimedia duo, with von Harbou writing scripts and publishing novels in multiple languages, while Lang directed the films. Von Harbou also wrote scripts for other major German directors including Carl Dreyer, E.A Dupoint and F.W Murnau.

Another striking example comes from Lewis Mumford, the great urbanist and theorist of technology. In his autobiography, Mumford, who was born in New York, describes his most memorable experience – one that stands out from all others even toward the end of his long life – as witnessing the transition from daylight to dusk while walking across Brooklyn Bridge:

> The towers, topped by the golden pinnacles of the new Woolworth building, still caught the light even as it began to ebb away. Three-quarters of the way across the bridge, I saw the skyscrapers in the deepening darkness become slowly honeycombed with lights, until, before I reached the Manhattan end, these buildings piled up in a dazzling mass against the indigo sky. Here was my city, immense, overpowering, flooded with energy and light […] (Mumford 1982, 129-130).

The same Broadway on which the Woolworth building was located was already becoming known as the "Great White Way" due to the intensity of its electric illumination. Writing to a friend in 1923, literary theorist Kenneth Burke noted how the Great White Way exceeded the sum of its parts: "Broadway is qualitatively rich; not a single light on it is worth a damn, but the aggregate of so many million lights demands attention" (quoted in Jay 1990, 131). Historian David Nye (1997, 88) argues that it was this electric cityscape that provided the *cultural* ground of modernism. Which is to say, the experience of being immersed in the atmospheric light of the electric city inspires a new cultural imaginary: one that is incontrovertibly a *techno-cultural* imaginary.

1. Light as Media

A few decades after electric lighting had become an urban commonplace, Canadian professor of English literature Marshall McLuhan started to advance his theory of media. Initially, he drew heavily on the work of economic historian Harold Innis (1950, 1951). Both Innis and McLuhan were interested in how different forms of mediated communication shaped the emergence of different social forms. Where Innis principally focused on the transition from oral communication to different modes of writing, McLuhan's main innovation was to bring the new electric media of the 20th century – especially television – into this framework. And where Innis emphasized the economic and territorial impacts of media, such as the role of paper-based writing in enabling the administration of more extensive empires, McLuhan paid a lot more attention to the transformation of human sensory perception. In his best-known text, *Understanding Media* that was published in 1964, McLuhan takes electric light as an exemplar, declaring it to be a "pure" medium:

> Whether the light is being used for brain-surgery or night baseball is a matter of indifference. It could be argued that these activities are in some way the "content"

> of electric light, since they could not exist without the electric light. This fact merely underlines the point that the "medium is the message," because it is the medium that shapes and controls the scale and form of human association and action (McLuhan 1964, 16-17).

Electric light is used by McLuhan to advance his main argument that changes in media correspond with changes in both individual perception and collective social life inasmuch as changes in media alter the "scale, pace and pattern" of social interaction.[2] Hence his provocation aimed at contemporary critics such as Federal Communication Commission chair Newton N. Minnow who famously lamented the "vast wasteland" of television[3]: for McLuhan, what was most important about television was not *what* was on the screen, but the fact that the screen was *on,* allowing millions of spatially dispersed viewers to be linked in a new experience of simultaneous witnessing. However, this transformation often drifts out of focus, precisely because we pay more attention to the message than to the effects of the medium. In 1967, McLuhan wrote an important essay for the Yale Architecture School journal *Perspecta*, in which he sharpened this argument. After restating his contention that all dominant media constitute a distinct perceptual environment, he argued that a dominant medium becomes taken for granted and therefore hard to perceive. Its *environmental* effects become invisible (McLuhan 1967). By the 1960s, the electrified city had arguably become this kind of "invisible environment." While people certainly saw electric lighting nearly everywhere they looked, they gave little or no consideration to its environmental – or *mediatic* – effects. Along one axis, these effects included the incubation of new patterns of sociality, as the working day was no longer so closely tied to the availability of daylight, while a leisure-based "night life" had gained new prominence. But electric lighting also altered perception of the city in a far more direct way. Andy Warhol seemed to understand this intuitively. In the context of discussing his *Empire State Building* (1965) film, he observes: "If you build buildings with lights outside, you can make them indefinite, and then when you're through with using them you shut the lights off and they disappear" (Quoted in Angel 1994, 15).

2. The Media City as (Invisible) Environment

Warhol's observation situates the electric city – the electropolis as it was often called at the time – as a new kind of mediated urban environment.

2 "For the 'message' of any medium or technology is the change of scale or pace or pattern that it introduces into human affairs" (McLuhan 1964, 16).

3 Minow used the "vast wasteland" phrase in his speech "Television and the Public Interest" given to the National Association of Broadcasters on May 9, 1961 https://en.wikipedia.org/wiki/National_Association_of_Broadcasters.

Electrification of lighting meant that urban appearances became dynamic in a new way, effectively rendering the city *editable*. These fundamental changes to the city's visual appearances worked in concert with the way that the embedding of modern media such as telephones and radio were progressively redefining the experience of urban inhabitation. To appreciate this historic shift, which constitutes the threshold of the "media city," (McQuire 2008) we need to break with the habit of understanding the relation between media and the city from within a traditional paradigm of representation. According to this paradigm, studying the media-city nexus is a matter of tracing how the city has been represented in a specific medium, whether this is literature, painting, photography, cinema or something more contemporary such as computer games. The underlying assumption is that the city is a pre-existing entity already awaiting its re-presentation as an image. My framing argument in *The Media City* is that, from the late 19th century, the embedding of various forms of electric media into material urban settings makes it more evident that the city can no longer be defined in advance of its "mediation".[4] Over time, these new media progressively redefine not only how cities look but also how they function as social spaces. The transition to the new environment of the media city creates what I have termed the modern *media-architecture complex*, designating a condition in which urban spatial experience comes to be *co-constituted* by the interlacing of material structures, embodied interactions and technological media.

Staying with McLuhan's example of electric light, we can note that the oneiric night city that emerges as such a distinctive facet of 20th century urban experience is emblematic of this new entanglement of media, bodies and urban space. Edison's initial public experiments with street lighting displays in 1879 attracted milling crowds to his Menlo Park establishment. Similarly, the excessive lighting schemas deployed from Woolworth's shining "cathedral" to the Great White Way were not simply something to be looked at from afar – although they undoubtedly featured in so many images – but provided an environment for collective immersion. As David Nye remarked:

> For the millions of tourists who came to stare at them in Times Square, the signs only incidentally advertised an array of products. They came to see the sheer size and magnificence of the flashing signs; they were engulfed in a restless crowd, and the roar of the city (Nye 1997, 88).

We can further grasp how different the *electric* city was from all earlier forms of urban illumination through the example of "the Zipper," a linear text display erected in New York's Times Square in1928. The Zipper consisted of 14800 light bulbs that could be programmed to display shifting letters. It was conceived

4 This is not to suggest that the city was ever *without* media, but is intended to draw attention to the fact that modern media provide fundamentally different affordances.

by Frank C. Reilly, who also designed many of New York's most famous electric advertising signs, and broadcast news headlines into Times Square for more than five decades (Cressman 2018).

Figure 2. "The Zipper." Crowds in Times Square read headlines concerning the D-day invasion, June 6, 1944. US Library of Congress, Office of War Information collection. Public domain. LC-DIG-fsa-8d36243

A reporter who visited Reilly's office in the 1930s described a three-panel cartoon on his wall. The first panel showed three men starting to cross the street when their attention was distracted by the Zipper. In the second frame, the men are hit by a taxi and sent flying into the air. In the third frame, they land and see the headline has changed to "3 hit by taxi in Times Square" (see Nye 1994, 191). This cartoon encapsulates the way that electric media, including dynamic signage such as the Zipper, start to generate novel feedback circuits in which an "event" and its representation can be linked in a new way, according to a (more or less) "realtime" temporality. While the cartoon is clearly poking fun at this condition, today these trajectories are much further developed. Static billboards have been converted into dynamic screens, while LED screens have been scaled to building-size skins, creating what Paul Virilio called "media buildings": structures that exist less for the purpose of inhabitation than display. The growth of networked capacity, coupled to exponential decreases in the cost of sensors and computing means that the feedback loops that can between established between media, urban structures and urban inhabitants are no longer a matter for ironic humour. Rather, these new modes of action and interaction, from

communication to urban navigation to large-scale data capture, have become the weft and warp of the everyday urban environment, dynamically defined by billions of interconnected devices. As the late Bill Mitchell from MIT's Media Lab remarked more than two decades ago:

> In cities today, electronically propagated narratives flow constantly and increasingly densely. These narratives – superimposed, as they are, on real space in real time – act as feedback loops recursively transforming the very situations that produce them. (Mitchell 2003, 107)

Media feedback has now become a key attribute of a new urban imaginary, conditioning how we think about the city and how we learn to act within it. If we take McLuhan's provocation seriously, this setting constitutes our new "invisible environment." We know it's there, but do we really understand it as an *environment* – which is to say, as *media*?

3. A Brief Archaeology of Immersive Media

Before I try to address this question, I want to make a slight detour. Current discourse about "immersive media" tends to focus on (relatively) new forms such as Virtual Reality (VR) headsets. As I began to draft this piece in mid-2023, Apple announced their new Vision Pro, accompanied by another round of news stories asking if this would be the year in which VR would – finally – "go mainstream."

As a media theorist, I find it instructive to compare these recurring popular narratives extolling the inexorable "progress" of new devices to a longer lineage of immersive media. Almost 20 years ago I was part of research project led by Dennis Del Favero, Jeffrey Shaw and others at the iCinema Research Centre that developed a prototype 360-degree digital camera.[5] This research was part of a larger suite of projects that eventually led to the development of the AVIE, a 3-D immersive and interactive visualisation system which has since hosted many different projects, from art works and interactive narratives to heritage and industrial training models.[6] The AVIE is representative of a new wave of audio-visual displays which took advantage of the flexibility of digital imaging to create innovative immersive environments that had new potential to be dynamic and responsive to users.

5 See http://www.icinema.unsw.edu.au/projects/spherecam/overview/

6 See http://www.icinema.unsw.edu.au/projects/avie/project-overview/ AVIE Project Directors: Jeffrey Shaw, Dennis Del Favero. Programmers: Ardrian Hardjorno, Volker Kuchelmeister, Matthew McGinity. (Additional Software and Hardware Engineering: Jared Berghold, Marc Chee, Robin Chow, Alex Kuptsov, Alex Ong & Xin Guan). Project Funding 2004-2020: ARC DP0209550, ARC DP0345547, ARC LE0453517.

Figure 3. Dennis Del Favero. *iFIRE*. 2023. (inside iCinema AVIE theatre). Image provided by the artist.

It is easy to fit the AVIE into a longer archaeology of immersive imaging that includes signal moments such as the Disney corporation's experiments with 360° cinema in the 1950s and 1960s, from 1955's Circarama using eleven 16mm projectors to Circle-Vision 360° a decade later using nine 35mm cameras. Or to the history of dioramas and panoramas that were a distinctive feature of popular urban entertainment culture in the 19th century (Huhtamo 2013). And, as Andrea Pinotti (2020) and others have argued, this lineage could include events such as the invention of geometric perspective, because it is clear that contemporary viewers experienced many of the same qualities, such as blurring of the protocols for distinguishing between 'image' and 'reality', that we tend to associate with immersive imagery in the present (see also Kittler 2010, 49-60).

In the 21st century, we don't usually think of painting or even cinema as particularly "immersive." This is partly because we can now judge their offerings against new forms such as 360-degree digital projection systems. But it may also be because our perceptual habitus has changed. Let me explore this idea briefly. Back in 1998, IMAX had been recently been privatized, after decades of life-support from the Canadian taxpayer. I was contracted by the Australian

Film Commission to study large-format cinema and consider whether the giant (70mm/15 perforation) film format could become more mainstream. In fact, this didn't happen. The main reason was economic, which I won't go into here.[7] But a second issue, relating to visual perception, is very relevant. One of the best interviews I did for the project was with Australian filmmaker John Weiley. He had directed one of the most commercially successful large-format films – the documentary *Antarctica* (1991) – and later helped to establish the IMAX cinema in Sydney's Darling Harbour. He also made a short (22 minute) 3D large-format film called *Imagine* (1993), which was partly inspired by the development of MRI technology. As Weiley describes it:

> Imagine is just an entertainment, it's not a serious movie, but what really inspired it was working with doctors at Boston who had just developed the first real time 3D magnetic resonance imagining. So we could have a 3D brain in front of our eyes experiencing stimuli and see the brain reacting in real time. It was fascinating and it taught me some basic things about the [large-format] medium. Because one of the things we discovered was that showing people movies on a television screen and showing them a television screen or print on paper activated the same regions of the brain in comprehension. But as soon as we put on our VR goggles, so that they have no frame of reference, the old areas of the brain, the sort of old reptilian brain was all brought into action – you know, the things that govern digestion and breathing and balance. They're all brought into play, they all became part of the experience, which is highly relevant if you're working in the giant screen, frameless medium (Interview with the author, 1998).

What's interesting here is the way that MRI allowed Weiley to literally see the relation between large-format film and VR headsets insofar as both aim at a condition of "framelessness" (Pinotti 2020). One uses a giant screen to saturate the visual cortex, while the other achieves the same effect by situating smaller screens much closer to the eye. Weiley went on to argue that conventional film style doesn't transfer well to the large-format medium because it is perceived more by the "old reptilian brain" and thus generates a different relation to the image. Using the short, sharp cuts that are the normal film language of contemporary cinema can disorient viewers and even make people feel sick. For this reason, large-format is better suited to long, slow tracking shots.

The deeper point I want to make via this detour into immersive media is that what one society or era experiences as "immersive" may well appear thin and unpersuasive to another. In other words, the experience of "immersivity" is neither fixed, nor simply a technical issue defined by factors such as screen size, image resolution or frame rate. Any experience of "immersive media" is about the relation established between a specific media interface and the spectrum of

7 See the report, *Maximum Vision: large-format and special venue cinema*, Sydney and Brisbane. Australian Film Commission and Australian Key Centre for Cultural and Media Policy, 1999.

situated and contingent perceptual experiences that collectively shape the human sensorium. It is instructive in this regard to recall Walter Benjamin's comments after visiting the Soviet Union in 1927. Benjamin (1999, 14) remarked on what he called the extraordinary perceptual experiment being conducted as illiterate Russian peasants were exposed to motion pictures for the first time.[8] Benjamin's point was that, unlike city dwellers, the Soviet peasantry had little or no exposure to the new machinic-electric urban environments that themselves generated perceptual impacts akin to what he called the "shock effect" of film. Lacking this acculturation, peasant responses to the impact of montage could well be heightened – even to the point of those first crowds reported to flee in the face of the oncoming train at the Lumiere's pioneering public screening.

While accounts of the credulity of early cinema audiences have been shown to be largely apocryphal, Benjamin's example encourages us to think about how human perceptual habits – and also social and political *habitus* – can change over time in concert with new technology. Changes in film language offer one small but significant example. The average shot length of commercial feature films is now less around four seconds and many films contain several thousand edits. This compares to twelve second average shot length in the 1950s and the one tenth of the number of cuts that mainstream films had in the 1930s (Cutting & Candan 2015). The bravura editing in the famous Odessa steps sequence of Sergei Eisenstein's *Battleship Potemkin* – which Benjamin clearly had in mind when he wrote about cinema's capacity to explore the urban environment with "the dynamite of its fraction of a second" (Benjamin 1999, 27) – has become the new normal.[9] Which is to say, taken for granted and receding towards invisibility as media.

8 Benjamin wrote: "To expose such audiences to film and radio constitutes one of the most grandiose mass-psychological experiments ever undertaken in the gigantic laboratory that Russia has become" (1999, 14). This "experiment" would later include novel projects such as Alexander Medvedkin's cine-train (adapted from the civil war agit-trains) in which film crews took specially equipped trains into remote rural communities (see Crofts & Enzensberger 1978). Film would be shot during the day, developed in labs on the train and then screened to the community at night. This allowed people who had never previously seen film to be suddenly exposed to images that included their everyday environment and even themselves. The aim was to use the experience of seeing one's own community represented on film to generate feelings of collective goodwill and national fervour.

9 Benjamin first uses this phrase in his 1927 reply to playwright Oscar Schmidt's dismissive review of *Battleship Potemkin*. A similar formulation celebrating the "dynamite of the split second" makes it into the second version of his famous "Artwork" essay (Benjamin 2002, 117) and persists into the better known third version (Benjamin 2003, 265).

4. Immersed in the digitally augmented city

This is a good point to return to the contemporary city, understood as an environment that is being profoundly remade by networked digital infrastructure. One thing we can productively pick up from Benjamin's argument about the film-city relation in the 1920s is that modern perceptual norms have increasingly been conditioned through their structural coupling with the city as a distinctive material-symbolic environment. If we transfer this insight to the social and perceptual experience of the contemporary city, with its vast assemblage of networked sensors including cameras and microphones, its multitude of large and small screens, and its connective networks enabling all kinds of devices to be linked to various databases as well as to each other, it is clear that this city has been newly "augmented" in many respects. But if we assert that the contemporary networked city has *itself* become a form of "augmented reality," what are we actually saying?

Let me begin by making a provisional distinction between what might be called "restricted" and "expanded" AR. I would use the former to describe specific examples of augmentation such as individual apps or projects. In contrast, expanded AR would be about acknowledging the way that media feedback has become *environmental* in the contemporary city. I'd hesitate to claim that networked digital urbanism is our new "nature," as McLuhan once provocatively asserted about electric media.[10] Rather, networked digital infrastructure, with its distinctive sociotechnical architecture and spatio-temporal patterning of communication (or 'feedback') has become part of the *ground* of the contemporary city. But this is a strange ground: it's what the sociologist Scott Lash (1999) once called 'groundless ground', referring to a ground that possesses neither fixed properties nor essential qualities but is inherently *relational*.

Groundless ground is part of the condition I have previously described as *geomedia* (McQuire 2016).[11] In my reckoning, geomedia is not simply a reference to the growing importance of so-called locative media but is about the instrumentation of the "geo" – the earth, the ground – at planetary scale. In terms of urban experience, this means that the social functions of urban structures and sites not only become more flexible, but that the affective experiences and meanings they support are increasingly defined by the capacities of networked digital media working in concert with material-symbolic properties of the built environment. The emergence of geomedia over the last two decades has enabled a new spatialization of media *within* cities, as well as a greater integration of media into place relations. The distinction I am making between restricted and general augmentation is intended to be strategic and heuristic. It should not

10 In *Counterblast,* McLuhan (1970, 14) asserted that "new media" "are not bridges between man and nature: they are nature".

11 I argue that media become "geomedia" along three trajectories – ubiquity, positonality and realtime feedback – which become increasingly dominant in the 21st century.

be hardened into an opposition since "general" or environmental augmentation is itself a function of the concentration and overlay of multiple specific augmentations within the contemporary city. These include projects for displaying spatialised information using the mobile phone screen, which is arguably the most common understanding of AR in the present. Early examples included the Museum of London's award-winning 2010 Streetmuseum app that enabled historical photographs to be seen at the site at which they had originally been captured. By carefully negotiating the position of their hand/phone-screen, users could produce a live "remix" of past and present as a screen image. In the same year Manifest.AR developed an app allowing digital artworks to be seen "inside" New York's Museum of Modern Art without curatorial invitation or permission. More recent examples have included a string of projects such as the *AR.TRAIL* exhibition held in Melbourne in 2022 which use phone screens to display artworks both inside and outside art galleries.[12]

Figure 4. Photograph showing the digital artwork *Shoeform* (sprouting) by Patricia Piccinini on site at Melbourne's Federation Square as part of the AR.TRAIL exhibition (August 22 to October 1, 2022) developed by the National Gallery of Victoria, Australian Centre for the Moving Image and Federation Square in conjunction with London-based Acute Art. (Photograph by the author)

12 See https://www.ngv.vic.gov.au/exhibition/ar-trail/

While these projects are often understood from the point of view of curatorial strategies for audience "engagement," they also demonstrate how spatialised information functions to alter and contest place relations. Changing the site at which you can access information changes its value and impact. This may relate to what is allowed inside a bounded and carefully curated space such as an art gallery. Or it may contribute to how a site is understood or remembered. Using spatially-curated information offers an as-yet largely untapped potential for addressing the legacy of colonialism and the wholesale overwriting of place memory by colonisers. A small but significant example is the guided walk app Billibellary's Walk, which provides a First Nation's perspective about the grounds and buildings of the University of Melbourne where I work.[13] Billibellary, who was born in 1799, was the *Ngurungaeta*, or clan head, of the Wurundjeri people who are the traditional owners of the land on which the University of Melbourne was established. The app provides a distinctive way of reflecting on a history marked by both violent dispossession, resistance and survival.

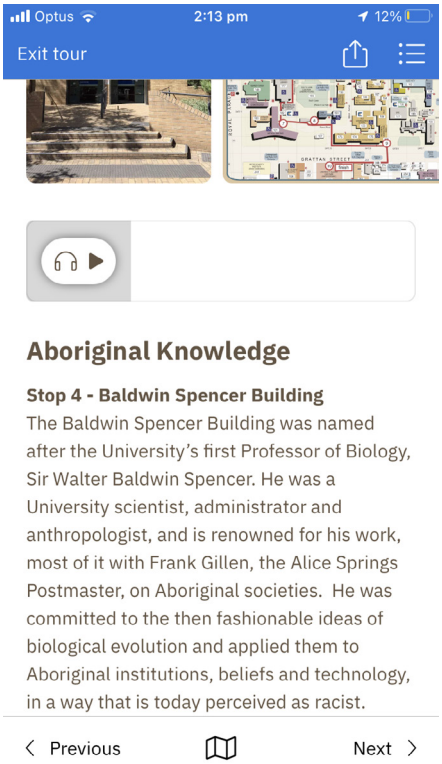

Figure 5. Screenshot from Stop 4 of the Billibellary's Walk app, Baldwin Spencer Building, University of Melbourne.

13 See https://billibellaryswalk.stqry.app/

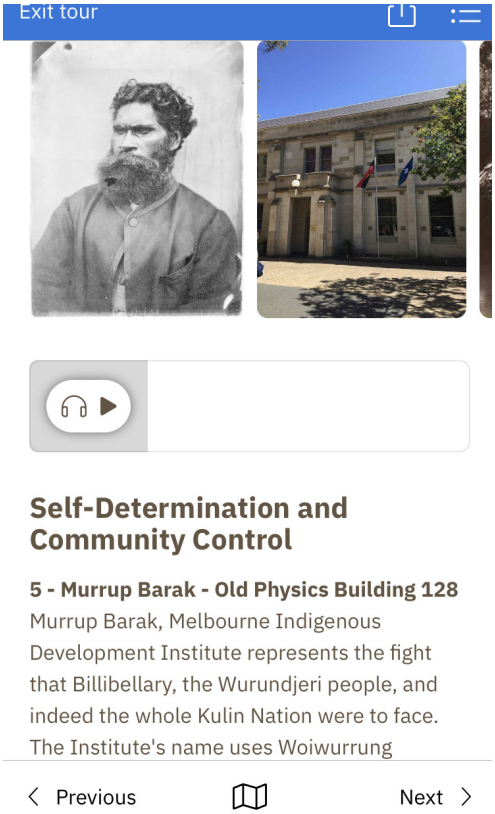

Figure 6. Screenshot from Stop 5 of the Billibellary's Walk app, Murrup Barak, University of Melbourne[14]

While AR apps using the small mobile screen inevitably tend to focus on individual experience, contemporary cities have also been progressively remediated by forms of "augmentation" that are capable of producing *collective* impact. The entire field of urban lighting has been radically transformed over the last two decades: first by the introduction of LED solid-state forms (which have also transformed screen displays), and second by the integration of lighting with computational control. As Bill Mitchell remarked a decade and half ago:

14 Billibellary's Walk was developed by a research team comprising of Onemda VicHealth Koori Health Unit and Murrup Barak with input from a reference group which included Ms Shawana Andrews, Ms Ngarra Murray, Mr Craig Torrens and Mr Warwick Padgham. The support of the following individuals and groups was critical: Wurundjeri Tribe Land and Compensation Cultural Heritage Council Inc – staff and members; Aunty Margaret Gardiner – Wurundjeri Elder; Aunty Joy Murphy-Wandin – Wurundjeri Elder; Office of the Provost, The University of Melbourne – Learning and Teaching Initiative Grant. More information: https://murrupbarak.unimelb.edu.au/home/about/billibellarys-walk

"the traditional distinctions between architectural lighting design and computer graphics are beginning to disappear. Anything that lights up can be treated as an addressable, programmable pixel" (Mitchell 2005, 88-9).

As a result of these changes, LED skins on buildings can be made responsive to diverse real-time informational inputs such as local weather conditions, or programmed to perform time-based patterns. Projection mapping techniques now enable images to be form-fitted onto buildings and other structures, enabling precise alignment of light-effects in relation to the surfaces, forms and volumes of physical structures. This range of new possibilities means that projection and light art has recently been widely adopted as a form of urban augmentation (Jackson 2015; McQuire 2022). Programmable urban illumination has become a tourist attraction and arguably – in the case of the nightly "Symphony of Lights" performance that has now run nightly for almost 20 years utilising the buildings of the Hong Kong skyline as a collective canvas – a form of state propaganda.[15] Moreover, lighting is no longer limited to urban surfaces. Fleets of drones can now used to construct elaborate mobile 3D light sculptures, in which each individual drone becomes an addressable and controllable light pixel functioning as part in a collective arrangement.[16] The growth of these projects, both in terms of their number and their scale, suggests they have fast become an integral part of the modern urban spectacle.

In this context, it is salutary to recall an*other* history of urban projection that specifically aims at using "augmentation" not as ornament but as a way of contesting the social and political relations of architecture and public space. Public space is what philosopher Hannah Arendt (1958) famously characterised as the "space of appearance." It is the site on which the fundamentally *political* acts of speaking and acting take place. Public space is both the "support" for such acts but its very "publicness" is also in part constituted by these acts. This dual role has been critical to the work of Krzysztof Wodiczko, who was one of the pioneers of urban projection in the 1970s and 1980s when first he became well known for his large slide-based images projected onto significant public buildings such as the Hirshhorn Museum. Wodiczko also undertook occasional, more tactical interventions such as his projection of the swastika onto the pediment of the South African embassy in London's Trafalgar Square at the height of the anti-apartheid movement in 1985.

For Wodiczko, projection offers a unique and direct way of contesting place relations – and doing this in public. Overlaying architecture with carefully calibrated symbols used the building as a "spatial medium" through which urban power relations were continually enacted and reproduced. Public projection offered a way of contesting this mythic dimension of power at its source:

15 See https://www.tourism.gov.hk/symphony/english/details/details.html.

16 Examples include the drone display Written in the stars that was part of the annual Vivid light art festival held in Sydney in May-June 2023. See https://www.youtube.com/watch?v=t-jt4vBog9QU.

> Public visualization of this myth can unmask the myth, recognize it "physically," force it to the surface and hold it visible, so that the people on the street can observe and celebrate its final formal capitulation. This must happen at the very place of myth, on the site of its production, on its body – the building. Only physical, public projection of the myth on the physical body of the myth (projection of myth on myth), can successfully demystify the myth. (Wodiczko 1983, 186)

Wodiczko's more recent projects have taken this approach a step further. A salutary example is his project staged in Weimar in 2016, which involved projection onto the imposing Goethe-Schiller monument erected in 1857. This monument to the two most esteemed German writers is one of the most famous in Germany. It has been credited with inspiring a "cult of the monument" with dozens of similar statues being erected across Europe and also the USA.

Figures 7 and 8. Krzysztof Wodiczko, Phoptographs from *Weimar Projection*, on-site projection, Weimar Theater Plaza August 26-28, 2016 KuntsFest festival, during Goethe's birthday celebrations. Available online at https://www.krzysztofwodiczko.com/public-projections#/weimar/. Photographer not named.

Wodiczko's project involved interviewing refugees, mainly from Syria and Afghanistan, about their experiences in coming to live in Weimar. The video recordings made with participants were then mapped onto the statue's dimensions and contours, enabling participants to temporarily "occupy" this monument with their own faces and bodily gestures. As Wodiczko notes: in this way "Refugees could become Schiller and Goethe in real time" (Wodiczko 2017, 39). In addition, a podium was erected to allow questions to be posed by the audience. Live responses from the refugee participants, situated in a nearby studio, were relayed onto the statue. Constructing this new "feedback circuit" moves the project from symbolic contestation focused on the statue towards a more explicit role as a temporary, experimental public sphere.

Transforming the Goethe-Schiller monument using refugee faces, gestures and voices is a particularly powerful gesture. We should remember that Schiller was himself a refugee. He was a doctor who had deserted from the army, and had to cross several checkpoints to get to Weimar. He was eventually protected on his arrival by Goethe. The square in which the statue commemorating their meeting is situated is the site where the Weimar Republic was formed in 1918 and where the national assembly met until the fascist takeover in1933. Wodiczko's project recollects this complex history and uses it as an opportunity for creating a unique form of contemporary public testimony.

These different practices – from the use of AR in mobile phone apps to the growing role of dynamic lighting and digital projection in the contemporary city – indicates both the range of techniques as well as the diverse ambitions these practices can encompass. Where some projects involve deliberate contestation of the symbolic heritage of the city, others seek more ambient effects, or seek aim to consolidate state power or brand image. This spectrum of uses maps onto the ambivalent trajectories that characterize the geomedia era and the digitization of urban infrastructure, where new possibilities for individual and collective expression are constantly counterpointed by new capacities for consolidated power and control.

5. Immersed in Data

This brings us to one of the most important differences separating light art projects in the 20th century from those using digital media to alter the dynamic of public space in the early 21st century. A key aspect of the contemporary digital city is enhanced capacity to collect, assemble and analyse data of all kinds. We've now arrived at a stage where this doesn't require a special apparatus: instead, mass data capture has become embedded in everyday urban operations. The kind of mass surveillance that has become the dominant business model of digital platforms, initiating what Shoshana Zuboff (2019) aptly describes as "surveillance capitalism," has expanded into urban space as a core element of

the digital city. New practices of datafication and capacity for large-scale data extraction have propelled the rapid rise of "smart city" agendas all over the world. These are all-too often imagined as command and control systems dedicated to what engineers term "optimization" – without asking basic questions such as optimized for who? To what ends? (McQuire 2020).

Vastly heightened potential for data extraction is pivotal in differentiating the 21st century digital media city from the older electropolis. We are no longer immersed in electric light alone but also in data. *This* augmentation has become a central part of the invisible environment of the contemporary city, and is fast infusing a new urban imaginary. Growing access to diverse data sources and new computational capacities has underpinned rapid advances in machine learning and automated decision-making – so-called "AI" – over the last decade. What happens when the digitized urban environment starts to become "self-organised?" We can already see intimations of this, from the use of algorithms in risk modeling around who gets bank loans or insurance policies; or in the adoption of machine learning for planning the allocation of policing and emergency resources (Safransky 2020). It is also evident in the new modes for controlling urban movement using data mining, pattern recognition and large-scale urban surveillance that were rapidly deployed as in the context of global Covid lockdowns.

We also know – or should know – that neither data nor algorithms are ever neutral or objective. Data always has to be selected, cleaned and made machine-ready. This involves trade-offs in terms of completeness as well as "bias" in Innis's sense, relating to the particular orientation of any medium or technology. Algorithmic techniques are also developed in specific social and institutional settings, with all the pressures and prejudices this entails. While new forms of machine-learning are clearly capable of generating novel insights into complex phenomena, they can also automate and obscure the reproduction of existing social hierarchies such as racialised or gendered biases. To recognize this is not about refusing "progress" or embracing technophobia. Rather, it is to argue that contemporary developments in digital media including new forms of machine learning and automated decision-making cannot be comprehended by a narrative which simply opposes "technology" to humanity – as if being human is a fixed and static quality. As philosopher Bernard Stiegler (1998) has argued, technology – in the broadest sense of *techne* referring to both capacity to use symbols and tools – has always been *part* of being human. But it is that that strange part which propels human evolution by taking us outside ourselves, resulting in an ongoing process of technological "exteriorization" that constantly reworks the terms of our "inner" being as well as our relations to others and to the world. This is why recognizing the new terms of *this* invisible environment that conditions social life has now become an urgent challenge. History shows that technological systems are much harder to alter or wind back once

they are established and embedded. Contemporary decisions about how the city is digitally instrumented will play a big role in shaping urban social life in the future. Will we continue to allow large-scale data extraction to become the normal fabric of life in the city? Or will we find ways to foster new forms of peer-based public communication that also support privacy and new forms of public commons? What interfaces, what information architectures, what forms of property rights and modes of governance might this involve?

How we answer these questions will also inevitably shape future ways of "being human." This brings me back to the questions I raised earlier about the relation between new technology and human sensory perception and modes of sense-making. There is a long history of concern about sensory overload as an effect of the modern city. You can find this at least since Nietzsche, Freud, and Simmel and it remains evident in much contemporary discourse about the networked city as an "augmented" urban environment. But, as much as I think there is an urgent need to develop critical perspectives about allowing data extraction or the spectacular commodification of public space to become the default conditions of the 21st century city, there is equally a need to remain open to asking whether our densely layered and always-on "augmented" urban environment is contributing to the evolution of a new mode of attention. Almost a century ago, Walter Benjamin (2002; 2003) wrote about modern urban experience as characterized by a novel form of distracted perception. He argued that distracted perception should not be understood as an inherently negative quality, but instead suggested that it offered a way in which reception of new cultural phenomena could potentially elude the established patterns of filtering that characterized conscious reception. Distracted reception could potentially lead to new forms of association and modes of understanding.

His provocation remains relevant today. If we only evaluate our experience of the "augmented" environment of digital media city using the tools of traditional phenomenology, or the forms of attention that characterized the connoisseur of painting or even the film spectator sitting immobile in front of a single image stream in a darkened cinema, we are likely to miss what is most distinctive to contemporary urban experience. As an augmented *environment*, contemporary urban space involves the conjugation of multiple elements that lack a domineering centre. For this reason, being immersed in the augmented environment of the networked digital city produces a field experience more akin to *ambient perception*, to adopt the term that Brian Eno introduced to music. Re-imagining and re-designing the future city to accommodate *this* new mode of perception demands a constant and deep consideration of the ongoing experiment into relations between human senses, media interfaces, and urban spaces that is being conducted in cities all over the world.

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Reworking Architecture as Art in the Age of Virtual Replication

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Abstract

Given nearly three decades of online 3D formats since VRML (Virtual Reality Modeling Language) designed to create virtual models, virtual spaces, and virtual worlds, to the hype of the "Metaverse" in 2022, we might be surprised the Metaverse is no clearer and not very much closer to the 31-year-old vision of the book *Snowcrash*. This paper will attempt to address key recent philosophers' and media critics' core challenges for how we can assess the cultural value of built space in a virtual realm. The challengers include a take and retake on Second Life by the philosopher Hubert Dreyfus, modernist architecture as sculpture by Antony Saville, the promise of convergence culture by Henry Jenkins.

Keywords: Virtual Reality; Internet; Digital Heritage; Immersive Literacy

Abstract

Negli ultimi tre decenni, i formati 3D online hanno fatto molta strada, dal VRML (Virtual Reality Modeling Language), concepito per creare modelli, spazi e mondi virtuali, fino al recente entusiasmo attorno al "Metaverso" nel 2022. Tuttavia, è sorprendente come il Metaverso resti ancora lontano dall'essere pienamente realizzato e distante dalla visione prefigurata 31 anni fa nel romanzo *Snow Crash*. Questo articolo analizza le principali sfide sollevate da filosofi e critici dei media riguardo alla valutazione del valore culturale degli spazi virtuali. Tra le questioni affrontate figurano la critica del filosofo Hubert Dreyfus su *Second Life*, la concezione dell'architettura modernista come "scultura" secondo Antony Saville e l'idea di cultura convergente di Henry Jenkins.

Parole chiave: Realtà Virtuale; Internet; Patrimonio Digitale; Immersive Literacy

Given nearly three decades of online 3D formats since VRML (Virtual Reality Modeling Language) designed to create virtual models, virtual spaces, and virtual worlds, to the hype of the "Metaverse" in 2022, we might be surprised the Metaverse is no clearer and not very much closer to the 31-year-old vision of the book *Snowcrash*. This paper will attempt to address key recent philosophers' and media critics' core challenges for how we can assess the cultural value of built space in a virtual realm. The challenges include disillusionment with virtual reality and related simulations, a denouncement of the Internet and virtual worlds by the philosopher Hubert Dreyfus, modernist architecture criticized by Antony Saville, and the earlier promise of convergence culture by Henry Jenkins threatened by corporate walled gardens and the rise of AI. My focus will be on virtual representations as virtual replications of the past. I will attempt to link the concepts of cultural presence, hermeneutic environments, and immersive literacy.

1. Virtual Reality: Less or More than Reality

Virtual reality is under attack. Australian Professor of Philosophy Janna Thompson (Thompson 2016) has written an article entitled "Why virtual reality cannot match the real thing." Her main criticism of VR is that it cannot supplant real-world travel, but the issue has wider significance, especially in the field of digital humanities. She proposed that real-world travel experience is difficult to simulate let alone be equalled by virtual reality technology and raises a further conceptual limitation: she only considers VR (and AR) capable of providing accurate and equivalent realistic interactive simulations of the existing real world.

A more recent article by Hannah Lewi, a Professor of Architecture writing in the same online publication as Thompson, has claimed that virtual architecture lacks atmosphere (Lewi 2020). The article reminds me of a 2004 seminar in Australia, where the eminent scholar Professor Marco Frascari argued computer reconstructions of architecture were far too exact and thus too limited in conveying the mood and atmosphere of architecture. Although Computer-Aided Design and Draughting (CADD) software used by architects are complex yet blunt tools focused on construction drawings rather than ideative design focused on the creation and expression of place, I argue the above philosopher and the two architecture professors have not kept themselves informed with the expressive power of game design, machinima, and virtual production. These tools offer new and exciting ways of conveying "lived" and experientially deepened notions of virtual heritage place-making. An even more fundamental point to make is that the above critics see virtual reality and digital tools as creating simulations to mimic reality yet the power of these tools is in explaining and expressing processes.

Consider, for example, the contemporary museum sector, ravaged by the long-term implications of COVID-19, and progressively competing with rival forms of media entertainment and information. Museum case studies reveal that visitors want physical experiences, and to sense that other people are there as well (Somers 2018; Hadley 2017). Curators and interpretation specialists are increasingly interested in VR and AR to engage younger users, as alternatives to text (Lynch 2020), and as more engaging ways to disseminate significant elements of their collection. This use of technology is not to show, but to reveal, not to explain but to allow support for self-directed learning. XR (extended reality, virtual, augmented and mixed reality) does not only have to copy what is there, it can allow people to reconfigure, view underlying hypotheses and processes or mix and match contested views or clashing interpretations.

Secondly, XR can show you, on-site or remotely, what you would not have seen, contested, inferred, amalgamated or extrapolated, from a more locally-situated or past point of view. In many discussions with scholars over the last two to three decades, I have been constantly reminded that great learning experience related to games and virtual environments is frequently what is learnt from designing them, not by experiencing (or playing them).

Third, and perhaps most controversially, technology is not necessarily an impediment to creativity; it is becoming an impediment to accuracy. As Eiteljorg (1998) wrote, "sanitized" images of the past are dangerous, they obscure our understanding of accuracy. Presentations of virtual reality environments tend to focus on final, fixed projects, they miss exciting possibilities in developing the immersive and interactive capabilities of XR as open-ended, discursive frameworks.

Perhaps we are too busy trying to comprehend the latest technology, we don't have the time and patience to perfect the content. But many of the technical devices, fundamentally, are not new. Scholars who have recently arrived in the field of virtual reality may be led to believe that virtual reality and augmented reality are new. Yet stereoscopic projects have been around since 1838 (leading to the View-master, patented in 1939), there was a form of multimedia cinema in the 1950s (the Sensorama) and augmented reality/virtual reality since Ivan Sutherland's projects such as the Sword of Damocles, in 1968. More recent developments, such as large-display VR systems (CAVES, Wedges, Cylinders, curved and cylindrical displays) as well theoretical definitions of computer games as "systems" may have also persuaded scholars to think that virtual reality's primary purpose was to create closed, abstracted simulations of reality.

XR technologies have typically been seen as the final and closed stage of data visualisation for the humanities; but there are many important and useful applications of this technology for providing open-ended, discursive research-questioning learning environments. In particular, for history and heritage fields, history is fluid and not a concrete and inviolable objective fact, the most engaging

virtual environments are not necessarily the most realistic ones, and a synthesis between artistic practice and the wider humanities may be mutually beneficial. I suggest this is also true for architecture as it peers into the haze of the digital horizon. Recent media releases of the Metaverse have not investigated this potential. If we put people into a virtual world and let them wander around, what will they be able to discover, to enact, to share? Large corporations have difficulty in accepting the benefits and risks of allowing creative communities to contribute to the development of virtual simulations (from massive multiplayer games to open online virtual worlds) and hence have conveyed the Metaverse as a simplified office meeting space and virtual cinema (Purtill 2021). Some science journalists paint an even more alarming future vision: a future all-encompassing Metaverse as slyly personalized mass manipulation (Waltzman 2022). This would also further confuse our understanding of what is real and what is virtual, both past and present. I hasten to note, though, that *Snow Crash*, the 1992 book by Neal Stephenson in which the term Metaverse emerged, was indeed dystopic but inspired by the many new interactive things one could *do* (Zenou 2022).

2. On the Internet

Thirty years ago, in 1993, the internationally interconnected computer network now known as the Internet was born: with, for the first time, a standard way for computer networks to communicate. Despite its altruistic start, Professor Hubert Dreyfus (Dreyfus 2008) made some interesting criticisms of the effectiveness of Internet-based distance learning and the wider use of the Internet via his book *On the Internet*. Despite my appreciation of his prose and clarity, I have concerns with both the method and the content of his approach. Only a few years after the first edition of the book, Dreyfus mentioned in an interview that the book was already dated (Kreisler 2006) but his content was also arguably restricted by a limited view of the Internet, while his selective method of projecting the thoughts of long-dead philosophers onto the issues of the internet and virtual worlds remains questionable. [1]

For example, Dreyfus suggested the Internet is the successor to the popular press of the mid-nineteenth century Danish philosopher Dr. Søren Kierkegaard (1813-1855). Kierkegaard derided the press of his time for its instant opinions, anonymity, and lack of an ethical (or even religious) position. *On the Internet* applies Kierkegaard's criticisms to the Internet: Dreyfus declared that Internet-based learning could not develop mastery or convey a sense of the presence of other people or reality in general and lacks embodiment (Dreyfus 2008, 2001). I

1 I published a longer critique of *On the Internet* (first edition) by Hubert Dreyfus in a 2004 issue of the ACM journal *Computers and Society* (Champion 2004).

agree that the currently accessible range of sensory experiences in virtual reality easily accessed by the public is still relatively small and virtual environments (and online worlds) have no or little sense of embodiment and thus the usefulness and meaningfulness of the Internet as an embodied and inhabited realm is fleeting, illusive and limited.

Interestingly, in the second edition version of *On the Internet* – which added a fifth chapter on Second Life (Dreyfus 2008) – Dreyfus rethought his earlier views. In his preface to the second edition, he declared "Second Life is the most prominent example of how one can create and control a virtual body in a virtual world" and based his argument totally on how Second Life "affects what sort of meaningful lives are and are not possible on the Internet." It is debatable whether Second Life is or was "the most prominent example of how one can create and control a virtual body in a virtual world," (Dreyfus 2008, xii) perhaps it was the most famous. Even if it were the most engaging, interactive and popular of virtual worlds, I would be reluctant to consider Second Life an exemplar of virtual embodiment. In its early years, the creation tools were behind some of its competitors, its use of streaming technology meant environments would float in an infinite space and the early gestures and overall animation of the avatars were limited. In terms of imagination and animation. I suggest computer games would have been worth investigating before Dreyfus decided to make his claim based on Second Life. Dreyfus also claimed, "they [creative work] make Second Life worth visiting, but these achievements don't give rise to new philosophical questions or insights." (Dreyfus 2008, 94) Yet, he later appears to contradict himself by saying philosophers should visit Second Life. He has visited Second Life, he has delivered some of his courses there, and he added a fifth chapter to the second edition of his book that centred on Second Life. Was he saying his new Chapter Five has no philosophical insights arising from Second Life? Dreyfus might have countered that as we enter into a virtual world voluntarily, stepping complicity into the magic circle, we cannot truly learn and meaningfully commit because our actions have no real-world, physical consequences. On page 95 of the second edition, he invokes the story of the Star Trek Holodeck to make such a claim: virtual worlds don't carry risk so they don't require courage or provide real thrills.

However, he then goes on to say "But, as Kierkegaard points out, an experimental life lacks seriousness and focus" (Dreyfus 2008, 106). Here we stumble upon another problem with this line of arguing, both Kierkegaard and Friedrich Nietzsche (whose views he also transplanted), had, arguably, very experimental lives. They certainly tested the public, their supervisors, and their colleagues.[2]

2 Ironically, given Dreyfus promoted campus-based learning and academic philosophy, both Kierkegaard and Nietzsche nearly failed their doctoral dissertations.

Dreyfus' other arguments against Second Life are that there is no shared spatial intimacy, shared focus or mood, or understood social proxemics. However, he then goes on to attempt to prove this by what I suggest is a faulty syllogism. He creates a scenario based on a character from the novel *Snowcrash* (Dreyfus 2008, 112) that however much programming may improve in the future, it will never be quite good enough. This raises an interesting question: what would the criteria for success be, and who would be a worthy judge?

3. Convergence Culture and Collective Intelligence

Perhaps the success or failure of Metaverse would be judged by the big corporations (or at least by how much money they could continue to do so) but perhaps they already have too much control over the future of the Metaverse. The book *Convergence Culture*, by Henry Jenkins (2006) is an enthusiastic and idealist counter-proposal to the challenges of corporate control via digital media (and, by extension, virtual reality and virtual worlds). Jenkins made these provocative claims:

- Fan Culture is equivalent to Collective Intelligence.
- Mainstream popular media is a good example of participatory media.
- There will be no one Black Box through which all media will have to flow.
- Old media does not die.[3]

I admit, I find his term "Convergence Culture" confusing. In Jenkins' introduction (2006, 2) and his glossary (2006, 282), convergence is:

> A word that describes technological, industrial, cultural, and social changes in the ways media circulates within our culture…the flow of content across multiple media platforms, the cooperation between multiple media industries, the search for new structures of media financing… the migratory behaviour of media audiences who would go almost anywhere in search of the kind of entertainment experiences they want. (Jenkins 2006, 282)

A second major theme in Jenkins' book is Participatory Culture: "Rather than talking about media producers and consumers as occupying separate roles, we might now see them as participants who interact with each other according to a new set of rules than none of us fully understands" (2006, 2). So even if the relationship can be unequal, for Jenkins convergence will not be the result of media appliances, or even the result (I imagine), corporations, but: "within the brains of individual consumers and through their social interactions with others" (2006,2). So, it is a democratic, collaborative and creative process. An

3 I explored these issues in more depth in the book chapter: *The cultural and pedagogical issues of new media and the humanities*, see: Champion 2015.

idealistic dream perhaps, but is it possible, and is it feasible for a high-tech, high-energy Metaverse?

Others, such as Bruce Sterling, have declared that old media has been superseded, but Jenkins quotes writers who have suggested that all future content will be controlled through a single proprietary device or network franchise. He denies there will be a Black Box, at least one that is "the nexus through which all future media content will flow" (Sterling 2003, 23-24). Is the Black Box metaphorical, hardware, or could it be a franchise? At least three global giants, Facebook, Apple, and Samsung, already practice Walled Gardens (Bajarin 2017; Grubb 2013). The Walled Garden phenomenon also applies to games. Gerardi (2012) writes: "Because of the strict ownership rules set in place by the various digital-only retail services, such as Valve Corporation's Steam for computer games and Microsoft's Xbox Live Arcade on the Xbox 360, preservationists have very few legal options when it comes to duplicating and distributing modern games for research purposes." The giant corporations are increasingly controlling the sale of computer games as a digital rather than physical phenomenon (Plant 2021). So even if there is not a single Black Box, there are certainly attempts by large corporations to restrict people to one device or one delivery service (Higa 2008). Ironically, it is the development of Walled Gardens and Black Box franchises that is preventing our interaction with *historical* new media, at least in the area of game design and almost certainly virtual worlds as well. As Henry Lowood, Curator for History of Science & Technology Collections and Film & Media Collections in the Stanford University Libraries, remarked: "Download-only distribution, copyright law and end-user license agreements – those lengthy contracts users agree to but seldom read when installing a new computer program – are the biggest hurdles facing video game preservation at the moment" (Gerardi 2012). In another article (Zarembsky 2013; Garcia and Calantone 2002), Lowood further warned against seeing game preservation as merely being about retaining working software, it is "rather a historically specific site of shared experience." To preserve games and various types of new media we must preserve not only the technology but also the cultural practices as well.

The third major theme in Jenkins' book is Collective Intelligence, a term coined by Pierre Lévy (1997). Jenkins argues that via Collective Intelligence: "We can put the pieces together if we pool our resources and combine our skills…an alternative source of media power" (Jenkins 2006, 4). The most detailed example that Jenkins (93-130) provides for Collective Intelligence is *The Matrix* franchise across the three films, games and websites. Jenkins' definition of a transmedia story is that it "unfolds across multiple media platforms, with each new text making a distinctive and valuable contribution to the whole" (97). The last two of the three conditions do not seem to be met: merely providing clues in one media to help understanding in another media is not a distinctive

use of the supporting media, and if it is not distinctive one wonders how the secondary media contribution can be valuable as a multi-media *unfolding*.

While collective intelligence and convergence culture sound like promising antidotes as a bulwark against the potential dehumanizing and exploitation of virtual world citizens via XR and global digital media, there is so far sketchy evidence for them. They do however raise the question as to how these potential (or perhaps already here) challenges can be resisted, and whether virtual architecture can support collective intelligence and convergence culture. Can collective intelligence and convergence culture resist or refashion machine learning and AI? Will the corporations and our weakness for convenience allow us to resist and refashion?

4. Critical Futures

4.1 Digital Heritage and Culturally Significant Presence

I have argued that virtual architecture can be atmospheric if we consider its role past the function of visual simulacra, beyond mere imitation of reality. Regards Hubert Dreyfus I have also suggested that his book's attacks on the internet as a civic forum for discourse are a little premature, inconsistent, or misapplied. While Convergence Culture and Collective Intelligence are laudable concepts, I don't think they are likely to answer the critics of virtual architecture, who view it as impoverished and incomplete aesthetic objects. To address critical issues besetting the future of virtual architecture we need to understand its context, and this means to also address its relationship with our past. The majority of the virtual architecture of the past lacks a sense of presence, of time, of care. And the subset (or intersection) of digital heritage, 3D, and virtual simulations of architecture, virtual heritage, far too seldom expresses the effect of time, the depiction of care, or even more generally, the value of that place to the local, historically situated, society. The depiction of care and value is social as well as environmental. According to Kojève's interpretation of Hegel's *Phenomenology of Mind*, we are the only species to desire the desire, attention, and respect of others, symbolized via physical artefacts such as awards and medals (Warminski 2013). And here it is not just the objects but the process by which desire and the value of desire is created, that is cultural. It is important to note that creating a culturally codified system of expressing desire does not (yet) appear to take place inside a virtual world or a digital game, just as badges in gamification examples are not cultural beyond the shared use of tokens.

Secondly, beyond social interaction, we are also cultural beings, we record, instruct and pass on knowledge and beliefs to future generations. However, despite virtual worlds and open online gaming environments affording degrees

of social presence, human visitors (players) lack a rich sense of awareness of each other *inside* the virtual world, and the ways they communicate social knowledge and practice are not culturally integrated inside that virtual world. Virtual worlds and online games do not pass on cultural instructions as players change content *internally*, their graphics and mechanics may change, but not from the actions of the players inside the virtual world. It may be graphically detailed and moving, but the inside of the virtual world or online game is not a cultural environment. I noticed this over two decades ago when I tried to apply the success of games and online simulations to the design of virtual heritage environments. Instructions are passed on outside the world, and following the instructions does not change the world for the players that go after you, there are no personalized traces, and instructions are never culturally transformed, damaged or eroded. Yet the potential of such digital media to convey history and heritage through interaction is huge, after all, culture is a process as much as it is a collection of objects. We could use the specific themes and affordances of this media to encourage visitors to understand that the typical ways they act, think and believe, are not appropriate or useful. We could provide cultural affordances to help people understand a world of values distant from their own. To measure and encourage a sense of another culture, I developed the term cultural presence, describing "not just a feeling of 'being there' but of being in a 'there and then' that is not following the cultural rules of the 'here and now'" (Champion 2002). For several decades virtual environments have been assessed in terms of their presence, how they communicate to us a sense of "being there." I noticed that even 3D digital cultural heritage models, on the few occasions they underwent user evaluation were not assessed on how well they afforded cultural presence, the meaning and significance of a time, place, or object to people of the past (E. Champion, Bishop, and Dave 2012). So yes, to Thompson and Lewi and Dreyfus, 3D digital environments seldom provide for critical reflection, they could greatly improve in terms of providing for more collaboration and sharing, but collaborating sharing and sense-making, architecture more than non-narrative games. This is partly because many of these projects are academic and short-lived, or they were designed to demonstrate scholarly or technical achievement, but these critics have confused what is available with what is possible. We can see many aspects of collaboration, creativity, and community participation in online forums, open worlds, social games, and game-modding communities but cultural understanding and transmission are not normally available on the inside of these designed "worlds."

4.2 Immersive Literacy

To clear up confusion as to whether presence or immersion was subjective or objective, Mel Slater proposed *presence* (the subjective experience of "being there") versus the more objective or general term *immersivity*: the amount the

virtual reality (or gaming) equipment supports a subjective sense of immersion. While I don't want to wade into the battle between immersion and presence, I suggest that the word *immersion* is highly relevant to the particular requirements of designing 3D environments, while presence is typically used in conversations in a highly subjective way. This leads me to propose a new term, *immersive literacy* (similar to visual literacy, but in a virtual environment). Immersive literacy, however, is not digital literacy. Contrasting information literacy to digital literacy, Becker (2018) explained digital literacy requires an emphasis on guiding and encouraging not just technical but also cognitive skills in a digitally literate person, as shown in their five traits. These skills can be summarized as discernment and judgement; understanding (of relationships between learning, privacy and stewardship); ability to socially connect; and civic participation. I suggest digital literacy implies a more interactive and participative skill than information literacy but does not clearly show the importance of non-textual literacy skills.

Of course, there is already the notion of media literacy. AMLA (Australian Media Literacy Association 2020) defined Media Literacy as "the ability to critically engage with media in all aspects of life. It is a form of lifelong literacy that is essential for full participation in society." Media literacy emphasizes the citizen element of digital media, so it adds a powerful civic participation element to a still very broad notion of digital literacy but is still not adequate to describe the learning one can achieve in visiting and designing virtual environments.

Educationalists warned us that how today's younger generations learn from social media and computer games indicates we need a new form of education delivery (MacArthur Foundation 2010). These new forms of media are fast-changing and highly interactive, hence their users are not just digitally literate, to be effective, they must also be digitally dexterous. Acquiring digital dexterity requires more effort than mere digital literacy. Immersive content is seldom found in typical digital humanities courses, apart from the recent impact of GeoHumanities, digital humanities studies often had a textual focus but not a multimedia let alone a concerted 3D media focus (Liu 2013).

This is a whole new field, beyond graphics, beyond traditional arts and crafts. Visual Literacy (Bowen 2017) includes non-visual senses and can incorporate the pedagogical advantages of dual-coding (Boser 2019) but is not necessarily proprioceptive and kinaesthetic. And XR can greatly improve its development of the multimodal and multisensory (Schraffenberger and Heide 2016), better leveraging participants' sense of embodiment. Therefore, for XR, (and related immersive games) we require a new term: *immersive digital literacy*.[4] Neither digital literacy nor digital dexterity quite cover the need to educate say, new would-be game designers on how participants must learn how to orient and navigate themselves with immersive media.

4 For the sake of clarity, I will refer to immersive digital literacy as immersive literacy.

Navigating and orienting oneself in earlier virtual environments frequently resulted in feelings of nausea and confusion. Even with more recent head-mounted display environments, motion sickness and confusion remain potential issues (Heffernannov 2014; Lewis 2016; Mason 2017). Virtual environments often lack the sensory cues familiar to the body, and they may also lack the navigational cues present in the real world, such as smell, touch, kinaesthetic, or proprioceptive cues. Also, learning how to *engage* people in virtual environments is not easy, because beginning game designers often underestimate the importance of mechanics, or creating challenging but also rewarding interaction that leads to a goal, that is not too easy or too difficult. Added to this challenge, games and virtual worlds are often far harder for non-designers, so a designer, must create engaging and rewarding (not sickening) immersive environments, based on the knowledge of how people move in immersive (virtual) space, what convinces and coaxes them to explore, and so on. Even highly experienced virtual world designers such as Raph Koster (Koster 2021; Takahashi 2022) have avoided 3D virtual worlds, for these very complexities. However, in their attempt to replace 3D virtual worlds with 2D virtual worlds, they have left themselves open to the criticisms of Levi and Dreyfus: it is even more difficult to create memorable and atmospheric 2D worlds than 3D ones. Our memories and our emotions are triggered and created by more than the single sense of sight, and our three-dimensional sense of self in relation to place and to others is an essential factor in the way societies have traditionally organized themselves, through urban design, housing, performance, customs, and rituals.

A further complication arises with the emerging field of XR. Augmented Reality (AR) Mixed Reality (MR) and Virtual Reality (VR), are now increasingly called XR or extended reality, it is not important to the participant whether their view is virtual, mixed between a real or virtual, or real-world with some digital "augmentations" overlaid, the software will automatically calibrate the content to fit that particular device and its interface. But this also means a designer may not know if the final use of their digital game or virtual world will be on a table or a phone, in mono or stereovision. Ideally, these digital environments will be designed and experienced in the future across a variety of platforms, but this requires digital dexterity and there are specific skills and knowledge required to develop robust, widely accessible and engaging XR-based games.

And digital literacy is not enough when faced with a 3D immersive and highly interactive digital environment which is even more taxing on the human brain. I suggest immersion into a virtual environment relies on convincing the brain of the sensation of being virtually in another place and this sensation is constantly and consistently supported. A player will not fall through the floor, the camera will not get stuck in a wall, physics will behave consistently and appropriately, the mechanics and events of the game will not snap the player out of a complicit magic circle, while the simulated building and environment will give the

sensation of being real, material, grounded. An architect may suggest digital architecture can cover these sensations, but digital architecture typically lacks a sense of player agency, and social change, and does not try to convince anyone they are in the real world when they are merely *viewing* 3D models.

In the real world, architects can visualize buildings from simple 2D plans. In digital games, experienced gamers can work out how to navigate, where to find and manipulate objects, and how to perform tasks faster and more efficiently than non-gamers. They are experienced with the special affordances or signifiers (Norman 2018), and clues of games and virtual worlds. In that sense, they have higher levels of *immersive literacy*. However, they may not necessarily gain a deeper understanding of the underlying content (Champion, Bishop, and Dave 2012). But there is another type of literacy when designers understand how the public would experience and navigate through a virtual reality environment or computer game. This is a crucial distinction: as I noted earlier, navigating and orienting yourself in earlier virtual environments could (and still does) often lead to nausea and confusion. More recent head-mounted display environments can still cause motion sickness and confusion (Heffernannov 2014; Lewis 2016; Mason 2017). There are far fewer sensory cues to the body in virtual environments, they can lack the navigational cues of the real world (there is usually no smell or touch, kinaesthetic or proprioceptive cues).

Also, learning how to *engage* people in virtual environments is not easy, because designers often under-estimate the importance of mechanics in games and motion sickness or nausea in virtual environments, and creating challenging but also rewarding interaction that leads to a goal, that is not too easy or too difficult (an always appropriate "Goldilocks" game balance is required to ensure this). So, there is also immersive literacy required of a designer, creating engaging and rewarding (not sickening) immersive environments, based on the knowledge of how less VR-experienced people move in immersive (virtual) space. For example, when participants first wear a Microsoft HoloLens version 1 Mixed Reality headset (Fig. 1.) and are asked to click the MR object to move it, they hold their fingers away from the camera not side onto the camera. So, the HoloLens cannot see the fingers gesticulate and won't work. Moving up or down or quick rotations in virtual reality headsets can also lead to nausea, and objects in many virtual reality headsets appear very differently from how they are in real life (apparent differences or sizes can be deceiving, text can be hard to read). Digital Literacy applied directly to VR makes little sense as reading is so much more difficult in most virtual environments, but the immersive literacy of the participants and the designer's awareness of that level of immersive literacy, are crucial factors to ensure the success of the conveyed content.

Figure 1. Microsoft HoloLens (PhD project: Mafkereseb Bekele, Curtin University).

5. Case Studies

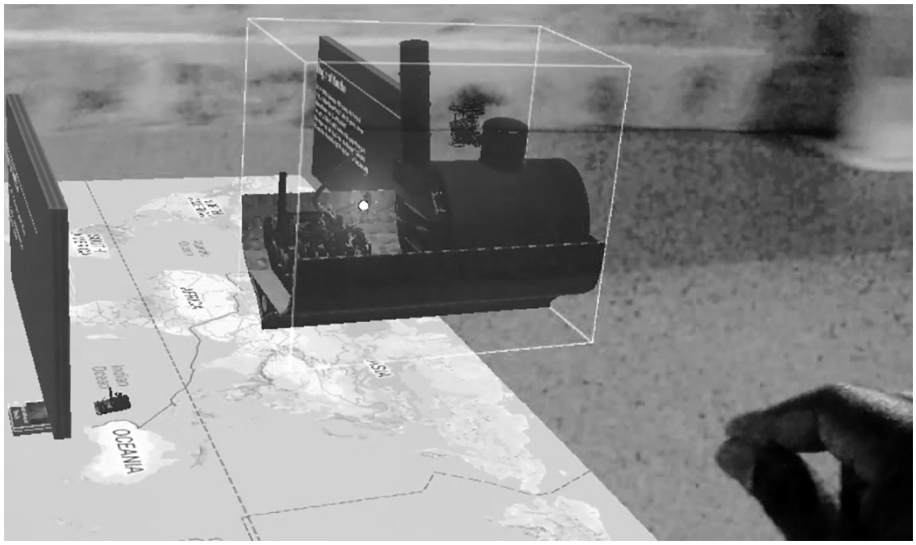

Figure 2. Microsoft HoloLens (PhD project: Mafkereseb Bekele, Curtin University).

Untethered mixed reality devices such as the Microsoft HoloLens allow people to walk around the real world and see virtual images or 3D models, with voice control, gestural control, and genuine 3D sound, manipulate them and see how they interact with their environment, providing a new dialogue between the mixed reality object and the physical surrounds (Fig. 2). However, the project by Mafkereseb Bekele (Bekele et al. 2021; Bekele and Champion 2019) took this further, two people have similar headsets and see the same physical world, but what they see and hear and can move or otherwise interact with digitally, can differ. This can induce visitors to try to decipher and share or even roleplay their own personal views, facts, narratives, or interfaces with others. In this instance, in Western Australia's Shipwrecks Gallery, participants walk towards a display and a map appears before them with a ship on it circling the world (the 1848 SS Xantho, and the museum managed to save and restore to working condition its original steam engine). They can find the related physical engine parts in the museum and move and place them to restore the virtual ship, or they can be given different tasks and views to each other. They then have to work together to solve the relevant puzzle or work out which social role each one has and why they see slightly different mixed reality views into the past. Mixed reality can reveal, merge and separate different views of the same past.

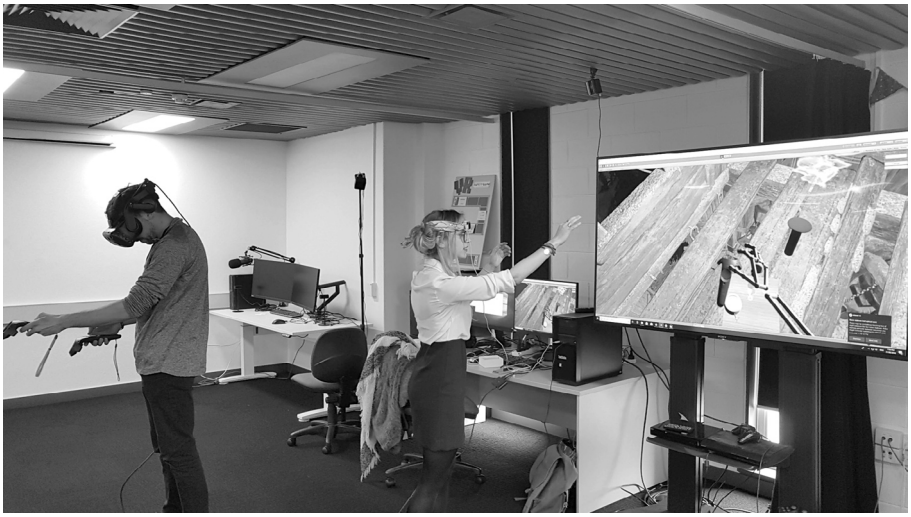

Figure 3. Shared personhood (intern project: Agathe Limouzy, Curtin University/ Toulouse University).

Another experimental project was developed by a French engineering student, who was an intern at Curtin University in Western Australia (Fig. 3). Here though the concept was to share an avatar's body between two people, how would they communicate to make the virtual body move? One person wore a

bandana with a leap controller that tracked her hands and passed that information to the screen. The other person was in a conventional HTC headset wearer, and this person could control the legs. Neither person knew what the other was looking at, and yet they had to learn to communicate to successfully move the avatar they both shared.

I'll mention a fourth example that is older than the other three. In 2010 a master's student originally from mainland China wanted to convey the intangible aspects of Taoism (via the stories of the four great arts: painting, music, Go, and calligraphy) to Western audiences. The student chose a hands-free monitor with a touchscreen (Fig. 4) and programmed four games in Adobe Flash that could track the fingertips of the player. The player's task was to draw, paint, compose or write in synch with the theme of the graphics or sound conveyed. Their relative success determined the transparency of a landscape painting that would appear when their task was finished. What most fascinated me was how entranced spectators were of those playing the games, the sense of touch used created a more empathic and memorable experience that also intrigued spectators far more than a conventional monitor and keyboard.

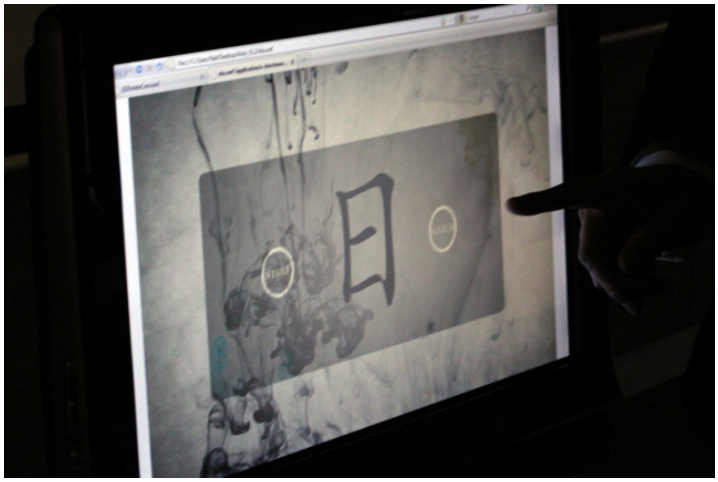

Figure 4. The Four Arts of Taoism (Li Wang, Masters project, Massey University).

In 2006 I supervised an even older and smaller project which connected biofeedback (thimbles that sat on your fingertips and detected heartbeat and GSR-Galvanic Skin Response) with Unreal Tournament and its various game mods (Champion and Dekker 2011). When a player's heart rate changes or their GSR changes, the game level design, the monsters (Zombies) the music and the game's shaders (filters) could all dynamically change as well (Fig. 5).

When the player was at peace they could see through walls, when scared or angry the zombies became more persistent.

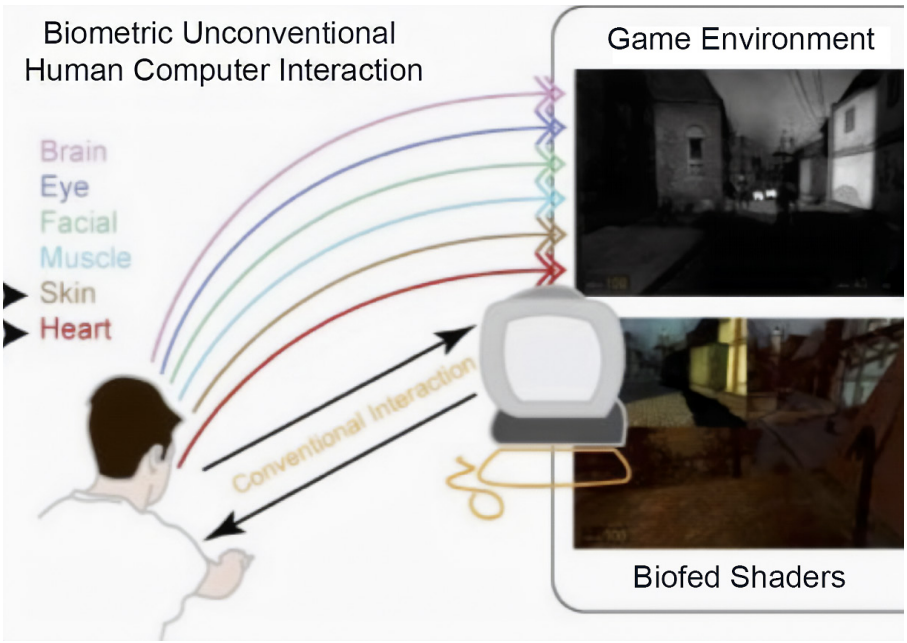

Figure 5. Biofeedback (Andrew Dekker, Honours project, University of Queensland).

5.1 Art, Aesthetics, and Virtual Architecture

What do these small experimental projects or case studies have to do with virtual architecture? They revealed to me that smaller-scale subtle interaction can still induce a sense of atmosphere, that interaction could be more subtle or more pantheistic, and that virtual reality (and XR in general) can more creatively afford, represent or otherwise constrain different viewpoints and beliefs. Game engines, advanced interfaces and sensors can more dynamically and powerfully provide personalized and reactive or calming virtual environments that are effective as processes rather than just as visual candy.

Pollution, the effects of mass tourism, age, or neglect can all be factored into the generation of the building. Visitors could roleplay different characters in a mixed reality environment, and each character might see only their view of reality and must learn to communicate or survive through teamwork.

I had also mentioned above that virtual immersion can mean a subjective (psychological) feeling of being immersed, but in what? In a game, or a virtual world per se as a world (the world of the medieval era, for example). Could it also signify immersion into a *historical* mode, or even being immersed as an

historian? I don't mean here to merely experience a simulation of a past place, but a simulation of a past place and an experiential frame where one acts and operates as a historian. Is there a playful historian's magic circle, and if so, can we communicate this to students? For example, I mentioned to a colleague that "Assassin's Creed: Odyssey" featured Vitruvius. I suggested to him that a virtual world or game could be based on Vitruvian theory and drawings and – in this virtual world – Vitruvius's slogan of commodity, firmness, and delight being the cornerstones of architecture. My colleague immediately reacted that Vitruvius' theory was archaic but he missed my point: we could experience the virtual world conceptually in a way that seems native, localized and highly situated even if the concepts and beliefs driving this past world are no longer highly valued in the present. I suggest this also relates to the importance of culturally significant presence: we can no longer be satisfied with the depiction of past models of architecture, we should aim to convey the values and meanings they contained for their people. There are of course many challenges. The cost and speed of technological change, the sheer lack of art appreciators in virtual realms of art, and questions surrounding the agency and creative vision of the "artist."

In various publications Stephen Davies (1990, 2015) argued that aesthetic theories could be considered to be function or procedure-based: the functionalist view of art is that it is art if it performs a particular function. The procedural view of art is that it is art if it has been created according to predefined rules and procedures. I won't investigate this concept further, apart from suggesting that machine learning and AI threaten to hide the steps and decisions of human designers. Given the apparent power and randomness of recent smart design aids and creative AI tools and the corresponding narrowed human agency, one wonders if the value of art is now lessened for the functionalist as well. In terms of virtual architecture, the apparent functionality is lessened because a virtual building does not need to protect us and itself from the environment. Apparent adherence to procedures is also no longer as clear, for the operations and processes are typically hidden from us.

What is apparent to me, though, is that virtual architecture experiences will become more intelligent, more aware, more personalizable, more directed towards goals, more capable of supporting rituals, and more embodied. To avoid some of the threats I mentioned above, virtual architecture will also need to accommodate more user creation, express and provide (and express) a sense of caring (for property and the environs and each other), new theories and practices of embodiment, and leverage XR's ability to convey processes and afford more experiential realism. Perhaps XR content also needs to "die" or at least fade away.

6. Conclusion

Current definitions of digital literacy are limited in terms of non-literary digital collections and 3D virtual worlds, especially for a wider audience. There are many impressive VR apps (Dutta 2021; Graham 2020) and from a digital humanities scholar's perspective, current game engines are powerful, impressive and engaging. They can import data and create impressive 3D, VR data visualisations, from drones, phones, human 3D designers or free and low-cost AI solutions. While games engage learners, the main game engines are too complex and favour designers with a strong 3D spatial sense. VR is expensive, usually, single-person, requires specialized and seldom portable equipment and MR headsets are more expensive. These constraints have restricted humanities experts and designers from creating successful immersive and meaningful worlds.

Arguably, we have not yet created multiversal and visionary virtual worlds, let alone a dominant Metaverse, but recent developments in AI, graphics, sensors, 3D media formats, enhanced portability and sheer computing power suggest the technology is advancing rapidly. What is not advancing rapidly is rich, satisfying content. And while we bind ourselves to merely advancing the power of XR, the situation will not drastically improve. Virtual reality and its relatives need better content. In terms of architecture, we need to improve our simulation of not just the world around us but also the simulation of the relationship we have to this simulated world. And we need to develop the capacity to convey this depth and sense of care to others while inside the simulated world.

Atmosphere takes time and intent, realism is not merely a simulation of the real, and Internet-based worlds should not be limited by extrapolations from either Second Life or from 19th-century philosophers.

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Virtual Dwelling: Immersiveness, Atmosphere and Spatial Presence*

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Abstract

The concept of dwelling is an integral aspect of human spatiality. In the present era, virtual and augmented reality prompt us to explore novel approaches to spatial habitation. In one instance, this entails complete immersion in an artificial milieu, whereas in the other, it involves the incorporation of new content into our experience. This raises the question of how human spatiality is reconfigured through these media. When viewed through a VR headset, also architecture dematerialises while opening up to infinite creative possibilities. It is possible to inhabit an artificial space that will (or will never) be built, experiencing not only its design vision but also its perceptual dimension.

Keywords: Dwelling; Lived Space; Atmosphere; Virtual Housing

Abstract

L'abitare è un aspetto integrante della spazialità umana. Oggigiorno la realtà virtuale e aumentata ci spingono a esplorare nuovi approcci nell'abitare lo spazio. In un caso, ciò comporta la completa immersione in un ambiente artificiale, nell'altro l'incorporazione di nuovi contenuti nella nostra esperienza. Ciò solleva la questione di come la spazialità umana venga riconfigurata attraverso questi media. Attraverso un casco VR, anche l'architettura si smaterializza, aprendo infinite possibilità creative. È possibile abitare uno spazio artificiale che

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sarà (o non sarà mai) costruito, sperimentandone non solo la visione progettuale ma anche la dimensione percettiva.

Parole chiave: Abitare; Spazio vissuto; Atmosfera; Dimore Virtuali

1. Being Immersed

Over the last fifty years, virtual spaces have multiplied out of all proportion, so much so that a great number of products involving the use of different devices with a wide variety of functions are now grouped together under this term. Undoubtedly, the global health emergency led to a growing familiarity with virtual space and, at the same time, to a heightened critical awareness of these dimensions. We have all experimented with new virtual places, so as to have the impression, even for a few minutes, that the space available to us was not confined to the walls of our own homes but could be expanded beyond them. In these circumstances, it has become even clearer how such dimensions can represent a real window on the world, a chance to recreate situations, optimise performances, and carry out activities that previously we could only perform in person.

In this perspective, it becomes evident that positioning a hyphen to separate the terms in the title of this volume, *Real Space-Virtual Space*, becomes increasingly precarious. On the other hand, that so-called real space was permeated by multiple virtualities was already clear from the arguments developed by Virilio (1980; 1984) and Baudrillard (1995). A more methodical investigation has been developed by Paul Lévy, who in *Becoming Virtual* (1995) further complicates the question. He in fact argues, following Gilles Deleuze, how much the virtual implies a constant *displacement* (Lévy 1995, 26) and the continuous reconfiguration of one's *presence*, in terms primarily of *corporeality*. The first thing to ask ourselves, in fact, is "Where are we?" when, for example on a video conference platform, we remain connected, perhaps even for several hours. The solution is not simple. The most immediate answer is limited to logging our geographical location. However, in such situations, this does not seem to adequately describe the place we actually occupy, the "Where" of our experience. In fact, through the screen, another space opens up in the image in which we immerse ourselves and which to all intents and purposes we inhabit, but without abandoning our actual physical location. This is one of the "dilemmas" that has always accompanied the experience of digital space: a sort of obligatory bilocation that negates neither one nor the other space, without affirming the existence of a third.

This becomes even more evident thanks to virtual reality (VR) devices that exacerbate this aspect through their *immersive capacity,* i.e. allowing users to be almost totally absorbed by the image, leaving only a slight trace of the physical space: once the helmet is on, I can continue to move (in limited fashion) in the

space around me, but my movements will be mirrored in the digital world generated by the headset. Given its peculiarity, this type of environmental imagery is defined by Andrea Pinotti as "an-icon" (Pinotti 2017; 2021). However, while it is true that, as Wiesing also argues, "so-called immersive imagery is not reinventing immersion" (Wiesing 2014, 142), it is also true that unlike other devices[1] virtual reality aims at an almost total degree of immersion. One could say that it is by its very nature immersive.[2]

If we genuinely treat these images as real spaces to be explored, traversed, in which we even meet other people, it is essential to ask ourselves, from a perceptual point of view, what kind of aesthetic experience they call for. Although, in fact, through this technology one is at close quarters with a display on which the digital content is exhibited in pixels, an experience is generated that no longer corresponds to simple image consciousness. In short, an-icons do not behave like the images we usually encounter. In fact, they ask us to inhabit them.

This forces one to broaden the discourse towards an analysis of spatial experience, since in many ways in the *an-icon* one is led to behave as if one were inside a real place[3] . In fact, the essential and defining distinction between VR and other forms of visual representation is that it deals directly with the immersive creation and representation of space. And this is a characteristic which makes this tool of increasing importance in certain fields, such as architecture, art or game design, all of which call for a far-reaching relationship between the experiencer and the surrounding environment. This technology makes the image an integral part of our sensory field, taking up a large part of it, to the point of almost completely overlapping with it. While there are clearly substantial differences between virtual and physical space, both must be understood as lived space (*Lebensraum*): the place where experience "happens," which acquires meaning through our acts, through our gaze and movements. VR, as an environmental image, also falls within this definition, since it realises a space *in the encounter* with the experiencer who is called upon to inhabit it, and which is *only* realised in the moment in which we do so, i.e. live it (*leben*).

1 In fact, many devices, from the oldest to the most contemporary, have sought to arouse in viewers the sensation of being surrounded by the image, evoking the idea of an "elsewhere" (Grau 2004). These include both analogue images and digital environments explicitly designed to elicit that kind of sensation, such as panoramas or the more recent *Caves*, but also media that are not explicitly immersive but can be considered as such, e.g. television.

2 On the topic of immersion and media see: Liptay and Dogramaci 2016; Lombard et al. 2015; Slater 2018. For a brief research framework on the issues of immersivity and presence see: Calleja 2011, 17-35.

3 From this point of view, the phenomenological perspective can offer a tool to address the essence of the experience of spatiality, bringing out some useful structures to describe virtual space. Specifically, this question – whether and how one can actually talk about the experience of space in VR – was developed in Bandi 2023.

2. Being Virtually Attuned

This idea, is in my view, intimately connected to that of inhabiting. To inhabit a place means first of all to consider what that place leaves us with and how that place makes us feel. In other words, it means being able to grasp what many scholars have defined as the atmosphere of a space. At the heart of this body of theory is the notion of *Stimmung* (mood), that is, what creates the experience of atmosphere in all its ambivalence: it exists as a relationship between subject and object, without belonging to either, as Simmel pointed out in his famous essay on landscape (Simmel 1913). What the philosopher describes in relation to perception is not limited to physical space, or rather, it can not simply be reduced to this. The landscape is in fact framed by the individual who endows it with a particular emotional connotation. The issue here is the human being's ability to resonate with the surrounding environment, highlighting the complex interaction between bodily modalities and context: atmospheres are actually a matter of music, as we can see from the verb *stimmen*, which means "to be tuned." Hence expressions such as "emotional tonality," "intonation," "tuning" and other related terms. In fact, we experience this on a daily basis: the moment we cross the threshold of an environment, we immediately perceive something indefinable that characterises it. Think, for example, of how the feeling of a room can vary according to the colour of the paint on the walls, the materials chosen for the furnishings or the use of light: an environment can be warm and welcoming, or gloomy, unwelcoming, and so on. According to Griffero – who picks up the threads from the thought of one of the fathers of atmospherology, Hermann Schmitz – atmospheres can be defined as "spatialised feelings," that is, what defines the specific emotional quality of a given lived space (Griffero 2010, 36). Naturally, from this perspective, sensory experience calls necessarily for the presence of corporeality, the *sounding board* of the atmospheric qualities of the environment:

> We sense what kind of a space surrounds us. We sense its atmosphere. This has consequences for the perception of architecture: if it is true that architecture creates spaces, then to evaluate them one must go inside these spaces. One has to be bodily present. Of course, one will then also consider the buildings and their structures, judging their scale and content, but to do so one needs not be present. (Böhme 2017, 74)

In light of the preceding considerations, it seems appropriate to enquire whether it is likewise reasonable to conceptualise the notion of an atmosphere in virtual worlds, and more specifically in those that afford a high degree of immersion. This question has been the object of debate in the field of game studies for a number of years. Felix Zimmermann (2022) edited, together with other scholars, a volume laying the foundations for an atmospherology in digital

games. He analysed, among others, some reviews of *Assassin's Creed Syndicate* (2015), the video game set in London during the Industrial Revolution, and showed how the word "atmosphere" appears repeatedly in the thousands of reviews left by users:

> [...] these few comments paint a vivid picture of a term that is used regularly, nonchalantly and - as it seems - without needing any further explanation. This colloquial use of the term and the seeming omnipresence of conversations about atmospheres - think about commentators lamenting the lack of atmosphere in football stadiums emptied by pandemic restrictions - has given atmospheres their reputation of being "mere linguistic phenomena" or "a mere metaphorical way of speaking. (Zimmermann 2022, 244)

Therefore, even in the context of video games, where the degree of immersiveness may vary depending on the device utilized[4], scenarios are capable of conveying an atmosphere effectively. This is particularly the case in virtual reality, where users experience a greater degree of bodily involvement, resulting in the digital world acquiring different emotional tones that aim to convey the qualitative fullness of an experienced space.

It is evident that VR is not merely a technology that provides a means of visual representation. Indeed, it affords the user the opportunity to engage with the image, to select a particular point of view and, in many cases, to navigate within the environment, in a manner that is analogous to being in a physical location. Furthermore, a variety of sensory experiences are involved, with vision being the primary sense, but hearing also plays a significant role. Indeed, there are some VR experiences that are specifically designed to facilitate this kind of engagement. For example, *Notes on Blindness: Into the Darkness* (Arte, 2016) brings a different kinaesthetic capacity into play, within an artificial space that is visualised little by little, and never completely. The work, based on the audio diary of the writer John Hull, who became blind in 1983, in fact proposes the paradoxical experience of translating blindness into images. To do so, the virtual space acquires depth from sounds. The narrative is divided into chapters; the first of these begins in the dark with the sounds of footsteps, a rustling of newspaper pages, a swoosh of birds, a child's crying. These are heard and rendered into an image as evanescent, luminous objects: starting from the darkness that surrounds the user completely, they gradually begin to appear, until, placing

4 Various devices, from the oldest to the most contemporary, have sought to elicit in viewers the sensation of being surrounded and elsewhere (Grau 2004). These devices include both images or environments explicitly designed for that kind of sensation, such as panoramas or the more recent *Caves*, and media that are not explicitly immersive but can be considered as such in an indirect way, such as television. However, if one can speak of degrees of immersion, virtual reality aims at a total immersion of the user – at least visually – that makes it distinct from other media. In other words, unlike other images, virtual reality is constitutively immersive.

themselves at different points in the scenario, they slowly form a multi-layered map. This experience allows us to observe in retrospect the progressive transition between the perception of a simple digital image and the creation of a real space in which we gradually gain a sense of immersion. In such instances, it becomes clear that VR cannot be reduced to the mere presentation of content, as the various applications aim not only at the elaboration and enjoyment of possible scenarios – e.g. the exact shape of a building, the precise size of a room, etc. – but much more.

In addition to auditory perception, the haptic and tactile dimensions are also to some extent recreated. Sometimes this occurs through feedback from the controllers (in experiences involving their use), and at other times it is achieved by utilising the eye as a conduit for alternative stimuli. In the same way, the tactile aspect of vision is a phenomenon that occurs in everyday perception (for instance, we can anticipate the softness of a fabric simply by looking at it or perceive the temperature of a material based on its visual appearance) but this capacity is particularly challenged in immersive environments, where vision must compensate for the limitations of other senses.

The mere fact that these circumstances are, so to speak, capable of reconfiguring the ways in which one interfaces with the world is, however, still not sufficient to speak of atmospheres. While there may be differences of opinion among scholars regarding the specifics of this concept, there is a consensus that *Stimmung* is generated through a sensible exchange between the subject and the environment, as previously stated. If the relationship with the environment can only be multisensory – as Merleau-Ponty held – the inseparable interweaving of sensory channels finds its meaning, not only ideal, in corporeality. If, therefore, it seems almost obvious that in the concrete world, *physical presence* is a necessary condition for the perception of atmospheres (as Böhme's assertion above affirms), in the virtual world this raises a thorny question. The reconfiguration of our bodily mobility and proprioception, which the virtual reality headset imposes, entails a distinctive mode of spatial habitation.

Rather than accepting the impossibility of establishing an analogy between physical and virtual atmospheres in the absence of a tangible bodily counterpart, as evidenced in the perception of the concrete world, I propose reformulating the question in a different manner. In such digital simulations, the atmosphere is experienced as a "spatialised feeling," which encounters another kind of feeling, namely "spatial presence" (Schubert 2009). This issue has been the subject of long-standing debate in discussion of immersive environments. It is in the interplay between these two concepts that I believe we can identify a promising avenue for describing the aesthetic experience of virtual reality space.

There are several theoretical models of this issue, but they are largely in agreement that spatial presence is determined by the cognitive awareness of the space within a virtual space. More precisely, the process is described by

Schubert in two stages. Initially, the user constructs a mental model of the simulated space. Subsequently, she/he accepts this spatial situation as a primary egocentric frame of reference (Schubert 2009). These steps are both regarded as unconscious processes. However, the actual issue lies in the transition from an unconscious state to a state of awareness, which then allows for action and interaction with both objects and the environment. To bridge this gap Schubert proposes to define this *being there* (Minsky 1980) as a cognitive sensation: "A feedback of unconscious process of spatial perception that tries to locate the human body in relation to its environment" (Schubert 2009, 170).

These feelings – the spatialised feeling of atmosphere and spatial presence as a cognitive feeling – are, despite their different natures, inextricably linked. If I were to attempt to articulate the sensation of being present in a virtual reality environment, I would posit that we feel present to the extent that we perceive and engage with the qualities of our surrounding space. Similarly, the experience of physical space cannot be reduced to a mere state of "being." This same phenomenon occurs in the context of immersive environments. In these scenarios, therefore, we position ourselves emotionally, thereby playing out our role as human beings within the world. Consequently, virtual environments can be considered as spaces with which we relate and which evoke genuine *moods*. One might consider, for example, the case of a funeral service taking place within a virtual world or the much-discussed incident of sexual assault that occurred this year within a metaverse (Conte 2024). Such events evoke a more direct and authentic emotional involvement on the part of the users, who are not merely pretending to experience distress, but are genuinely affected. Likewise, the virtual space, in its formal and aesthetic structure, does not have a neutral connotation; rather, it elicits a certain affective response, which may be more or less explicit and evident. To give one example, the environments traversed in the escape room *Alice VR* (ARVI Lab, 2021) evoke the dreamlike and vaguely unsettling quality portrayed in Carroll's novel. Similarly, in *Remember This Place* (Liras, 2023), an experience that straddles documentary and fiction, the landscapes traversed convey not only the fragility of life in Palestine but also the aridity of the climate and the oppressive atmosphere of temporary housing.

3. Virtual Housing

Given that inhabiting a place entails the ability to perceive its atmosphere, it is intriguing to highlight the original connotation of the term, which directly relates to the concept of habitation. As Bachelard (1957) recalled, the life of the human being begins in the womb of the home, which is a privileged place where the act of dwelling commences. The meaning of this act is defined by the *con-fused* relationship established between the body of the individual and the

dwelling[5]. In light of the increasing prevalence of diverse housing solutions in online realms, it seems pertinent to examine the interrelationship between the concept of home and virtual spaces, with a particular focus on recent cases.

The first is *VR Alcove*[6], an application developed by AARP Innovation Labs in 2020, which enables users to experience a virtual environment resembling an ordinary house. Indeed, this software replicates a real home in a virtual domicile designed so that family members residing in disparate locations can come together and engage in the exchange of experiences and content. It is evident that the interiors can be tailored to suit individual preferences, and a wide range of activities, including yoga and chess, can be undertaken in the dwelling's living room. Despite its inception during the pandemic, a period when direct contact was arguably more crucial, it is noteworthy that this experience (as evidenced by the testimonials on the company's website) fostered closer engagement with the device particularly among older people. Furthermore, the application was presented as the inaugural "Social App for Families" (Alcove VR, n.d.), thereby explicitly indicating that it was designed not only to allow users to spend time together with others, but also to employ the VR headset to recreate and delineate a home as a safe place to meet with loved ones.

The second case study, which is of a completely different nature, concerns Krista Kim's entirely virtual home, her 2020 *Mars House* (Fig. 1).

The artist launched the project as a meditative design space, in which to rediscover psycho-physical well-being through the practice of meditation. While this is not the first instance of an online property sale[7], the financial value of this transaction – the purchase raised the exorbitant sum of USD 500,000, the first ever sale of an NFT file on SuperRare (see Notaro 2022; Parker 2021) – is a notable aspect that merits attention. It may be considered an investment, analogous to the purchase of other virtual works, or alternatively, a harbinger of a more far-reaching trend. In light of this case, it is pertinent to question whether such a striking sale should be compared to the purchase of a physical property where one actually takes up residence. It is therefore legitimate to enquire whether it is feasible to inhabit a virtual house and establish the intricate

5 This idea became central for Otto Friedrich Bollnow, who in *Mensch und Raum* (1963) describes the phenomenology of this habitat, a reflection largely inspired by the thought of Heidegger and Merleau-Ponty. The latter, in particular, made great strides with his phenomenology of corporeality, which emphasises the role of the human body in the experience and understanding of space. His ideas ushered in a new way of thinking about housing (also fundamental to many architects of later generations), which considers the bodily, sensory and perceptual dimensions of inhabiting a space. Cf. Merleau-Ponty 1945.

6 VR ALCOVE. https://www.meta.com/it-it/experiences/alcove/3895528293794893/?srsltid=AfmBOoohglPtO412LE7RpTs5FMtEQ6uwnJrXCf4iXWRpJJPPi_cPAX0z

7 The phenomenon has a number of predecessors. One thinks, for example, of the thousands of plots of digital land purchased in one of the first successful digital worlds, *Second Life,* founded by Philip Rosedale in the early 2000s.

spatial and emotional bond that should be forged with one's surrounding environment, although in a digital domain. A similar issue arises in other cases, albeit in a different form. For example, the *Aurora project* (2022)[8], a complex of nine luxury residences designed by the German NFT consulting studio Shift/Space, represents the inaugural undertaking by a genuine architectural firm in the Sandbox metaverse. Moreover, in virtual environments, digital twins representing identical copies of existing physical structures are also found widely/commonly found. A notable example is the sale in 2023 of the Sierra Mansion, a villa spanning over 1,000 square metres in Miami. It was conducted by ONE Sotheby's International Realty in collaboration with NFT collector Gabe Serra. The transaction, which exceeded eleven million dollars, was the first of its kind, as the physical building was not the only item sold; its digital twin was also purchased. This identical digital property, created by Voxel Architects, was located in The Sandbox and made the construction of the first "MetaReal" mansion (Casillo et al., 2022).

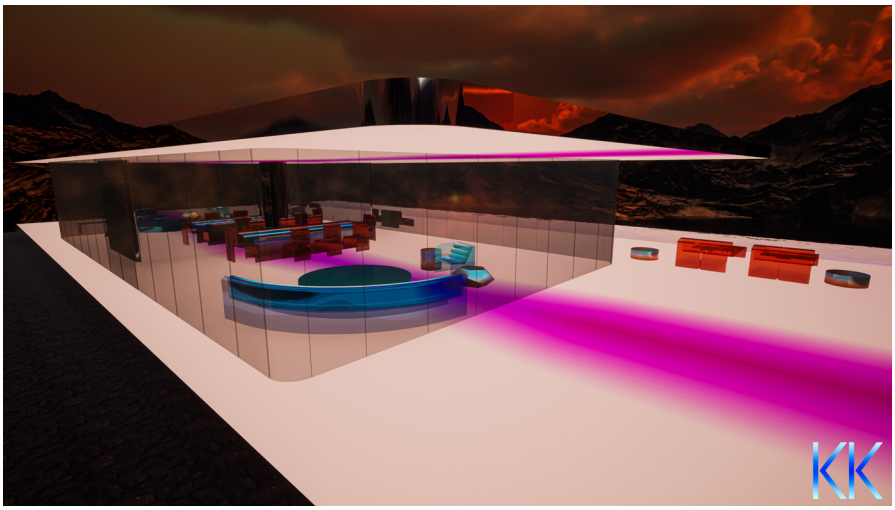

Figure 1. Krista Kim, *Mars House* (2020). Courtesy the Artist.

The issue may seem rhetoric, but there are some scholars, such as Jaron Lanier and Frank Biocca (1992), who have argued that a house constructed in a computer-generated environment is not merely a representation, but a genuine residence. This perspective posits that a place can be considered a home simply because it is shared with someone, albeit artificially:

8 See the detail of the project in Shift/Space Studio Brings Out Metaverse Residences to The Sandbox with Project Aurora: https://medium.com/sandbox-game/shift-space-studio-brings-out-metaverse-residences-to-the-sandbox-with-project-aurora-e87a60937bbb

> If you make a house in virtual reality, and there's another person there in the virtual space with you, you have not created a symbol for a house or a code for a house. You've actually made a house. It's that direct creation of reality; that's what I call post-symbolic communication. That's just a huge uncharted territory. (Lanier, Biocca 1992, 161)

This affirmation serves to exemplify a broader concept that is closely aligned with the notion of *virtual realism*[9]. Proponents of this concept assert that virtual objects and environments are, in fact, real. However, the fact that the two scholars selected the house as their object of study is particularly noteworthy. The variety of objects that can be encountered inside digital worlds is vast. However, if we consider the home in its affective and experiential complexity, it is evident that the experience of one's own home cannot be compared to that of dwellings in the various metaverses. Indeed, if we accept Lanier's argument that the creation of a virtual house is tantamount to the construction of a physical one, then it follows that the experience of inhabiting such a space should be equally authentic. It would be reasonable to expect that one would feel a similar sense of connection to these virtual environments as one would to their physical counterparts. However, the connection one forms with one's own abode is a multifaceted phenomenon that, as Bollnow affirms, is contingent upon the body-home relationship. One can even speak of *embodiment*, a concept that extends beyond that of mere extension or identification.

Indeed, it is from our nest that we first learn to know the world, and then, in a process that may be likened to that of a Russian Doll, gradually move further and further away to form our own personal topology. So, the relationship between the human being and their home can be described as *prosthetic*, to the extent that the violation of this space can be experienced as a violation of the self. Moreover, this is not a one-way connection. This is not a matter of how an individual affects and constitutes their private space. The home also exerts a profound influence on one's existence, particularly with regard to one's aesthetic relationship with one's surroundings. Indeed, this influence is such that an individual would not exist in the same way in a different location.

From this brief discussion, it can be discerned that there is a fundamental distinction between inhabiting one's own home and experiencing a digital living space. The two experiences cannot be considered equivalent. Nevertheless, the statement by Lanier can be interpreted in a way that emphasises the collective dimension of experiences associated with the concept of "home." This perspective is supported by the examples previously discussed. In particular, *VR Alcove* was conceived with this objective, but the 'residential' projects in the

9 David Chalmers' position, referred to as 'virtual digitalism', is noted; according to this, virtual objects are real in that they are digital, since they exist as data and computational processes. See Chalmers 2017, 309-52.

various metaverses can also be interpreted in this way: they create alternative spaces for sharing with others. This vision is consistent with the broader concept of virtual reality that Lanier has espoused in more recent times. Indeed, he characterised this medium as a "shared, waking state, intentional, communicative, collaborative dream" (Lanier 2017, 534) and as an "arbitrary experience, shared with other people, conversationally, under our control" (Lanier 2017, 89). In conclusion, he affirms that VR should not offer a solipsistic experience, but rather one that is shared and capable of evoking a sense of community. This position, with appropriate distinctions, can also be extended to virtual environments that are not fully immersive, such as the various virtual worlds created in online video games, in which the collective dimension is a crucial element.

4. Conclusion

In conclusion, virtual dwelling can result in the generation of novel forms of experience which, in certain respects, can be interpreted in a manner analogous to the experiences of places encountered in the tangible world. The case of atmospheres provides an illustrative example of this phenomenon. Despite the lack of bodily presence in VR worlds, the environmental dimensions acquired by an- icons render them capable of eliciting an emotional response from users, which is shaped by the interaction between them and the computer-generated landscape. The sense of presence that VR requires must also be understood as the potential for individuals to connect with their surrounding space on multiple levels. This includes the capacity to perform actions within the space and to receive information from the surrounding environment, albeit in a sensory modality that differs from physical reality. However, the concept of "dwelling" must be reframed in the context of these virtual spaces, as it is inevitably lost in the transition from its original meaning to a new context. That said, the example of the Mars House, along with other virtual dwellings, illustrates how these spaces can become significant locations for social interaction, where the dimension of community and sharing assumes a central role. This, therefore, suggests that the concept of home can also be extended to digital environments. Finally, through these diverse forms of media, individuals are granted the opportunity to reimagine and reinterpret the contemporary concept of dwelling. This term is not only amplified but also multiplied across various platforms, thereby facilitating and encouraging innovative forms of aesthetic experimentation. As a result, new and diverse approaches to understanding and experiencing living spaces emerge, pushing the boundaries of traditional notions and fostering a richer dialogue between aesthetics and media studies.

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Digital Tools in Architectural History and Identity of Virtual Space. Research and Teaching Experiences for the Enhancement of Cultural Heritage*

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Abstract

How can digital tools relate to the history of architecture, and what identities can virtual spaces have in respect of the monuments of the past? Recently, digital approaches have been applied in many different areas of the humanities, leading to the emergence of a major new cross-disciplinary field that brings together disparate. The digital approach is a common denominator in specialised research and teaching as well as in archival practices, dissemination and publishing. This paper aims to outline a panorama of current research issues, challenges and practices between Digital Humanities and Digital Cultural Heritage, and to present some case studies addressed in the DAda and PLAY Lab at the University of Pavia.

Keywords: Digital Humanities; Virtual Heritage; History of Architecture; Virtual Reconstruction

* This contribution is the collaborative effort of the authors. For the final draft, sections 2 and 3 were contributed by Massimiliano Savorra, section 4 by Silvia La Placa, and the introduction and conclusions were co-authored by both. Silvia La Placa also undertook the editing of the English translation and iconographic elements.

Abstract

Come possono gli strumenti digitali rapportarsi alla storia dell'architettura e quali identità possono avere gli spazi virtuali rispetto ai monumenti del passato? Recentemente, gli approcci digitali sono stati applicati in molte aree diverse delle scienze umane, facendo emergere un nuovo importante campo interdisciplinare che riunisce competenze disparate. L'approccio digitale è un denominatore comune nella ricerca specialistica e nell'insegnamento, così come nelle pratiche archivistiche, nella divulgazione e nella pubblicazione. Questo articolo si propone di delineare un panorama delle attuali problematiche, sfide e pratiche di ricerca tra Digital Humanities e Digital Cultural Heritage, e di presentare alcuni casi di studio affrontati nel DAda and PLAY Lab dell'Università di Pavia.

Parole chiave: Digital Humanities; Patrimonio Virtuale; Storia dell'architettura; Ricostruzione virtuale

1. Introduction

This paper aims to explore the relationship between the use of digital tools and the history of architecture, and to examine the identities that virtual spaces can have in comparison with historical monuments. There are many different ways digital tools can be employed, therefore the first step in our methodology was to summarize, through the analysis of some realized projects, those we consider the most effective in our field.

Recently, digital applications in various sectors of the humanities have led to the creation of a major new cross-sector area which brings together disparate expertise and necessitates interdisciplinary cooperation (Gold 2012; Weller 2013). In this process, the digital approach should be viewed as a common denominator in specialized research and teaching, as well as in archival practices, dissemination and publishing. Digitization was just the first transformation brought about by the use of technology. In the following years online resources, open-access collections, and publications grew exponentially. As a result, historians suddenly gained access to vast amounts of new data – records, images, and information – from archives and collections around the world. In academia, digital history has created new opportunities for teaching and learning. Digital history can provide students with access to historical documents and texts as demonstrated by projects developed at the turn of the century by various universities (*Burdick 2012)*. Meanwhile, pioneering lab models such as the Stanford Humanities Lab developed by Jeffrey Schnapp, who now leads the Harvard MetaLab, have spawned research centres that integrate digital technologies into

humanities research[1]. These developments have significant implications, particularly given the changing cognitive methods of digital natives. New "digital historical products" could give rise to long-lasting effects, including impacting the meaning of history in society (Chapman 2016). The innovative use of digital approaches in history could make documentary research and information highly accessible, with an enormous impact on society, potentially leading to a significant increase in public knowledge of historical data (Quintero 2007). From a historical perspective, Digital Heritage and Digital Humanities approach different aspects of heritage. The former focuses on tangible and intangible cultural heritage objects and their preservation, education and research, while the latter focuses on the application of digital technologies to support research in the humanities (Bellotti 2013; Classen 2012).

2. The Methodologies and Questions

The history of architecture is a discipline that straddles the humanities and the technical sciences related to the field of building construction. Based on this premise, this paper aims to outline an overview of current research topics, challenges and practices at the intersection of Digital Humanities and Digital Cultural Heritage. Our research methodology is guided by fundamental questions: How are digital humanities and architectural history contributing to cultural heritage research? What are the objects, topics, concepts and research methodologies of Digital Humanities and Cultural Heritage?

The data characterizing digital humanities include texts, images, and objects. The use of digital methods in text-oriented disciplines is currently well established and standardized (Münster 2019). In contrast, the field of digital methods related to images and other visual objects (or based on vision rather than close reading) remains – despite various attempts – largely unexplored. Possible reasons for this situation include the "different nature of the methods used" in disciplines focusing on these types of artefacts, such as art and architectural history, cultural heritage studies, or museology, as well as the varying levels of establishment of digital research methodologies in these disciplines. Based on these premises, this research attempts to classify and put forward five different and effective ways of using digital tools in architectural history: A. The first method consists in digitalising historical documents, drawings, and ancient texts; B. The second method centres on the analysis of drawings as documents that can reveal unpublished aspects and new interpretations; C. The third method entails studying and verifying historical hypotheses, and then make them known; D. The fourth method consists in applying virtualization to real buildings, such as those with degraded elements, by securing the original

1 https://mlml.io/

element and replacing it with a virtual replica; E. The last method concerns the forms of communication and dissemination of scientific studies, including processes of critical analysis and interpretation of historical-architectural facts or documents.

To analyse these five methods, some exemplary cases were studied. *The Digital Serlio project*, curated by the Avery Library and Francesco Benelli, is an appropriate example illustrating mode A. Digital Serlio provides access to the holdings of Columbia University and its Avery Library in a digital and user-friendly format[2]. The project directly links current research on Serlio's works with digital acquisitions of the works themselves. The method involves the use of visual, textual and material analysis processes based on high-resolution digital images. This structuring allows for a re-examination of Avery's corpus of Serlio to address questions about 16th century domestic architecture and Serlio's socio-economic model for early modern European town planning. Project outputs include a web page that collects digital versions of all existing manuscripts by Sebastiano Serlio. The page clearly indicates the holding institution and provides links to external sites maintained by each repository. The project also provides online access to new research on various topics, such as the materiality of manuscript paper and the definition of national typologies of domestic architecture. These are accessible in the form of essays contributed by international scholars, along with Avery's entire collection of published editions of Serlio's complete works.

In recent years, digitalisation has allowed us to see what was previously invisible to the naked eye. The virtual exhibition, organized a few years ago by Costanza Caraffa and Mauro Mussolin with the photo library of the Kunsthistorische Institut in Florenz [3], is an effective example of method B. The exhibition aims to reveal some of Michelangelo's drawings that are difficult to observe in photography or even with the naked eye, highlighting the artist's extraordinary ability to prefigure shapes before tracing them on paper. These almost imperceptible signs are imprinted on the paper, capturing gestures and transformations as if recorded. Some drawings by Michelangelo in the *Casa Buonarroti Museum* continue to raise questions for scholars (Mussolin 2012). The recognition of sketched figures is only partially possible: subsequent erasures, stratifications, or even the reuse of the sheets as writing paper by Michelangelo himself, have made it challenging. Paola Barocchi, in the 1964 catalogue, defined part of this collection as "indecipherable sketches." Through digital photography and the related technical reconstruction possibilities, lines and shapes that are barely perceptible to the naked eye can be made visible. Raking light,

2 In particular, the project focuses on Benelli's research on Sebastiano Serlio's works, including those published in multiple editions, and the manuscript of his unpublished masterpiece, *On Domestic Architecture*. For further details see https://library.columbia.edu/libraries/avery/digitalserlio.html.

3 https://www.khi.fi.it/it/aktuelles/ausstellungen/2014-11-visualisierung-des-unsichtbaren.php.

backlighting, or ultraviolet light reveals hidden signs. By further manipulating the image contrasts or digitally extracting successive layers, previously unknown conceptual ideas can be brought to light leading to new interpretations of Michelangelo's work.

The methodologies employed by Digital Humanities have introduced radical changes in the enjoyment of cultural heritage. At the same time, the use of digital and new media has profoundly changed historical research, which underpins the knowledge and understanding of cultural heritage (Svensson 2015; Sullivan 2016). The most obvious effect is a kind of "public use" of history. Method C concerns the new possibilities offered by virtualisation processes to study incomplete, deteriorated or demolished architectural structures, such as unfinished church façades or lost monuments and cities, such as the temples of Nubia in Egypt. For example, archaeologists often use virtual reality to "restore" (recreate and study) lost cities and environments (*Bawaya 2010;* Tamborrino 2016). As for unfinished façades, the case of the façade of the church of San Lorenzo in Florence is illustrative (Ferretti, Savorra 2015). The incompleteness of the façade has led many architects to attempt completion projects over the centuries, including Michelangelo, who made detailed drawings, studying the materials, and paying particular attention to the use, cutting, and arrangement of marbles. A wooden model of his design was also created. Digital reconstruction has allowed speculation on the façade conceived by Michelangelo. The outcomes of digital history are more accessible for the purposes of preservation and, at the same time, to the general public interested in cultural heritage. Cultural information becomes more comprehensible by linking data within spatio-temporal frameworks. Digital re-processing was thus used to study how the façade might have been realised. Projections were made on the façade with video mapping to disseminate the research results. The use of space and time creates an immediate user orientation that successfully influences the enjoyment of heritage sites. The digital approach also enhances full appreciation by activating user participation. However, the connection between historical information and its fruition is not as straightforward as the spatio-temporal link in historical approaches. Certain prerequisites must be met, which will be discussed below.

3. Methods and Tools

In the case of architectural or decorative elements which have deteriorated over time, a common practice is to replace the original element with a copy made from digital acquisitions (Balletti 2019). This approach has the dual benefit of preserving the overall image of the building and safeguarding the original element. This method, referred to as Scenario D, is increasingly applied and, recently – in parallel with rapid technological development – has been associated

with phases of experimentation and historical research for representing the investigated element across different temporal phases. An example is the project concerning the church of San Michele in Pavia[4]. Documentation and surveying with digital instruments enabled the creation of a metrically accurate redrawing of the church's exterior decorations. These were then redrawn in vector graphics with a high level of detail to facilitate upcoming restoration operations. The analysis revealed significant degradation of the façade stones, caused by incorrect restorative treatments over the years that drastically accelerated the stone erosion process.

Figure 1. Digitization process of the tile of Saint Giorgio and the Dragon of San Michele Church, Pavia, 2022, DAda-LAB, DICAr, University of Pavia. Above: integrated survey methodology of St. Michael's Church; middle: detail of photogrammetric models of the facade; bottom: digital and 3D-printed reconstruction of the tile of St. George and the Dragon. Project managers: Prof. Sandro Parrinello, Prof. Marco Morandotti. Research team: Prof. Francesca Picchio, PhD. Silvia La Placa, PhD Student Elisabetta Doria, Research Fellow Hangjun Fu, Research Fellow Alessia Miceli, Intern Alberto Pettineo. Image processing: Silvia La Placa.

4 The project, for which Marco Morandotti is the scientific director and Sandro Parrinello is the coordinator, concerns the analysis of the façade and external elevations of the church, aimed at developing architectural, material and structural reflections and analyses. The project, started in 2020 and still ongoing, is conducted by researchers of the DAda-LAB and PLAY laboratories of the DICAr of the University of Pavia and with Francesca Picchio currently as scientific coordinator.

As part of the larger research project, an experiment was conducted on a single decorative element: PhD students, scholarship holders and the DAdaLAB researchers digitally reconstructed the damaged tile depicting St. George through digital sculpting (Doria 2023). They used a digital duplicate of the actual tile, acquired via a structured light laser scanner survey. The digital copy was then modified based on historical archive drawings and photographs that depicted the tile in its original condition. Finally, as an additional experiment, the digital duplicates (both the current condition and the original status) were 3D printed at a scale of 1:5. Printing was done both with the classic PLA filament method[5] and in concrete, using a cast, to reproduce the material of the original stone as faithfully as possible (Fig. 1).

The final method, Scenario E, concerns the forms of communication and dissemination of scientific studies, focusing on the processes of critical analysis and interpretation of historical-architectural facts or documents. This mode raises several questions that research and literature have attempted to answer over the years. What kind of relationship or interaction can cultural heritage have with digital space today? Here, cultural heritage refers to a set of historical, artistic, and architectural assets. These questions are challenging to answer, especially given the rapid evolution of digital technology and the consequent swift changes in the perception of environments, architectural structures and memories affected by it. A few years ago, William Mitchell, in *City of bits* described an immaterial condition of cultural heritage (Mitchell 1995). According to him, the diminishing importance of physical heritage is leading to a dramatic increase in access to a multiplicity of knowledge tools. Today, over twenty years later, the windows onto the world of immaterial communication now map a global network that overlaps with the physical landscape of objects. A distant reading replaces consulting books, studying documents, contemplating works of art, or the study of architectural structures that were designed or merely imagined. It is therefore pertinent to discuss the implications of this radical shift: moving from a focus on documents to a focus on images to be consumed.

This mode of consumption seems to lead to addiction. However, there is no need to be apocalyptic a priori. Quoting Sergio Solmi, when "crazy explorations of future worlds," a "chain explosion" of fantastic discharges between the ingenious and the childish, influence human lives, it indicates a state of crisis. In his *Divagazioni sulla science-fiction* [Digressions on science fiction], Solmi explained these symptoms as reflecting "the individual's unsuitability to the terms of destiny, and societies to their determined historical configuration and their ordinary ways of development" (Solmi 1978, 47). These observations still serve as a warning against using the "fantastic" as something for more than mere

5 A low-cost Creality Ender-3 FDM2 type printer was used to produce the model, using a white PLA (polylactic acid) filament. The FDM method is based on a nozzle that deposits a molten polymer layer by layer to create the geometry of the part.

entertainment. It is urgent to investigate the limits and conditions of applying immaterial communication: both for creating popular entertainment processes and, more importantly, for organizing and managing stratified databases of the past. These include libraries, documentary archives, and archives of artists or architects, which collect the heritage of our past.

Today, these reflections should be revisited and reframed, focusing on the most interesting aspect, linked to the current use of the dematerialisation of interventions on architectural heritage, as an act of "reduction" (De Fusco 1976). Among the many examples, immersive virtual environments accessible through Oculus headsets and the artistic expressions of video mapping are notable. The latter are fundamental not only as creative acts but also as tools for understanding the past. For example, video mapping can be used to understand the history of built architectural structures and to show unfinished projects or places that no longer exist due to their destruction. One example is the performance that took place in Florence[6], where Michelangelo's projects were projected onto the unfinished facade of the church, to explain the artist's intentions to the general public. This performance illustrated what the facade might have looked like if completed and possibly emphasized the significance of leaving it unfinished.

4. Teaching and Research Applications

The Department of Civil Engineering and Architecture at the University of Pavia has a Drawing Archive that brings together various collections, which have never been sorted and are even distributed within university spaces without a specific known location. Since January 2023, a process of collecting, counting, and analysing different types of architectural drawings and documents has begun, to consolidate them into a single physical space[7]. To date, more than two thousand drawings have been counted, and the process is ongoing. The collection space is insufficient, given its size, current equipment, and furnishings, to conserve and simultaneously make usable larger papers as well as older and more fragile ones. To safeguard the memory of these works, it was decided to create a virtual space in parallel with the physical one.

This digital container is intended to bring together different types of data, allowing researchers to virtually navigate between the author, the work, the architectural typologies connected to it, the references, and more. In the digital space, it becomes possible to establish immediate connections between

6 https://www.ultraprime.net/project/la-facciata-di-michelangelo-costruita-con-le-luce/.

7 The activities of collecting the documents in a single space were coordinated by Prof. Massimiliano Savorra. The current temporary physical space of the DICAr Drawings Archive is a room located within the Library of Science and Technology of the University of Pavia. The possibility of using and setting up the room is due to a collaboration with the Director of the Library, Dr. Anna Bendiscioli, and the Technical Office of the University of Pavia.

different works, facilitating the development of new interpretations and the deepening of established knowledge.

The initiation of this digital construction involved a comparison with the five methods described in the previous section. To determine the most suitable method for describing the contents of the Drawing Archive, a teaching and applied research path was started. The experiments focused on the relationship, in the digital age, between the researcher, the history of architecture and representation, and heritage, whether existing or now missing without trace. Due to the vast number of catalogued drawings, only one collection was selected for research: that of architect Sebastiano Giuseppe Locati (Fig. 2).

Locati gained prominence in the late 19th and early 20th centuries and was appointed professor at the University of Pavia in 1899. At Pavia, he taught ornamentation and architecture, architectural composition and practical architecture (Di Marco 2005). Among his many architectural works, he designed and realised the setting up the 1906 Milan International Exhibition in Parco Sempione. The exhibition, dedicated to the opening of the new Sempione railway tunnel, was a temporary event. This aspect makes it a particularly suitable case study for our purposes. The pavilions, architectural structures and infrastructures built for the Exhibition were all demolished at its conclusion[8].

An experiment combining didactics and research was thus initiated, involving students from the History of Architecture Laboratory 1 (academic year 2022/23). The theme for the academic year concerned analysing the possibilities offered by virtually reconstructing environments and places from the past that no longer exist, have been damaged or were designed but never built. Activities were conducted in the utopian workshop "LaBUR / Laboratory Built, Unbuilt, Rebuilt," which examined architectural structures which were ephemeral, destroyed or solely designed for competitions. The aim was to understand the importance of virtual reconstruction for exceptional architectural structures. Among these, the 1906 Milan International Exhibition was examined. Following a methodological process "from the archive to the model", three-dimensional models of the demolished pavilions were created based on the original graphic design drawings[9].

Widely used in ex-ante design and architectural surveys, 3D models are powerful tools for studying and understanding historical sites and buildings, as they

8 Only the Aquarium building, designed by Locati, remains of the 1906 Milan Exhibition, and is still visible in Parco Sempione in Milan.

9 Coordinated by Massimiliano Savorra, Silvia La Placa and Paola Barazzoni, the process of research, historical documentation and reworking with two-dimensional graphic renderings and 3D models, told through the creation of exhibition panels, was the subject of an exhibition in the second edition of the Pavia Digiweek international event. The exhibition, promoted by the University of Pavia, was open from 26 September 2023 to 5 October 2023, in the spaces of the Department.

allow for deeper, richer and more controlled interaction with places and spaces. Historical research can thus be represented in digital environments, visualising the relationships between buildings and sites, landscapes and changes which have taken place there.

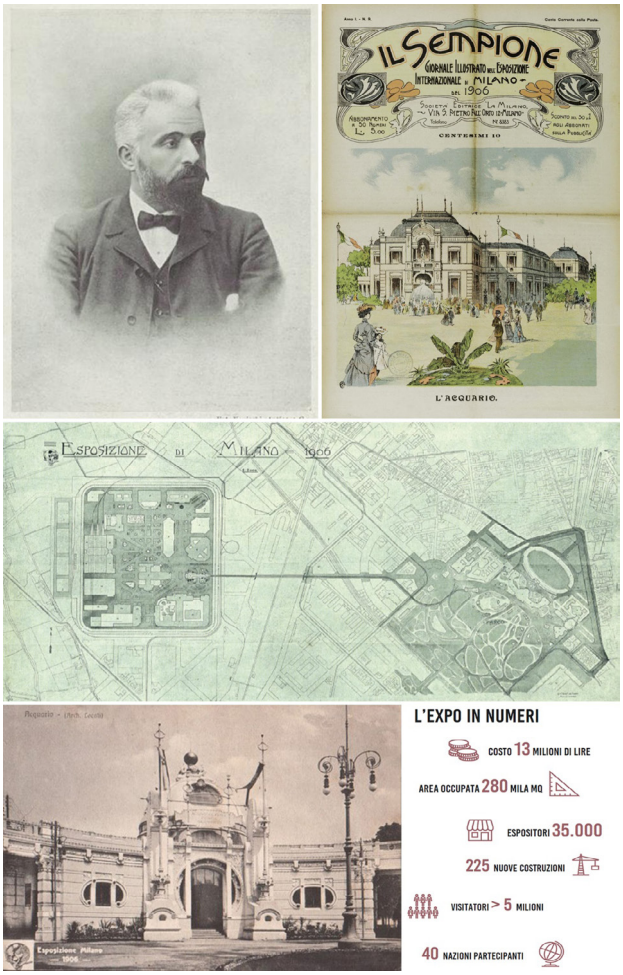

Figure 2. Overview of the 1906 International Exposition. From top: photograph of Architect Sebastiano Giuseppe Locati, in charge of the exhibition area of Parco Sempione; middle: map of the two exhibition areas in Milan, connected by a raised electric railway for the transportation of visitors; bottom: historical photograph of the aquarium building, designed by Architect Locati and the only building still visible of the temporary Exposition. All the images that make up the composition were scanned from the originals in the Drawings Archive (director Prof. Massimiliano Savorra) of the DICAr of the University of Pavia. Image processing: Silvia La Placa.

Three-dimensional digital models are useful not only for describing the current state of things, but also for illustrating processes related to the building of architectural structures that no longer exist. The overall aim of the workshop was to explore the possibility of laying the groundwork for the construction of 3D virtual reality environments.

The model construction methodology followed scientific and systematic reconstruction principles, enabling a metrically reliable reconstruction of the Exhibition based on drawings, graphs, maps and historical documents[10]. The archive research, initially conducted at the Drawings Archive of the DICAr of the University of Pavia, was later expanded to include archives in Milan and throughout Lombardy. Project drawings (such as plans, sections, axonometric views, study perspectives) were scanned and used as the basis for digital vector redrawing. Using AutoCAD software, two-dimensional graphic drawings were produced, serving as the basis for developing three-dimensional hybrid NURBS-mesh models of the vanished pavilions[11]. In addition to the metric drawings, postcards, historical photographs, and posters from the time were employed to reconstruct the Exhibition's architectural form. These sources allowed for an understanding of not only the purely architectural aspects of the Pavilions but also the material components of the structures, the overall complexity, the artefacts and objects displayed inside, and the ways in which the external spaces and infrastructures were used.

These aspects are crucial for developing a virtual environment in which users can relive the experience of the 1906 Exposition. Based on this premise, initial experiments were developed to integrate digital duplicates into game engine platforms for interactive use of the Expo[12]. Following the gaming methodology widely applied to virtual reconstructions of lost archaeological sites (Anderson 2009), the goal is to contribute, by shaping a hybrid analogue-digital methodology, such as that "from the archive to the model", to the valorisation of this heritage, which is no longer visible today (Fig. 3).

10 For more details on the method, see Galasso 2023. On these topics, see also Parrinello 2024.

11 Sketchup and Rhinoceros software were used for modelling, working with extrusion, cutting and subtraction of shapes.

12 The experiments, still in progress, are conducted within the DAda-LAB Drawing Architecture Document Laboratory of DICAr, University of Pavia. Action by research fellows Silvia La Placa and Francesca Galasso. A first experiment sees the comparison between the possibilities of user-model and user-user interaction within Unity and Mozzilla Hub.

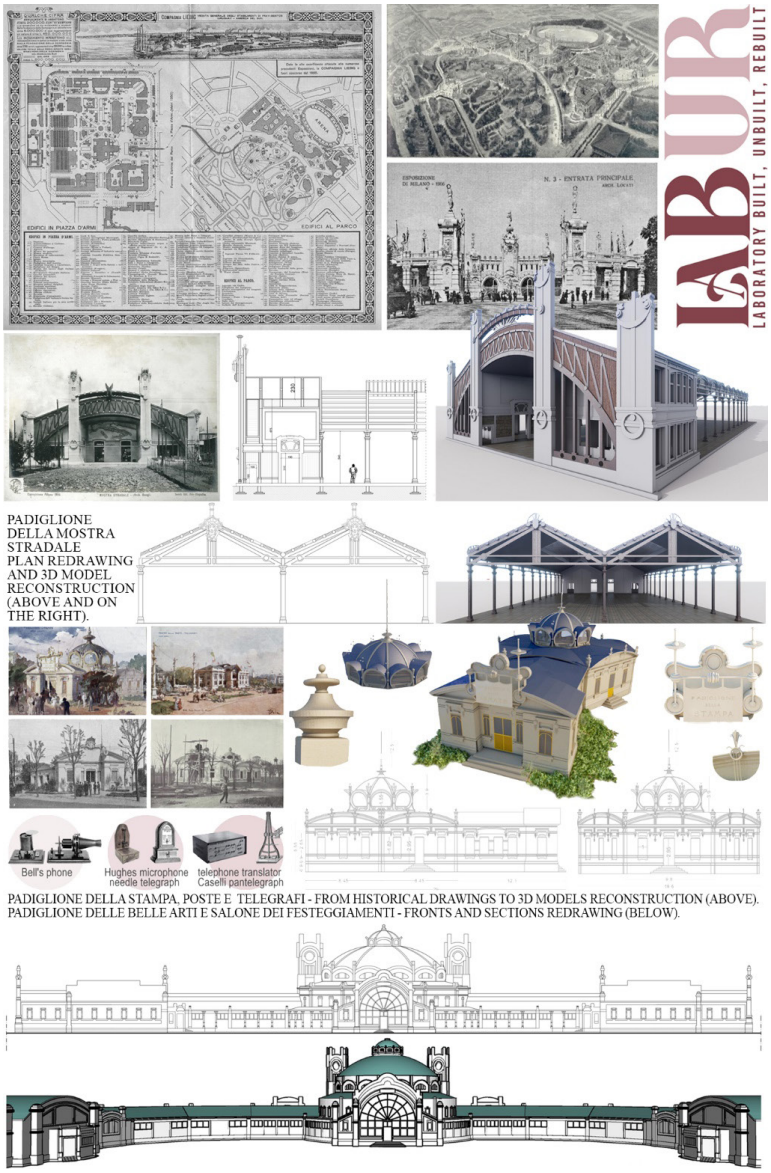

Figure 3. Overview of the activities of the LaBUR (Laboratory of Built, Unbuilt and Rebuilt) Laboratory, within the course of History of Architecture I, academic year 2022/2023 (course director Prof. Massimiliano Savorra, assistants: Arch. Silvia La Placa, Arch. Paola Barazzoni) in the Building Engineering and Architecture degree course at the University of Pavia. The image narrates the process from the archive to the three-dimensional digital model. The historical images are taken from the Drawings Archive of the DICAr of the University of Pavia. The 2D digital drawings and 3D models were made by students during the course. Image processing: Silvia La Placa.

5. Conclusions

In the early 2000s, several "thinking network" studies raised questions about the role of digitization. At that time, concerns were related to the danger of the proliferation of methods for creating images and information, along with various cataloguing approaches, which could result in a chaotic communication landscape akin to Babel. This chaotic scenario has become a reality, not only because of the myriad languages used, but also because miscommunication is fuelled by an increasingly diverse array of images, which are becoming a necessity. The demand for images has intensified in recent years, as "creative" individuals– not only artists and architects, but anyone capable of producing images – have made, and continue to make, representation a unique communication device (Sisto 2022).

In a present and future time in which technological forces – interdependent and unstoppable – reshape society (Kelly 2016), word and critical thinking are irremediably "reduced" to images.[13] In the past, architecture, also understood as "imago," could have been compared to a mass medium, namely an information tool that influenced behaviour and characterized urban civilizations. The question of the "gap" between poverty and opulence, between politics and culture, between professions and universities, between architecture and society, and between the image and substance of things, seems to resurface more than half a century later. Now, in addition to these age-old questions, there are new ones concerning representational referentiality. The changes in the means of presentation, reproduction and diffusion of images have consequences comparable to those that René Berger (1972) feared for all artistic expressions, due to the non-existence of artistic objects.

In virtual reality, experienced by means of headsets, one immerses oneself in environments that stimulate actions and movements. This results in the loss of that freedom to "look outside the field, outside the image". In this regard, Andrea Pinotti recently wrote: "The property of presence (the effect of 'presentification', i.e. of making the environment present to the experimenter and the experimenter present to the environment) seems to undermine the foundations of a paradigm that has informed the main theories of the image since ancient times, evolving and articulating itself in different variations in the contemporary world: the paradigm of representation." (Pinotti 2021, XIII)

Pinotti reminds us that the image is the "representation of a reality that pre-exists and exists independently of the image that depicts it." (Pinotti 2021, XIII) Immersive virtual environments, due to their strong sense of presence, seem, however, to openly challenge the assumptions of vision (Girvan 2018).

13 The term "reduction" is here used according to its Latin etymological root of *re-ducere* [to bring back].

But if the image is "mimesis" according to the classical formulation, then we should speak of unreality for virtual representations.

It is no coincidence that in physics, the term "virtual" contrasts with the term "real." Video mapping, on the other hand, does not produce a loss of senses, nor does it generate a simulated world alternative to the real one, though it is equally complex and compelling. Monuments serve as a surface for images. The images are in front of those who view them, distant from them. Yet video mapping can also generate destabilization. This happens when video mapping intersects with historical heritage considered untouchable. Even if non-invasive, video mapping interventions are often controversial and debated, precisely because they alter the perception of the representation of an architectural structure or monument. Beyond the controversies, cartographic projection interventions are certainly useful. Consider, for example, cases where, for ideological reasons or to preserve the memory of destruction, it is not possible to undertake restoration work on architectural structures or cities (Pavoni 2017).

Beginning in 19th century France, young apprentice architects at the Ecole des Beaux-Arts, known as *pensionnaires*, were required to imagine, in their fourth year of study, a "restitution" of the image of lost monuments. Paradoxically, it was the seductive watercolours of entirely invented environments – more than the *ex-novo* projects of the fifth year – that contributed to the success of many architects. Today, one could argue that this line of historical study – of virtually hypothesizing a past world – is still relevant. The attempts to answer the questions posed at the beginning of this discussion suggest that our relationship with new technologies – both in the production and consumption of images – is not at all secondary (Messinger 2008; Klinger 2022). We modify images and images modify us. The "gigantism" of virtual worlds can create a wasteland, eliciting loneliness. In the 1960s, scholars such as Jean Gottmann warned of the risks associated with the gigantism of true megacities, the oversized metropolises springing up worldwide (Gottmann 1961). Now, the megalopolis is virtual, formed by the network, which gave substance to the global village prophesied by Marshall McLuhan. The virtual megalopolis is inhabited by the societies of the new millennium, which choose to dematerialize images in systems made up of masses of data. Paraphrasing observers of the time, we can hope that in the virtual megalopolis, a digital "urbanization" of consciences will advance to define an identity for digital space. However, it may be more appropriate to speak not of a single identity of digital space, but rather of multiple identities. Adriano Prosperi recalled an idea of the American writer Saul Bellow in a 1988 speech: the identity of a human being is that defined by the story of their life (Prosperi, 2016: VIII). By extension, Prosperi deduced that the identity of a people or society would be its history. Again, by extension, it would be possible to say that the multiple identities of digital space interacting with cultural heritage are those with which we attempt to safeguard and narrate real space.

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Unveiling Heritage in XR: The Role of Immersive Technology in Redefining Virtual Museum Experiences and Heritage Sites

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Abstract

The advent of BIM technology has changed our perception of buildings, which are now viewed as digital entities encompassing all their components and associated information. This paradigm shift from 2D CAD drawings to 3D models has facilitated interdisciplinary collaboration and enabled the storage, documentation, and sharing of heterogeneous content. Moreover, BIM techniques have been extended to the built heritage, which has opened up new avenues for communication and sharing through Heritage Building Information Modelling (HBIM) models. The current challenge is to explore new levels of interactivity and immersion in digital worlds to enhance the knowledge and sharing of built heritage values.

Keywords: Virtual Heritage; Building Information Modelling (BIM); Virtual Museum; Interactive Virtual Objects (IVOs)

Abstract

L'avvento della tecnologia BIM ha cambiato la nostra percezione degli edifici, che ora sono visti come entità digitali che comprendono tutti i loro componenti e le informazioni associate. Questo cambiamento di paradigma, dai disegni CAD 2D ai modelli 3D, ha facilitato la collaborazione interdisciplinare e ha permesso l'archiviazione, la documentazione e la condivisione di contenuti eterogenei. Inoltre, le tecniche BIM sono state estese al patrimonio costruito, aprendo nuove strade per la comunicazione e la condivisione attraverso i modelli Heritage Building Information Modelling (HBIM). La sfida attuale è quella

di esplorare nuovi livelli di interattività e immersione nei mondi digitali per migliorare la conoscenza e la condivisione dei valori del patrimonio costruito.

Parole chiave: Virtual Heritage; Building Information Modelling (BIM); Museo Virtuale; Interactive Virtual Objects (IVOs)

Archaeological sites, historical buildings, and museums are on the verge of transcending conventional platforms that merely exhibit tangible and intangible heritage and collections through static images and descriptions. In this age of digital progress, the landscape of museums is evolving. No longer constrained by passive showcases, virtual museums emerge as vibrant platforms, embracing sophisticated modalities such as 3D digital surveying, Building Information Modelling (BIM), Virtual Reality (VR), and Augmented Reality (AR). These advances redefine the essence of engagement, crafting a captivating, interactive, and deeply personalised learning environment. The goal is to create virtual realms where physical interaction intertwines seamlessly with 3D digital representations of heritage sites and museums. This initiative caters to a digital audience, particularly those less inclined toward traditional museum visits. The success of this interaction hinges on the fusion of cutting-edge technologies: state-of-the-art 3D modelling, advanced digital surveying techniques, Visual Programming Language (VPL), and the developmental capabilities of Extended Reality (XR) platforms. Immersive technologies come alive, orchestrating real-time human-computer interactions that extend far beyond mere representation. They weave a tapestry of experiences, melding the worlds of VR and AR into the realms of gaming and virtual museums. Accessibility stretches across devices, from VR headsets to web-based AR platforms, mobile devices, tablets, and personal computers. This enriched encounter transcends the boundaries of traditional museum presentations. It is a transformative intersection where art, culture, and history converge, inviting audiences on a narrative-driven journey through time and heritage.

1. Digital Transformations in Cultural Heritage: From Preservation to Immersive Experiences

As defined by the European Union:

> Cultural heritage is a rich and diverse mosaic of cultural and creative expressions, the legacy of generations of Europeans who have preceded us and bequeathed it to future generations. Cultural heritage encompasses natural, architectural, and archaeological sites, museums, monuments, artworks, historic cities, literary, musical, audiovisual, and digital works, as well as the knowledge, practices, and

> traditions of European peoples. [...] Cultural heritage enriches the individual lives of citizens and, in addition to being an important resource for economic growth, employment, and social cohesion, offers the opportunity to revitalise urban and rural areas and promotes sustainable tourism as a driving force for the cultural and creative sectors. ("EU Policy for cultural heritage" n.d.)

In the cultural domain, the significance of both tangible and intangible heritage is paramount, serving as a testament to the historical and cultural evolution of humanity. Tangible heritage includes objects, monuments, buildings, and sites of cultural, historical, artistic, or scientific value, serving as vital testimony to the past and acting as cultural and touristic resources for local communities and the global population. This category encompasses diverse institutions such as museums, libraries, archives, archaeological sites, historic parks and gardens, churches, palaces, castles, villas, and more.

In contrast, intangible heritage encapsulates values associated with representations, practices, historical memories, knowledge, and skills that communities construct, utilise, and transmit. It includes practices, representations, expressions, knowledge, and techniques that communities, groups, and, in some instances, individuals recognise as part of their cultural heritage. This is transmitted across generations and continues to evolve over time. Examples of intangible heritage include oral traditions like stories, legends, and poems; artistic expressions such as music, dance, theatre, and craftsmanship; social practices like festivals, celebrations, rituals, and games; as well as knowledge and practices related to nature and the universe ("What is Intangible Cultural Heritage?" n.d.). The value of intangible cultural heritage is substantial as it represents a critical source of cultural identity for communities and individuals. Moreover, its recognition and promotion can foster cultural diversity, stimulate creativity and innovation, and help build more inclusive and sustainable societies.

Within this framework, through the Horizon 2020 research and innovation program, the European Commission invests in developing cutting-edge digital tools and technologies to support cultural heritage:

> Digital technologies will play a cross-cutting role in the following areas: *(i)* the preservation and restoration of cultural heritage, *(ii)* the sustainable financing of museums and cultural institutions, *(iii)* the revitalisation of traditional crafts, and *(iv)* the strengthening of the innovative potential of cultural and creative sectors. However, adopting digital tools for promoting and disseminating cultural heritage still poses a challenge for various sectors that still need to fully grasp the value of such instruments ("Shaping Europe's digital future" n.d.).

Technological revolutions profoundly influence the course of human history, triggering major changes in social structures. (MacKenzie & Wajcman 1999). Beginning with the era of the agricultural revolution, which saw the rise of the

first settled communities, and progressing through the industrial age, characterised by mass production and mechanisation, to the contemporary information age, marked by the proliferation of computers, the Internet, and social media, these shifts have revolutionised communication and increased access to novel forms of knowledge (Bojanova 2014). This transition has profoundly impacted the transmission and preservation of information, rendering both more efficient and expeditious through advanced tools such as cloud computing, big data processing, machine learning, artificial intelligence, extended reality (XR), and virtual museums (Huhtamo 2013). Multimedia tables, multi-user touch tables, video mapping, apps, and totems are the primary tools for enhancing knowledge while taking part in a multimedia journey. However, they might be considered less advanced in terms of their level of interaction and immersion. On the other hand, cutting-edge tools based on VR and AR enable an exploration of new levels of interactivity, allowing visitors to immerse themselves in virtual environments and gain new insights (Schweibenz 1998).

As of today, VR and AR offer a wide range of possibilities. AR is considered an enhanced reality capable of enriching our visual perception through a mobile device such as a tablet or a smartphone. Tim Sweeney, founder and CEO of Epic Games and creator of Unreal Engine, states: "Once you have an augmented reality display, you don't need any other form of display. Your smartphone does not need a screen. You don't need a tablet. You don't need a TV. You just take the screen with you on your glasses wherever you go" (Takahashi 2015). In contrast, VR is an interactive three-dimensional environment that "replaces" reality, allowing users to navigate in the first or third person (Kassahun and Champion 2019).

According to Tom Furness, a pioneer in human interface technology and the "grandfather" of virtual reality, this technology offers the opportunity to experience what would otherwise be impossible. It allows us to explore distant and unfamiliar places and engage in activities that we could never otherwise perform (TaotiTalks 2024). In contrast to AR, creating a VR environment requires extensive knowledge and commitment in digital modelling, development, integration of VR devices, and identification of suitable technologies.

In this context, the recurring question is whether Building Information Modelling (BIM), AR, and VR can evolve from simple management tools and occasional accessories to true customisable technological platforms capable of disseminating heritage values. Another question arises as to how the use of Historic Building Information Modelling (HBIM) through digital surveying, archival research, and digital representation can play a crucial role in the integration of these technologies into cultural heritage.

2. From Physical to Virtual: Transforming Museum Experiences in the Age of Technology

Museums serve as bastions of cultural heritage, preserving objects and memories that define a community's identity and historical narrative (Falk and Dierking 2016). These institutions engage in rigorous scientific research, communication, and conservation efforts, undertaking activities ranging from collection and safeguarding to documentation, research, and dissemination of knowledge to diverse audiences (Soren 2009). A museum is conventionally structured with separate rooms, each housing a variety of artworks. These exhibits are typically accompanied by informational aids like descriptions, captions, audio guides, or on-site personnel providing insights into the works displayed. Recently, virtual museums have emerged alongside their physical counterparts. This paradigm offers a means to engage a broader audience and promote the dissemination of historical and cultural knowledge, ultimately revitalising interest in the artworks displayed (Woods et al. 2004).

The origin of virtual museums is attributed to Nicolas Pioch, a student who, in 1995, conceptualised and established the WEB Museum, an online platform dedicated to sharing artworks (Bowen 2010). Subsequently, numerous museums worldwide established their digital presence, spanning various disciplines, including artistic, archaeological, anthropological, and scientific-technical domains. These online platforms often mirror the structural and content attributes of their physical counterparts (Huhtamo 2013). Furthermore, several established museum institutions and non-profit organisations operating through consortiums and multimedia databases have undertaken significant endeavours in the digitisation of cultural heritage, thereby making a wealth of digitised cultural artefacts accessible to the public (Schweibenz 2019). While various types of virtual museums have emerged over the years, ranging from replicas of physical museums to exclusively online platforms, featuring virtual tours based on 360-degree panoramas, they often do not facilitate high levels of interactivity between users and the museum itself. This limitation partly arises from the necessity for technical expertise in diverse fields such as computer graphics, programming, advanced modelling for digital representation, restoration, and archaeology. Recent advances in software and computer graphics have streamlined processes, reduced costs and expanded their application into previously underutilised areas (Sundar et al. 2015). For instance, digital surveys generate point clouds, which can be seamlessly integrated with 3D data from laser scanners, total stations, and GPS. This integration creates a unified 3D environment, allowing professionals to work with diverse data inputs while maintaining consistent georeferencing. The structure from motion (SFM) technique, reliant on point collimation from images, facilitates object shape reconstruction (Özyeşil et al. 2017). This involves extracting key points, inferring

photographic parameters, cross-referencing identifiable points across images, and computing spatial coordinates using computer vision algorithms. The resulting key points aid in processing the point cloud, culminating in textured digital models. A number of studies have refined digitisation and modelling techniques, assessing the merits and limitations of mesh models. While digital photogrammetry excels in creating textured mesh models, they are not automatically recognised as BIM objects by major applications like Autodesk Revit and Graphisoft ArchiCAD, due to their being composed of dense polygons. Grades of generation (GOGs) 9 and 10[1] have introduced techniques like HBIM digitisation and scan-to-BIM, capable of converting basic points from 3D surveys into BIM parameter objects (Banfi 2021). These modelling requirements use geometric entities to create informative models conveying material, physical, and historical attributes. This graphic approach integrates survey drawing and interpretative synthetic drawing, gathered by means of the scrutiny of archival and bibliographic sources, juxtaposed with the current status of dimensional and formal-compositional verification. Subsequently, this foundational bedrock undergoes further processing to generate digital models that communicate the discerning intent underlying the reworking of sources. Identifying, analysing, and discerning stratigraphic units, materials, and historical occurrences is imperative in procuring an accurate and informative volumetric representation. The conception of intelligent parametric objects and their reciprocal interrelations is instrumental in information mapping and in the constant sharing of intricate scenarios. This succinct overview reveals the pivotal role that graphic and iconographic representations assume as highly effective communicative tools, particularly for built heritage. We can reach a deeper understanding of the external environment by gathering the multiplicity of forms that constitute reality. This evolution heralds a new era in the conservation and accessibility of our shared cultural legacy.

Integrating XR in a scan-to-BIM process can significantly elevate the levels of interaction possible in digital environments, enhancing communication through digital forms capable of sharing diverse data types and formats. This paradigm shift in understanding and IT management of digital models, coupled

1 GOGs 9 and 10 facilitate the conversion of laser scans and point clouds from digital photogrammetry into BIM models using specific scan-to-BIM requirements. BIM applications typically struggle with generating complex elements, such as historical buildings with vaulted systems, arches, damaged walls, and decorative features. GOGs 9 and 10 overcome these limitations by utilising specialised Non-Uniform Rational Basis-Splines (NURBS) algorithms. GOG 9 identifies key geometries using the slicing technique, creating a 3D wireframe model from point clouds, which is then interpolated with NURBS algorithms to produce a BIM object in Autodesk Revit without further remodelling. GOG 10 simplifies and accelerates the modelling of complex elements by directly interpolating scan data without the slicing technique. The primary requirements for creating a BIM model include determining the outer edge of the element and the internal points that define its geometry.

with the use of leading XR development platforms, unveils new prospects for professionals working in the fields of architecture, engineering, restoration, archaeology, and history, as well as students, virtual tourists, and museum curators, many of whom may not possess specialised IT application development skills (Hammad et al. 2021). To this end, this research paper endeavours to establish a methodology which can be adapted to any artefact, demonstrating how various 3D objects derived from digital surveying, laser scanning, photogrammetry and 3D modelling can be dynamically rendered in different XR modalities. Key elements in effecting this transition encompass 3D modelling, visual programming language (VPL), and model interoperability (Ray 2017). It is crucial to consider how the use of digital technologies can influence human communication and interactions, not only on a physical level but also on a cultural and social level. Proxemics[2] thus represents a tool for the comparative analysis of non-verbal inter-human communication modes, wherein different behavioural systems presuppose distinct sensory worlds that can remain separate and unintegrated. In this regard, an in-depth exploration of proxemics proves crucial for creating interactive digital representation experiences that consider the centrality of both the user and the information. Creating virtual environments based on a scan-to-BIM process aims primarily at offering immersive user experiences in which the sensation of "being part of" the virtual environment is as realistic and interactive as possible. Managing space, distance, and interaction between the user and virtual objects has proven crucial to achieving this goal. The constituents of reality are transformed from atoms into signs and then into bytes, making the relationship between the user and Interactive Virtual Objects (IVOs) essential for effective 3D spatial-virtual representation. In this context, proxemics takes on a new form: the "digital" form (Banfi et al. 2023).

Virtual heritage represents an evolving interdisciplinary field that transcends the mere application of virtual reality to cultural heritage. In Banfi (2023), digital proxemics is examined so as to establish sustainable and practical parameters for developing interactive virtual representations. To enhance awareness of these interactions, it is essential to explore how representation, visual factors, interoperability paradigms, interactivity, and immersion of digital models influence the perception and understanding of virtual environments. This exploration reveals how variations in these factors, whether related to the "container" or "content," induce different spatial sensations and affect user experience. The application of a scan-to-BIM process and subsequent computer implementation can lay

2 The American anthropologist E.T. Hall introduced in the 1960s the term "proxemics," derived from the word "proximity," to denote the study of interpersonal distance and human space in their signifying nature (Hall 1968). Proxemics investigates the meaning individuals attribute to the distance between themselves and others, objects, and, more broadly, the cultural and historical value of how individuals position and organise themselves in space, considering psycho-sociological and ethnological factors.

the groundwork for addressing European needs to extend the utility of digital models to built heritage and the digitisation of archaeological sites, museums and collections. Specifically, emphasis should be placed on how drawing (in its various 2D and 3D forms), representation and digital models can "come to life" through user-model interaction, transitioning from static 3D representations to dynamic models capable of sharing different types of information and fostering experiences related not only to architecture but also to archaeology and museology. At the same time, the need for proper management of digital technologies to enhance cultural heritage through primary representation techniques is highlighted, to avoid the risk of excessive trivialisation and detachment from real cultural heritage. Therefore, it will be essential to strike a balance between the use of technologies, drawing, and digital representation to protect and enhance cultural heritage in its authenticity and integrity.

3. From Static Scan-To-BIM Models to Interactive Virtual Objects

The scan-to-BIM process has seen significant improvements in recent years, benefitted new construction, and proven particularly valuable for preserving built heritage. Prominent articles in the field of HBIM highlight the importance of developing Advanced Modelling Techniques (AMT) and creating informative models characterised by high levels of detail (LOD) (Lovell et al. 2023; Yang, et al. 2020). These models aim at capturing irregular architectural and structural elements not typically included in standard BIM libraries. The primary objectives of this specific research field include reducing the production costs of HBIM through the refinement of AMT and the effective management of conservation plans for surveyed artefacts. As Volk highlighted, it is evident that BIM was the most widely researched area from 2005 to 2012 across various disciplinary and application domains (Volk et al. 2014). This study further demonstrates that the most beneficial applications of BIM are directed toward maintenance and "BIM Creation and Modelling" rather than design and data management. The rationale behind this is that modelling requires in-depth studies to enhance the generative aspects of heritage buildings and their ongoing management. Therefore, the true challenge lies not in BIM, with its advantages for new construction, but rather in research fields oriented towards built heritage, as stressed above. Since 2012, research centres such as Autodesk Research and Bentley Systems have enabled the integration of digital survey data into their CAD and BIM software, fully seizing this market opportunity. The surveying sector has been revolutionised with the widespread adoption of laser scanning, which can rapidly capture very large quantities of 3D points and produce digital point clouds of surveyed surfaces (Slob and Hack 2004).

Advantages observed in the use of these tools include:

1. Reduced time for data acquisition.
2. Rapid collection of all necessary information, eliminating the need to revisit the site for integration with new 3D surveys.
3. Non-invasive surveying ensures no direct contact with the surveyed building, by integrating laser technology into instruments.
4. Higher measurement accuracy is achieved through the integrated use of total stations.
5. Cost-effective data acquisition phase, reducing costs and time necessary for the 3D survey campaign.
6. Surveyed spaces can be analysed using innovative software compared to traditional 2D representations.

Identifiable drawbacks include:

1. High initial investment in acquiring new tools.
2. Using the software requires extended learning and practical training phases, and post-survey data processing necessitates the use of various applications and an in-depth understanding of modelling techniques.
3. Output processing formats for post-processing are commonly called "dumb" files, as they are simply a vast quantity of points in space and lack any intelligent parametric function intended for three-dimensional reconstruction.

Several studies published in recent years have sought to outline the state of the art in the scan-to-BIM field, analysing techniques and procedures that emphasise the integration of HBIM with other technologies such as VR, AR, GIS, and with virtual museums (Lovell et al. 2023; Yang, et al. 2020; Xiucheng, et al. 2020). Through systematic reviews of international literature, these studies have reported the main trends and present and future potentials in the field of heritage digitisation. Today, the integrated use of digital photogrammetry (terrestrial and aerial) and laser scanning could allow for the development and application of an approach that converts point clouds and meshes into an environment capable of interacting with state-of-the-art environments, such as Web-VR (Banfi and Mandelli 2021). The osmosis between digital environments and information has defined new spatial experiences in which users can immerse themselves and actively discover new digital worlds composed of IVOs (Interactive Virtual Objects) that can "come to life" and respond to user input (Fig.1). In this specific domain, key elements identified are: data collection; 3D modelling (scan-to-BIM process); information mapping; information sharing.

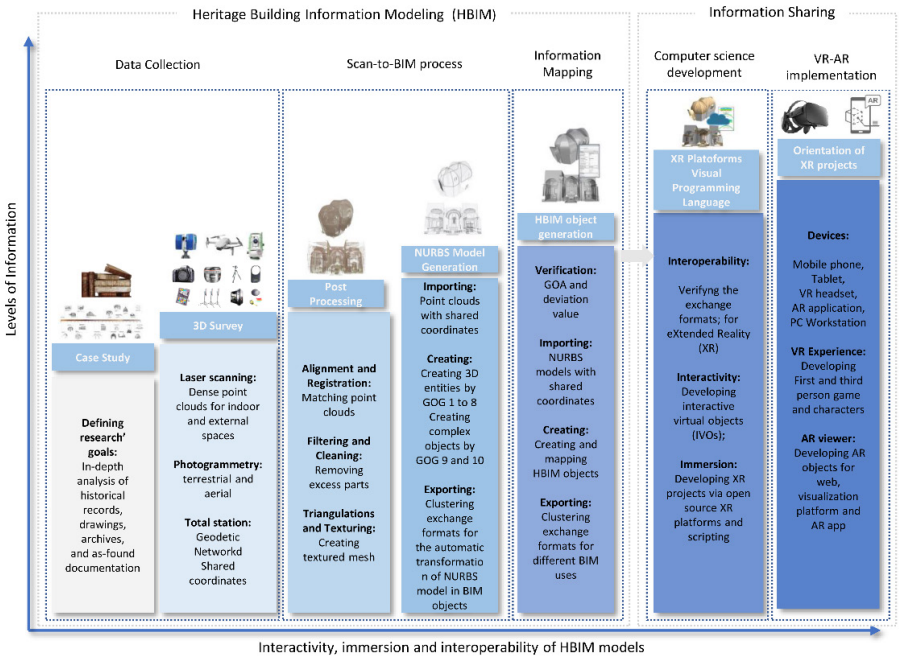

Figure 1. Proposed approach: from data collection and HBIM uses to VR-AR implementation in Banfi 2023.

Digital representation in graphic, infographic, and multimedia languages has evolved into 2D, 3D, and XR dimensions, becoming a vital tool capable of managing morphological and typological complexity paradigms. It analyses existing values and enhances visual communication, oriented towards different dimension scales. This includes the geometric descriptive foundations of drawing and digital modelling based on surveys as tools for understanding the surveyed reality. In this scenario, 3D modelling is understood broadly, encompassing the expressive and cognitive aspects of formal structures. The need to increase the information level of HBIM models is directly proportional to their subdivision into sub-elements capable of representing theoretical and semantic decompositions, not necessarily dictated solely by geometry. Determining "granular objects" can prove vital for subsequent mapping and sharing of information in complex scenarios such as archaeological sites, historic buildings, and museum collections. Geometric model verification also involves applying an automatic verification system (AVS) to communicate the standard deviation value between point clouds and the HBIM model. Assuming that the geometric reliability of each model derives not only from the accuracy of the survey but also from the interpretation and modelling phase of each element, the scan-to-BIM process and HBIM projects have achieved highly faithful accuracy values with respect

to the established representation scale. Each element can be returned with a Grade of Accuracy (GOA) of approximately 2/3 mm, starting from an error value of about 1/2 mm related to the photogrammetric survey precision. The geometric reliability of the model in terms of accuracy can be conveyed within the HBIM project by developing specific parameters. The identification of each data point used, and its corresponding GOA should be specified in the property windows based on the principles of "transparency" and "reliability" of HBIM models (Bianchini et al. 2021). Once the modelling phase is completed, it is also possible to optimise the use of digital models to define virtual-visual storytelling (VVS), transitioning from static forms to interactive digital representations capable of communicating the tangible and intangible values of heritage.

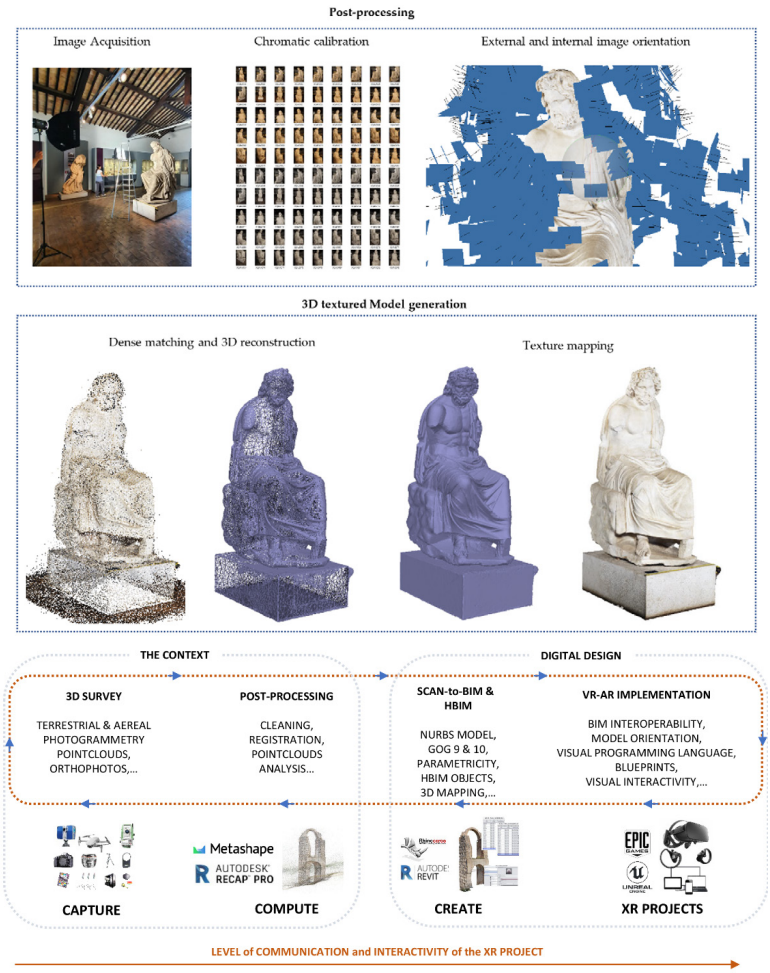

Figure 2. From digital surveying to the scan-to-BIM-to-XR process.

To achieve maximum credibility, an XR environment must exhibit specific characteristics, including *(i)* highly detailed models corresponding to real-world exhibited objects, *(ii)* high-resolution textures displaying authentic material properties, and *(iii)* accurate scaling in the virtual environment relative to the user. These requirements are precisely addressed through adept 3D modelling, which must be coupled with VPL in its most advanced forms, enabling the transition from a static mesh to IVOs.

Navigation through an avatar in an interactive virtual environment (IVE) and interaction with IVOs are essential elements that enrich the user experience and elevate levels of interactivity and immersion. Combining advanced 3D modelling techniques with virtual reality tools like VPL to support XR development enables new levels of interactivity between the user and IVOs[3]. These objects can be animated and brought to life, providing novel forms of human-computer interaction. The quality of the experience offered relies on modelling techniques and exchange formats that facilitate the generation of hyper-realistic objects and genuine interaction between avatars, IVOs, and IVEs.

An innovative approach involves creating customised IVEs and IVOs, significantly simplifying the phase of modelling the scene and objects. Thanks to growing interoperability between modelling applications and XR development platforms, it is possible to develop more detailed experiences in less time, aided by real-time rendering, blueprints, and the FBX format.

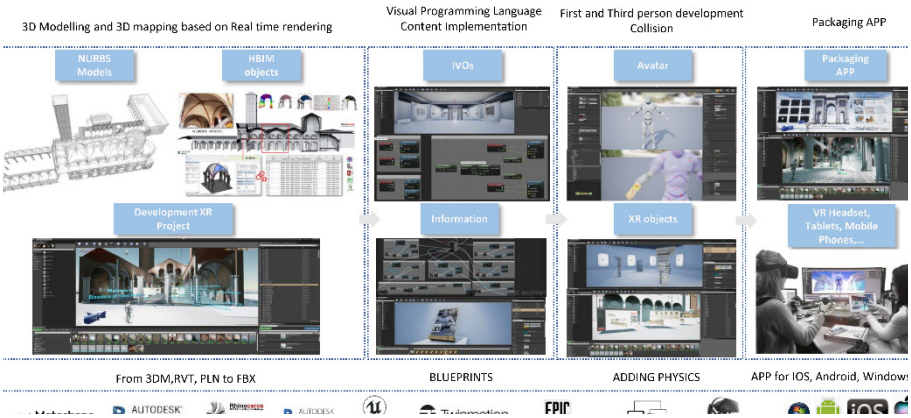

Figure 3a. The Scan-to-BIM-to-XR project of the Basilica di Sant'Ambrogio, Milan, IT in Banfi 2021.

3 Specifically, IVOs consist of a mesh geometry composed of vertices, edges, and triangles/polygons, taking various forms such as informational panels, fantasy characters, interactive guides, flip-through books, level changes, or teleportation points, and features which serve to alter weather and other conditions.

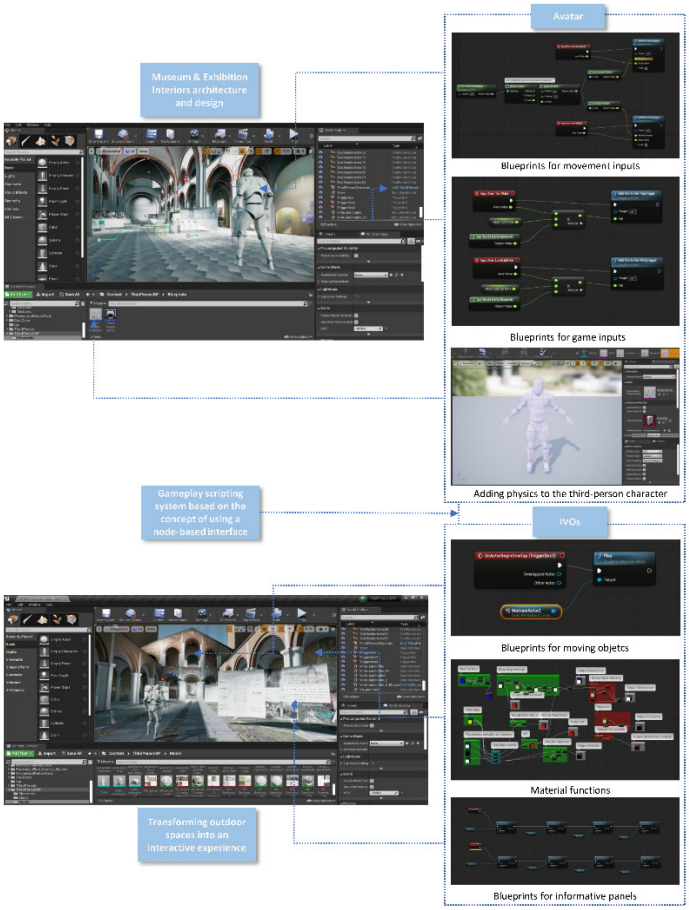

Figure 3b. The Scan-to-BIM-to-XR project of the Basilica di Sant'Ambrogio, Milan, IT in Banfi 2021.

Recent technological advances have streamlined the development process, incorporating the use of modelling software or BIM platforms alongside XR development platforms. Specific add-ins facilitate real-time synchronisation between these two types of software, allowing them to work simultaneously and benefiting from the unique features of both without the need to save and import mesh models. In the context of AR and VR, VPL represents a crucial element for creating interactive environments and engaging experiences. It serves as a primary tool for scripting and adding interactivity to AR and VR projects (Fig. 4).

In XR projects, script files are integrated resources alongside textures and models, playing a fundamental role in creating dynamic objects. XR development platforms support the use of various programming languages, including C#, JavaScript, and Boo, with C# being the most widely used programming

language in environments like Unity and Unreal Engine. However, its adoption often involves lengthy generative development times, limiting development possibilities. On the other hand, the scan-to-BIM-to-XR process can emerge as a promising alternative, particularly for individuals who lack expertise in traditional coding. It has facilitated the development of interactive environments using a visual interface based on a graph of interconnected elements following a node-logic structure. This simplified approach has allowed the transition from static models to dynamic objects, associating specific behaviours with each scene element, thereby enhancing direct or indirect interaction with the user through an avatar. Using nodes, events, actions, and conditions that are visually connected, various Blueprints can be implemented to code in C++, creating dynamic 3D objects that bring to life static mesh models derived from photogrammetry.

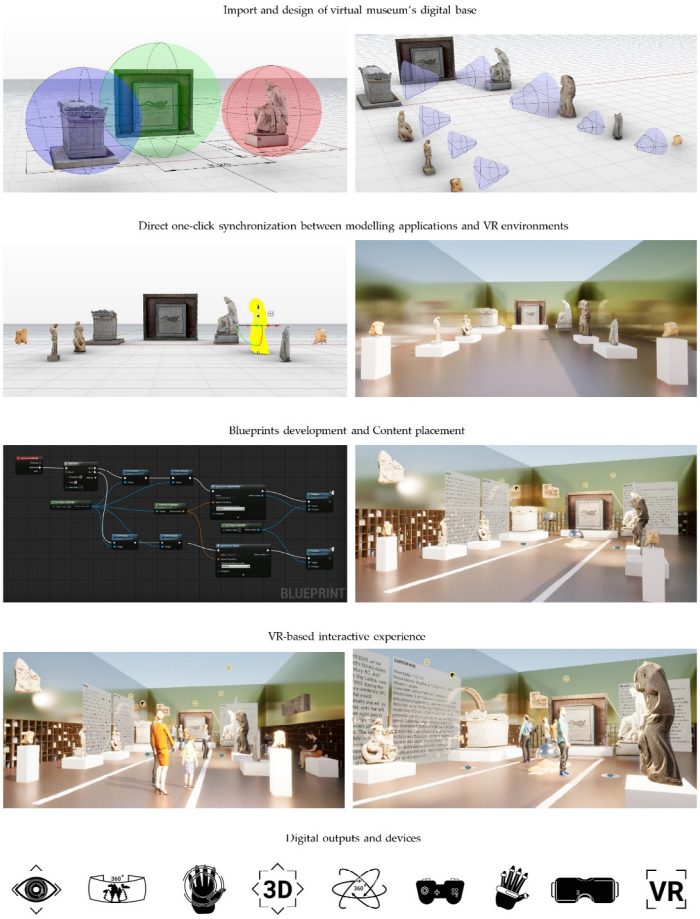

Figure 4. The development process applied to the digital interactive representation of the virtual museum: from textured models to the VR headset in Banfi, et al, 2023.

Furthermore, the effective use of exchange formats, transitioning from modelling software to XR development platforms, is crucial for ensuring precise visualisation, navigation, and interaction inside the digital environment.

In line with contemporary technological capabilities, the proposed digitisation process integrates diverse forms of photogrammetric digitisation (both terrestrial and aerial) with AMT and GOGs to create VR-AR environments. This integration seeks to facilitate user interaction with innovative IVO forms where representation serves as a driving force for knowledge transmission, fostering the creation of web-VR projects and educational experiences related to architecture, archaeology, museums, and the environment (Fig.5).

Figure 5a. The web-VR project of Villa dei Quintili, Rome, IT in Banfi 2023.

Figure 5b. The web-VR project of Villa dei Quintili, Rome, IT in Banfi 2023.

4. Conclusions

Within the scan-to-BIM-to-XR continuum, creators of digital worlds serve as both architects and storytellers, crafting immersive and interactive experiences that redefine human interaction with the realm of the virtual. Their expertise in transforming digital representations into engaging virtual spaces is invaluable, creating experiences that transcend the limitations of the physical world. These experiences, incorporating new forms of interactive representation such as VR and AR, merge seamlessly with the real world, paving the way for innovative approaches to communication, learning, and entertainment.

The expertise of creators in translating concepts and ideas into Interactive Virtual Environments (IVEs) and Interactive Virtual Objects (IVOs) is crucial for making digital content both accessible and engaging. By meticulously selecting visual, audio, and interactive elements, they shape the atmosphere, narrative, proxemics, and emotions that define the overall user experience. At the core of this creative process is digital representation, which transforms data, concepts, and visions into three-dimensional models and interactive spaces that extend beyond mere visualization. These models become interactive scenarios where users can explore, interact, and experiment. Attention to detail in creating elements such as NURBS, mesh, texture, avatars, VPL, lighting, VVS, and animations is essential in making these digital worlds realistic and engaging.

Interactivity and digital proxemics are fundamental to this paradigm. Creators devise that interactivity which allows users to manipulate objects, perform actions, and fully participate in the experience, resulting in dynamic scenarios where user decisions shape the course of events, enhancing the overall impact.

The approach proposed here can significantly enhance XR ecosystems. The ability to convert digital representations into engaging and interactive virtual spaces enriches experiences that surpass the limitations of reality, offering captivating scenarios that shape the future of human interaction and exploration of limitless virtual worlds. Those experiencing this generational shift have the privilege and responsibility of inheriting and advancing the knowledge and methods of their predecessors for future generations.

Furthermore, this approach serves as an integrative framework for the contemporary museum system, opening new possibilities for implementation and interactive representation techniques. The aim is to create immersive experiences that support the digital transformation of museums. Drawing, 3D modelling, and XR have proven to be highly effective communication tools, capturing the diverse forms that constitute reality and powerfully conveying the tangible and intangible values of our cultural heritage.

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PRACTICES

Uses of Virtual Reality in an Applied Philosophy Course*

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Abstract

The paper focuses on the theoretical assumptions and the way in which an experimental course on the phenomenology of space, designed for architects and interior designers, was conducted. The course used virtual reality to allow students to directly experience the perceptual and cognitive effects induced by spatial forms, colour, the texture of materials, and light. Virtual reality also made it possible to translate certain philosophical concepts related to the phenomenology of space into an experiential and applicable field close to the sensitivity and spatial culture of the designers. The themes addressed gave rise to a progressive elaboration that allowed the students to develop an increasingly complex project and to experiment with intricate issues.

Keywords: Phenomenology of Space; VR Design; Interior Design; Immersive Education

Abstract

L'articolo si concentra sui presupposti teorici e sullo svolgimento di un corso sperimentale sulla fenomenologia dello spazio, ideato per architetti e interior designer. L'uso della realtà virtuale ha consentito di sperimentare direttamente gli effetti percettivi e cognitivi indotti dalle forme spaziali, dai colori, dalla texture dei materiali e dalla luce. La realtà virtuale ha inoltre permesso di tradurre alcuni concetti filosofici legati alla fenomenologia dello spazio in un campo esperienziale e applicabile, in sintonia con la sensibilità e la cultura spaziale dei

* This article is an updated and abbreviated version of a previous paper: see Vegetti, 2022.

progettisti. I temi trattati hanno dato luogo a uno sviluppo progressivo che ha consentito agli studenti di realizzare un progetto sempre più stratificato e di confrontarsi con questioni di crescente complessità.

Parole chiave: Fenomenologia dello spazio; VR Design; Architettura d'interni; Educazione Immersiva

Virtual reality (VR) holds educational potential of great interest for all disciplines that deal with spatiality and even more for those, like architecture, that have a privileged relationship with lived space, that is to say with the interaction between the body and its environment. I attempted to demonstrate this thesis through the conception and development of a course on "Phenomenology of space" that makes use of virtual reality to study the perceptual effects of architectural design.

The course began as a research project funded by an internal call for proposals in the "department of environments, construction, and design" of the University of Applied Sciences and Arts of Southern Switzerland (SUPSI-DACD, Mendrisio, Switzerland) dedicated to digitization. From the outset, its implementation required the formation of a small interdisciplinary research team. It included, alongside myself (philosopher and professor of spatial theory), Pietro Vitali (architect and professor of the degree course in interior architecture), Matteo Moriani (architect and assistant for the course developed by this project), and Marco Lurati (interaction designer and lecturer). The final goal of the educational project (which subsequently won the Credit Swiss Award for Best Teaching 2021-2022) was to create a course in phenomenology applied to architecture with the help of Oculus Quest 2 headsets. In other words, rather than just learning theories, the students would need to sharpen their spatial sensibility by experimenting with these theories in a virtual environment. The challenge was thus double: on one hand to offer a course on applied philosophy, and on the other to introduce virtual reality into a theoretical course, making it the tool for the application of theory.

VR has already come into use in university teaching. It has recently emerged in architecture and the arts as novel means for visualizing different design solutions and for building up the design model and its virtual environment.

In a manner similar to these applications, VR is commonly used in architectural education in the design process, as it provides the designer with an image to create the spatial and topological relationships of a project. Although the use of VR for teaching purposes is not yet widespread in architecture faculties (in Europe at least), its pedagogical effectiveness has been clearly documented (Khavari and Kaiser, 2022). Several studies on the pedagogical function of VR in architectural training have shown that the use of this technology increases the designer's

awareness during the design process in terms of the structural properties and component assembly of a structural system, (Abdelhameed 2013), helps develop students' approaches to these issues, critical thinking abilities, and problem-solving activities (Khavari and Kaiser, 2022), creates the possibility to "feel like being in the place," (Chandrasekera, Fernando, Puig, 2019) strengthens the memory and awareness of the spatial configuration (Angulo, 2013), augments their "spatial abilities"(Chandrasekera, Yoon, 2015; Schnabel et al., 2001) and trains their capacity to switch naturally from a planar representation of space to a 3D representation of the same space (Milovanovic et al., 2017). However, the use of VR that we wanted to experiment with differs from the common uses of this technology in architecture or design faculties. It is in fact designed to develop an "applied" philosophy of space (a philosophy with a phenomenological orientation). In other words, thanks to virtual reality, the students were able to experiment in various ways, according to a number of controlled possibilities, with how the manipulation of certain variables (positions of openings, colours, scales, relationships between objects in space, artificial lights, sequences of spaces) impact the spatial experience on a perceptive and cognitive level. The aim was not to obtain a realistic representation of space, nor was it to learn about and visualize certain spaces and construction processes through VR. The aim was rather to verify with one's own (virtual) body the perceptual effects induced by certain design choices, and to develop a method to derive generalizable knowledge from experience.

1. Phenomenology in Virtual Space

Phenomenology is undoubtedly the theoretical orientation most closely related to the intelligence of architects, who are accustomed to thinking about space "live," so to speak. Among the characteristic abilities of the architect are the capacity to consider the relationship between spaces and bodies, to imagine the atmosphere of environments and the way in which shape, colour, and spatial scale influence our experience of them, and to organize solids and voids, exteriors and interiors, the visible and the invisible, light and shadow, volumes and matter, as though they were elements of an aesthetically expressed spatial language. It is precisely this sort of sensibility that the course sought to thematically develop, strengthening students' awareness of and ability to design perceptual (i.e., not only spatial) environments imbued with cognitive and emotional meanings. To best realize the desired encounter between philosophy and architecture in this pre-categorical level of spatial experience, I found it useful to refer to phenomenology broadly defined, largely enough to include Gestalt psychology and some elements of behaviourist psychology. Before giving a synopsis of the thematic contents of the course, it will be necessary to evaluate the contribution that virtual reality can offer to the encounter between phenomenology and architecture, mediating between their languages. VR's potential

consists in its particular qualities as an immersive medium, or more specifically in its capacity to insert perception into an immaterial, interactive, and programmable *Umwelt*. The first aspect is perhaps the most important. If there is a single quality that the spatial intelligence of the architect must necessarily develop during the course of study, it lies in the capacity to move from an understanding of space based on plans – made up of lines, symbols, numbers, and so on – to a subjective understanding, ideally placed in the space that those signs represent abstractly. The passage from an objective and external gaze (the one that reads the plan) to an internal, embodied one, capable of bringing the signs to life in a volumetric space and corporealizing them, is normally entrusted to the imagination. But given the complexity of this mental operation, it is always necessary to turn to a plurality of media: sketches, models, photographs of the models taken from the inside, rendering, etc. None of these tools, however, is capable of physically including the subject, who thus continues to have a distanced and disembodied understanding of space. Given the importance of the role that the body plays in spatial experience, it is clear that the value of virtual reality lies in the possibility of transferring the subject inside of the space of representation, in such a way that allows them to have a direct, aesthetic, and even synesthetic experience. Thanks to VR, the architect can jump in and out of the representation: he or she can "enter the plan," making it into an immersive experience, and then exit, modify the design on the basis of this experience, and finally return to the virtual space to check the outcome of the operation. This movement in and out of the space of representation provides the intelligence of the architect with a new medium; this is not, however, virtual reality, but rather his or her own body as an "analogical" tool, one that provides an analogue to embodied sensory experience. On the one hand, virtual space replicates the intentional structure that the world presents to us: space moves with me, shows itself and hides itself in relation to my gaze, and declares its secondary qualities (for example, showing itself to be narrow and oppressive, or disorienting – all qualities that are related to a certain kind of subjective experience). On the other hand, even if they are "embedded" in a virtual environment, the subjects still maintain an interior distance, a remainder of objectivity; they know that they are in a representation, just like at every moment they know that their own body is only an *analogon* of the sentient one, which allows them to have a mediated, self-observed experience, and to register its effects. If virtual space is a distant relative of the sketchpad, the body that explores virtual space is a distant relative of the pencil that draws in the sketchpad, or more precisely of the manual intelligence involved in that experience. The risk of virtual reality causing the architect to lose an authentic relationship to space, or to "authentic space," is, when taken from this point of view, less serious than one might fear – and all the more so due to the fact that VR does not by any means claim to substitute itself for the traditional forms of mediation, translation, and representation of

space, but rather to integrate them into its own capabilities. Furthermore, VR remediates within itself many media to which we have long been accustomed, from the drawing pad to the cinema; from this perspective, rather than eliminating all mediation, it entails a deep and layered media culture. This is also confirmed by the educational usage of VR, given that in order to adequately use it, the students will necessarily continue to move through the representational languages of different media (from manual design to CAD, as well as the photos and films that can be made within virtual reality).

2. The Contribution of VR to the Phenomenological Study of Space

On a general consideration, the use of virtual reality in the architectural context can be summarized in four points. These, as we will see, were developed in the course through a series of exercises.

1) *VR allows for the modification of space at will, and for the verification of its effects on perceptual, emotional, and cognitive levels (depending on what one is interested in determining) in an immersive environment.*

For example, the height of a ceiling is, from one point of view, objective and mathematical, identical in any space. It is what it is, regardless of other spatial variables like colour and depth. Within the perceptual dimension, however, things proceed very differently, since all of these variables intertwine and influence one another in a manner so clear that to define it as subjective would be misleading. The depth of space modifies the perception of height in direct proportion to its increase. This can easily be experienced in virtual reality precisely because it only applies to a sentient body, which on paper does not exist. Experiments of this type can examine the relationship between colour and spatial perception, the modification of an environment through light (or shadows) depending on the hour of the day or the season, the perception of one's centre of balance in space, the relationship between different scales, the relationship between different volumes and shapes, synaesthesia, and many other analogous situations.

2) *VR allows for the implementation of "phenomenological variations" and the experiencing of their effects on different levels: aesthetic, psychological, ontological.*

The use of phenomenological variation (a Husserlian expression that I use very freely here) within the context of the project meant the possibility of varying one or two special elements, altering in a controlled way their position, breadth, depth, and other characteristics. One can, for example, modify the perception and geometry of an entire environment by changing where the entryway is located, thus deforming the environment in relation to the observer's centre.

Depending on the breadth or depth of the entry, the experience of entering, and of the relationship between outside and inside, is modified. Depending where the two entries in a room are located – given that these establish between themselves, on a perceptual level, a reciprocal connection, a sort of invisible corridor – space will be "sliced" by that connection in different ways, redistributing internal space and generating areas (compartments) of variable shapes and dimensions.This method requires experimenting with a limited and controlled number of variations, and that the results be recorded from a perceptual and even ontological point of view. The dimensions of a window can be varied in such a way as to produce significant aesthetic discontinuities, but beyond a certain threshold of size the window changes in nature, becoming, for example, a glass door (if it alludes to the possibility of transit, taking on the potentiality of an opening-threshold), or a glass wall, where wall and window meet, each giving up one of its intrinsic potentialities (in the case of the wall, the possibility of visually separating spaces, and in the case of the window, that of connecting an inside to an outside atmosphere). The exercise of variation can take on many forms, all useful for testing a wide range of spatial effects with aesthetic, symbolic, or even ontological significance. To give a final example, which highlights the possibilities of VR, we might think of the effect of all of the possible variations applied to the height of a small room, from the minimum or even insufficient measurement to a generous one, say of 3 meters, up to a decidedly out of scale measurement of 10 or 20 meters. This modification allows for the discovery through intuitive evidence of the discontinuous relationship between stimulus and perception, or of the differential thresholds that punctuate the qualitative passage from one psychophysical condition to another (claustrophobic, comfortable, roomy, oppressive, etc.). The qualitative thresholds can also cause a change in the sense of space itself. For instance, a space in which the ceiling is too low will not be perceived as inhabitable. Habitability is a spatial quality that requires a certain minimum height, even if it is still a claustrophobic one. But if one exceeds this measurement greatly, one enters into a new context of meaning, for example that of an artistic installation, and space takes on a poetic significance that it did not have before.

3) *VR allows for the firsthand study of relationships between form and meaning*

Here, I turn to the field of Gestalt psychology, and more particularly to the possibility of simulating and studying phenomena of orientation and mental maps (at the base of which lie the tools of the psychology of shapes). To once again in this case offer some examples, one might think of virtual space as a site in which to experiment with different strategies for functionally dividing up space, for grouping families of objects on the basis of the principles of "figural unification," for generating rhythms, for anticipating the sense of space (directions and meanings), and for inducing motor responses. Within this field

of experimentation also lies the possibility of giving symbolic significance to a certain element of the environment (for example, the main entrance, the most important painting, the state room, etc.) as well as that of articulating in various modes the relationship between voids and solids, distances, or objects with different shapes and sizes.

4) *VR allows for experimentation with the constitutive factors of atmospheres*

This fourth point is the result of the interaction between all of the preceding spatial components and their relative interactions, and thus cannot but appear last. Experimentation with the constitutive factors of the atmosphere becomes explicit when attention is shifted to the holistic aspects of the environment, the emotional impact that the space has on us, and the moment of encounter with an atmosphere and the way it can be an object of design. The usefulness of virtual reality in respect to the phenomenological analysis of atmospheres is clear: precisely because an atmosphere is in itself an immersive and synesthetic phenomenon, it can only be observed through bodily presence. One is always *inside* an atmosphere, to the point that the very presence of a certain atmospheric connotation defines, when perceived, the confines of an interior (the interior of a work of architecture, of a certain city or neighbourhood, or of a particular culture, etc.). VR thus shows itself to be extremely effective as a tool for the analysis of the psychological aspects of atmosphere, facilitating an applied atmospherology. The various aspects that comprise the atmosphere of a place, that is to say its social and emotional characteristics, can become the object of critical analysis and can be used for the revision of designs. Within this field of experimentation there is also the possibility of observing space from any desired perspective and of moving, even if in a limited way, in a manner that unites visual and synesthetic experience.

3. The Course

The course (held for the first time during the first semester of the 2022 academic year) was divided into a wide introduction and 5 units. The introduction delivered a reflection on the relationship between body and space, bringing to light some of the fundamental issues in Merleau-Ponty and Heidegger's phenomenological approaches (Heidegger 2000; Merleau-Ponty 1945). Through the definition of these concepts and the relationship between them (space as correlate of the activity of a living body, as environment, as site, as a felt, perceived, lived space, invested with meanings), the course established a theoretical basis sufficient for understanding its aims[1].

1 Subsequently, together with Dr. Fabrizia Bandi, I edited an anthology entitled *Corpo, spazio, architettura. Fenomenologia dell'esperienza spaziale*, Morcelliana, Brescia 2024. The anthology

The first unit was dedicated to the theme of thresholds, or rather to the diverse configurations of the divide between interior and exterior that make the experience of space as a place possible (the possibility of "entering" or accessing that only the crossing of a threshold allows). Experimenting with the different thresholds that comprise space and mastering their rhetorical significance means knowing how to articulate space like a complex text, full of caesuras, connections, leaps, transitions, and transformations. Especially for architects, it is literally a fundamental issue. Le Corbusier writes:

> I ask a young student: how would you make a door? With what dimensions? Where would you place it? In which corner of the room would you have it open? Do you understand that these different solutions are the are the very basis of architecture? Depending on the way that one enters into an apartment, on where doors are located in the walls, you feel very different sensations, and the wall that you that you drill likewise takes on very different characteristics. You then feel that this is architecture. (Le Corbusier 2015, 182)

Each threshold represents a critical point in space because it is called upon not only to manage the different practical and symbolic functions of the environment, but also the relationship between seemingly irreconcilable opposites: interior and exterior, public and private, the familiar and the foreign, the inside and the outside. The phenomenology of thresholds thus aimed to show through numerous examples how the threshold could be designed and conceived of in different ways depending on goals and intentions (aesthetic, symbolic, practical). The second unit, which clarified some of the theoretical elements already present in the first, analysed the principles of field theory, or better, an ensemble of theories based on the shared presupposition that a space occupied by volumes does not coincide with their physical space, but extends beyond it, without however being independent of the originating form (Arnheim 2009, Portoghesi 1971, Marcolli 1971 and 1978). To quote Paolo Porteghesi:

> By emphasizing the generated field in addition to the architectural object, one raises once more the problem of space, but in different terms by giving the concept a different value. In traditional criticism space is aa homogeneous structure, a kind of counterform to the mural envelope, indifferent to the lighting conditions and to its position in relation to the buildings, whereas the notion of field stresses the continuous variability of what surrounds the architectural structures" (cited in Arnheim 2009, 31).

The field thus coincides not with the borders within which everything is enclosed, but with a certain arrangement of forces and vectors acting in space.

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brings together a series of classic and recent contributions on the body-space relationship, also considering, in the last section, the specificity of virtual space.

Space thus becomes an active and reactive environment: a field of psycho/physical forces. Every volume present in the field, by virtue of its mass and its shape(s), changes the field's appearance. The field generated through design deeply affects our perceptual schemas through the play of forces that act within it. But within the concept of field, the concept of centre, already encountered in the previous unit, plays a fundamental role. While geometrically a centre is simply a point, perceptually it extends as far as the conditions of stability that it is based on will permit. Of course, the centre may or may not be indicated. In architecture, it can be indicated (or suggested) by a ceiling lamp, a mobile, a decoration, or a mosaic. Or, it can be an empty space at the centre of two diagonals or of the geometry dictated by the positions of the thresholds. Normally, however, there are multiple centres at work in each field, each of which attempts to prevail over the others. The unit thus brought attention to the problem of the interaction between fields of different shapes and strengths, suggesting the possibility of making corrections to one's designs by working on the centres, the directions of the volumes that generate the field, or their distance from one another. This illustrates the concept, well known to phenomenology and cognitive psychology, that space is born as the relationship between objects. On the basis of this idea, shifting attention from the shapes of objects and their interaction to the void that separates them, the lesson then also discussed the concept of "interspace," and along with it the fundamental law of attraction-repulsion: "Objects that look 'too close' to each other display mutual repulsion: they want to be moved apart. At a somewhat greater distance the interval may look just right or the objects may seem to attract each other." (Arnheim 2009).

The third unit insisted on the importance of understanding the multisensorial character of perception since, whether one likes it or not, space communicates with bodies in this way, through the intertwining of different perceptual faculties.

> Synaesthetic perception – claims Merleau-Ponty – is the rule, and we are unaware of it only because scientific knowledge shifts the centre of gravity of experience, so that we have unlearned how to see, hear, and generally speaking, feel, in order to deduce, from our bodily organization and the world as the physicist conceives it, what we are to see, hear and feel . . . The senses intercommunicate by opening on to the structure of the thing. One sees the hardness and brittleness of glass, and when, with a tinkling sound, it breaks, this sound is conveyed by the visible glass. One sees the springiness of steel, the ductility of red-hot steel, the hardness of a plane blade, the softness of shavings. (Merleau-Ponty 1945, 266-267)

By relativizing the predominance of sight in the structure of perception, the theorists of synaesthesia invite us to discover the persistence of "unauthorized" sensory registers (like sound and temperature in colours, or touch in something perceived visually), which condition experience in mostly unconscious and unconditioned ways. The many examples referring to the field of architecture had

the aim of leading the students to a decisive point: given the original complicity between body and space, to design means, perhaps before anything else, to organize a complex perceptual environment in which each element not only has multisensory potential in itself but also inevitably relates with that of the others. By experimentally testing the synesthetic effects of the designed space in virtual reality, intertwining their own bodies with it, the students had a way to determine the results of their choices on multiple perceptual levels. These could work towards creating syntonic or dystonic effects, or could play with the composition of different synesthetic qualities within the same element, for example, combining a given material with a colour that contrasts with it in temperature.

The fourth didactic unit was dedicated exclusively to the topic of light and colour. The reason for this choice resided primarily in the importance of these two factors for spatial perception (in various ways: from coloured light to the relationship between natural light and materials that reflect it). Furthermore, light and colour play a decisive role in the connotations of atmospheres. In dialogue with various others, from Goethe (1970) to Conrad-Martius (1923 and most importantly 1929), from Sedlmayr (2009) to James Turrel (2018, Govan 2013), the lesson highlighted both aspects: the perceptual dimension and what Conrad Martius calls "the character" of light, or rather the way in which a given property of light is intermittently given expression. Light is undoubtedly a special atmospheric agent, since temperature and colour can give space a very clear emotional timbre. But it can be used—as in the phenomenological art of James Turrel and Robert Irwin—to change the form of space, up to the point of distorting it and erasing its borders.

VR is a unique instrument for testing how light reacts to surfaces, their textures, and their colours in the widest range of different conditions (for example, depending on the time of day, and also by adding natural light to artificial light sources). It is also useful, though, to create spaces and spatial languages linked to the psychology of shapes. Five possible functions of light capable of perceptually altering space in respect to different design aims: illumination, indication, division/unification, connection, creation of rhythm. Of course, each of these functions raises specific questions (the type of light source and its temperature, the shape and position of the light sources, the relationship between light and darkness, background and foreground, etc.), but in a theoretical sense, the exercise aimed above all to demonstrate the potential applications of a complex theoretical framework like the one mentioned above.

Finally, the discussion turned to the phenomenological theme of atmospheres, a field that, as already noted, could only appear last, once the basic elements for an analytic understanding of the body-space relationship had been acquired. With few exceptions, "atmosphere" is a concept used in a very intuitive way by architects, yet is central to their specific form of spatial intelligence. It is here that VR perhaps offers its greatest contribution: it is one thing to

introduce students to the thought of the usual authors on the subject, such as Böhme (2002, 2010), Norberg-Schulz (1991), Schmitz (2012), Ströker (1987) or Zumthor (2006), and quite another for them to have the chance to analyse atmospheres from within, to study their perceptual effects, and to modify their factors in the desired (often experimental) way. Describing the extraordinary power of atmospheres to influence our mood is much simpler and more effective when one has the possibility of interacting with a virtual environment. From within these environments, variation in light can be understood atmospherically in all of its significance.

Thanks to VR, the symbolic and potential connotations of an atmosphere – which are often an involuntary outcome – can finally become the objects of direct experience, which would otherwise be impossible.

The final didactic unit dealt with the theme of spatial orientation on the basis of the line of research opened up by the work of Kevin Lynch (Lynch 1960, Letenyei 2019). At the basis of this choice are two assumptions. The first is that Lynch has given us a scalable methodology, which can also be effective when applied to interior spaces. The second is that such a methodology, based on psychology of shapes and on a study of mental maps that we might say are akin to phenomenology, places itself in continuity or in dialogue with the content already explored in the preceding units of the course. The formation of mental maps takes place in the interaction between subject and environment. On a cognitive level, for Lynch the maps reveal the constant presence of five elements, which we can also define as structures, in the sense that they structure the experience of (urban) space by connecting it back to a universal mental schema. Such irreducible elements, even if they are not necessarily always co-present, are the path, the edge, the district, the node, and the landmark. A space's degree of comprehensibility, or rather our own capacity to orient ourselves in space and to have a clear mental image of it, depends on the form, character, and composition of these structures. The capacity of design to give spaces identity, structure, figurability, and meaning is fundamental in fostering a positive interaction between subject and environment, or even to induce emotional well-being. This gives us the capacity to anticipate how space will be understood, to support our spatial awareness (and hence our confidence in the space), and to develop a positive identification with spaces. Using only the spatial language of the five fundamental elements (appropriately scaled) and working in syntony with the principles of the psychology of shapes, the students were asked to give their design a high cognitive value for the users. VR is a very useful tool for studying phenomena of orientation and environmental image. Its usage, however, can be extended to other psychological aspects related to the design of the environment, as for example to the concept of affordance, which in Gibson's language refers to the physical qualities of objects that suggest to a subject the appropriate actions for manipulating them (Gibson 2015).

Descrizione

Stanza 1
- *Essenziale*
- *Croma prevalente grigio*
- *Texture ruvide*
- *Pareti in calcestruzzo*
- *Pavimento in pietra*
- *Soffitto e parete di fondo intonacato*

Stanza 2
- *Luce naturale abbondante*
- *Spazio neutro*

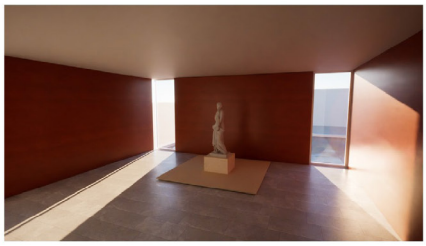
Percezione

Stanza 1
- *Spazio arioso*
- *Minimal*
- *Pulito*
- *Fresco*
- *Rigido*
- *Ruvido*

Stanza 2
- *Abbagliante*
- *Fresco*
- *Arioso*
- *Liscio*

AIS200/23/ Irene Gallus, Matteo Nava, Alex Dumitrescu, Miriam Masala

Figure 1a. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023).



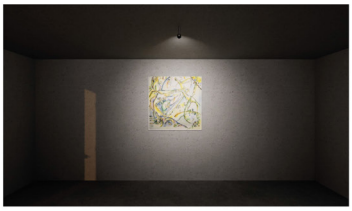
Stanza 3
- *Pareti e soffitti intonacati*
- *Luce abbondante*

Stanza 4
- *Pareti in legno di mogano*
- *Pavimento in pietra*
- *Soffitto intonato*
- *Luce naturale abbondante*

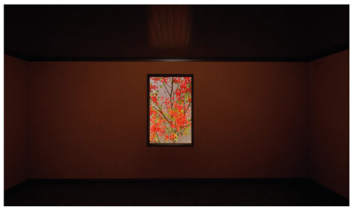
Stanza 3
- *Luminoso*
- *Accogliente.*
- *Casalingo*
- *Fresco*

Stanza 4
- *Avvolgente*
- *Caldo*
- *Luminoso*
- *Richiama la natura*
- *Liscio*

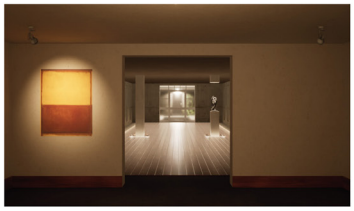
Figure 1b. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023).



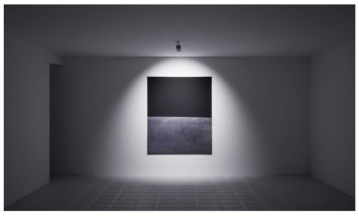
Gruppo 1



Gruppo 1



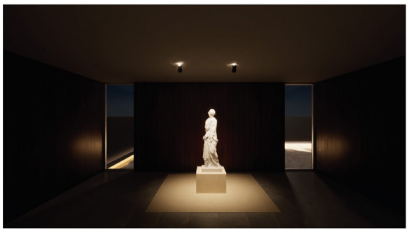
Gruppo 3



Gruppo 4

Luce come strumento per mettere in evidenza i riferimenti

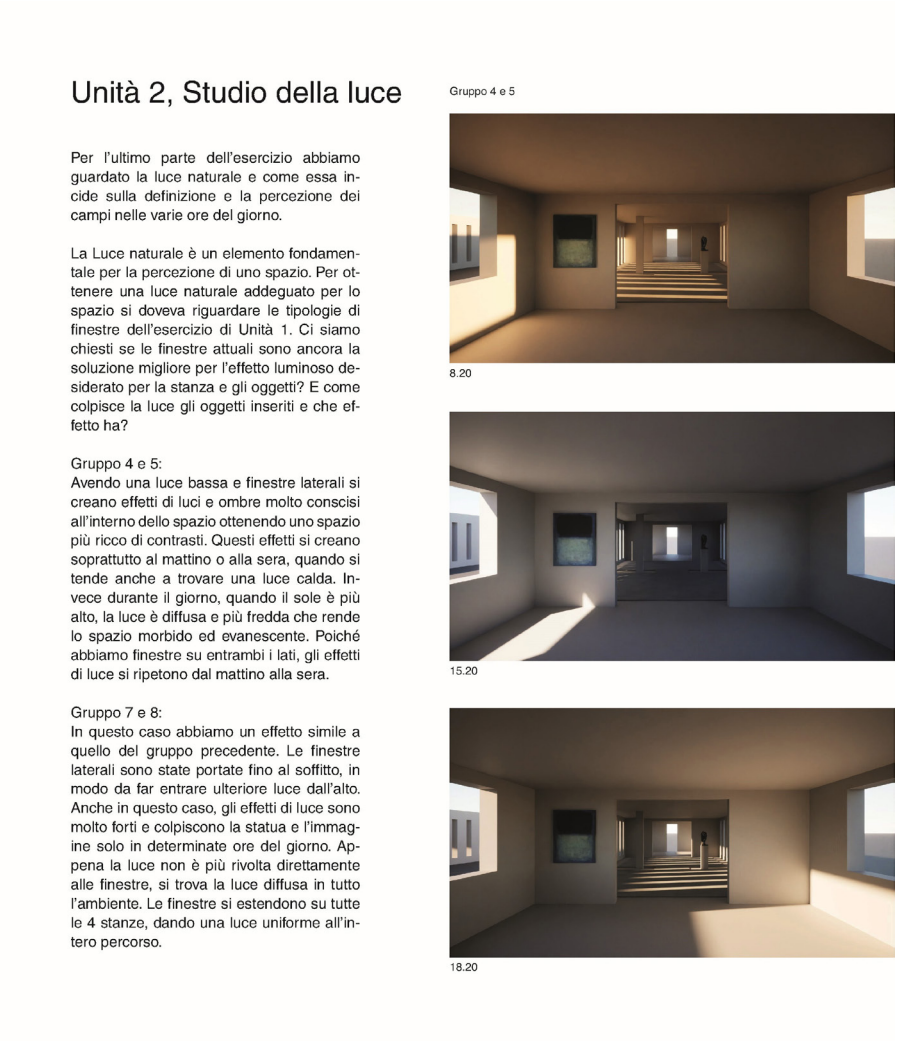
Figure 2a. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023).



Gruppo 2

Gruppo 5

Figure 2b. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023).



Unità 2, Studio della luce

Per l'ultimo parte dell'esercizio abbiamo guardato la luce naturale e come essa incide sulla definizione e la percezione dei campi nelle varie ore del giorno.

La Luce naturale è un elemento fondamentale per la percezione di uno spazio. Per ottenere una luce naturale addeguato per lo spazio si doveva riguardare le tipologie di finestre dell'esercizio di Unità 1. Ci siamo chiesti se le finestre attuali sono ancora la soluzione migliore per l'effetto luminoso desiderato per la stanza e gli oggetti? E come colpisce la luce gli oggetti inseriti e che effetto ha?

Gruppo 4 e 5:
Avendo una luce bassa e finestre laterali si creano effetti di luci e ombre molto conscisi all'interno dello spazio ottenendo uno spazio più ricco di contrasti. Questi effetti si creano soprattutto al mattino o alla sera, quando si tende anche a trovare una luce calda. Invece durante il giorno, quando il sole è più alto, la luce è diffusa e più fredda che rende lo spazio morbido ed evanescente. Poiché abbiamo finestre su entrambi i lati, gli effetti di luce si ripetono dal mattino alla sera.

Gruppo 7 e 8:
In questo caso abbiamo un effetto simile a quello del gruppo precedente. Le finestre laterali sono state portate fino al soffitto, in modo da far entrare ulteriore luce dall'alto. Anche in questo caso, gli effetti di luce sono molto forti e colpiscono la statua e l'immagine solo in determinate ore del giorno. Appena la luce non è più rivolta direttamente alle finestre, si trova la luce diffusa in tutto l'ambiente. Le finestre si estendono su tutte le 4 stanze, dando una luce uniforme all'intero percorso.

Gruppo 4 e 5

8.20

15.20

18.20

Figure 3a. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023).

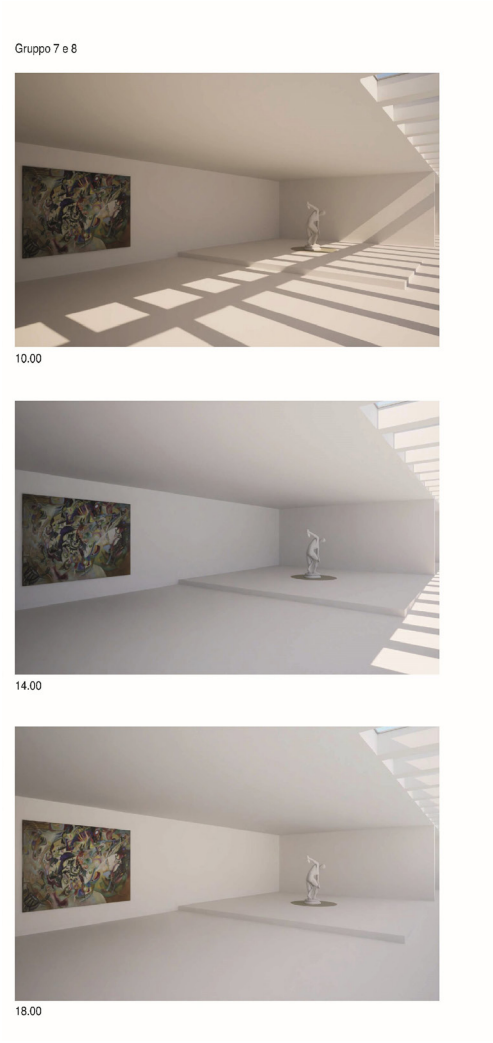


Figure 3b. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023).

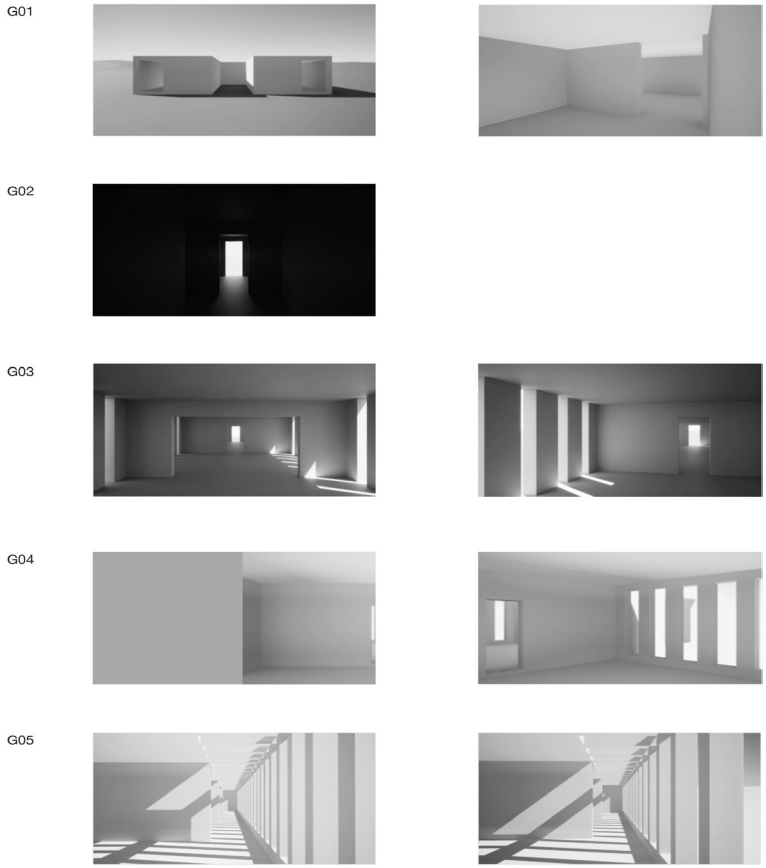


Figure 4a. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023)

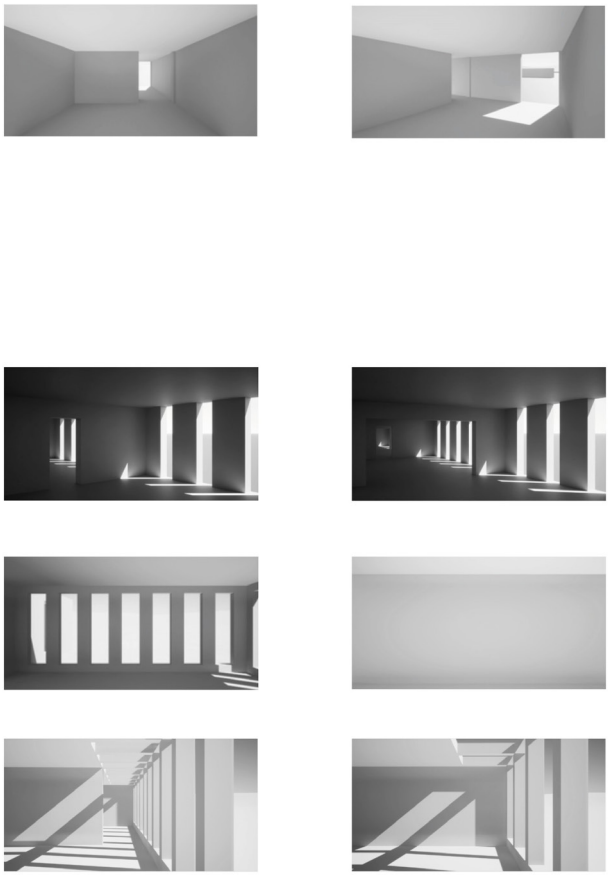


Figure 4b. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023)

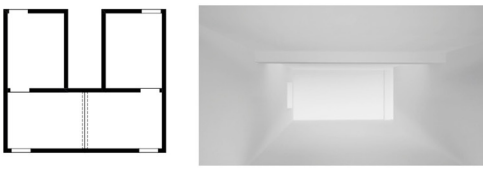
Unità 1.4

In questo esercizio la parete interna è stata sostituita con un elemento soglia, le soluzioni scelte infatti sono diverse tra loro in modo da capire come può modificarsi lo spazio.

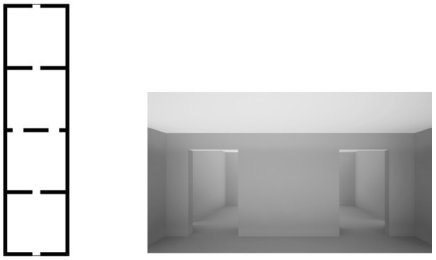
- L'uso del gradino risulta essere un elemento debole se utilizzato singolarmente, in quanto risulta una soluzione percependo un unico spazio, bisognerebbe quindi stabilire una gerarchia dettata dal gradino e lo spazio rimanente o inserire un elemento aggiuntivo come una pedana.

- La presenza della trave determina un abbassamento in corrispondenza del varco e dunque, un segnale visibile e percepibile di una differenziazione di spazio. Tuttavia, le due stanze rimangono invariate e dunque, questo elemento architettonico non è in grado di sostituire a pieno la presenza percettiva di un vero e proprio varco soglia.

- La soglia è stata bensì duplicata sull asse orizzontale con diverse dimensioni.
È stato analizzato come cambia la sensazione tra attraversare una soglia stretta e una larga.
Attraversare una soglia stretta causa una sensazione di compressione e confinamento ma anche di intimità con ciò con cui ha un contatto ravvicinato.
Mentre attraversare una soglia larga crea sensazione più positive, tra cui apertura, accoglienza e una transizione graduale tra gli spazi.
Il passaggio risulta fluido e continuo, ciò può far sembrare i due spazi connessi.



G01



G02

G03

Figure 5a. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023)

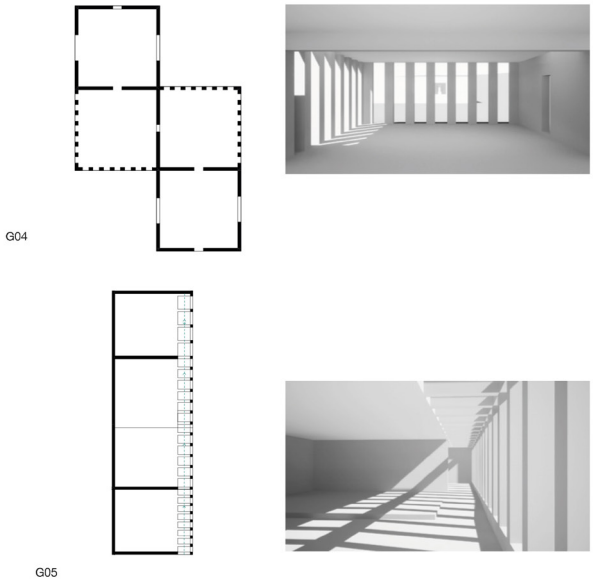


Figure 5b. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023)

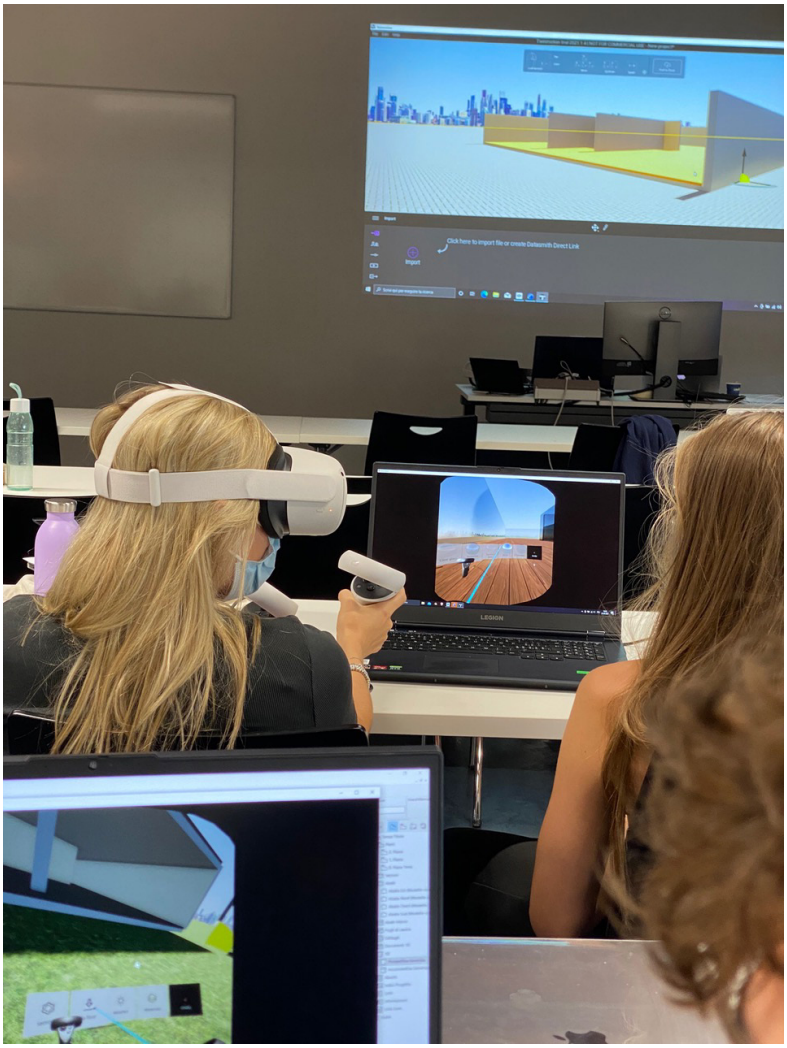


Figure 6. Final presentation of a selection of spatial experiences in virtual reality developed by the "Phenomenology of Space" class, SUPSI-DACD (2023)

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Interview with Valentina Temporin, ULTRA

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DOI: 10.54103/milanoup.223.c381

Abstract

This text presents an interview conducted by Fabrizia Bandi with Valentina Temporin, co-founder with John Volpato of ULTRA, a project focused on virtual design, immersive environments and new technologies.

Keywords: Digital Architecture; Virtual Reality; Maurizio Sacripanti, Osaka '70.

Abstract

Questo testo presenta un'intervista condotta da Fabrizia Bandi a Valentina Temporin, cofondatrice con John Volpato di ULTRA, un progetto incentrato sul design virtuale, gli ambienti immersivi e le nuove tecnologie.

Parole chiave: Architettura digitale; Realtà virtuale; Maurizio Sacripanti; Osaka '70

This text presents an interview conducted by Fabrizia Bandi with Valentina Temporin, co-founder with John Volpato of ULTRA, a project focused on virtual design, immersive environments and new technologies.

F: Let's begin with the origins of ULTRA. How did you approach virtual reality? You and John have different academic backgrounds, how did your project come about?

V: I come from a background in architecture and John from a background in art and new technologies. I studied at the IAUV, in Venice, and John at

the Academy of Fine Arts. We both had previous careers in Venice linked to technological innovation, which had already broadened our research fields, but were not yet focused on what we are doing now. When we met, he and I were combining spatial design with technology to create immersive interactive environments. We met in a laboratory in Rovigo, *Poplab*, which is part of the Science and Technology Park/Galileo Visionary District in Padua, a hub for innovation in architecture and design. As part of this experience, we decided to purchase a virtual reality headset. It was an environment that was already rich with tools tightly linked to Manufacturing 4.0, such as milling machines, 3D printers and the Internet of Things (IoT). For instance, John and I had collaborated on a project that later won an award from Eni on the use of IoT technology in photovoltaics. So there had already been a form of experimentation in that direction: the idea itself of experimenting with new technologies, especially with potentially interested companies in mind, was in fact a testing ground linked to the Venice Region General Confederation of Industry.

F: Virtual reality is more than just an image. Through this medium, we can enter and explore a digital environment designed for interaction, not merely observation. What opportunities have you discovered in VR as a designer and creator?

V: Initially, the purchase of the headset was intended as a way to make our project presentations in physical spaces more compelling, and then as a working tool to draw clients closer to the projects we conceived. Yet from the moment we first tried it, we realised it was a much more powerful medium than that. We understood that VR was not merely a tool for showcasing a project in physical space, but also a powerful medium for displaying content directly into virtual environments, content designed specifically for virtual spaces. We realised how involved users were in this kind of project narrative. Later we won public funding from the Veneto Region, which aligned with our vision. This project gave us an opportunity to experiment with this perspective.

F: Let's now discuss the work that brought us together, *Osaka '70* (Fig. 1), a work dedicated to an iconic and visionary project of kinetic architecture that was never actualised. How did the idea for this project come about during such a "particular" time – that of the pandemic – when virtual reality was creating new possibilities for connection?

Figure 1. *Osaka '70*, ULTRA

V: We won the project at the end of 2019 and started working on it in February 2020. We all know what happened after that, but I think it gave us an additional incentive to continue. The health emergency somewhat transformed the original direction of the project: it led us to consider a multi-user mode of interaction within the virtual environment, a now crucial element in our work. Initially, the first prototypes of this experience, *Osaka '70*, were in single-player mode. Later, we reconsidered our approach to the project, because we had few social interactions and we were locked inside our labs and homes.

We wanted to bring it to the public, so on the one hand we imagined a home tour: instead of exhibiting the work in a museum space, we would be taking it to the homes of architects, designers, professionals. This was an intriguing first step. But on the other hand, we wondered how, despite physical distance, we could create a connection, you could say an empathic connection.

F: Indeed! One common criticism of this medium is precisely that it promotes isolation: popular works often involve only one person at a time, suggesting a solipsistic experience.

V: Yes, *Osaka '70* prompted us to explore a different direction, driven by the need to create something that would allow us to illustrate this content, Maurizio

Sacripanti's project. One of the first people we shared it with was architect Franco Purini, who was Sacripanti's young assistant at the time of the project's inception. We thought it was essential. We got him involved in the project and demonstrated how it was done. We were very concerned because he belongs to a different generation and we feared that he would not fully grasp this method of navigating a virtual environment. This circumstance prompted us to consider a guided mode of experience: entering together, creating a story, a narrative, guiding participants as if in a museum.

F: Drawing from our experience as a user research group, bringing unrealised projects to life requires a delicate balance between preserving their original elements and integrating them with creative innovations. I'd like to ask you now about the challenges you faced with *Osaka '70*, but also about the beauty you uncovered in "manipulating" and interpreting Maurizio Sacripanti's work.

V: Yes, there were different stages and levels of awareness along the way, as it was our first encounter with this technology. At first, we took the classic approach of studying and researching Sacripanti's documents. It was then that we realised that some details had been omitted: and they weren't simply missing, we realised that he had not considered it useful to delve into the details of a project that had to be, first and foremost, an expressive icon. So, we came to the conclusion that we had to create an environment where what was missing could not be concealed. In a virtual space everything is visible. Everything is explorable, so we couldn't fool anyone. On the other hand, we didn't want to add fictitious elements, that we had no record of, so we tried to research some missing aspects through interviews with people who had worked on the project. Other elements we decided to completely omit, and that was when we realised that the project's essence was not in showcasing, but in translating what we had, granting the visitors a degree of freedom. We let them imagine what the final design could be, using each individual's imagination to shape the project in its entirety and complexity.

For us, this is what it means to interpret a piece: bringing to light what was most important to Sacripanti at the time, which is the idea of dynamic architecture. It was clear that dynamic architecture was the project's protagonist and at that time he did not need to define the materials for the balustrade or the height of the step, and the same was true for us. We decided that the key to the interpretation of these drawings was specifically the theme of dynamism, so we focused on that: we meticulously reproduced the dynamic aspects of the project. As for the structure, we also tested its feasibility, while leaving other details broadly sketched. We always emphasise to our audience: this is not the realisation of Sacripanti's construction, but his vision of this project. This is an important distinction. It's a bit like taking a tour inside his head. We've seen

other digital reconstructions of the *Osaka Pavilion*, almost down to the last detail. But we believe that this is not the best way to create an immersive work. You run the risk of taking the author's place**,** leaving no room for the audience to interpret and imagine.

F: Yes, of course. It's like gaining access to the creative process rather than looking at the finished work. It's a very different experience. In the Virtual Architecture course you held at the Raffles Institute in Milan, you presented other projects of buildings that were never constructed, could you tell us about them?

V: Yes, it was a very challenging experience. What I aimed to convey to the students was the narrative quality that can be created through the virtual space at our disposal. What we need to convey is not so much the raw drawing, the model, as can be seen even in the preliminary sketches. Rather, it is the narrative that unfolds within, driven by sensations. The atmosphere, noises, sounds, and lighting are also very important. A particularly talented student in the course presents the case study of a synagogue designed by Louis Kahn that was never built in Jerusalem. She recreated an atmosphere with a dry light, an almost dusty interior, as if there truly was a desert outside.

F: You got me thinking about the whole matter of atmosphere. The philosopher Gernot Böhme talks about atmosphere generators, including sound and light. These fantastic atmospheres – not in the sense of unreal – are on the contrary very real, tangible, felt on the skin. They have to do with our bodies, albeit shifted and relocated. Virtual space seems to offer us a deeper understanding of the physical one, as if it were a kind of reverberation. Jean Baudrillard and Paul Virilio, among others, argued that the virtual, the digital, the simulated might engulf the real, but perhaps one way forward is to view the virtual as something that gives us back a sense of the real. The light, the sound... I loved your description of this environment as "dusty" because it evokes a multi-sensory dimension. VR is all about stimulating the senses, and one could argue that these environments also foster a particular form of multisensory experience.

V: Yes, you're right. Sight does dominate, that's true. But the challenge lies in being able to activate the other senses without neglecting those that are inaccessible at that moment. It's a new way of experiencing that dimension too, of expanding in a different way within a space. As you say, there is a return, a reverberation.

F: It's a delving within, a reactivation of aspects that we don't normally use in this way. Pierre Lévy, echoing Gilles Deleuze, argues that the virtual relocates us, compelling us to rearrange ourselves according to the environment.

V: Among creatives, this critical awareness has certainly not yet developed. We're still in a phase of experimenting and perhaps an understanding of the results will come later.

F: This is another important point: the spread of the medium as a creative tool. The age of consciousness, as Vilém Flusser put it, takes a certain amount of time. Another project of yours, *The Deception of the Senses* [*L'inganno dei sensi*] (Fig. 2, 3), I found particularly interesting in regards to this subject matter. I would be curious as to how it has developed and what form it has taken today. I think this work is particularly important because you've created an experience in a *mediarcheological* perspective – that's one of the axes of the AN-ICON project we have developed at the University of Milan.

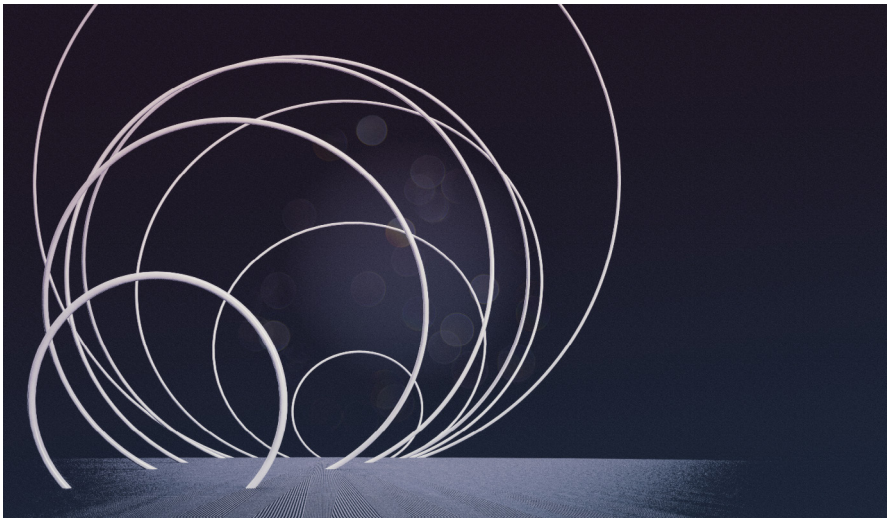

Figure 2. *The Deception of the Senses [L'inganno dei sensi],* ULTRA.

V: *The Deception of the Senses* is a project that made us more aware of the tool. This experience is a contemplation of the special relationship between the work of art and the viewing eye, when the work of art itself asks its viewer to be integrated into the apparatus, to participate in its construction and trigger the magic of illusion. Immersive virtual reality is now seen as a powerful tool to exploit the deception of the senses, but the process itself is not new; in past centuries, increasingly effective objects and machines were built to stir the audience's

curiosity and steer it to a possible elsewhere. Ultra therefore proposes an investigation into the ancient relationship between the physical world and its possible extensions. We became clearer about what we wanted to achieve. Undoubtedly, through this work we realised that an important element for us was to be able to guide the public across virtual spaces. In the initial stage of the path a series of objects are placed around the visitor, evoking the deception of the senses and the search for a possible elsewhere in past ages, from the stereoscope to the magic lantern, a phase in which one remains somewhat passive. However, in the final stage of the experience, there is a generative, active part where participants engage interactively with each other. We aimed to incorporate the role of the guide figure, who we call a "human performer," more consciously into the experience. We use this term to denote someone who accompanies the audience and activates specific modes of engagement within the virtual world. We consulted with a company of actors who began contemplating what it means to perform for a virtual world**,** where there isn't, let's say, an audience standing in one place, there isn't a stage and a defined space, but a whole realm of possibilities. Compared to what you experienced, this work has now been optimised and we have presented it at several international festivals. However, feedback highlighted that a multiplayer and guided work is complex to set up and manage during events. This made us wonder about the future of VR. We genuinely questioned, as authors, which direction we should pursue. We know of successful location-based multiplayer works that are showcased internationally, but we wanted to explore something different, so now we are also exploring the relationship between single player and space.

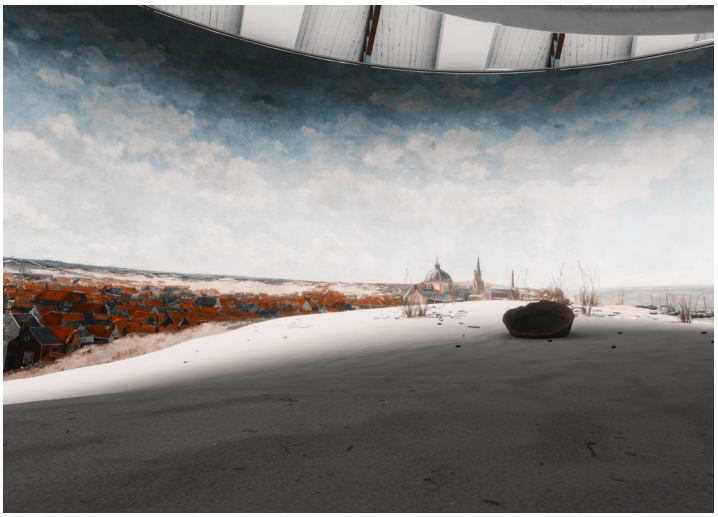

Figure 3. *The Deception of the Senses [L'inganno dei sensi],* ULTRA.

F: When you work with single players, the intimacy is different. Perhaps you focus more on the sense of presence that VR gives you, the so-called *being there*.

V: Yes, definitely. It's also fair to think that these works should be enjoyed by as many people as possible. So we need to find a formula that is sustainable, which makes it accessible to the public, otherwise we would be creating works for a select few. For that reason**,** we're focusing on formats that still support multiple users, but may not require a guide.

F: Where do Italian institutions stand regarding VR? From my experience as a user, I have to say that there are few contexts in which I've found adequate preparation, especially when the works require physical movement. Unfortunately, this can sometimes detract from the experience itself.

V: It's fair to say that finding exhibition spaces perfectly equipped to host VR works is still challenging. Even distributors don't like the idea of curating an *ad hoc* installation, organising a suitable space and following it up from a technological point of view. Sometimes museums lack the necessary tools: a work designed for Quest 3 may not be compatible with Quest 2. In contrast, in France, they are creating dedicated venues for VR experiences so as to broaden public accessibility to such works.

F: Staging and presentation to the public are also crucial aspects of the work, perhaps even more so than in other artistic genres at present.

V: Yes, absolutely. Last year we created a metaverse for a large company in Madeira. During the presentation, the CEO wore the visor and stood in front of a gathering of 350 people, with a big screen behind him on which the virtual world was displaying the virtual world. However, instead of simply mirroring the visor to the screen (which could have made the audience feel sick), we developed a software specifically to create a "second person ghost" that showed what the CEO was seeing, thus avoiding perceptual effects that would cause discomfort to the audience. So, there's a whole study that goes beyond content production.

F: Taking into account what we've discussed, what direction will your future projects take?

V: As I mentioned, we've revisited the concept of single-player experiences, imagining a kind of intimacy with space. We're proposing this format in our third work, *Our Place* (Fig. 3), based on a contemporary opera by Marco Gnaccolini. It's a very poetic, at times poignant, twenty-minute work that

explores themes of love, the passage of time and the accompanying emotions. This opera won the prize for best contemporary opera in Verona last year, and had its world premiere in May at a Chicago theatre, the Thompson Street Opera Company, with music composed by Marco Emanuele. We were quite taken with it and felt that the theme of the passage of time could resonate well with what virtual reality can achieve. The structure is ideal, consisting of short chapters set in different time periods but in a single location. We wrote an adaptation and presented it to Jole film, the Veneto-based production company founded by Marco Paolini. Almost everything will be expanded to integrate the narrative with the surrounding physical space, whatever that may be. A key aspect of the work is its focus on the user, who is the real protagonist of the work with nearly complete control over the narrative.

Figure 4. *Our Place*, ULTRA.

F: There's a lot of talk about artificial intelligence these days. Are you working with it? In particular, I was wondering if your work as creatives, as well as the experiences themselves, could somehow be part of this new technology?

V: We believe AI can become an integral part of the narrative. In *Deception of the Senses*, we hinted at this possibility: in the final chapter, set in a future world, there's a generative aspect: the user interacts with the environment (which has an algorithmic matrix), which responds to gestures by creating new forms. The reference to artificial intelligence is evident here. There can be elements in a scene that don't solely originate from the author's imagination, but from the interaction between the individual and the environment.

In a project we submitted to one company, we experimented with AI as a tool for the creative organisation of archives. I believe that this technology can be an essential resource in this field. For example: it can help in sorting through our seemingly unlimited possessions, both tangible and intangible. In our experimentation of this approach with this particular company, which has a huge textile archive, we imagined taking their archive, dividing it into thematic areas (patterns, colours, etc.) and creating a narrative experience in virtual reality, generating new images, patterns or colours. In this way, AI can serve as a tool which expands the narrative, making it truly generative.

Osaka '70, Narrating the Invisible*

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Abstract

Osaka '70 is a virtual reality project that revives a kinetic pavilion designed by Maurizio Sacripanti for the 1970 Osaka Expo, which was never realized. Coordinated by John Volpato and Valentina Temporin within the T.E.A.M. (Time Enhanced Architectural Modeling) research project, *Osaka '70* allows viewers to experience this visionary architecture, which integrates time and movement as core design elements. The VR experience, enriched with a virtual guide, fosters social interaction and honours Sacripanti's interdisciplinary approach and dynamic vision. Showcasing immersive virtual heritage, *Osaka '70* exemplifies how digital tools can reinterpret cultural artifacts and deepen our engagement with the architectural heritage.

Keywords: Digital Architecture; Virtual Reality; Maurizio Sacripanti, Osaka '70

Abstract

Osaka '70 è un progetto in realtà virtuale che rievoca un padiglione cinetico progettato da Maurizio Sacripanti per l'Expo di Osaka del 1970, mai realizzato. Coordinato da John Volpato e Valentina Temporin nell'ambito del progetto di ricerca T.E.A.M. (Time Enhanced Architectural Modeling), *Osaka '70* consente ai visitatori di esplorare questa architettura visionaria, che integra tempo e movimento come elementi essenziali del design. L'esperienza VR, arricchita da una guida virtuale, promuove l'interazione sociale e rende omaggio all'approccio interdisciplinare e alla visione dinamica di Sacripanti. *Osaka '70* dimostra come gli strumenti digitali possano reinterpretare il patrimonio culturale e approfondire il nostro rapporto con il patrimonio architettonico.

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Parole chiave: Architettura digitale; Realtà virtuale; Maurizio Sacripanti; Osaka '70

1.Introduction

Osaka '70 is an immersive virtual reality work that allows exploration of a never realised, extraordinary kinetic architecture, designed by visionary architect Maurizio Sacripanti and his project team. Sacripanti realised his most innovative projects between the 1960s and 1970s, using time as a design material, an architectural tool like any other. Among these unrealised projects is the pavilion that secured second place in the competition to represent Italy at the 1970 Osaka International Expo. In 2020, thanks to the T.E.A.M. (Time Enhanced Architectural Modeling) research project[1], coordinated by John Volpato and Valentina Temporin, the pavilion was brought back to life. To show the outcome of the scientific project, at a time when the pandemic and resulting restrictions prevented museums and exhibition venues to open, the project coordinators devised a home delivery format. This resulted in an itinerant tour, which also witnessed the emergence of the working methods that characterise Volpato and Temporin's work today: social experiences with several participants interacting within the digital environment and a virtual human guide who accompanies guests on their visit, ensuring respectful narration of the cultural content they are translating for the virtual environment.

The tour got one hundred Italian professionals involved: designers, architects, lecturers and museum directors. This offered numerous opportunities for discussion and the chance to have conversations about technology that is changing the way we see and transmit art and culture.

Osaka '70 is a clear example of how a virtual reality experience, conceived as an immersive digital work, can serve as a powerful tool for the dissemination of cultural heritage, while illustrating the importance of the chosen mode and language of representation in conveying the message in an effective, respectful and engaging manner.

1 T.E.A.M. - Time Enhanced Architectural Modeling was born in 2019 thanks to POP LAB s.r.l.'s winning of the Veneto Region POR FESR 2014-2020 Call for Proposals. The project team members were: Valentina Temporin, project coordinator; John Volpato, project coordinator and design manager; Pio Lorenzo Cocco, computational designer; Andrea D'Angelo, developer; Marco Tieghi, developer; Marta Grossi, communication consultant; Gabriel Pressman, English language consultant; and Luca Trombin, digital production support. *Osaka '70* and the other research products developed within the T.E.A.M. project were released as free software under the MIT licence: https://github.com/TEAM-Poplab/Osaka70.

2. Maurizio Sacripanti: The Architect and His Vision

Maurizio Sacripanti (a Roman architect born in 1916, who passed away in 1996) was always drawn to the conquest of the fourth dimension inspired and influenced by the avant-garde, but also by abstract art, kinetic art and programmed art, movements whose artists and leaders he personally knew and with whom he had an ongoing exchange of ideas and experiences. In designing the Osaka Pavilion, Sacripanti was able to materialise his lifelong pursuits, surpassing the architectural precedents of his predecessors.

As he himself wrote, "the architect's task is to take possession of technology and transform it into language," (Neri, Thermes 1998, 111) foreseeing the themes that would later develop in *high-tech* architecture in the 1980s. Franco Purini, dispelling any comparisons of Sacripanti's work with sterile contemporary experimentation, asserts: "Contrary to common belief, he was an architect attentive to functional issues, to the point of considering function itself the crevice through which to trigger the mechanism of invention." (Purini 1998, 18-19) The Osaka pavilion, in Paolo Portoghesi's words, is a Pantheon set in motion[2]. The adaptable arrangement of the elements that make up architectural space is not unique to the Osaka project alone, but a recurring theme in Sacripanti's work, which explored dynamic possibility in structures as early as the early 1960s. Examples include the design for the Peugeot Skyscraper in Buenos Aires, consisting of movable panels for the façade cladding, and the Teatro Lirico in Cagliari, inspired by John Cage's ballet performances [3] , where the floor and ceiling configurations define the space through variable arrangements. Fascinated by structural movement possibilities, Sacripanti also tried his hand at bizarre experiments in interior design such as a propulsion wardrobe, able to move around the different rooms of the house according to the actual needs of the user (Purini 2021).

In Sacripanti's work, alongside the pursuit of kinetics in architecture, there is an equally innovative feature: his interdisciplinary approach to each design challenge. He was a master "conductor," able to harness the talents of different professionals, such as physicists, engineers, artists, writers, designers. Even in his design lectures at La Sapienza University in Rome, he engaged his favourite artists in a fruitful, cross-curricular exchange with his students. Far from speculative mindsets and a true outsider in the university context, in his

2 From the *lectio magistralis Progettare il mutevole. Maurizio Sacripanti 1916-1996*, given in 2016 by Paolo Portoghesi.

3 "At the last Biennale, a ballet by Cage with sets and costumes by Rauschenberg was being performed. We went there. Upon entering, we were greeted by eclectic, mixed, pensive and remixed music. It was a new performance: no longer a scene with fixed objects, but a 'non-stage' organised with mobile elements and a language derived solely from the modularity of moving planes, painted dancers' bodies, material images, and tapis-roulants," Maurizio Sacripanti quoted in Giancotti, Pedio, 2000,18.

studio-workshop brimming with stimuli, inventions and visions of the future, Sacripanti's projects thrived on unpredictability, the latter understood as the impossibility of encapsulating the entirety of architecture in a single frame, due to the ever-changing nature of time and humanity. It is impossible to capture in a single frame the numerous configurations especially of his early works; perhaps the only way to grasp their essence is to walk through them and experience them. That is why we did not settle for digitally reconstructing the form and mechanics of the Osaka pavilion in detail; instead, we went so far as to create a virtual reality experience in order to immerse ourselves in it, finally becoming spectators of a dynamic and ever-changing architectural landscape.

3. The Osaka Pavilion Competition

The pavilion's design was submitted to a 1968 ideas competition to select Italy's representative building at the 1970 International Exhibition in Osaka, Japan[4].

In the project's accompanying report, Sacripanti and his team emphasise how International Exhibitions always serve as experimental platforms. Referencing pavilions by Ludwig Mies van der Rohe in Barcelona in 1929 and by Alvar Aalto in New York in 1939, they advocate for unprejudiced inventiveness that inspires future directions. Sacripanti points out how these pavilions were able to convey intrinsically new ways of using space and, between the lines, one can also read his intolerance for certain undefined aspects in the competition brief, such as the absence of specific exhibition content guidelines, on which he comments: "The call for tenders focuses merely on the shell, neglecting the contents to be exhibited: thereby programmatically severing the relationship between signifier and signified." (Neri, Thermes 1998, 110) Sacripanti's solution, then, is that architecture itself implicitly encompasses its contents: "that is to say, architecture would be entrusted with the very task of promoting and defining them." (Neri, Thermes 1998, 110) To him, kinetic space therefore also takes on a political role, as it is intended to symbolise a nation that, amidst a thousand difficulties, is dynamic and constantly in motion. This then becomes the aim of the project: identifying a fundamentally contemporary way of experiencing architecture and using time as an incisive parameter. More precisely, in Sacripanti's words, "the project proposition is simply to use time as an incisive parameter, one that can be tangibly manipulated, as an architectural medium on a par with others on a technical level. By doing this, navigating through a constructed space becomes navigating through a combinatorial bundle of constructed spaces, each novel in dimensional values but always tightly bound within the project's framework: the fourth dimension availing itself of the other three." (Sacripanti 1969, 2).

4 For the competition for the Italian pavilion at the 1970 International Exhibition in Osaka, the project team consisted of: arch. Maurizio Sacripanti; arch. Andrea Nonis; engineer Maurizio Dècina, automatisms; engineer Giulio Perucchini, structures. Contributors: Achille Perilli, Renato Pedio, arch. Sandro Latini, arch. Giancarlo Leoncilli.

The notion of kinetic space was therefore, in Sacripanti's view, an unrestricted and technologically viable domain, waiting to be explored through experimental and iconic realisations.

An additional, important consideration underlying the pavilion's dynamic attributes was understanding the "perceptual parameters inherent to a mutable space." (Sacripanti 1969, 2) Sacripanti draws upon his ties to contemporary art movements (particularly Kinetic and Programmed Art), believing the time had come to integrate its principles into architecture.

The design proposal stands as a masterful synthesis of form and concept. The symmetrical, mirrored, and inverted composition of the pavilion, features two sets of seven blades, which comprise the building blocks and units of measurement of the dynamic space, – a series of large vertical rings generated by two progressively larger, eccentric circumferences, oscillating on pivots via a pneumatic system. Inside the blades are two curved suspended exhibition planes, with an elastic membrane (dubbed the mantle) between them, featuring a contribution by abstractionist painter Achille Perilli. The mantle serves as a cover for the exhibition galleries, adapting to the movements of the blades and contributing to spatial variations enhanced by natural and artificial lighting. However, in the Osaka design, technology is expressly intended as a means, not an end; it serves to animate the structure. The oscillation of the fourteen blades combined with the mantle's flexibility was meant to mimic the breathing in and out of an animate being, resulting in an architecture that resembles a living creature rather than a machine. In Sacripanti's words, "an architecture cannot resemble a piston, or a connecting rod, generating a cyclical movement: a kinetic architecture should become a living thing." (Sacripanti 1969, 2)

The movement of each blade, designed with young engineer Maurizio Dècina, was independent from the other axes, with an unpredictable combinatorial motion, so that the entire system would not repeat the same configuration throughout the Osaka 1970 Exhibition, providing infinite spatial and perceptual changes through controlled randomness. Remarkably advanced for its time, this complexity was to be managed by an Olivetti Elea 9003 electronic computer[5]. The report outlines how blade movements could also adapt to the audience's movements, through motion sensors – a prescient notion of interaction between space, technology and users, a theme that was still foreign to architectural design at the time. The pavilion's generative power thus lies in the visitor's experiential interaction, where internal dynamics manifest externally in the structure's physical form. The blade movements are an invitation, a call to explore the space in the first-person.

Despite its ground-breaking technological and architectural features, Sacripanti's design did not win the competition. The winning project was

5 The Elea 9003 (Machine 1T) is one of the ultra-high-performance mainframe calculator models developed by Olivetti as part of the Olivetti Elea family. Conceived, designed and developed between 1957 and 1959.

realised by Studio Valle, in collaboration with Sergio Musmeci, who was responsible for the structural design.

4. The Rebirth of The Pavilion in Digital Form: The Three-Dimensional Model and The Experience for Virtual Reality

Osaka '70, a case-study of the T.E.A.M. research project, presented a unique opportunity to explore methods and language suitable for digitally representing an unrealized architectural space. The project unfolded in two phases: scientific research and construction of the pavilion's three-dimensional model from competition documentation in the first phase; and creation of an immersive virtual reality experience and search for a language that both transported visitors into the project's vision and honoured the architect's work.

4.1. Phase I: The 3D Model

Like archaeologists uncovering a partially known structure, we reconstructed the Osaka Pavilion fifty-three years after its conception. For the digital model's design, we first studied the documentation submitted for the 1968 competition. The documents are kept in the archives of the MAXXI museum and at the Accademia Nazionale di San Luca in Rome[6]. The drawings and technical reports detail both the pavilion's architectural structure and the electro-pneumatic system governing the blade movements. As it was an ideas competition, the documentation revealed limited construction detail, complicating interpretation of some architectural and technological aspects. Conversely, the engineering design for the electro-pneumatic system was exceptionally comprehensive, providing essential data for a thorough technical examination of its feasibility and, in our view, affirming the project's safety for public execution, should it be realised. Given occasional inconsistencies in the architectural drawings and omitted specifications for the materials and characteristics of some components (e.g., the parapets of the various exhibition levels), we made some decisions autonomously. To do this as respectfully as possible to the original project, we integrated our study of the documents with interviews with some of Sacripanti's main collaborators in the design process.

6 The archive of Maurizio Sacripanti is divided into two sections: the first, housed at the Fondazione Museo delle Arti del XXI secolo - MAXXI, Centro archivi architettura, was granted in 2011 on a free loan by Sacripanti's heirs for the MAXXI Architettura collections; the other part of the archive is located at the Accademia Nazionale di San Luca, where it arrived in 1995 at Sacripanti's own request.

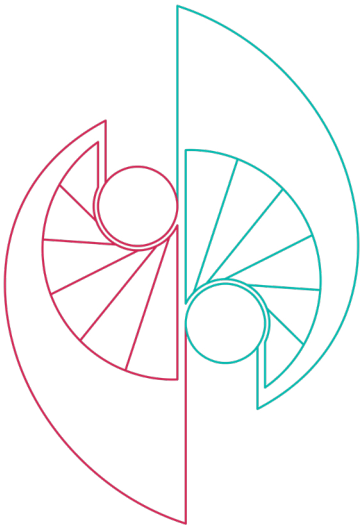

Figure 1. Schematic summary of the pavilion developed during the T.E.A.M. research project, courtesy of the studio.

Amid that year's challenging circumstances, that confined us to our studio, we managed to get in touch with key figures for the project. Collaborators, family members and friends[7] gave us invaluable insights both on the pavilion and on Sacripanti as a person and visionary, in a continuous cross-reference between documents and memories. Notably, we would like to mention the initial dialogue with architects Laura Thermes and Franco Purini, with whom we later had the privilege of bringing the experience to life in virtual reality, and the contribution of engineer Maurizio Dècina, project leader of the electro-pneumatic system. The project research was supplemented by the realisation of physical scale models of key architectural elements and construction details, mainly to help us understand the functioning of the pavilion's dynamic elements.

Before starting the reconstruction, we extracted and analysed all available information in the documentation we possessed, developed a framework (Fig. 1) for a geometric synthesis of the structure, and finally delineated a strategy for tackling the task. We continued collecting information, after the first exploratory modelling phase, by contacting Franco Purini, who worked with Sacripanti from 1964 to 1968 and later from 1971 to 1973. While still a student, Purini supplied the drawings for Sacripanti's most important projects of that period, in addition to the Osaka pavilion: the theatre in Cagliari, the hospital in Domodossola, the museum in Padua and the church in Partanna. He is also the author of the ink drawing that became emblematic of the design for the Osaka

7 Special thanks, with affection and esteem, go to architect Carlo Serafini and Sacripanti's son, Andrea.

pavilion itself. The interview with Purini proved to be an extremely valuable contribution, rich in insights not only for gathering information on the pavilion, but also for outlining Sacripanti's personality, understanding his thinking and his approach to his work. Regarding the missing details in the delineation of architectural elements in the documentation, Purini in our conversation provided a comprehensive explanation, of which we report a significant excerpt:

> Due to the experimental nature of the proposal, all the technical solutions necessary to make the project operational were discussed and planned. In fact, this phase would have been addressed if the competition had been won, as the competition announcement, being a competition of ideas for awarding the contract, did not require any particular technological details. The winner would then have prepared the executive details. Even the drawings of Tommaso Valle's project, which won first prize, represented the essential idea of the proposal without a technical description of how it would be realised. Generally, in competitions for ideas, the demands of the call for entries are not detailed and precise, both to allow contestants the possibility of shaping original interpretations of the theme, and to leave the project open to subsequent fine-tuning. It must be noted that the openness of the project to different functional and formal solutions is particularly essential in the case of competitions for an exhibition pavilion. I myself was on the board that chose the Italian Pavilion for the 2010 Shanghai International Expo. The winning project, while remaining tied to its initial formal indication, was reimagined during the implementation phase, especially from a functional point of view. The distribution system, as a matter of fact, cannot be fully defined in the competition proposal since it depends on post-competition planning concerning, for example, what is to be exhibited; the organisations, industries, and artists that will be present; the number of conventions that will be held, the way the public will move, etc. In the case of Shanghai, in the execution phase the winner therefore had to revise and provide a more precise outline of the initial proposal, adapting it to the gradually more detailed requirements. Sacripanti, in competitions like the one in Osaka, focused on providing the decisive elements for conveying the initial idea and indicating mechanisms that we might compare, with a grand but necessary reference, to Leonardo's sketches and their modern reimagining. Although technological invention was a determining factor in the configuration of his projects, he did not go into much technical detail because, moving forward would have required initiating a very long and arduous process of advanced technological design, given the experimental nature of his proposals. Sacripanti, even in the initial stages of design, nevertheless drew on the support of engineers, to ensure that his innovative spatial visions were actually feasible (Purini 2021).

Another practical problem we encountered during the exploration phase was the exact position of the piston, which generated the blades' kinetics. We therefore turned to the system's chief designer, engineer and professor emeritus Maurizio Dècina, who found a scan of the drawing showing the precise

location of the piston. It should be noted that we were not the first to tackle the digital reconstruction of the Osaka Pavilion, but, according to our research, this work had never been undertaken with the aim of making the model explorable in virtual reality. This is significant because, in a virtual reality model, you cannot use tricks to hide any missing information as you can in a static rendering or video. Visitors must be able to explore the pavilion as if they were physically in the space; everything must therefore potentially be present and functioning. To be believable, the work had to be approached from scratch, as if it were to be physically built, starting from the drawings and tackling the "construction."

The various phases of the reconstruction, including the initial strategic and research part, took about four months and were carried out as follows:

- For the 3D modelling, we started with an exploratory model built following the compositional logic of the pavilion to understand how to handle its complexity. Using a trial-and-error strategy, we defined the guidelines for creating successive iterations of the model neatly and efficiently.
- Out of the available digital tools, we chose Rhinoceros[8] as the main software for the model, due to the freedom offered by NURBS[9] , combined with Grasshopper[10] and the Kangaroo physics engine[11] for the initial dynamic simulation. We then used the Blender application[12] to create the groundwork for the animations and for the final optimisation of the mesh (grid defining an object in space) for virtual reality.
- The scenario in VR, the combinatorial motion of the blades, interactions, sound design, and multi-user aspects were programmed in Unity[13] through a combination of C# scripts, VPL nodes[14] and PBR materials[15] .

8 Commercial application software for 3D modelling of sculpted surfaces (*free form*) by Robert McNeel & Associates.

9 NURBS is an acronym that stands for Non-Uniform Rational Basis-Splines.

10 Grasshopper is a visual programming environment and language that runs within the Rhinoceros 3D application. The programme was created by David Rutten at Robert McNeel & Associates.

11 Kangaroo is a *Live Physics* engine for interactive simulation, *form finding*, optimisation and constraint solving developed by Daniel Pikerit. It consists of a software library and a set of components for the Grasshopper software application.

12 Blender is a free, cross-platform modelling, *rigging* (a technique used in so-called '*skeleton animation*' to represent and control a 3D model using a series of interconnected digital bones), animation, video editing, compositing, rendering and texturing of three- and two-dimensional images. It is developed by the Blender Foundation (2002), an independent non-profit organisation.

13 Unity is a cross-platform game engine developed by Unity Technologies, announced and first released in June 2005 during the Apple Worldwide Developers Conference as a Mac game engine.

14 VPL, which stands for Visual Programming Language, is a type of programming language that allows users to create programmes by manipulating programme elements graphically rather than specifying them textually.

15 PBR, an acronym for Physics-Based Rendering, is a *pipeline* (i.e. the logical queue of all instructions for parallel processing of the computer processor) of virtual materials that can simulate any type of physical material to define the representation of a 3D model.

4.2. Phase II: The Virtual Reality Experience

Having completed the careful research and reconstruction phase described above, the next challenge was to define the correct language of representation for this architecture in immersive virtual space. We were at this point confronted with the correspondence to an original that never existed, with the limitations of experience, with the connection between reality and virtuality, with the flow of time, so dear to Sacripanti, and lastly with the modalities of fruition of a purely digital architecture (made of bits and not atoms).

The pavilion for Osaka was not built, and the project never reached executive detail; therefore, trying to reproduce a realism that never occurred seemed to us from the outset a sterile and meaningless operation. Our choice was rather to conceive the virtual reality experience as a dream-like journey, imagining that we could enter Sacripanti's vision. *Osaka '70* is thus a dream, composed of essential symbolic elements: glass, metal, cement, the mantle and the light that defines its contours. The digital materials outline an almost sketched (we could perhaps say "16-bit") world that, like a literary text, leaves the viewer's imagination free to complete the vision. In order to facilitate this transference, we chose not to reconstruct the surroundings, i.e. the Expo panorama. The plot of land dedicated to the project became an island suspended over a stretch of water extending to the horizon. Having developed a language consisting of a *palette* of essential symbolic elements we were then able to devote a large part of the performance to another essential aspect: appreciating the pavilion in all its lighting conditions. Thus, we decided to integrate dynamic lighting whereby shadows and reflections are generated in the scene in real time. The sun rises, moves across the sky, and sets several times during the experience; a day on "Osaka Island" lasts about 8 minutes, during which the materials of the architecture are coloured in a dynamic relationship with the environment. The changing pattern of the shadows, together with the continuous movement of the blades and the mantle, contributes to understanding the kinetic aspects of the pavilion.

In this dreamscape, we also felt it was important to suggest a connection to the real event; we therefore incorporated soundtracks originally used by some of the national pavilions bordering the Italian building in 1970. When, in the virtual scenario, you approach the boundaries of the project area and stand outside the pavilion, near the stretch of water, you can hear the distant sound as if carried by the wind.

As for the user experience, we decided from the outset that visitors should enjoy the experience with maximum freedom. Creating a scenario free of "photorealistic" ambitions made it possible to use VR headsets completely independent of a computer, such as the then brand-new Oculus Quest[16] . These tools

16 Oculus Quest is a virtual reality device developed by Oculus, a brand of Facebook Technologies, LLC, released on 21 May 2019. It is a standalone device that can run games

offer the advantage of being fully autonomous; however, their performance is limited compared to the graphics cards of a modern computer. We took full advantage of two other features of this headset. The first is its ability to read the user's hands and use them to interact within virtual reality without the need for the controllers typically used with these devices. The second feature is its ability to accommodate multiple visitors simultaneously within the scenario. *Osaka '70* is therefore a multi-user experience: guests, each with their own headset, enter the scene with an avatar and can communicate and move around as they would in the physical world. What is noteworthy is that it is possible to share the virtual scenario even while being physically in different places.

5. The Tour and Virtual Human Guide

One aspect that deserves special attention and that distinguishes this work from many VR experiences is the presence, during the immersive experience, of a human guide who is accompanies the guests in the virtual environment. The guide can be physically in the same exhibition environment or remotely active, even from faraway places.

The idea emerged during the initial stages of the tour (Fig. 2): whereas in filmic virtual works the experiencers' point of view remains consistent for the entire duration of the event, in the case of *Osaka '70* the space is interactive, allowing users to be active participants who can move around freely and explore every detail. However, external help during the virtual experience can be counterproductive, acting as "another" voice that is not part of the immersive experience. Hence, the concept of accompanying visitors as one would in a museum, where the presence of an expert can enrich the understanding of the works. Over time, the role of the virtual guide has gained additional meaning and functionality. During the tour (Fig. 3), we tested the quality of the user experience in a practical manner and improved it based on participants' suggestions. Today, the *Human Virtual Guide* system is used in each of our projects, and we believe it enriches the experience by adding depth to the interaction between virtual environments and real-time narration. This role includes additional functionalities compared to other users: a special toolkit that facilitates operations and helps support guests if needed, without requiring assistance from the outside world.

The tour not only helped us refine many technical details but also provided a unique opportunity to test the experience with a very large audience. In addition to the one hundred official numbered tickets, we presented *Osaka '70*

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and software wirelessly with an Android-based operating system. It supports positional tracking with six degrees of freedom, using internal sensors and a camera *array* at the front of the device rather than external sensors.

at universities and public events and exhibited it at the InnoCult International Festival held at MEET in Milan in spring 2022 and at the Campus OnLive Festival in Turin in 2023. To date, more than five hundred guests have experienced this work, expressing their appreciation for both the experience and the project's originality. The wealth of feedback we have received has allowed us to refine the way we design new experiences, understanding that the work does not begin with putting on the headset and does not end with taking it off. For us, the rituals that come before and after are part of the work itself and complement the attention given to the person and their entry into a new dimension which, if well-designed, can expand artistic and cultural content in ways never experienced before.

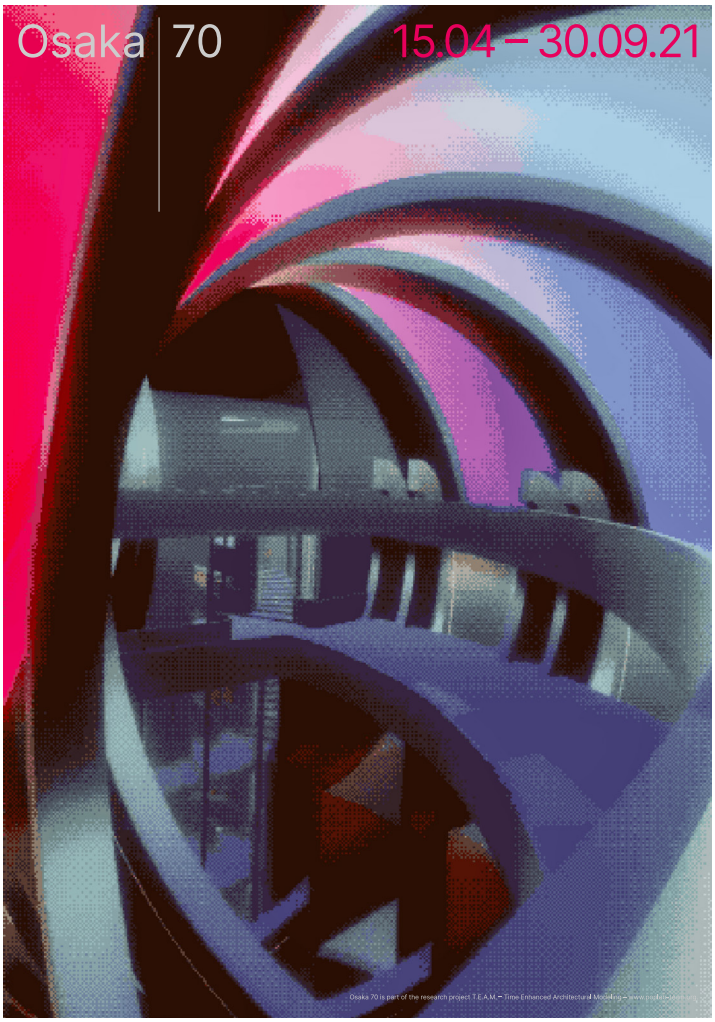

Figure 2. Image of one of the posters created for the Osaka '70 tour, courtesy of the studio.

Figure 3. Image from the Osaka '70 tour featuring Valentina Temporin and John Volpato, courtesy of the studio.

Figure 4. Image from the Osaka '70 tour featuring Valentina Temporin and John Volpato, courtesy of the studio.

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ZHVR Group: Zaha Hadid Architects' Journey into Virtual Realiy

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Abstract

This paper presents the work of the ZHVR Group, an immersive technologies research team within Zaha Hadid Architects (ZHA), alongside research conducted in academic settings at the Architectural Association School of Architecture's Design Research Lab (DRL) and the Bpro postgraduate programs at UCL Bartlett. The focus is on advancements and applications related to the Metaverse and Mixed Reality technologies, highlighting emerging innovations within these fields.

Keywords: Zaha Hadid; VR Architecture; Metaverse; Metrotopia

Abstract

Questo articolo presenta il lavoro del gruppo di ricerca ZHVR, specializzato in tecnologie immersive all'interno di Zaha Hadid Architects (ZHA), e le ricerche svolte in ambito accademico presso la Architectural Association School of Architecture (Design Research Lab - DRL) e i programmi post-laurea Bpro di UCL Bartlett. L'analisi si focalizza su tematiche legate al Metaverso e alle tecnologie di realtà mista, esplorando le innovazioni e le applicazioni emergenti in questi contesti.

Parole chiave: Zaha Hadid; VR Architettura; Metaverse; Metrotopia

Zaha Hadid Architects (ZHA) has long been synonymous with architectural innovation, continually pushing the boundaries of design and technological integration. One of the firm's most revolutionary undertakings has been its

transition to a fully digitized 3D design process, positioning ZHA as a leader in digital design coordination and production. In 2014, ZHA established the ZHVR Group as a dedicated research team with the primary goal of exploring the integration of virtual reality (VR) technology into its design practices. This marked the beginning of a paradigm shift in how architecture is conceived, experienced, and interacted with—laying the groundwork for a profound transformation in both the profession and its relationship with space.

The integration of VR within ZHA is more than just a technological enhancement; it represents an ontological shift in architecture. As the boundaries between physical and digital spaces blur, the ZHVR Group has been instrumental in leveraging VR to go beyond traditional visualization and presentation. VR offers immersive spatial experiences and fosters new design methodologies that transcend the limitations of conventional architectural practices. In this respect, ZHA's use of VR is a form of *poiesis*, an act of creation that opens new pathways for understanding and interacting with spatial environments.

At the heart of ZHVR Group's work are three key areas:

1. the adoption of VR as an essential design tool,
2. the development of VR platforms and applications for both design teams and clients
3. the exploration of the aesthetic and formal potentials of virtual environments.

Through collaborations with the extended reality (XR) industry and the construction sector, ZHVR Group continues to pioneer new forms of collaboration and spatial experimentation. This drive for innovation is evidenced in a range of projects, each contributing to the ongoing evolution of architecture as an interactive, immersive, and democratized process.

One of ZHA's earliest ventures into VR was a collaboration with Google Arts & Culture, aimed at developing virtual reality experiences based on Zaha Hadid's early paintings and drawings. These VR experiences translated Hadid's abstract, visionary artworks into three-dimensional spatial narratives. This project illustrated the power of VR to transcend traditional architectural representation, allowing users to explore Hadid's work in a manner that bridges the gap between art and spatial design.

The Danjiang Bridge VR Experience is another project that exemplifies VR's potential in architectural visualization. Developed for the Global Design Laboratory Exhibition in Taipei, Taiwan, this project allowed users to virtually explore ZHA's Danjiang Bridge from multiple perspectives, highlighting key design elements and lighting scenarios. Such immersive experiences are not just informative but offer experiential insights into the interplay of form, function, and aesthetics in a way that traditional renderings cannot match.

In 2018, ZHVR Group further expanded its exploration of real-time rendering in VR through a collaboration with Epic Games and Line Creative. The

project focused on the Heydar Aliyev Centre in Baku, Azerbaijan, using Unreal Engine 4 to create a real-time VR experience that emphasized the immersive qualities and visual intricacies of ZHA's iconic design. This collaboration highlighted the synergy between architectural vision and cutting-edge gaming technologies, showcasing the potential of VR to not only visualize architecture but also engage users in deeply interactive spatial experiences.

ZHVR Group's innovative spirit continued with Project Correl 1.0, an interactive VR installation developed for the *Design as Second Nature* **exhibition** in MUAC, Mexico City. This project allowed multiple users to collaboratively sculpt and manipulate virtual environments in real time, pushing the boundaries of collective creativity and underscoring VR's role in democratizing the design process. The experience demonstrated how VR can transform the design environment into a shared space of experimentation, where users can engage in an active dialogue with the architectural form.

In 2022, ZHVR Group unveiled the SuperChalet, a cybernetic architecture concept developed in collaboration with NASA astronaut Scott Kelly and FUTURLOGIC. This project represents a shift in architectural thinking—where architecture, communication technologies, and feedback mechanisms merge to create new modes of inhabiting space. The SuperChalet exemplifies ZHVR Group's commitment to redefining architecture in light of emerging global lifestyles and technological advancements.

One of the most ambitious projects undertaken by ZHA, with contribution from the ZHVR group is the launch of Metrotopia, a metaverse platform that serves as a virtual hub for the global design community. Developed in partnership with ArchAgenda in Chicago, Metrotopia bridges multiple design disciplines, including architecture, urban design, fashion, and product design. Metrotopia is now a metaverse company with an open access model and a curated community, Metrotopia fosters collaboration, cultural exchange, and design discourse on an unprecedented scale. It brings together creative professionals, educational institutions, museums, galleries, and media outlets, creating a nexus for innovation in both the virtual and physical realms.

Metrotopia made its debut at the 2023 Venice Architecture Biennale with the virtual exhibition *Knowledge Transfer* as part of the *Students as Researchers: Creative Practice and University Education* exhibition. The project featured works from renowned architecture studios, including OMA, Morphosis, Coop Himmelb(l)au, UnStudio, and ZHA, as well as contributions from artists such as Kenny Schachter and faculty from Sci-Arc. This exhibition underscored Metrotopia's role as a platform for creative experimentation and the dissemination of architectural knowledge in the digital age.

As Zaha Hadid Architects continues to explore the potentials of extended realities (XR), it is clear that the fusion of architecture and VR is not merely a technological novelty. Rather, it is a catalyst for redefining how we conceive,

design, and experience the built environment. By embracing virtual reality, ZHVR Group is paving the way for a future where architecture is no longer bound by physical constraints but can evolve as a dynamic, immersive, and participatory medium, transforming the way we engage with space, history, and culture.

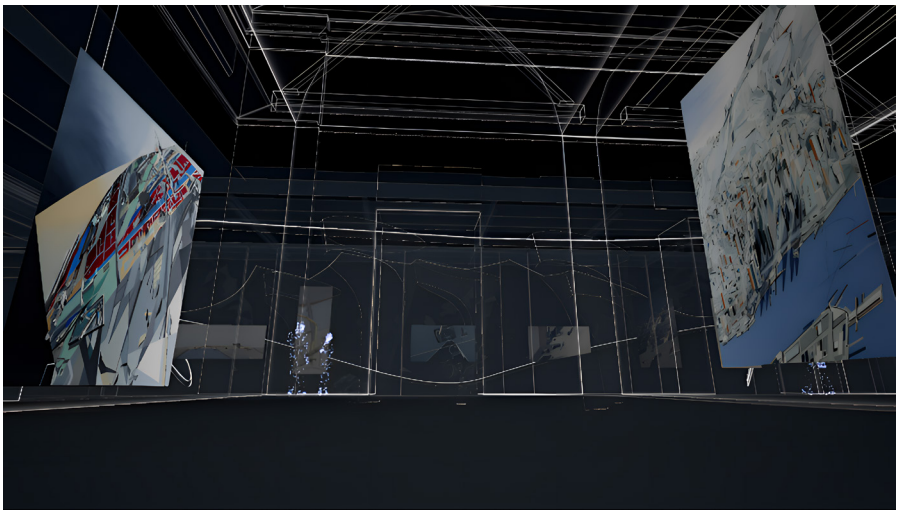

Figure 1. Zaha Hadid, *Early Paintings and Drawings Exhibition*, courtesy of ZHVR Group.

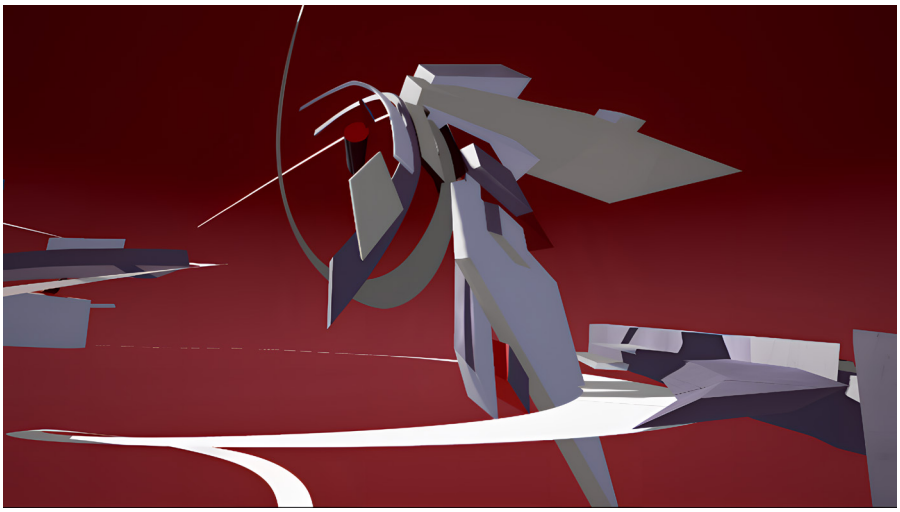

Figure 2. Zaha Hadid, *Early Paintings and Drawings Exhibition*. The Great Utopia (1992), courtesy of ZHVR Group.

Figure 3. ZHVR, *Danjiang Bridge. Virtual Reality Experince*, courtesy of ZHVR Group.

Figure 4. Heydar *Aliyev Centre*. Collaboration between Zaha Hadid Architects, Epic Game, and Line Creative, courtesy of ZHVR Group.

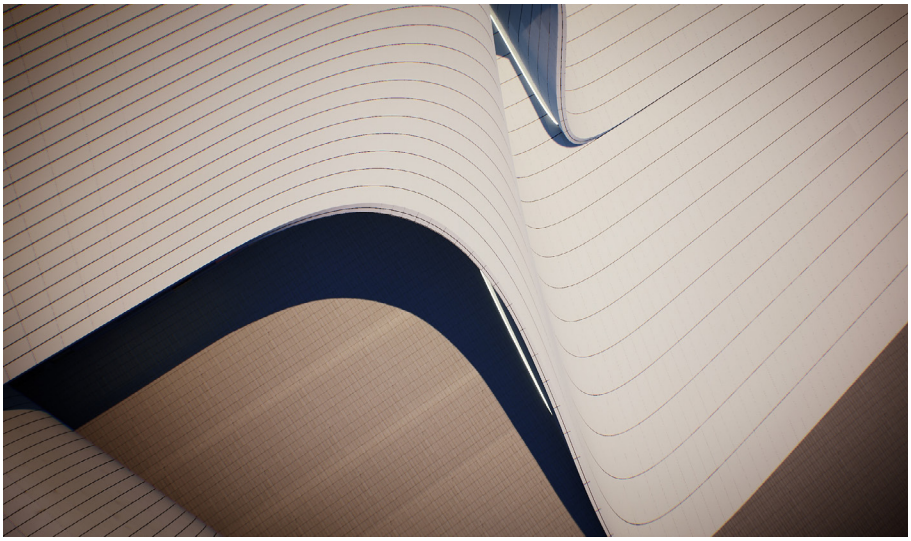

Figure 5. Heydar *Aliyev Centre*. Collaboration between Zaha Hadid Architects, Epic Game, and Line Creative, courtesy of ZHVR Group.

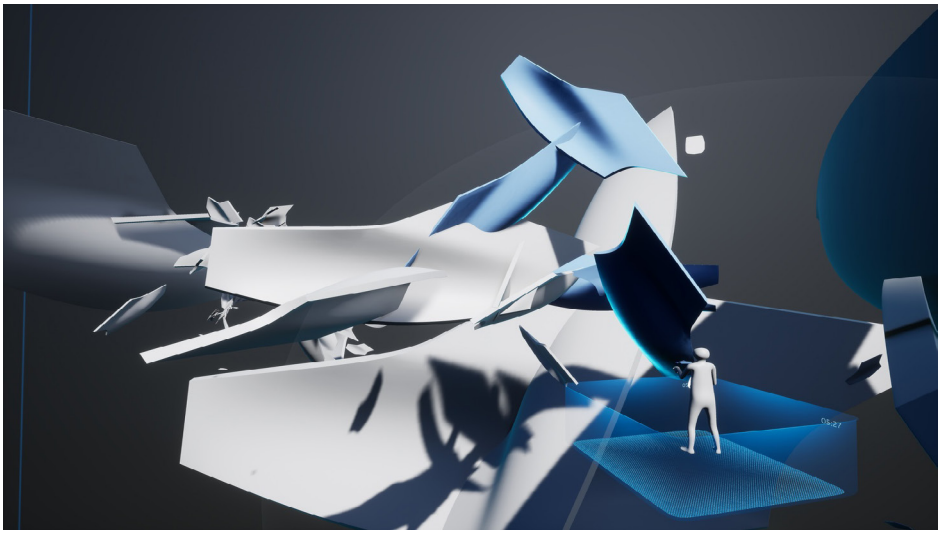

Figure 6. *Project Correl 1.0*, courtesy of ZHVR Group.

Figure 7. *Project Correl 1.0*, courtesy of ZHVR Group.

Figure 8. *SuperChalet by ZHVR Group*, courtesy of ZHVR Group.

Figure 9. *SuperChalet by ZHVR Group*, courtesy of ZHVR Group.

Figure 10. *Metrotopia Metaverse by ZHVR Group*, courtesy of ZHVR Group.

Figure 11. *Metrotopia Metaverse by ZHVR Group*, courtesy of ZHVR Group.

Contributors

Fabrizia Bandi is a postdoctoral researcher in the ERC project AN-ICON, at the University of Milan. Her research focuses on phenomenology and aesthetics, with particular interests in architecture and art. In 2019, she held a postdoctoral position at the Academy of Architecture in Mendrisio (USI). She taught Aesthetics at Politecnico di Milano from 2016 to 2020. Currently, she is adjunct professor of Aesthetics of Objects at the University of Milan and Aesthetics of Luxury at IULM University. She is the author of *La percezione armata: esperienza estetica e immaginazione in Mikel Dufrenne* (Mimesis, 2018), *Spazi Virtuali. Esplorazioni estetiche fra ambienti elettronici e immersivi* (ETS, 2024), and co-editor of *Corpo, spazi, architettura. Fenomenologia dell'esperienza spaziale* (Morcelliana, 2024, with Matteo Vegetti).

Fabrizio Banfi, a researcher at the Department of Architecture, Construction Engineering and Built Environment at Politecnico di Milano, has been actively engaged in research activities related to Building Information Modeling (BIM), 3D survey, Scan-to-BIM, Extended Reality (XR), and virtual museums since 2013. In 2016, his research was supported by the Social Sciences and Humanities Research Council (SSHRC) through the New Paradigm/New Tools for Architectural Heritage training program at the Carleton Immersive Media Studio (CIMS) Lab – Carleton University research centers in Ottawa and Autodesk Research Toronto, Ontario (Canada). After a year of international experience, he completed his multidisciplinary doctorate with honours and won the SIFET Award 2018 as the best thesis at the national level. Currently, he is an adjunct professor at Politecnico di Milano. He also collaborates as a teacher at the Raymond Lemaire International Centre for Conservation (RLICC) of the KU Leuven within the Archdoc Workshop (Architectural Heritage Documentation for Conservation & Virtual Palace Workshop).

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2021), *The Phenomenology of Real and Virtual Places* (Routledge, 2018), *Game Mods: Design, Theory and Criticism* (ETC Press, 2012) and co-edited *Screen Tourism and Affective Landscapes* (2022), and *Cultural Heritage Infrastructures in Digital Humanities* (Routledge, 2017).

Silvia La Placa is a research fellow at DICAr (Drawing Architecture Document Action Laboratory) on the topic of "Archives and digital models for the study of the territory and historical landscape," she obtained her PhD in April 2023, in Design Modeling and Simulation in Engineering at the University of Pavia. Since 2019 she has been collaborating with the DAda-LAB laboratory in national and international research. As an Early-Stage Researcher, she participates in European Projects on the development of strategies for documentation, digitisation and valorisation of Cultural Heritage.

Scott McQuire is Professor of Media and Communication in the School of Culture and Communication at the University of Melbourne. He is one of the founders of the Research Unit for Public Cultures which fosters interdisciplinary research at the nexus of digital media, contemporary art, urbanism, and social theory. Scott is the author or editor of nine books including *The Media City: Media, Architecture and Urban Space* (2008, the *Urban Screens Reader* (2009), *Geomedia: Networked Cities and the Future of Public Space* (2016), *Art Seen Under Digital Light: Photography, The Image, and the Aesthetics of Data* (2018), and *Communicative Cities and Urban Space* (2021). *The Media City* won the Jane Jacobs Publication Award offered by the Urban Communication Foundation in 2009 and has been translated into Chinese (2011, 2014) and Russian (2014) while *Geomedia* has also been translated into both Russian (2018) and Chinese (2019).

José Pareja Gómez was born in Mexico City and holds a MArch in Architecture and Urbanism from the Architectural Association in London, UK. He has lectured at various technology and architecture forums across Latin America and Europe. As an Associate at Zaha Hadid Architects (ZHA), he has contributed to a range of urban and architectural projects, specializing in computational design processes. Additionally, he is a lead VR developer with the ZHVR Group, ZHA's research and development team focused on AR/VR innovation. Previously, he was a course tutor for the Bartlett UCL BPro's Research Cluster 9, a unit exploring extended realities and augmentation in architectural design and fabrication. Currently, he teaches at the Architectural Association's DRL (Design Research Laboratory) master's program at Architectural Association (AA).

Roberto Paolo Malaspina is a postdoctoral researcher at Department of Philosophy "Piero Martinetti" at the University of Milan. He obtained a PhD

in Philosophy and Human Sciences (Aesthetics) in 2024 at University of Milan, with a thesis on erotic images and immersive devices in the frame of ERC AN-ICON project. Previously, he concluded his MA degree in Visual Arts at the University of Bologna (2019), with a dissertation on the theoretical identity of postmodern architecture. He attended CAMPO (2019-2020), course for curators of the Fondazione Sandretto Re Rebaudengo, Turin. He is adjunct professor of Theory of Perception at IED Academy (Milan) and academic fellow in the course of Philosophy of Art at Bocconi University.

Massimiliano Savorra is a professor in History of Architecture at University of Pavia. He received a PhD in History of Architecture from Iuav University of Venice (1999), and a degree in Architecture from University of Naples Federico II (1994). He has participated in numerous conferences and lectured in Italian and foreign universities. He has obtained fellowships and grants in Italy and abroad, has conducted studies in France, Canada and the United States. He has also curated conferences and exhibitions, among them *"Pietre ignee cadute dal cielo". I monumenti della Grande Guerra* (Venice 2014). His recent publications include *Per la donna, per il bambino, per la razza: l'architettura dell'ONMI tra eutenica ed eugenica nell'Italia fascista* (LetteraVentidue, 2021), *Questioni di facciata. Il «completamento» delle chiese in Italia e la dimensione politica dell'architettura 1861-1905* (Franco Angeli, 2018).

Valentina Temporin studied architecture at the Iuav University in Venice, where she coordinated the Master in Processi costruttivi sostenibili from 2010 to 2014. Working between Rome and Beijing, in 2015 she established Poplab, a multi-award-winning digital manufacturing startup that focuses on 3D printing for the production of everything from objects to façade components. From 2019 to 2022, alongside John Volpato, she managed the research project T.E.A.M. (Time Enhanced Architectural Modeling) on architecture and virtual reality. Today, she is a VR consultant for companies and a lecturer for both universities and private institutions. Her research has always been focused upon imagining solutions that optimise the relationship between people, buildings and new technologies, applying a human-cantered approach to architecture and design.

Matteo Vegetti is professor of Aesthetics and Philosophy of Space at the Academy of Architecture in Mendrisio and professor at Supsi (DACD) of Theories of Space. He is also a member of the Master in Geopolitics at the Sapienza University of Rome. For many years he was lecturer of Aesthetics at the Politecnico di Milano and from 2019 to 2022 he was visiting professor at the University of Bergamo. Among his works: *La fine della storia* (Milan 2000), *Hegel e i confini dell'Occidente* (Naples 2004), *Lessico socio-filosofico della città* (Varese 2005),

Filosofie della metropoli (Ed., Rome, 2009), *L'invenzione del globo* (Turin 2017), *The Global Spatial Revolution* (Milan 2022), *Earthscapes. Le conseguenze della visione della Terra dallo spazio* (Ed., with T. Morawsky, Rome, 2023), *Corpo, spazio, architettura. Fenomenologia dell'esperienza spaziale* (Ed., with F. Bandi, Brescia 2024).

John Volpato comes from an artistic background, and he holds a great passion for technology that has led him to explore creativity in many different fields. Passing from product design to art, and from communication to the world of exhibit design, he captures a synthesis that is able to merge human expression with technology. From 2010 to 2015 he worked within his own design studio in Venice, realizing interactive multimedia exhibitions and immersive installations commissioned by entities and institutions that included the Biennale di Venezia, Cipriani, the Academy of Fine Arts, and the Querini Stampalia Foundation. From 2019 to 2022, he co-ordinated, alongside Valentina Temporin, the research project T.E.A.M. (Time Enhanced Architectural Modeling) on architecture and virtual reality. Since 2018, he works as a VR consultant for companies and institutions, curating, among other things, the VR settings for the exhibition 'Supernova' by Cao Fei at the MAXXI museum in Rome.

Real Space–Virtual Space

Aesthetics, Architecture, and Immersive Environments

Edited by Fabrizia Bandi and Roberto Paolo Malaspina

This volume explores the complex relationship between real and virtual spaces, analysing how digital media are increasingly reshaping architectural and urban environments. Contributors examine the impact of new technologies on spatial experiences in the contemporary mediascape, from everyday life to urban spaces and immersive architectural design. Through a combination of theoretical essays and concrete case studies, the volume focuses in particular on Virtual Reality (VR) as an innovative tool capable of reimagining spatial design, transforming the interaction between built environments and digital spaces, and offering new perspectives on the future of architecture, urbanism and cultural heritage.

Cover: Reconstruction of Maurizio Sacripanti's project for the Italian pavilion for the 1970 Osaka Expo, used for the immersive and interactive work Osaka '70. John Volpato, Ultra (2020).