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ARCHITECTURAL DESIGN AND METAVERSE: KEY CONCEPTS IN DIGITAL SPACE PRODUCTION

PROJETO ARQUITETÔNICO E METAVERSO: CONCEITOS-CHAVE PARA A PRODUÇÃO DO ESPAÇO DIGITAL

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Abstract

Digitizing analog objects and processes has led to a virtual world that increasingly feels like a new kind of reality. This paper examines the intersection of architecture and digitization, focusing on the creation of spaces in the metaverse. It addresses the challenge of designing immersive environments that emulate real-world interactions while fostering self-actualization and creativity. The study employs five key concepts—parallax, everted space, circumvent space, the Proteus effect, and the holographic universe—to analyze how digital technologies reshape architectural design. Methods include exploring kinesthetic perception, avatar-influenced spatial navigation, and the merging of physical and virtual components. Parallax and everted space facilitate deeper interactions and foster creativity in virtual architectural spaces. Avatars are more than replicas, they upgrade a digital presence for the creative user-subject-designer into virtual worlds, circumventing physical limits, since consciousness and imagination surpass object-based thinking. Architectural designers can be influenced by avatar characteristics within and outside of a virtual environment, such as the Proteus effect. Furthermore, by merging the real and virtual worlds, the holographic universe accelerates human perception and creativity.

Keywords: architecture, parallax, Proteus effect, cyborg, virtual worlds

Resumo

A digitalização de objetos e processos analógicos levou a um mundo virtual que se assemelha cada vez mais a um novo tipo de realidade. Este artigo examina a intersecção entre arquitetura e digitalização, com foco na criação de espaços no metaverso. Aborda o desafio de projetar ambientes imersivos que emulam interações do mundo real, ao mesmo tempo em que fomentam a autorrealização e a criatividade. O estudo emprega cinco conceitos-chave — paralaxe, espaço evertido, espaço circunscrito, efeito Proteus e universo holográfico — para analisar como as tecnologias digitais remodelam o design arquitetônico. Os métodos incluem a exploração da percepção cinestésica, a navegação espacial influenciada por avatares e a fusão de elementos físicos e virtuais. A paralaxe e o espaço evertido facilitam interações mais profundas e fomentam a criatividade em espaços arquitetônicos virtuais. Avatares são mais do que réplicas; eles fomentam uma presença digital para o usuário-sujeito-designer criativo em mundos virtuais, contornando os limites físicos, uma vez que a consciência e a imaginação superam o pensamento baseado em objetos. Designers arquitetônicos podem ser influenciados por características de avatares dentro e fora de um ambiente virtual, como o efeito Proteus. Além disso, ao unir os mundos real e virtual, o universo holográfico aprimora a percepção e a criatividade humanas.

Palavras-chave: arquitetura, paralaxe, efeito Proteus, cyborg, mundos virtuais

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INTRODUCTION

Digitization is a defining feature of the contemporary era, significantly impacting various fields, including architectural design. In this context, physical and tangible objects are transformed into quantifiable units of graphical information. While virtual reality cannot meet physiological needs, it can improve self-awareness and creativity. Architectural projects, for example, are often represented through abstract models that capture the essence of natural and man-made environments. Computers process these models and render them as 3D images, which allows for a more dynamic and precise visualization of designs.

Beyond its impact on architectural design practice, digitization is also having a significant impact on education and academic research. It is increasingly common to find virtual worlds (VWs) integrated into the learning environment, providing tools such as global classrooms, virtual laboratories, and interactive design platforms. Students may, for example, work collaboratively in virtual laboratories to simulate real-life scenarios without being bound by physical restrictions. Furthermore, interactive design tools enable learners to experiment with architectural concepts in a virtual environment, encouraging creativity and innovation.

Digital architecture explores how architectural objects and spaces are conceptualized in digital culture. A virtual environment, such as avatars and VWs, is used to examine the evolving relationship between bodies and spaces. The shift from physical to virtual paradigms involves the conversion of physical spaces into readable datasets through the use of technical strategies and semiotic units. Voxel-based or parametric modeling is often used to create interactive, navigable architectural designs in VWs such as Second Life and Minecraft.

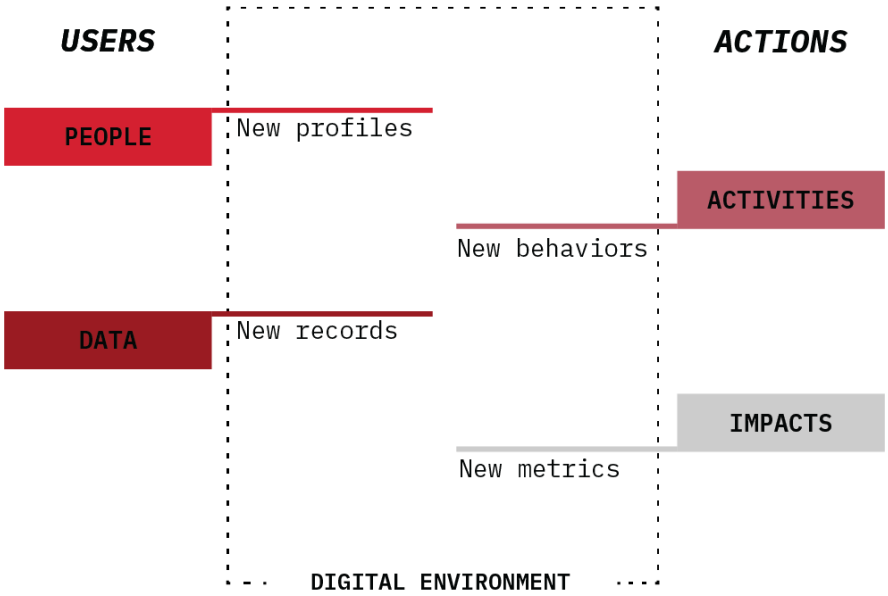
Within this environment, the creative process is being redefined with the use of tools such as artificial intelligence (AI), avatars, automation, mixed reality (MR), and datafication. By using AI, for example, building layouts can be optimized, while MR allows real-time interaction with 3D models, automation can ease repetitive tasks, and avatars can mimic human interaction. Geospatial datasets are also analyzed via datafication for purposes such as predicting traffic patterns or optimizing energy consumption.

Technology plays a significant role in human-computer interaction (HCI) by fostering communication and cooperation between humans and machines. In the digital age, communication, experiences, and opinions are processed in real-time. Digitization transforms life by creating inventive ways to connect, collaborate, and live. Zoom, Google Meet, and Microsoft Teams allow remote work and education, while Instagram and TikTok allow creative and political expressions. Meetup and Couchsurfing enable shared interests, while Airbnb and TripAdvisor revolutionize travel with user reviews. Metaverse communities such as Decentraland and Horizon Worlds offer immersive spaces for interactivity. All these platforms have user-driven communities that demonstrate how digitization not only facilitates communication, but also changes the way individuals interact, collaborate, and contribute to society.

The use of digital technology has been influencing not only architectural design, but marketing practices as well, by altering the expectations and behaviors of consumers, resulting in enormous pressure on traditional firms

and disrupting a variety of markets. By utilizing the latest technology available in Virtual Reality (VR), architectural marketing managers can promote a positive image of their projects to customers. VR offers immersive and interactive environments that can be used to enrich brand experiences and engage clients in new ways (1). People, data, and activities are transformed into digital profiles, records, and activities that are measurable on their own terms as a result of digitization (fig. 1).

Figure 1: Digitization & digital environment.



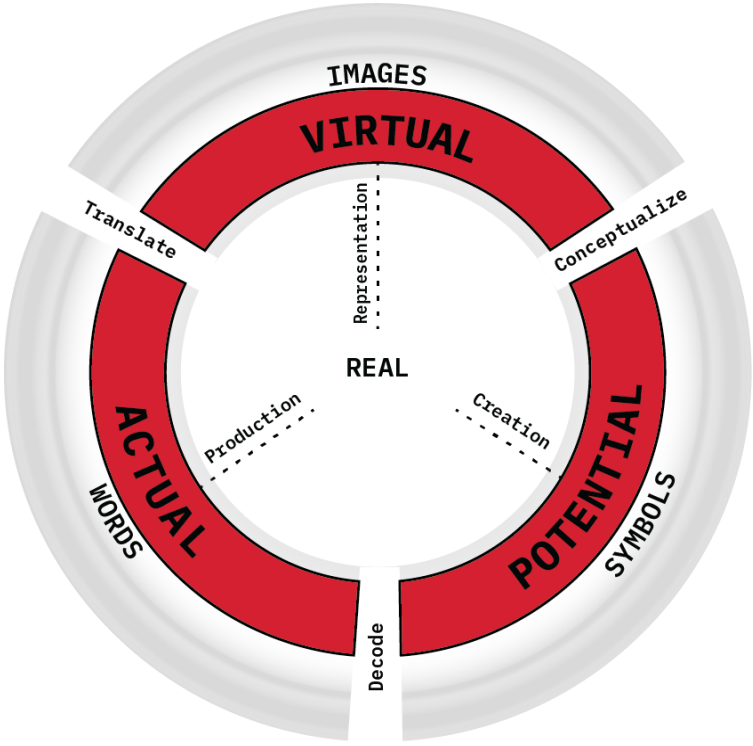
Recent studies have deepened the hybridization between virtual and physical settings, focusing on the experience of implanted visualizations while navigating the physical space. Other approaches use Extended Reality (XR) to combine Augmented Reality (AR), MR, and VR, merging both the physical and the virtual (2). Therefore, VR technology applied to the visualization of architecture provides new ways of studying and interpreting ancient buildings, new projects, and new paradigms of the discipline, by removing the physical restrictions of traditional architecture (3). Approaches to architectural education in the digital age must integrate information and communication technologies linked to learning design elements (4).

Virtuality is usually involved in the historical opposition between mind and body, nature and culture, object and subject, structure and agency, and reality and perception. Some, like Massumi, understand virtuality in terms of potentiality (5); that is to say, that the virtual is an approach to the actual and that the distance between this potentiality and reality is what separates and determines the VW, with respect to real life, the same distance that allows the distinction between the online and the offline worlds.

Real existence does not have a privileged place over the virtual presence, and the VWs are not in direct opposition to real existence. Therefore, the “virtual world” takes part in the “real world” or can be viewed as a continuous movement through it. This means that, virtual, potential, and actual are three different ways of experiencing the real world, each with a different code — images, symbols, and words respectively— and an interactive relationship

between them: images are conceptualized to become symbols, which are then decoded into words, and words are translated into images (fig. 2).

Figure 2: The real, the potential, the virtual and the actual.



In architectural design, the virtual, potential, and real worlds are interconnected, providing three ways of interacting with the physical environment. During a site analysis, images are transformed into symbols, which are then decoded into words or key concepts. The concepts developed from these design forms are then translated into visual representations of both 2D and 3D projects. Architecture students experience this creative process as a journey that bridges perception with action through three different modes of expression.

The design process for virtual spaces involves continuous displacement of the user, just as if they were moving through a physical environment. In this type of mobility, it is necessary to have an unlimited space, which can be in a room (room scale VR) or an industrial warehouse (warehouse scale VR). For the user to be able to move in this scenery, it is essential to measure the user's position at all times and thus transfer their movement from the real world to the VWs. Positional tracking is carried out using different devices, for example, movement sensors that can “capture the movement” of the user through the use of a gyroscope, magnetometer, and accelerometer. Another method to capture motion is with the use of cameras. Within the world of VR, this type of action is known as "tracking,” since the movements of a person are followed in real time. In cinema and video games, it is better known as “motion capture.”

In virtual spaces such as Metaverse, spatial models are inhabited according to the scope of corporalities and the way they are expressed in digital environments. The analysis proposed in this study aims to deepen the continuity between real and virtual space design focusing on three key areas: 1) how architectural movement and perception shift in parallax and everted

spaces, 2) how avatar characteristics influence designers' behaviors in their physical environments (Proteus' effect), and 3) the collaborative processes in VWs design that shape the holographic universe.

METHODS

The analytical procedure was semiotic and systemic in nature. In the analysis, architectural spaces are compared with their forms and functions within digital environments. The exploration of virtual profiles and activities in the virtual spaces of VR is aimed at unveiling the significance of architectural displays in digital environments and how these living spaces reorganize human experience mediated or conditioned by new representational mechanisms.

The results are conveyed in architectural diagrams and somatic practices where the digital environment is at the same time —although not simultaneously— the main theme and support for architectural design. The initial exercise consisted of an inductive movement through a virtual environment as unstructured data, which was then expressed in a structured way to be codified in contextual-explanatory models. The use of graphical diagrams allows us to explain the results in terms of formal configurations, zones, and networks of virtual and physical embodiments. The interpretive phase focused on the determinants of architectural design in virtual displays: 1) the technical-formal components of digital architectural models (such as physical and aesthetic structures), 2) the connotative meanings of the representations (such as sociocultural structures and the environment), and 3) the conditions of validation and legitimation of graphic discourses.

FINDINGS

The ubiquity of digital technology has implications beyond the need to change certain daily habits to adapt to new work practices, new communicative elements such as emojis, memes, and stickers, and expressions and neologisms in digital culture. Accelerated by the global contingency of COVID-19, digitization implies the redefinition of the human environment and praxis. Embodiment and virtual presence in MR implies adaptation to new forms of life in which two dimensions that were initially differentiated (physical and virtual) converge and intersect. Inhabiting architectural configurations of MR consists of a bidimensional movement within the borders between the real (material, tangible, physical) and digital (immaterial, discursive, semiotic).

PARALLAX AND EVERTED SPACE

The digital environment is no longer an alternative system for the management, exchange, and protection of data; it is also a new space for human action. Virtual environments function as a new architectural place for interactions between individuals, commonly known as users, to share experiences, knowledge, and ideas through virtual communities. Furthermore, the digital world has become an ontological modality of contemporary human existence. There are two key elements to set the actual discussion of virtual environment and architectural experiences through the biological/digital

body/avatar: the kinesthetic senses and the perception of the spaces as a parallax.

According to several studies, kinesthetic senses are very relevant in VR since there are underlying stimuli for perception that do not come exclusively from the visual sense. Different signs complementing visual stimuli come from the kinesthetic senses, such as the vestibular (responsible for the sense of movement) and auditory (responsible for balance), in such a way that the physical body, in metrics such as size, height, weight, and speed, is combined as a framework that fixes a reference for the recognition of the distance and location of every object and the assembly.

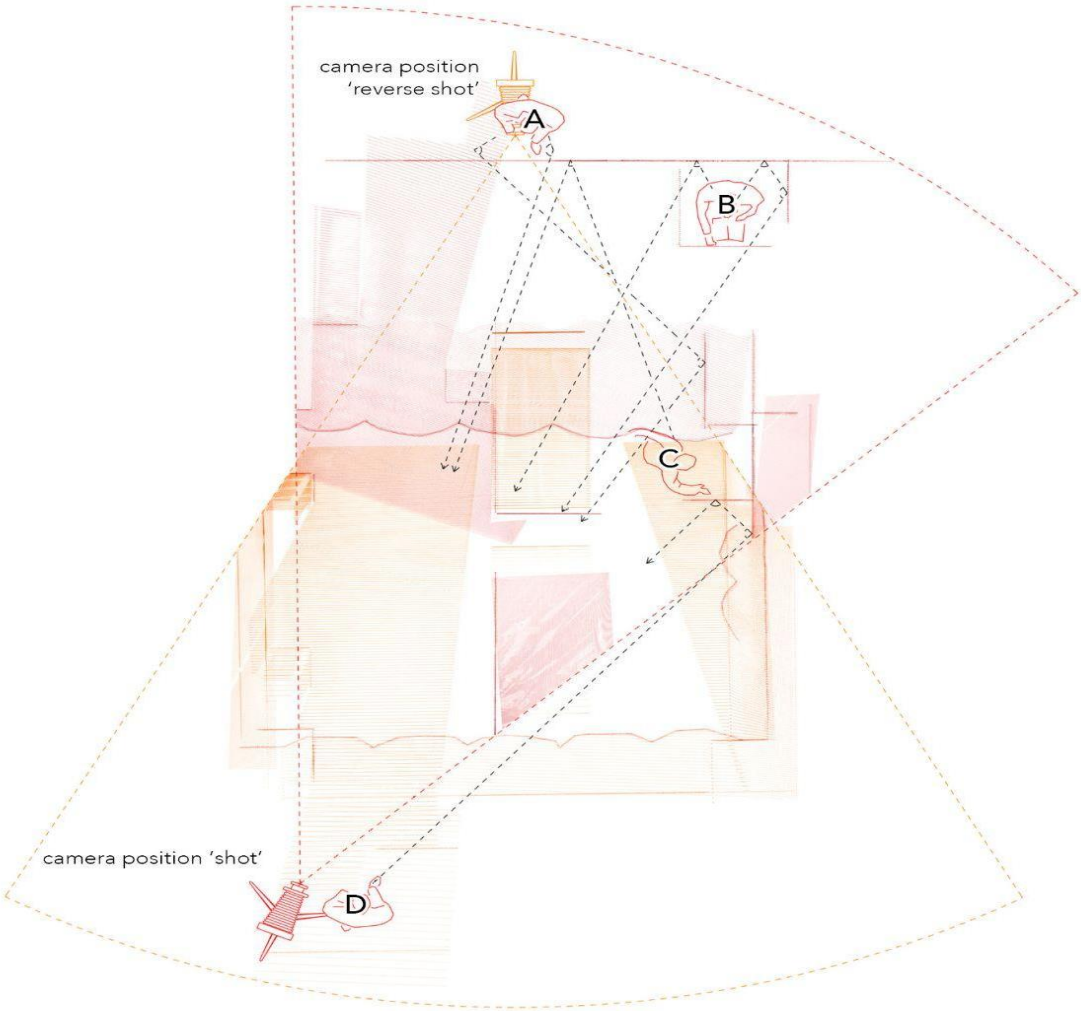
Kinesthetic factors and tactile sensitivity are correlated with fluid intelligence because kinesthetic sensitivity exemplifies an ability to determine (or remember) the position of the arm, or the trajectory of arm movements, without using vision [while] tactile sensitivity represents an ability to discriminate and infer the form of stimuli applied to the skin (6). Kinesthetic learning amplifies experiences in education, offering a better understanding of concepts, graphs, and formulas (7); it is also used as an assistive technology application specifically designed to support children with disabilities like autism (8).

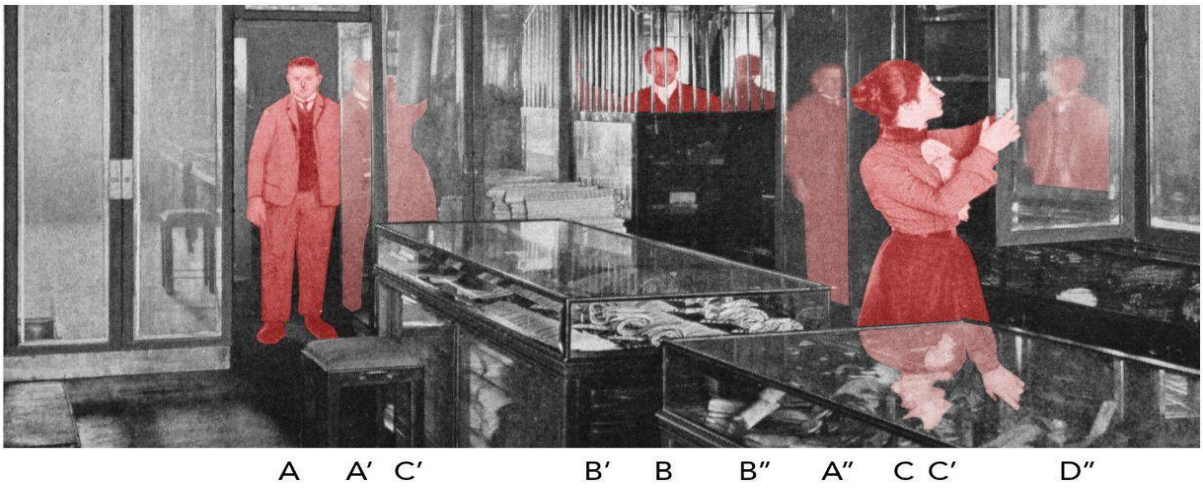
Most research on AR and cognitive load focuses on explaining how AR can be used to learn or perform better (9), while other studies focus on augmenting human intelligence with machine intelligence (10). Architectural displays in VR are observed using two essential items: perceived distance and perceived depth. New information is acquired by different senses, assembled, obtained at the perceptual level, and validated by previous visual references. Some measurements are derived directly from the eye, such as the focus or ocular convergence. However, as objects in the virtual environment appear to move, parallax is perhaps the most important measure for determining location and distance in virtual environments.

Parallax consists of the displacement or change in an object’s apparent position when viewed from two different points of view. Parallax is caused by a change in the observer's point of view, and is measured as an angle formed by the direction of two visual lines relative to the observation of the same object from two different points, sufficiently far apart, and not aligned with it. Owing to the binocular view, parallax can be obtained with a static object regarding the distance resource (fig. 3).

Since parallax refers to how an object's appearance shifts with the viewer's perspective, it offers a compelling lens for exploring the experience of moving through different architectural (virtual) environments. Although parallax existed before, modernism fully embraced it, revolutionizing design during the twentieth century (11). Buildings with dynamic facades that change appearance depending on the viewer's angle—such as those with perforated metal panels or layered glass—spiral staircases, and gently sloping ramps all use parallax to reshape how we perceive space and dimension as we move through them. Mirrored surfaces or layered constructions shift and transform as observers walk past or through them, creating a sense of movement and visual engagement. In modernist spaces, the focus shifted from a static, linear view of architecture to an evolving interplay of dimensions, much like the parallax effect itself.

Figure 3: Plan view of the positions of the reconstructed protagonists. Pearse, 2024



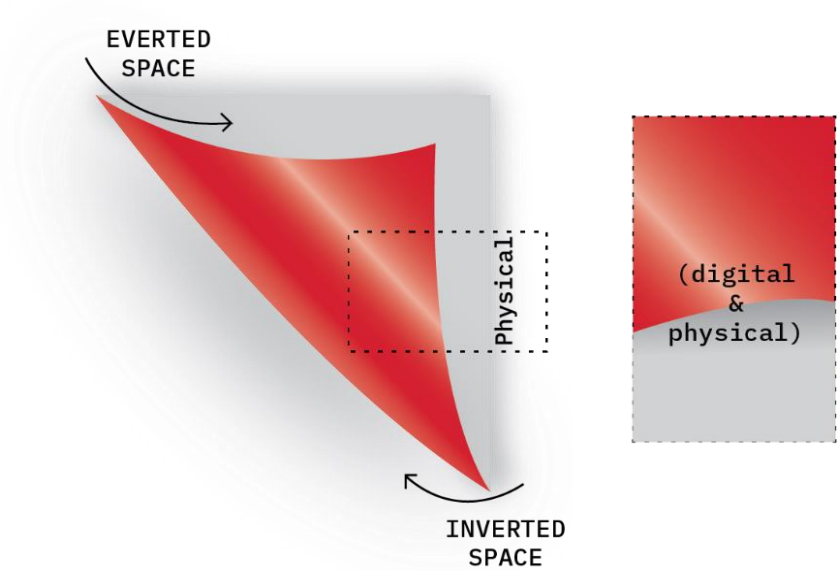


The use of stereo and motion parallax in virtual environments is fundamental to the connection between human perception and architectural design. A stereo parallax effect replicates real-world depth cues by rendering separate images for each eye, whereas a motion parallax effect adjusts object motion to reflect viewer movement, creating a dynamic sense of space. The use of these techniques allows users to perceive scale, proportion, and depth accurately, which supports the evaluation of spatial configurations, lighting, and materials. VR facilitates immersive exploration of designs by incorporating stereo and motion parallax. In addition to enhancing user engagement, VR provides insight into how spaces will be experienced once they have been built. Through this alignment with human perception, architects are able to create environments that are both functional and emotionally satisfying, bridging the gap between conceptual design and lived experience.

Parallax is a fundamental resource in perceived space because there is an important variation between real and virtual environments (12). Binocular vision is especially useful for perceived distances in the nearest sphere, but this ability becomes more subtle and less powerful when greater distances are evaluated. The use of parallax clears up the perceived virtual surroundings by comparing different images over time, especially if the subject is aware of the displacement, which happens to a greater degree if the movement has been carried out by their own means.

This phenomenon can be represented by the scheme of eversion, considered an inside-out turn, the unfolding from one world to another. Jones (13) proposes the notion of "eversion" that exemplifies this transition in the perception of digital things as a separate world, towards its integration with the real world, as if both dimensions were continuous. Everted space involves turning outward or reversing direction in thought or space perception, leading to new viewpoints or perspectives. It can also mean a shift in how something is perceived, aligning with the phenomenological concept of 'epochē,' where judgment is suspended to view reality differently. In synthesis, everting the digital from the physical perception represents a change in perspective or exploration beyond the ordinary (fig. 4).

Figure 4: Everted space and mixed reality



However, such indistinctness between the digital and material world does not imply harmonious unity. Rather, it leads to ontological and epistemological problems, among which those related to the different conceptions of identity, body, and being/inhabiting in the real world converge —and even antagonize— with the digital world. This can be abbreviated in the question: how has the digital world affected human existence? Eversion allows us to answer this question, as it is a communication between virtual and physical environments, an architecture unfolded to the digital, organizing objects and spaces for material bodies inhabiting the VWs.

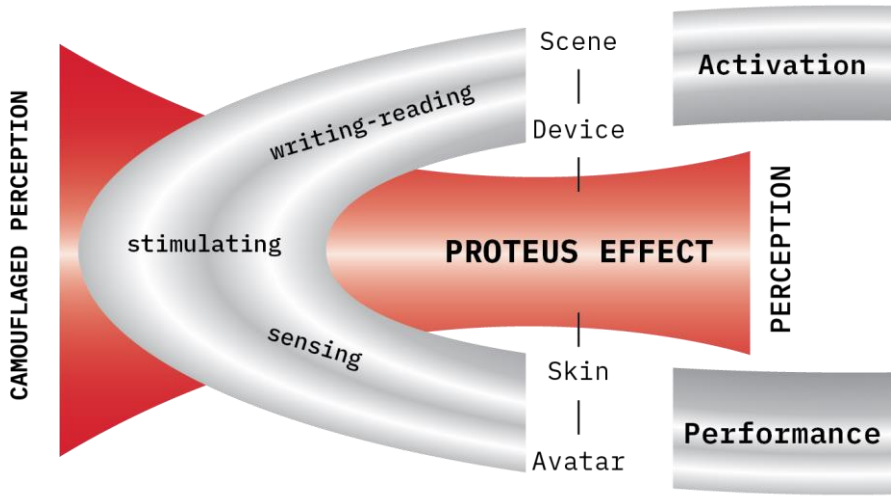
Thus, eversion functions as a complex twist in reading the constellations of data that characterize the metaverse; however, the greatest reach of eversion lies in its ability to convert the data matrix into a landscape. While the human sciences have focused on making explicit the implicit, eversion is the other side of this movement, because it reveals the work of the new digital humanities: digital forensics (forensic architecture), critical code studies (semiotics), platform studies, and game studies, not to mention work with linguistic data and large text corpora, data visualization, and remote reading. It is a response to the culture's shift towards a more mundane, layered, hybrid experience of digital data and digital media being brought into direct contact with physical objects, in physical space, from archival manuscripts to Arduino circuit boards (13).

THE PROTEUS EFFECT

As many scholars have noted, embodiment in MR refers to the feeling of immersion and presence. Immersion is feeling completely surrounded and engaged by the virtual world, while presence is feeling like the virtual body is the real body. Users perceive their virtual form as an extension of themselves, enhancing realism and emotional engagement. Movements, such as walking or gesturing, can feel authentic even if the user is stationary. With sensory feedback and a strong sense of presence, the virtual experience is not only visually compelling but also physically and emotionally convincing. Feeling resistance when pressing a virtual button, feeling weight when lifting a digital object, or perceiving texture on a virtual surface make these experiences even more compelling. Bringing together virtual and physical worlds, they form a unified experience.

Research is also ongoing on a phenomenon called the Proteus effect, which describes how our behavior is influenced by the characteristics of our avatar in VWs. According to Greek mythology, Proteus morphed into scorpions, eagles, trees, leopards, water gods, and pigs to evade detection. In VWs, the "Proteus effect" illustrates how avatar appearance directly influences behavior. Taller avatars tend to engage in more aggressive negotiation, while more attractive avatars tend to engage in more open discussions. A muscular avatar enhances competition confidence and a formal avatar enhances professionalism during virtual meetings (14). Using virtual avatars, ordinary individuals will be able to alter their self-representations instantly and easily. In addition to the changes in self-representation, changing one's avatar can affect one's psychological self as well as their social environment (fig. 5).

Figure 5: The Proteus effect and virtual-space design



The architectural design curriculum of today emphasizes a variety of digital skills that enhance creativity, precision, and teamwork. Tools like 3D modeling, BIM, CAD, and VR are revolutionizing the field. Students can use these tools to bring ideas to life, streamline processes, and work closely with stakeholders and clients. Embracing powerful and influential avatars can enable students to feel more empowered in digital environments. In architectural education, the Proteus effect could play an important role by influencing individuals' behavior and self-perception. Students may experience enhanced confidence and creativity when they explore metaverse architectural scenarios with powerful avatars. In a virtual space, they can experiment with bold ideas and take risks without the constraint of physical limitations (15).

In virtual environments, architectural designers often blur the line between their digital and physical selves. Avatar selection and behavior are influenced by psychological predispositions, influencing real-life behaviors and challenging the idea that avatars are mere tools. Virtual environments mirror real-life social norms, reinforcing the overlap between the two realms. Because designers spend a considerable amount of time in digital spaces, their behaviors and interactions may affect face-to-face interactions, creating a more difficult distinction between their physical and digital identities and contexts. A deeper study of avatar selection and virtual engagement is necessary, especially for architects whose creativity and spatial understanding are reflected and tested in these environments.

CIRCUMVENT SPACE AND HOLOGRAPHIC UNIVERSE

Embodiment in virtual environments is initially determined by the technical-formal components of digital architectural models (such as physical and aesthetic structures). The idea of virtuality does not imply per se a completely new field of understanding but is based on the human possibilities of perception and representation. Just as the real world can be discerned and

represented from structures such as geometric shapes and numbers, virtual reality is built from the observer's mental structures and the way that they reconfigure their ideas, regardless of whether it is something that it is “out there” or “inside” the mind (16). In this sense, if the characteristics of the VW can be encrypted in computer systems, the representations that result from this information will always correspond precisely with reality.

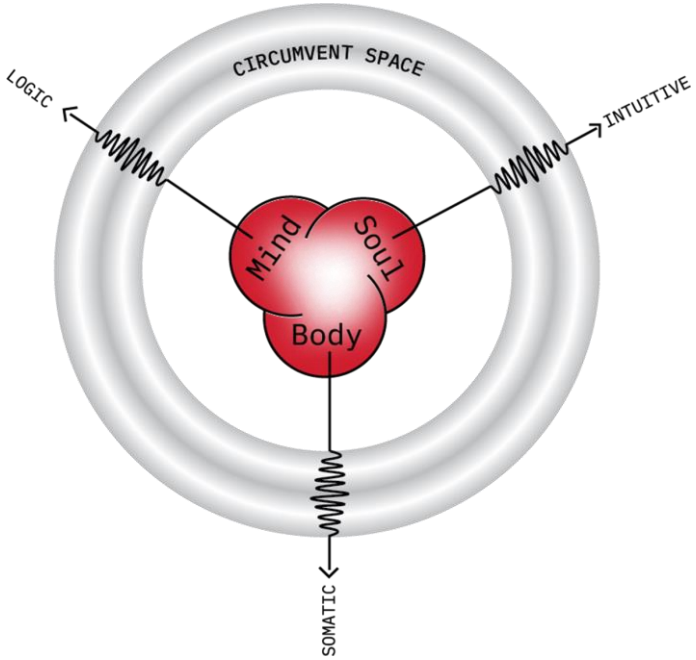
In the metaverse, the figurative, geometric, and numerical structures in which representational fields operate are expanded when it comes to artistic practices. In fact, from the first moment, the disciplinary fields between the artistic and the technological are exceeded, both for the scope in the field of creativity and for the visualization of artistic creations. In this proto-metaverse, architecture unfolds in hybridizations between cybernetics, engineering, and mathematics, so works can no longer be limited to the individual disciplinary characteristics of the architectural field. Designing in the metaverse implies the creation of new fields of understanding of the complexity and dynamism of languages that overlap with digital scenarios.

On the other hand, artistic representations in the metaverse correspond to a "post-symbolic" visual language of great technical refinement, which results in works of art so subtle that they pass through perception itself or perfectly merge with it (17). The greater sophistication of the channels of representation is at the same time a challenge to analyze and interpret the art and virtuality from the scope of each work and author. As an alternative, two concepts are proposed that help decode the representations and resignifications. The first is immersion, which refers to interactivity and haptic experiences in virtuality; the second is ritual, as a means of interpretation based on shared representations.

With reference to immersion, although it is possible to describe the space through the simulation of routes in virtual models on a computer screen, the sensation of being present in space requires the viewer to feel inside, wrapped, and immersed. The best way to approximate this sensation is by using a VR headset (Head Mounted Display or HMD) and recreating parallax; that is, the subject can physically move in a virtual space (3). It is in games such as Warzone and Mindcraft where immersion and parallax are better exemplified.

Jaspers introduces the concept of 'the enveloping' or 'the circumvent,' which spans multiple human domains. It encompasses being-there, consciousness, and imagination that extend beyond mere object-focused thinking. These elements are framed within thought, implying that comprehension of the objective world is essential to access the transcendental realm of the circumvent, as knowledge of the objective world is the key to reaching this higher dimension. The mere intention of going beyond the real world goes through the possibility of other explanations, explorations, ways of interacting, and constructing meaning; all this is achieved virtually and opens a new field for the creative mind of artists (fig. 6).

Figure 6: Circumvent Space

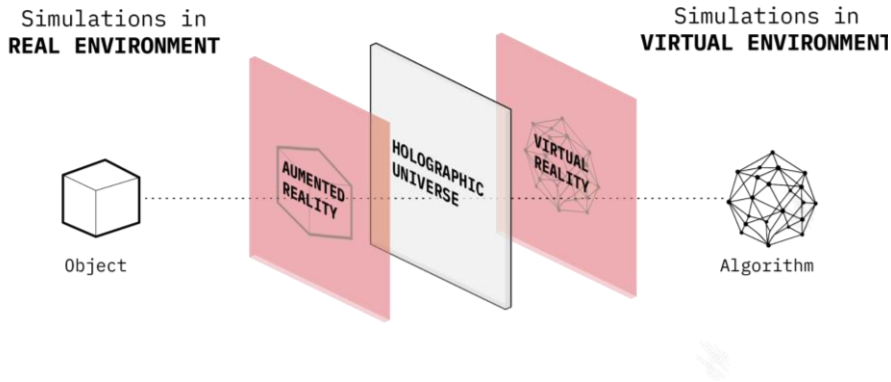


According to Jaspers' postulates, this way of apprehending humans reduces their knowledge to objective fragments that can be observed, losing the whole and limiting access to their psyche. The alternative presented by the author is based on the phenomenological method over the scientific one, with the purpose of intuitively representing the human psyche from the description of psychic manifestations, self-descriptions, and confidences.

The question about the body of the future that corresponds to VR is added to the idea of cyberspace, which has been positioned in the academic arena. The first alternative is that of the cyborg, which is a digital body based on computational logic. It is about vindicating the relationships between the human organism and its mechanical operations through communicational relationships because the operations depend on signals that are shared in time and space, like music. This possible encoding of messages in time/space helps link humans and machines, and goes even further, because words can link time and space, human bodies, and machines through etymology-based feedback loops that govern present and future actions, so that words can institute a story that is etymologically operationalized in a present-physical spatial context (18).

Holographic universe is an example of eversion in which the borders between the online and offline worlds begin to blur. The debate opens on whether virtuality constitutes an alternative space for organization or is subject to the logic of hyperconsumption, hyperdisplay, and simulation. The limitation of virtual identities is that they are reduced to the cognitive apparatus. However, art activates polysensual and interactive experiences in highly symbolic simulated spaces (fig. 7).

Figure 7: Holographic universe: Augmented Reality + Augmented Virtuality (AR+AV)



Cultural systems determine both physical and virtual environments by connotative meanings of representations (such as sociocultural values and the arranged environment). Similar to the physical body, new information and communication technologies mediate experience. The key concepts of the entire experience in digital environments are immersion and interactivity. The immersive scope of virtuality is determined by two main elements: the interactivity in haptic experiences and the rituals inscribed in the VWs. As Boring explains,

> [when] you confront the perceiving mind with a sensory pattern that lacks adequate meaning and get that pattern focal, then the inevitable result is that the perceptual core gets further specification by the organism. The strange is what lacks sufficient meaning, and the business of perception is to make the strange familiar (19).

The notion of "cyberspace" is attributed to the science fiction writer William Gibson in his novel Neuromancer (20). Gibson defined cyberspace as the computerized scenario and the interconnections that delimit an anthropological space of computer networks. In cyberspace, the relationships between users are recorded in telematic networks that constitute a cybersociety.

In addition to cyberspace, cybertexts and cybermaps appeared as representations of the real world. The cybertext, understood as "digitized, reconfigurable and fluid text [...] composed of elementary blocks joined by links or loops that can be explored in real time on the screen" (21), implies forms of navigation other than sequential text, because in cyberspace the most common way of reading is by hypertext scrolling. The cybermap, for its part, allows the parageographical representation of complex information that is displayed in cyberspace.

Immersion and interactivity are elements of a digital aesthetics. Both VR and AR are ways to produce new experiences that prepare users for the sensory (haptic) stimuli in digital environments and facilitate immersion. The question that arises is whether social behavior is reproduced only in virtual environments or whether other behaviors and rituals specific to cyberspace are also reproduced, which will have to be deciphered from cybertexts and cybermaps. Social conventions assume interactions and constructions of meaning that are established in unconventional normative fields (22).

The metaverse concept is considered the next step in the evolution of the internet. VWs, more than a digital narrative of the real, offer an immersive and collaborative space where multiple participants create avatar-mediated social networks. The metaverse is at present the most organic interaction between the real and the virtual. One of the basic principles of this interaction is the organization of human practices in rituals. The basis of rituals is the representation of shared beliefs between people who meet in one place. The place is itself a middle ground that brings together the disparate elements of ritual communication (17), so that communication rituals, such as ceremonies, festivals, and academic events, will only be possible to the extent to which a place is assigned where the groups of individuals come together.

In metaverse experiences, the collective sense of presence and immersion ritualizes both space and interaction. Social interactions are a form of dramatic realization: the subject assumes a role, and their performance will depend on their mastery of the current codes. Rituals are a form of dramatization, a kind of translation of events that gives them meaning. In cyberspace, rituals amplify immersion and interactions in an abstract way, created and manifested through shared behaviors (such as dialogue).

Rituality facilitates the identification of regularities in virtuality. A symbolic space is constituted owing to the fact that the system registers the activities of the users and transfers them to a virtual representation that corresponds to the virtual environment (23). The identification of interactions is made possible through contextual information that documents the user, their activities, and the dynamism of the commands and virtual spaces that they use. From the perspective of cultural productions, architecture in the metaverse operates registers of perception and triggers experiences that go beyond the conceptual and semiotic standards of cultural industries such as films and television.

DISCUSSION AND CONCLUSION

Virtual art —says Heim— breaks with modern aesthetics in which the spectator is passive and is closer to the transhumanism communicated by shamans and mystics, so that it is more like vertical reality than VR (24). The articulation between space and time through human–machine communication is the main support for virtual interactions. The expansion of the technological field modifies not only human relations but also ways of conceiving and thinking about the reality that is now made up of other spaces and images. In this sense, the production of VWs disrupts both the ways of being of the human body and the spaces it has access to. Other configurations also appear, the limits of which are diffuse in a transparent, homogeneous, and floating nature.

Immersion makes sense in virtual spaces because it is operated by devices capable of isolating the sensory systems to the point of making the human user feel as if they have been transported and occupy other places. The dilution between the virtual and real world is becoming increasingly less significant because those who participate in the metaverse show that what happens in the VWs is as important as what they do in daily and real life. Metaverse applications for business or education are the most tangible way in which human interactions can occur in the virtual environment; this interaction is real and brings the virtual existence closer to real life.

From the point of view of the human as an actor, whenever they interact in any of the worlds, they have a kind of avatar, the same for virtuality as for real social interactions in which the avatar is a physical body. The representation of this physical body in VR is what expands the options that the virtual avatar has over the physical one. Some users, for example, represent themselves as birds or fish, making clear the break between the norms of representation and conventional social models. In VWs, the legal and social norms of care and relationships can be challenged (25) so that family guidelines or romantic relationships are not followed. These are worlds with other configurations and rules.

The cyborg is the corresponding body that inhabits the metaverse and is the starting point to reformulate nature. From the perspective of language and architecture, the cyborg functions as a discursive element that reprograms biological conditions in today's technological environment. Rawdon referred to the cyborg as a prosthesis that marks an intersection between two systems, two underlying networks of rhizomes, technological and organic, as a cybernetic part of the body (26).

It cannot be ignored that cyborg technology has only one face, because its proponents exist at the same time as its fierce detractors. Improvements to the body or cyborgian hybridizations have been considered as monstrosities that have the double face of the mechanical manipulation of humanity and the mechanical that facilitates the reconfiguration of identities through technologies that transcend the organic-biological human being. The metaverse designer does not wonder about his status as a discursive cyborg when it comes to producing a work. On the contrary, he uses technology for creative purposes based on the cyborg as a metaphor, the avatar as an indispensable resource to amplify immersion and interactivity in virtual existence. Following Rawdon's postulates, the main merit of productions in virtual spaces is the articulation between biological bodies and digital avatars.

Metaverse’s sustaining principle is the existence of a content user-creator. Metaverse's expansion dynamics constantly increase the densities of both the number of users and the content. Thus, we can speak of millions of simulators used not only by creators but also by many entrepreneurs who have amplified the scope of communication to financiers in an environment with their own currency and financial model. This amplification has to do with the way in which information is presented in increasingly symbolic formats that not only communicate ideas but also build new images and representations through interactions with the mechanical system of cyberspace.

For architects, the real challenge of metaverse is acceleration, because cultural support moves ten times faster, and text and language simulators are capable of facilitating intercultural interactions that would not be possible in the real world because of the diversity of languages and cultures. In the field of education, VR offers the possibility of transferring more knowledge than any existing didactic technology. In the field of economics, architectural designers of the VWs demand not only the intellectual rights to their works, but also their monetization and commercialization.

The future of architectural education and training should focus on developing theoretical frameworks that address emerging dynamics in metaverse environments. Furthermore, longitudinal studies are needed to investigate the

psychological and social impacts of sustained participation by architectural students in digitally created environments (27).

Both the formation of human identities and interactions are shaped by the new environments of the metaverse. Architectural design practices are a sample of how the reinvention of the human and its exploration is now forged in other codes and with more open meanings. In fact, the information that Metaverse supports is of a collective and collaborative nature, in such a way that creative processes are both an interaction and a co-creation of art and technology without distinctions. Furthermore, the possibilities of interaction through virtuality are outlined in the relationships of learning and commercialization of the works that manifest, as a result of creativity collectives willing to challenge not only the field of ideas but also the format of architectural production in the real world.

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