Extended Reality of Architecture: Beyond Photo-Reality of Architectural Representation and Visualization

Proširena realnost arhitekture: izvan foto-realnosti arhitektonske reprezentacije i vizualizacije

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Abstract Digital information technologies are extending the realm of reality through various types of virtual, mixed, and augmented reality encompassed by the term "extended reality". This research redefines the concept of extended reality, interpreted within a broader conceptual framework that synthesizes representation and visualization of architecture, with phenomenology and post-phenomenology, cognitive theories of extended mind and philosophy of technology. Considering that photorealistic digital images currently dominate architectural visual representation, comparative analysis of the conceptual differences of photorealism and the proposed concept of extended reality reveals major distinctions regarding cognitive and phenomenological features, as well as the character of technological mediation.The theoretical conceptual framework of extended reality is based on the assumption that the technological mediation of visual spatial experience generates a dynamic space of interaction between multiple realities across many layers of experience. It provides a deeper comprehension of the role of architectural representation not merely as an instrument for visualization of ideas and descriptions of material objects. Architectural representation has generative, projective, and cognitive capacity that could augment and extend reality across multiple dimensions. The digital information technologies and generative models can be meaningfully integrated within the architectural design process by understanding their potential to change, develop, and extend the reality in which architecture is not only articulated and expressed but also concretized and experienced.

Keywords architectural representation; extended reality; photo-reality; technological mediation; visualisation.

Sažetak Digitalne informacione tehnologije proširuju područje stvarnosti kroz različite tipove virtuelne, miješane i dopunjene stvarnosti obuhvaćene pojmom "proširena realnost". Ovo istraživanje redefiniše koncept proširene realnosti koji je interpretiran unutar šireg konceptualnog okvira koji sintetizuje reprezentaciju i vizualizaciju arhitekture sa fenomenologijom i postfenomenologijom, kognitivnim teorijama proširenog uma i filozofijom tehnologije. S obzirom na to da fotorealistične digitalne slike trenutno dominiraju arhitektonskom vizuelnom reprezentacijom, komparativna analiza konceptualnih razlika fotorealizma i predloženog koncepta proširene realnosti otkriva glavne razlike u pogledu kognitivnih i fenomenoloških karakteristika, kao i karaktera tehnološke medijacije. Teorijski konceptualni okvir proširene realnosti zasniva se na pretpostavci da tehnološka medijacija vizuelnog prostornog iskustva generiše dinamičan prostor interakcije između višestrukih stvarnosti kroz mnoge slojeve iskustva. Koncept proširene realnosti omogućava dublje razumevanje uloge arhitektonske reprezentacije ne samo kao instrumenta vizualizacije ideja i opisa materijalnih objekata. Arhitektonska reprezentacija ima generativni, projektivni i kognitivni kapacitet koji može da dopuni i proširi stvarnost kroz više dimenzija. Digitalne informacione tehnologije i generativni modeli mogu se smisleno integrisati u proces arhitektonskog projektovanja razumijevanjem njihovog potencijala da mijenjaju, razvijaju i proširuju stvarnost u kojoj se arhitektura ne samo artikuliše i izražava, već i konkretizuje i doživljava.

Ključne riječi arhitektonska reprezentacija; proširena realnost; foto-realnost; tehnološka medijacija; vizualizacija.

1 Introduction

The new dimensions of space generated by digital information technology are extending the realm of reality through various types of virtual, mixed, and augmented reality, enveloped in the term "extended reality". The development of Artificial Intelligence (AI) generative models creates new synthetic reality environments, whose dimensions and effects on human world are still mostly unknown. Through the notion of photo-reality, the digital images are exposing some fundamental features of the modern forms of image creation. Photo-realism seems to close the gap between the representation and a presumed reality. This "gap" is the fundamental site of this research, grounded on philosophical stances of phenomenology, post-phenomenology and cognitive theories.

Architecture, with its technological, material, social and cultural dimensions, is questioning the reality of its foundations extended by the new realities of artificial imaginations and visualisations. Today, the photorealistic digital images dominate architectural visualization and presentation. The concept of photorealism holds deeper implications for understanding how visual experience mediated by technology can define and alter the nature of spatial reality. It is not only providing a foundation for spatial visualization and representation in architecture, but also playing a major role in shaping social space and visual culture. S. Sontag stated that photography would evolve beyond its own medium, becoming the fundamental way how something might be experienced, giving the viewer a way to participate in the photographed scene, altering the visual experience, and changing the perception of reality (Sontag, 1990). Manovich argues that photorealism is a constructed style, not just a representation of visible reality based on human perception (Manovich, 2017). According to Ackerman, representation is not just a reflection of some "reality" in the world, but is a "means of casting onto that world a concept — or subliminal sense — of what reality is." (Ackerman, 2002).

The following research is questioning the implications of architectural representation considered as objective and precise description of reality, produced by algorithmic systems of digital technology and recent development of AI generative models. The research is based on the assumption that technological mediation of visual spatial experience becomes not the basis of objective visual representation of some external given reality but opens a dynamic space of interaction between different realities that extends through multiple layers. The research is grounded in the philosophical work labeled as postphenomenology, which explores how technology mediates human experience of reality (Ihde, 1990). The study further incorporates cognitive theories of the extended mind (Clark & Chalmers, 1998), which argue that cognition extends into the external environment, including technology. These theoretical foundations are integrated with critical perspectives on the dinstinctive character of architectural design and its modes of representation. The hermeneutic and indeterminate character of the design process (Snodgrass & Coyne, 1997) are contrasted with the deterministic logic that underlies the development of computer-aided design (CAD) and building information modeling (BIM) technologies.

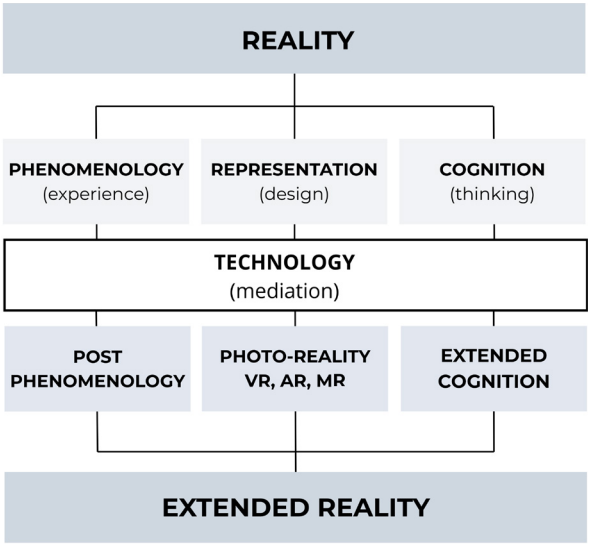

Figure 1 Basic theoretical framework of the research, defining key concepts and relations. Source: Author, 2025.

The research, through a review of the concept of representation considered in an expanded scope, explores the significance of technologically mediated visual experience, from graphic representation and photography to digitally enabled technologies. Focusing on the role of photorealism in architecture, a comparative analysis is used to identify conceptual differences between modern and postmodern representations of reality, which are further explored with regard to the development of digital technology and its further impact. The concept of extended reality as technologically mediated reality is developed and interpreted in the wider framework of contemporary thought by reframing relations of technology to concepts of representation, cognition, and phenomenological experience.

Through a complex synthesis of multiple aspects of the representation of the architectural design process with the theoretical fields of phenomenology and post-phenomenology, philosophy of technology, and cognitive theories of extended mind, the research aims to generate new theoretical insights. Research methodology is based on analytical, hermeneutic, and comparative analysis and synthesis of the key theoretical concepts, further integrated into a conceptual framework defined as extended reality. In comparison with existing research that focus primarily on digital technology, this framework is developed integrating the domains of phenomenology, cognition, and representation with technological mediation. The conceptual framework serves as an interpretative model, rather than a predictive or deterministic.

Further comparative analysis of the conceptual differences of photorealism and the framework of extended reality reveals important distinctions regarding cognitive and phenomenological features and the character of technological mediation, leading to a deeper understanding of the potentialities of representation mediated by technology that can define the nature of spatial reality.

The proposed conceptual framework of extended reality, provides a deeper insight and understanding of the fundamental role of architectural representation that can extend reality in its multiple imaginative, cognitive, experiential, material, and socio-cultural dimensions. The theoretical synthesis of the research reflects a critical stance, emphasizing conceptual and critical reflection.The theoretical nature of the study requires further research in domains such as design cognition or design practice.

2 Representation and Extended Reality

The notion of representation refers to the description or symbolization of an object, idea, or phenomenon in an adequate model and medium of human perception and cognition. The concept of representation encompasses many disciplines, such as philosophy, linguistics and cognitive sciences, media and communication, sociology and politics, art and visual culture, including the field of architecture. Its role in architecture is fundamental, but rarely has it been adequately explored in all its aspects. Representation in the field of architecture is mostly based on visual representation in the form of images with various characters and functions, such as conceptual drawing sketches and diagrams, orthographic two-dimensional spatial plans, or three-dimensional visualizations.

Representation is a complex topic, touching on the concepts of presence and absence, spatio-temporal reality, perception, and cognition. Its character could be mimetic and descriptive, symbolic and metaphorical, or speculative and projective. Representation is both a perceptual and cognitive activity. The concept of representation is closely related to visualization, language, and image. The mechanisms and principles that enable the potential perceptual presence of something absent include media, techniques, and socially shared codes that allow interpretation as recognizable meaning. The intertwining of the present and the absent in representation makes it complex, because the way in which the gap between the present and the absent can be bridged is neither simple nor obvious.

2.1 Modes of representation in relation to reality

The relationship between reality and representation is one of the key philosophical questions. Vesely emphasized the role of representation as a way to participate in the world that we consider as real: "What we normally refer to as reality, believing that it is something fixed and absolute, is always a result of our ability to experience, visualize, and articulate — in other words, to represent so as to participate in the world." (Vesely, 2004, p.3).

Different modes of representation could be categorised in relation to the common notion of reality. *Representation as a reflection* of the observable reality describes or depicts something that exists in reality as directly perceivable to the senses. This interpretation of representation often serves as the foundation of the traditional concept of representation regarded as representational realism. *Representation as disclosure* is making the invisible, intangible, or hidden reality visible, revealing something that cannot be directly perceived. This kind of representation requires transformation of information, translation, and mediation, often using abstraction or technological mediation. *Representation as concretization* gives perceptible form to abstract ideas, concepts, principles, or values. It often includes symbols, metaphors, or analogies based on shared cultural or conceptual codes. *Representation as projective anticipation* proposes, or suggests, the potential future that does not yet exist. It projects vision forward, into the reality of a possible future.

The creative and ethical complexities of representation are based on different modes of representation in relation to reality (Table 1.) and specific purposes: to document or depict, to reveal or interpret, to articulate or embody an intangible, and to propose, persuade, imagine, or anticipate. It's the context in which they're used and the intentions behind representations that determine whether they become implemented in cognitive and creative exploration or as a tool for perceptive or ideological manipulation.

2.2 Representation as extension of reality

The meaning of the concept of reality is not fixed, and it could refer to the knowledge about our environment produced by our senses, our mind, and our body, but it could also include mediation by social and cultural codes or technology. The role of representation is often questioned in relation to the concept of reality. Representation is in some cases evaluated in contrast to an external reality, as a substitute that lacks the complexity and richness of direct experience. Conversely, representation is understood as a process that constructs and constitutes reality. Webb states that "the processes of representation do not simply make connections, relationships and identities visible: they actually make those connections, relationships and identities." (Webb, 2009, p.17).

Table 1 Modes of representation in relation to the common notion of physical reality. Source: Author, 2025.

Reality	Modes of representation	Main characteristics
Observable/Visible	Reflection	Visual clarity, accuracy, likeness.
Hidden/Invisible	Disclosure	Translation, transformation, mediation.
Abstract/Symbolic	Concretization	Metaphor, analogy, code.
Potential/Possible	Projection/anticipation	Intentional, imaginative, speculative.

According to the cognitive theory of extended mind, cognition is not the inner representation of the world stored in the brain, but it is open, directed outwards, and actively interconnected with the world. "Cognition leaks out into body and world." (Clark & Chalmers, 1998). The extended cognition is situated and distributed, extending beyond the brain across the wider environment, tools and technology, language, media, cultural practices, and social structures. Active mental phenomena are coupled and integrated with the external world.

Our knowledge about the world, with accordance to the theory of extended mind, could be extended by its representations. We could overcome the limits of our perceptive and cognitive capacities by including many levels of representation as mediating processes that could include technology as a mediator. If representation is considered as perceptually extended cognition or distributed cognitive structural support, it does not replace reality, but it instead constitutes reality as its perceptual and cognitive extension. Representational systems act as transformative media through which cognition becomes distributed and concretized by continuous feedback loops.

The notion of representation as augmentation and extension of reality should be further explored in relation to the architectural design process, accepting the mediating character of our perception and cognition integrated with technological mediation.

3 Architectural Representation and Visual Experience of Architecture

Thinking, seeing, and drawing, as the basis of the architectural profession, are framed by representation that at the same time guides perception and cognition and opens conceptual possibilities. Representation is shaped and communicated mostly by visual language, graphic medium, and shared knowledge as a product of cognitive, cultural, and social processes. Architectural representation has multiple roles in different design phases: registering and guiding the design process, testing and iterating different aspects and options of ideas, communicating and presenting ideas and solutions, negotiating and persuading, directing and instructing the process of material production, and recording and documenting existing architectural heritage. According to the characteristics and phases of the design process, its representational character can be specified as ideational, notational, or experiential (Bafna, 2008; Fuente Suarez, 2016). It includes different levels of abstraction and perceptual and cognitive representational methods and techniques.

3.1 Indeterminacy of architectural representation

Tracing the origin of architecture and its representation, we could explore its history from the first drawing plans, Rennesaince perspective drawings, to photographic and digital images: in all cases that could be explored, architecture drifts somewhere between its graphic representation in the form of drawing images and external "reality" in the form of material building. Gomez remarked that "the distance between architectural drawing and building has always been opaque and ambiguous." (Pérez-Gómez, 2012). Exploring the gap from idea to built object in architecture, mediated through architectural drawings, Evans (1997) questioned the common notion of a direct, representational nature of such mediation. He discussed the priority of architectural drawing to the reality of object, where the medium puts the logic of the classical notion of realism to "stood on its head", as the drawing images here are not reflections of existing reality but productive of a reality (Evans, 1997, p.165). Architectural representation encompasses seemingly opposing domains: the invisible and the visible, notational and imaginative, undetermined and determined, ambiguous and precise, instrumental and symbolic. Although the architectural plan is considered to be completely determined in relation to the architectural object, Evans emphasized two opposing characters of objects and drawings: "in the one corner, involvement, substantiality, tangibility, presence, immediacy, direct action; in the other, disengagement, obliqueness, abstraction, mediation and action at a distance." (Evans, 1997, p.160).

The realities of physical material construction and human vision and cognition appear to be distinct, creating a challenge for architecture in bridging these two realms. Architectural representation is separated into two seemingly divergent domains: the images that simulate the visual experience of architecture and the abstract design drawing plans that enable precise spatial planning, defining of measurements, and directing the material process of construction. Architectural plan, considered as an abstract representation that determines architectural object, is treated as a neutral, objective means of description. The phenomenological dimension of architecture is correlated with its perceptual experience. Merleau-Ponty's phenomenological approach argued against the objectivity of the world representation. According to Merleay-Ponty, "The perceptual 'something' is always in the middle of something else, it always forms part of a 'field.'" (Merleau-Ponty, 2005, p.13). He pointed to the ambiguity of visual experience, with the visual field as the "strange zone," and emphasized the contextual dimension of perception "perceived, by its nature, admits of the ambiguous, the shifting, and is shaped by its context" (Merleau-Ponty, 2005, p.13). From a phenomenological standpoint, the indeterminacy becomes a positive phenomenon.

Opposing the supposition that the design process could be completely described, codified, and explained by a model derived from the philosophical logical positivist concept of exact and determinate language, Snodgrass and Coyne stated that design is a hermeneutic process, as a "never-ending play of interpretive readings" (Snodgrass & Coyne, 1997). Logic is not suitable to comprehend the "irrational, contradictory and confused nature of much of the designer's activities" (Snodgrass & Coyne, 1997, p. 88).

Architectural drawing images are neither just reflexive representations of thought nor mimetic representations of a material object, but mediators from the abstract to

the concrete, from the indeterminate to the determinate. The output of architectural representation is not predetermined but open to potentialities that transcend initial abstraction and indetermination towards the existence of an architectural object that is situated and context-dependent.

3.2 Architectural visualization and visual experience

The relationship between architecture and its representation is ambivalent. It is often considered as the primacy of a determined plan over an indeterminate idea, or as the primacy of material building as a more authentic experience than its graphic representation. Pallasmaa (2005) expressed his critique of the prevailing visual dimension of architecture. He sees "the dominance of the eye" and privilege of vision in Western thinking as suppression of other senses, leading to "detachment, isolation, and exteriority," claiming that "vision separates us from the world whereas the other senses unite us with it" (Pallasmaa, 2005, p.19-25). Architecture's reliance on visuality is often considered an insufficient, partial, and impoverished form of perceptual experience. The other senses support immersion in the spatial and temporal here and now, but vision separates us from it, extending our experience in front of our current position and projecting the mind ahead. The projective character of architectural representation and visualization is directed toward a future that is phenomenologically absent but projectively present. The reliance of architectural representation on visuality is not only related to sensory perception of the optical sight. Architectural representation drawings are not just reflexive visual descriptions of the building. Bafna pointed out that it is not just the visual experience of the building that is the aim of imaginative representations, but to invoke a "particular mode of attention." (Bafna, 2008) Some qualities, such as the point of view, proximity, the amount of information, the structure of information, and the contextual conditions of attention, as representational aspects of architecture, go beyond sensory visual perception, expanding the cognitive spatial experience.

In the classic view, representation is considered as resulting from the internal subject-object relationship, as understanding and interpretation of the visible and known world of external objective reality. The notion of visualization is sometimes established in opposition to this kind of representation, having more external dimension and supporting communication and interaction. Flusser explores the nature of images which he refers to as "technical images", characterizing them as "computation of concepts" rather than objective representation based on observation of objects (Flusser, 2011, p.10). Here he classifies photography and film media, where we could further include digital images. For Flusser, such images are not passive depictions; "Images are intended to serve as models for actions." (Flusser, 2011, p.11) He is not considering visualization as passive representation of something outside the image that could be described and explained, but as "projection in intentional direction" (Flusser, 2011). Flusser claims,"It is the concrete experience, the adventure, the information that the visualization communicates that is interesting. The explanation is abstract; it is the visualization that is concrete." (Flusser, 2011, p. 36).

Visualizations that simulate human visual experience have a significant role in the design process, serving as a bridge between more determinate, measurable, abstract plans and indeterminate, concrete living experience. Visualization is used in architectural design simultaneously as a means of presenting proposals, simulating the future, and assisting in decision-making. Aiming to draw attention and get acceptance, architectural visualisations are frequently focused on external communication and dialogue with clients and the general public. For Latour it is not perception that is fundamental for visualization and cognition: it is mobility, but also immutability, presentability, readability, and relational quality (Latour, 1986). Visualization involves social dynamics, a network of participants, and established continuity of meaning and understanding. The role of visualization, presentation, and persuasion in architectural practice is mostly supported by "realistic" images that manipulate vision, aiming to suggest completeness, concreteness and objective representation of reality. Contemporary digital technology supports this "realism," not just as static but as dynamic images, expanding visual experience into the virtual technological domains.

4 From Photo-Reality to Hyperreality of Architecture

4.1 Technological mediation and representation

Don Ihde (1990) confronts the general notion of technology as neutral applied science. He explores the concrete and experiential notion of technology as "artifacts of material culture" (Ihde, 1990), focusing on its non-neutrality and mediating role in human experience and how it affects the way of perceiving, understanding, and acting in the world. He defined his work, labeled as postphenomenology, as a "phenomenology of human-technology relation" and "hermeneutics of technology-cultural embeddedness" (Ihde, 1990). Focusing on technology as a mediator, he extends phenomenological interest in the perceptual embodiment of human existence. Ihde makes a difference between "micro perception" as subjective sensory perception and "macro perception" as cultural and hermeneutic. Microperceptions are multistable, correlating to the range of cultural contexts (Ihde, 1990).

Ihde defines key types of human-technology-world relations: *embodiment relation*, where technology becomes part of the extended body; *hermeneutic relation*, where technology interprets the world by technological mediation (e.g., thermometer, map, drawing, language); and *alterity relation*, when technology appears as a quasi-other, semi-autonomous realm or agent (Ihde, 1990). A specific case is a *background relation* when technology shapes the context, becoming integrated as invisible, transparent infrastructure. (Ihde, 1990). Wheeler influenced by Heidegger and Chalmers' extended mind

theory, argued that for something to be part of an extended cognitive system, it must be transparent in use, as part of the seamless flow of thought or action (Wheeler, 2019). Transparency, as fluent functional integration, makes the system invisible, in the background of experience.

Simondon, in his foundational work on the philosophy of technology, "On the Mode of Existence of Technical Objects" (Simondon, 2017), correlates technical objects and human culture, exploring the human reality within technical reality, claiming that "culture must incorporate technical beings in the form of knowledge and in the form of a sense of values" (Simondon, 2017, p.15). He considered technical object as a process that evolves toward a more coherent internal structure, which he called "concretization". Technical objects are never fully concrete but contain potential for further development, integration, and adaptation (Simondon, 2017). In Simondon's terms, architecture is a technical object whose abstract design gains reality through concretization, as a dialogue between the design plan and materials, site, construction, and cultural and social context.

Technology, as a mediator of perceptual experience, has its significance in architectural representation and concretization of the visual experience of architecture. The evolution of technologically mediated visual experience unfolds from recording optical information traces to generating and synthesizing visible information patterns. Starting from the geometric construction of perspectival drawings and the automatic mechanism of photography to the generated three-dimensional (3D) computer graphic (CG) renders and synthesized images of the latent statistical space of artificial intelligence (AI) generative models and neural networks, we can specify a cascade of mediation, where each new level imitates the visual experience of the previous but with fundamentally different principles of generation, human participation, and autonomy of the system.

4.2 Photo-reality of architecture from modernism to postmodernism

Although the modern age is often characterized as a period marked by the transition from the age of literacy to the age of visuality, Mitchell argues that the so-called "pictorial turn" is not unique to the modern age and new media technology (Mitchell, 2002). The development of linear perspective, technical inventions like the printing press, photographic camera, television, computer technology, and digital graphics mark significant key points in the history of how humans represent the world as well as how they see and comprehend its reality.

Heidegger (1997) claimed that what distinguishes the essence of the modern age from previous periods is the notion that the world becomes a picture. The picture is related to the objective representation of the world relying on the modern scientific worldview, with its "objectiveness of representing," defining truth "as the certainty of representing." (Heidegger, 1997) Both real and representational space are abstracted scientifically and geometrically. The construction of the world and the images are becoming the same. Modernism problematizes traditional forms of representations because they constrain understanding of the world. Relying on visuality, modernism rationalizes seeing through new technologies of image production that bring new abstract models of visualization. Crary (1992) highlights the discontinuity of modernist vision that developed since the turn of the 19th century in comparison to preceding historical periods, focusing on the role of the observer himself, who is not just a passive spectator. It is not only about changing the conventions of representation but also about the reorganization of knowledge and social practices that change productive and cognitive human capacities (Crary, 1992).

Exploring the transformations brought by modernity, Giddens (1991) stated that modernity, besides extreme dynamism and separation of space and time, disembedded social systems from their local context. Social interactions are abstracted, mediated through systems that transcend local experiences, displacing social life from its unique presence. By contrasting earlier representational techniques with a photographic image, modernism emphasizes the power of the photographic image in creating a new structure of society. According to Benjamin (1980), photography becomes a medium that separates an object from its traditional context, enabling liberation from the old rigid representational frameworks of reality and transcending established interpretations of the world. The role of photography as a realistic, objective, and accurate mechanical reproduction of reality gives it the power of persuasion, drawing the viewer into the given space of the image as a real space. "Realities understood in the form of images were now being given to realities understood to be images." (Sontag, 1990, p.119)

Scruton argues that photography cannot be a mode of classical representation because it, like a mirror, establishes a direct identity of the object of the image and its appearance at some particular moment (Scruton, 1981). Barthes analyzes photography as "analog perfection," giving photography a special status in relation to other imaging techniques. Photography, treated as a "mechanical analogy of reality," a continuous "message without code," without cultural symbols that would be associated with its reading, distinguishes it from previous forms of pictorial and symbolic representations (Barthes, 1977). Photographic images based on mechanical principles and a symmetrical relationship between the mind and the world are connecting visual sensory experience with a rational model of the world (Mitchell, 1984). The image becomes a transparent medium, as a window to the world. The interpretation of the role of photography as a direct visual copy of the real world on the one hand enhances its suggestive power, but on the other hand leaves its creative, cognitive, and cultural dimensions on the margin. Barthes noticed a paradox in photographic images as the "co-existence of two messages, the one without a code (the photographic analogue), the other with a code (the 'art,' or the treatment, or the 'writing,' or the rhetoric, of the photograph)." (Barthes, 1977, pp.17-19)

As a technological product that both mechanized and democratized the process of production of images, photography, further propagated by mass media, reveals the social significance of image creation. Photography discloses the nature of space, perception, and representation as a dialectical relationship between the world and the image in a cultural context (Mitchell, 1984).

Transcending the documentary role of technologically based images, photography becomes a collective cultural phenomenon that marks the 20th century and has a special role in modern architecture.

In the modern era, architecture is inextricably linked to photography, which plays the most important role in spreading the cultural influence of modernist ideas, supporting the valorization of modern architecture through print and electronic media. In the context of architectural representation and visualization, which occurs after the materialization of the design process, the role of photography in modern architecture becomes ubiquitous. As a technique of visual registration and description of material objects, photography has become a transparent medium through which the reality of a built object is represented and reflected. It transforms the material architectural object into its seemingly objective image, bridging the gap between the architectural drawing and the material object.

Photography in modern architecture breaks down the hierarchical privileged position of the built object and replaces it with a complex interaction of inter-media relations, finding its expression in the translation between the media of drawing, material objects, and photographs (Tanaka, 2000). To a large extent, photography influences the interpretation of architecture and its cultural significance. The strong connection between architecture and photography is based on the understanding of photography as a reliable, objective copy of the registered world, enabling direct transmission, precise description, and stable representation. Photography is treated as correlated to a direct sensory insight into reality that was mechanistically rationalized, thereby confirming the modernist rational view of nature that synthesized science and art.

According to Lyotard, modernity's discovery of the "lack of reality," referring to classical representationalism, is resolved by inventing other realities as the abstract and objective, which has a high price (Lyotard, 1984). Postmodernism problematizes the possibility of direct objective representation of reality. Lyotard stated the postmodern declaration: "Let us wage a war on totality; let us be witnesses to the unpresentable; let us activate the differences..." (Lyotard, 1984, p.82) Through juxtapositions, collages, and montages, postmodern representation attempts to represent reality as a myriad of images, not to supply reality but to invent allusions to the conceivable, which cannot be presented (Lyotard, 1984). Postmodernism points to a gap between the human experience of reality mediated by perception and the structures of language and symbols. Cultural symbols of images from the past are inserted into other images, including photography, as cultural context that determines their meaning. Against the totalitarism of objective representation that equates the realism of architecture with the objective realism of photography, postmodernism deconstructs the image of an object by breaking visual form and deforming perspective. Using digital technology to deform, break, and fold the surface image of an object, its privileged, unique objective position and transparent representation are problematized.

Considering mimetic images as deceptive phenomena that hide distorted and arbitrary mechanisms of representation are not only postmodern discourse, tracing back to Plato. "Realistic" images hide their artificiality, according to Mitchell (Mitchell, 1984). Seeing is not just a mechanical process but a product of experience and inherited cultural patterns that include the experience of making images. The photographic image does not just reflect the material world as an objective registration of a scene or event; it articulates and interprets reality, extending its visual experience. Photography could be considered the predecessor of modern digital information models that, in contemporary architecture, become fundamental representational tools, questioning the boundaries of material and immaterial space.

4.3 Synthetic hyperreality and digital determinism of architecture

Digital technology has facilitated the process of image production and automated it, also enabling great possibilities for image manipulation. The tendency towards automatism and a certain autonomy of systems and models of representation, which is characteristic of photography, takes on an even more generative character in digital information technology. 3D visualization is a term that envelops the digital techniques of image generation from digital 3D models, under the terms "3D rendering" or "3D graphics."

Architecture becomes immersed in the digital space where the photorealistic digital images dominate architectural visualization and presentation. It is considered as a possibility for increasing real experience of architecture, as a precise and more realistic representation of architectural projects. Just as photography relied on older painting techniques for its visual expression, so too do the digital images of virtual 3D models rely on the visual expression of photography. Digital 3D imaging takes on an analogy with some principles of photography, defining interface tools that regulate image parameters as a camera shot, including characteristics of photographic conditions such as camera position, focal length, and camera angle, along with algorithmic simulation of light effects and textures.

An image rendered from 3D digital models as a simulation, not directly correlated to the objective perceptual world, could be correlated to Baudrillard's definition of simulation as "the generation by models of a real without origin or reality: a hyperreal" (Baudrillard, 1994, p.1). Digital simulation becomes photorealistic, imitating the visual experience of photography. To increase visibility and readability of images, digital technology produces an overwhelming amount of detail and exaggerated composition, intensifying specific properties of perception. Photo-reality proceeds into the hyper-reality of high-resolution images and their virtual dynamic extensions. Treating architectural representation as a mirror of reality, "realistic" precision and high resolution become imperative for architectural visualization. Manovich (1994) pointed to the overemphasized reality of "perfectly real — all too real" images as a problematic aspect. He argues that digital images, free

Figure 2 The photo-real architectural visualization produced by AI technology, simulating photography and 3D renderings. Source: Author, design by text-to-image AI image generator PicLumen, 2025.

from limitations of human or photographic vision, are hyperreal, as different, inhuman visions of synthetic reality (Manovich, 1994).

Digital tools could hyperdetermine reality, leaving no room for the indeterminate aspects of design. Indeterminate phases and aspects of architectural design (conceptual or speculative) are excluded by digital tools like BIM technology. Treating architectural representation as a neutral, transparent, instrumentalized set of instructions that can be directly actualized in material space, hyper-determination of the abstract plan may reduce architectural design to a pre-programmed output, restricting its evolving, iterating, recursive and creative character. The further development in this direction leads to fully abstract design, where there is no need for any human visualization, because 3D printing technology integrated with 3D digital models doesn't rely on human visual experience.

Flusser argues that technical images (photographic images, 3D images, and AI images that simulate both photography and 3D visualizations) are not passive, neutral representations but actively become the program of reality, shaped by their apparatus (Flusser, 2011). The photo-reality of architectural visualization, using digital tools to reinforce predetermined models of reality, is taking modernist abstraction to the extreme. The "realism" of such abstract design becomes based on false visual concretization as "photo-reality" of 3D renderings. Lyotard, in his critique of "fantasies of realism," stated that the only definition of realism is "that it intends to avoid the question of reality" by preserving consciousness from doubt, stabilizing the referent, and endowing it with recognizable meaning. (Lyotard, 1984. p.74-75). "Realistic" images based on a common communication code too easily achieves approval and produces mass conformism (Lyotard, 1984).

5 Extended Reality of Architectural Representation

5.1 Architectural representation as a mode of cultural and social production of reality

According to Berger (1991), the construction of reality as a product of collective consciousness is based on interactive dynamic relations. For him, the consciousness is "capable of moving through different spheres of reality," so the world of consciousness consists of multiple realities. He gave a privileged position to the "reality of everyday life" (Berger, 1991). The reality of bodily "here" and present "now" are directly accessible to reality manipulation, but there are also different degrees of spatial and temporal accessibility to reality. For Berger, "The reality of everyday life further presents itself to me as an intersubjective world, a world that I share with others." (Berger, 1991, p.37). The shared reality of everyday life is often taken for granted, but it should be questioned considering its foundations and relations to "other" realities. The reality of everyday life emerges from a socio-historical context that also could include artificial systems, which possess a certain degree of autonomy and are not fully under the control of human perception and cognition.

Robbins analyzes the role of "the phenomenal representation of a conceptual practice" as architectural language of representation in the form of drawing, not just between imagination and realization but in relation with society and culture (Robbins, 1994). "Drawing is at once an idea and an act, an autonomous concept and a mode of social production." (Robbins, 1994, p.7). Ingold emphasized the social dimension of representation: "Whereas sensations are private and individual,

representations are public and social." (Ingold, 2002, p.158).

Architectural representations are not just fundamental mediators of the design process, but as a "shared medium of architectural discourse," they define the cultural and social dimension of the architectural profession (Robbins, 1994). Representation of different aspects of architectural practice, from conception and development to guiding the production of material artifacts, also includes the structure of relations that integrates cultural, social, and technical production. Representation constructs the social role of the architectural profession, not just separating the subjective mental idea and material building but making the material object culturally embedded in the representational field.

Architecture is the most visible example of the collective character of reality, which can never be just the sum of fragmented individual perceptions and experiences. Snodgrass and Coyne concluded that "the design process belongs to the domain of social actions and interactions, is firmly embedded in a human situation, and is a focal nexus within a network of intersubjective relationships" (Snodgrass & Coyne, 1997, p.92) Architecture is a shared experience, as a collective representation of technical and cultural extensions of reality. The material object becomes a representation of functions outside itself. The architectural function arises from the coordinated actions of the users in the interactive space of social dynamics, rather than just from the material object. The architectural object transposed into visual information is placed in a wider context of other images that form a network of representational space. This space allows for a more intense experience than immediate local perception, representing an extension of visual experience.

Representational aspects of architecture are expanding the spatial experience into the cognitive domain but also into the social and cultural dimensions. Through technological mediation the visual experience becomes mobile and exchangeable. The system of representation is also a system of concepts, the meanings of which depend on the relationship between the conceptual system and the object within the cultural conceptual maps. Architectural representation becomes an extended realm of expression, experience, intention, and cultural and social programs.

5.2 Extending architectural reality beyond the conventional representation

If we go deeper in history, before any architectural plans were drawn or buildings were built, can we find any architectural trace? The origin of architecture may lie not in some primitive hut, but in the cave space. (Jacob, 2018). Architectural space emerges from the representational field of inscribed drawings, giving it meaning, defining space as the medium of representation of some value and function, a space with memory, meaning, and potentiality. "Inside the cave, we occupy the drawing just as the drawing occupies and manufactures space." (Jacob, 2018) Establishing space constructed by the conceptual force of visual images, representational space has been created, augmenting the reality of the cave and extending its real spatial experience.

Focusing on examples when architectural projects as drawings were never materialized into buildings, Bafna (2008) explored the significance of the iconic example of the Brick Country House project by Mies van der Rohe, based on a few incomplete, ambiguous, and incoherent drawings. He emphasized the experiential qualities of the building invoked through the drawing. Perceptual aspects that are available only through drawings are still generating aesthetic experience that is architectural (Bafna, 2008). So architectural representation should not be considered just as a finished and clear depiction, description, or visualization of the final product of architecture — the building—but as the means of transfiguring spatial relations into an "imaginatively engaging meaningful entity" (Bafna, 2008).

Architecture in the modern information age is placed somewhere between the concept of the virtual, understood as a dematerialized simulation of reality, and the physical material reality. Is a materialized architectural object more than the sum of its representations, or is architecture more than the materialization of an architectural object? An architectural object is only one of the possibilities that can emerge materialized from its representation. Some can pass into other representations. According to Ingold, "Building, then, is a process that is continually going on, for as long as people dwell in an environment. It does not begin here, with a preformed plan, and end there, with a finished artifact. The 'final form' is but a fleeting moment in the life of any feature, when it is matched to a human purpose, likewise cut out from the flow of intentional activity." (Ingold, 2002, p.188)

Extended reality concept considered in this research is not just some objective reality that could be depicted by "photo-realistic" images, nor alternate version of reality like virtual reality, or reality enhanced by digital displays, but becomes a mode through which reality is unfolded and reshaped through perceptual experience, cognition, and representation.

The extended reality conceptual framework applied in architecture transcends physical buildings to include unbuilt visions, virtual spaces, and socio-cultural

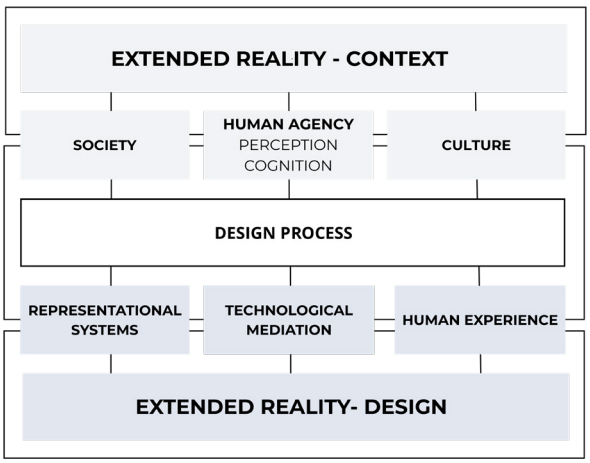

Figure 3 Conceptual model of extended reality mapping how design process includes interrelations and interactions with and through different conceptual domains. Source: Author, 2025.

Table 2 Conceptual differences of photo-realism and proposed framework of extended reality. Source: Author, 2025.

	Photo-Realism	Extended Reality
Representation	Reality as objective and determinate, presented by final image.	Dynamic processes of reality construction as a field of possibilities and variations.
Cognition	Flattened complexity, closed gap between reality and representation.	Exploration of complexity, distributed extended cognition.
Phenomenology	Reality as appearance.	Reality as a multi-layered, mediated process of experience.
Technology	Transparent, neutral, instrumental.	Technology as a mediator actively modify perception, cognition and experience.

narratives. Architecture as built, unbuilt, virtual, and cognitive domains exist within human dialogue with technology, social systems, and speculative futures. The conceptual model of extended reality, is showing that we could consider reality as continuously extended and distributed by the social, cultural and technological mediation, becoming reality that is not just experienced in its multiple contextual dimensions, but also designed.

5.2.1 Exploring the latent design space with AI technology

The world mediated by technology expands and extends in multiple dimensions, material and immaterial, sensorial and mental. The term "extended reality (XR)," in the narrow sense was introduced adressing digital technologies that simulate sensory experiences in real or imagined environments, including notions of augmented reality (AR), mixed reality (MR), and virtual reality (VR). By replacing or augmenting the physical world with mediated sensory inputs, XR is enhancing spatial perception and cognition, turning information into experiences (Marr, 2021). Digital technology of virtual and augmented reality opens up insights into new spaces and experiences that include the reality of artificial systems integrated with human experience.

Artificial intelligence (AI) tools are creating image-based reality, where the human role, skill, and effort are almost removed in the process. AI models could further include synthetic agents that autonomously perform tasks, learn, and make decisions. Synthetic reality becomes a product of generative processes that are the property of the artificial imaging system itself. Automation of the process, similar to the role of photography, seemingly further democratizes the creative work. Extracted patterns from latent design space could be explored and experienced, translated, and mixed through different media — including text-to-image, text-to-animation, text-to-3D, or image-to-video. Generative AI technology trains a neural network to extract patterns from large datasets of existing media that can be set within the space of cultural history, so Manovich suggests that AI technology is redefining postmodern historicity, giving it a new approach (Manovich & Arielli, 2024). It can simulate photography, 3D renderings, or any artistic and graphic style, but it can also be used to explore "new methods for reading cultural databases and creating new narratives" (Manovich & Arielli, 2024).

AI technologies are becoming ubiquitous and often mostly invisible as the transparent background of many processes. (Wheeler, 2019). Background relations, defined by Ihde as an invisible technological field, have a subtle impact on the experience of reality, conditioning its context (Ihde, 1990). Many forms of technologies are not referred to as AI as soon as they seamlessly become integrated with wider processes (Manovich & Arielli, 2024). Wheeler claimed that transparency of "smart" partly autonomous technology labeled as AI is becoming a part of our cognitive processes, enabling us to "offload the contextual reasoning too onto technology" (Wheeler, 2019, p.861), thus influencing our thoughts, judgment, and actions. AI systems extract the statistical average of training data, so some rare details or singular examples are hardly noticeable and learned, producing generic outputs (Manovich & Arielli, 2024). Wheeler warns that "deep learning networks are learning to categorize the world in ways that do not coincide with the way that their human users will categorize the world" (Wheeler, 2019, p.863). We should be more aware of the consequences of depending on autonomous technology to help us think and make decisions.

The true potential of AI technology in intellectual and creative work lies not in the automation and simplification of the complex process, providing definitive answers and finite solutions, but to recognize the complexity unfolding latent possibilities and connections. Instead of producing "deep fakes" of "photo-reality," AI technology could become an experimental creative partner, operating beyond the conventional forms of representation and visualization. It could produce a matrix of variations, at different levels of abstractions, create synthesis of conflicting ideas, or explore decision branches revealing critical points.The future of design needs technology that recognize, navigate, manipulate and modulate the complex, multi-layered texture of mediated, extended reality.

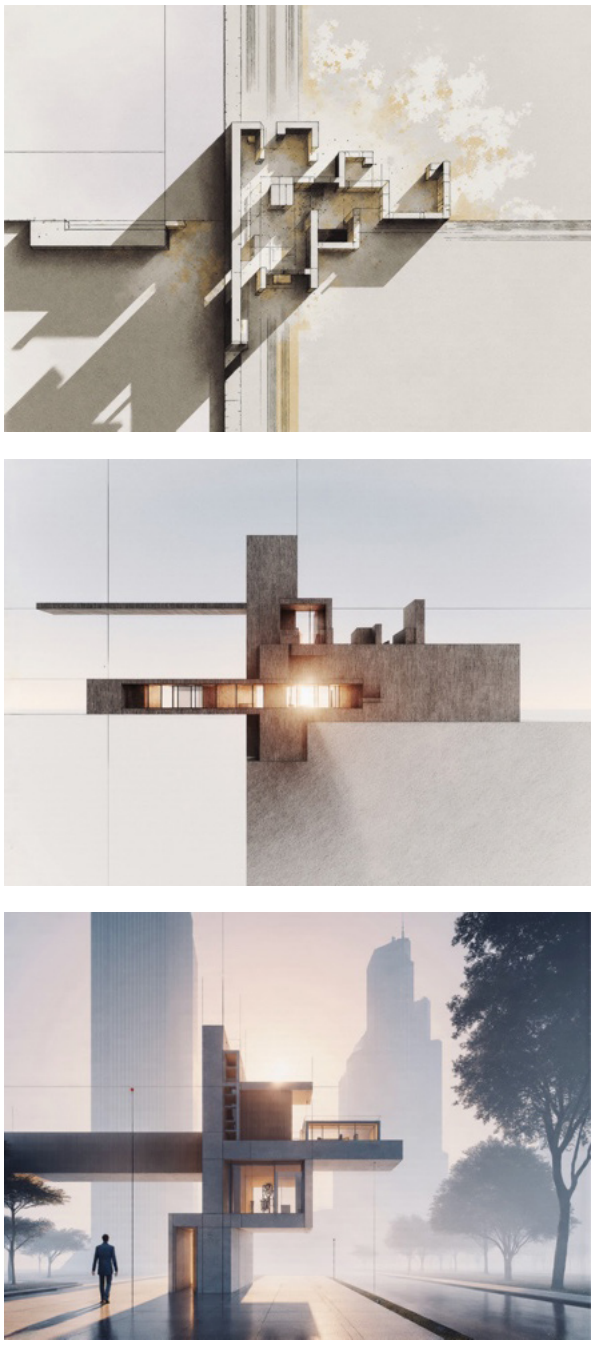

Figure 4 Artificial intelligence (AI) technology as an experimental conceptual tool, exploring variability and mixture of methods and styles: AI visualization of multidimensional variable interpretations based on the referent of the Brick Country House project drawing by Mies van der Rohe. Source: Author, by AI image generators PicLumen and Krea, 2025.

6 Conclusion

In the digital information age, architectural design practice should go beyond classical notions of its representation as an accurate description or depiction of the idea that determines the reality of the built object. Photo-realism enhanced by digital technology becomes the representational shortcut that hides technological mediation, flattening the depth of complexity and masking the ambiguity of the design process. The concept of extended reality, framed in this research, reveals the complexity of dynamic processes of design, enveloping representation, cognition, human experience, and technological mediation.

Incorporating insights from post-phenomenology and extended mind theory, the conceptual framework of extended reality evaluates design processes as distributed across human and nonhuman domains, where technology as mediator becomes integral part. Architectural representation in the form of drawing mediates perception of reality and unfolds conceptual spatial and temporal experience, extending cognitive capabilities. It should not be seen just as descriptive and instrumental, but as a platform for mutual dialogue and negotiation between representational, technological, material, cultural, and social dimensions of architecture. The act of design becomes an extension of reality. The concept of extended reality offers a notion of reality that is constantly constructed, deconstructed, and reconstructed, expanding its meaning and its scope.

Architectural representation encompasses the domain of the abstract and the domain of the perceptible, visualizing the multiplied aspects of reality, transcending the limiting frameworks that divide the world into separate domains: human and artificial, subjective and objective. Extended concept of reality incorporates the reality of artificial systems in a dynamic interactive relationship — from the optical geometry and the photographic camera to digital algorithmic systems and generative models of artificial intelligence. The architectural project is partly indeterminate, open to different scenarios of the future. The architect's role in the technologically driven future is not to determine a totalizing plan but to mediate between abstract and concrete, to find a balance between determinacy and ambiguity. The connection between the sketch, the conceptual project, and the object is not direct and purely instrumental; it opens up and expands the reality of architecture, as it unfolds and emerges from the latent space of possibilities.

This research contributes to theoretical discussions related to the role of technology in the field of design, focusing not only on new technological tools and their capabilities, but also on how they mediate and change the conditions of thought and representation that underline design itself. The proposed conceptual framework of extended reality enables an understanding of the role of architectural representation that goes beyond the exact visualization of ideas or precise descriptions of material objects, including cognitive and generative potentials that could extend reality in its multiple layers. By changing and expanding the reality in which architecture is experienced and concretized, new possibilities of generative digital models can be meaningfully integrated as a result of this understanding.

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