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The Ontology of Digital and Virtual Architecture

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Abstract: The emergence of digital technologies has significantly transformed architectural practice, particularly in design representation and spatial experience. Traditionally, architecture has been understood as the design and construction of physical structures that shape human environments over time. However, the development of digital modeling tools, virtual environments, and immersive technologies has introduced new forms of architectural space that exist independently of physical materiality.

This transformation raises important philosophical questions regarding the ontology—that is, the nature of existence—of architecture within digital and virtual contexts. This study explores the ontological status of digital and virtual architecture and examines how technological advancements are redefining the concept of architectural space.

Adopting a qualitative research approach, the study investigates the characteristics and implications of digital architectural environments through a review of relevant literature and case studies of virtual platforms such as Second Life and Minecraft. These platforms demonstrate that virtual environments can replicate many spatial qualities traditionally associated with physical architecture, including enclosure, circulation, and social interaction.

The findings suggest that architectural development can be realized through computational constructs rather than solely through physical structures. Digital architecture thus represents an evolving domain within architectural theory and practice, requiring new conceptual frameworks that acknowledge both physical and virtual forms of architectural space.

Keywords: *Curvilinear Design, Cybrid Space, Digital Avatars, Digital Architecture, Metaverse, Modeling, Data, Augmented Reality.*

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I. INTRODUCTION

The rapid advancement of digital technologies has fundamentally transformed architectural design, representation, and experience. Over the past few decades, evolving from a discipline primarily concerned with the design and construction of physical spaces to one that increasingly engages with digital and virtual environments. Digital tools like Revit, Grasshopper, Protege etc., now enable architects to create complex forms, simulate spatial experiences, and construct entire architectural environments that exist exclusively in virtual space. (He, 2025).

This transformation raises important philosophical questions concerning the nature of architecture in the digital age, where traditionally, architecture has been understood as the design and construction of physical structures that shape human environments. However, with the emergence of digital and virtual spaces, architecture can now exist independently of physical materiality. As virtual environments found in immersive digital platforms allow users to experience spatial environments that are not physically constructed yet possess many qualities associated with architecture, such as enclosure, circulation, and spatial hierarchy.

The concept of ontology, which concerns the structural study of the nature of being and existence, provides a useful framework for examining these developments by exploring the ontology of digital and virtual architecture, becoming possible to investigate whether architecture must necessarily be material or whether it can also exist as an immaterial digital construct.

Also, redefining the concept of architectural space, analyzing the characteristics of digital architecture, evaluating how virtual environments produce architectural experiences, and examine the implications of these developments for architectural theory and practice.

II. DIGITAL ARCHITECTURE AND VIRTUAL ARCHITECTURE

In the field of architecture, space is a crucial factor that influences human experiences, functionality, and social interactions within built environments, (Joyce, 2020). This

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systematically includes considerations of physical layout and spatial configuration, which are particularly evident in the design of for instance museum exhibition spaces, (Tang, Zheng, Chen, Yan, & Chen, 2024). The arrangement of these spaces not only dictates the circulation patterns but also significantly affects how the spaces are utilized by visitors. Ultimately, thoughtful spatial design fosters a more engaging and effective interaction between the users and the environment.

Some designs come with aesthetic experiences of the users in design through cultural preferences, as Dai, Zou, Wang, Ding, & Fukuda, (2022), indicate subjective judgments of users are affected by structural features in a building. Westerners favor curvilinear contours, high ceilings, and open spaces, which may differ. Curvilinear design emphasizes flowing, organic lines over rigid, angular ones, fostering movement and natural harmony in various fields such as architecture, art, interior design, even digital art, giving comfort, balance, emotional resonance, and aesthetic fluidity, (Stevanović, & Stevanović, 2018).

Explaining further, examining the Chinese aesthetic judgments, people prefer high ceilings and open spaces consistently. However, their preference for curvilinear contours depends on the context, being favoured only with low ceilings and closed spaces. Overall, while high ceilings and openness are robust preferences in China, the preference for curvilinear designs is less consistent.

The concept of space in architecture has evolved, transitioning from traditional physical dimensions to a redefined understanding in digital and virtual perspective, (Wang, & Liu, 2024). In these modern scenarios, space becomes a construct influenced by data, perception, and interaction rather than bound by Euclidean geometry.

Virtual space is characterized by its fluidity, non-linearity, and dynamic reconfigurability. With the notion of place, associated with meaning, identity, and human attachment, detaches from geographic confines, evolving instead through user interactions and narrative embedding. Consequently, the ontology of space transforms from a fixed physical entity to a relational and experiential phenomenon, to a cybrid space which is an environment where physical space and digital (cyber) space are tightly integrated and experienced together as one. (Purwanto, & Sanjaya, 2025), fundamentally shaped by code and cognition.

Digital architecture focuses on architectural processes, representations, and outputs that are generated, evolved, or communicated through computational systems as parametric modeling, algorithmic design, and digital visualization, where the computer serves as both the tool and the medium of design thinking. With emphasis on using parametric or computational design formed by algorithms and adjustable parameters, enabling complex, adaptive geometries and rapid variation of options (Kurmapu, & Mishra, 2023), it also centers on digital models, especially BIM (Building Information Modeling), which combine 3D geometry with information about building materials, performance, cost, and duration. (Kösenciğ, & Özbayraktar, 2024). Lovendianto, Samodra, Ekasiwi, & Kim (2025), showed in studies that it also considers architectural forms and environments created to represent physical buildings or as entirely digital constructs that do not necessarily translate into physical construction, serving as a logarithmic elements and interaction with virtual world.

Virtual architecture specifies architectural environments that exist within simulated digital spaces. According to Vergunova, (2025), it entails 3-dimensional virtual environments being designed to either replicate or enhance physical spaces used for various activities such as living, working, cultural engagements, and recreation. Notably, virtual cities, galleries, museums, and interiors, as well as cybrid spaces so as to integrate physical structures with digital overlays, creating a hybrid reality. Making it exist along a real–virtual continuum, from digital twins that mirror real buildings to fully fictional, speculative worlds which are explorable through immersive technologies as networked digital worlds Virtual Reality (VR) and interactive spatial systems such as Augmented Reality (AR).

Another emerging concept is the Metaverse, which describes persistent virtual environments where users interact socially and spatially through digital avatars, (Hussein, 2025). Within these environments, architecture plays a critical role in structuring digital spatial experiences.

III. PHILOSOPHICAL FOUNDATIONS OF ARCHITECTURAL ONTOLOGY

Ontology of digital architecture is examining philosophical perspectives on space, place, and existence, (Stevanovic, 2021), the long explored relationship between human experience and built environments.

➢ *Dominant Ontological Paradigms in Architecture*

Martin Heidegger posits that architecture is deeply intertwined with the concept of dwelling, proposing that buildings transcend mere physical structures to influence human existence and meaning. This view as supported by Dymchenko, & Kurilova, (2023) which implies that architecture is essential in shaping human experiences and creating spaces imbued with significance. Maurice Merleau-Ponty argues that architecture is understood through perception and bodily experience. Space is beyond physical form showing how people interact with and sense the environment.

This idea is broken into the following;

- *Semantic / Aristotelian Ontology*

The semantic ontology of architecture, rooted in Aristotelian metaphysics, conceptualizes reality through substances, essences, and purposes, (Mahalingam, 2022). Architecture is viewed as a meaningful artifact defined by its material and functional identity. It has a four causes which includes material, formal, efficient, and final, inform this perspective, emphasizing that the essence of a building is intertwined with its form and intent.

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- *Phenomenology and Lifeworld*

According to Milivojević, (2024), it emphasizes lived experience over abstract essence in architecture, drawing from Martin Heidegger and Maurice Merleau-Ponty. It views architecture as a field of human experience within the lifeworld, focusing on embodiment, perception, and atmosphere. This perspective prioritizes how space is felt and inhabited, (Wiryomartono, 2022), which highlights material presence and sensory engagement to elicit emotional responses. However, criticized in rates that it may risk excessive subjectivity, potentially overlooking broader socio-political or technological idea in a built environment.

- *Object-Oriented Ontology (OOO) and Flat Ontologies*

According to Weir, & Harman, (2022), Graham Harman, positioned human and non-human as object and have equal ontological status, forming a flat ontology. This perspective views buildings as autonomous entities existing beyond human function, interconnected with materials, technologies, environments, and non-human actors. Its approach aligns with digital spatial thinking and disputes the importance of human experience, stressing the inaccessible nature of objects.

- *Weak Ontology*

Stephen K. White, advocates for a non-foundational view of being that recognizes ontological commitments as historically contingent and subject to interpretation. In architecture, this results in a critical and pluralistic perspective where multiple theories coexist, with meaning shaped by cultural, political, and temporal ideas, (Shank, 2021). Relevant to contemporary practice, weak ontology prompts architects to engage with various epistemologies and global influences. While it promotes reflexivity, and relativism.

- *Theological and Metaphysical Ontology*

This approach links to a cosmic order derived from religious traditions, exemplified in sacred architecture as a bridge to the transcendent. Influenced by thinkers like Thomas Aquinas, this view integrates philosophy with theology, reflecting cosmic symbolism through architectural forms and orientations, (Stevanovic, 2021). With studies on exploration on spiritual and symbolic meanings of space, asserting the role of architecture in metaphysical experiences. However, this perspective is dependence on transcendental assumptions, limiting its applicability within secular or critical frameworks.

- *New Materialist / Assemblage Views*

Gorny, R. (2018), studied the influences of Deleuze and Guattari, where ontology is a dynamic and relational, emphasizing that reality consists of assemblages, that is networks of interacting human and non-human elements. This view highlights material agency, indicating that materials and environments actively shape outcomes, making buildings ongoing processes rather than static objects. This perspective is particularly pertinent to issues like sustainability and digital systems, where architecture engages with complex ecological and technological networks.

Digital environments, despite lacking physical materiality, can create significant spatial experiences giving a sense of presence. Immersive technologies enable exploration of virtual architecture from a first-person perspective, akin to navigation in physical spaces. Key aspects influencing spatial perception include visual cues, scale relationships, and interactive elements simulating architectural features. Digital avatars serve as embodiments for users, facilitating movement and interaction within these virtual environments. Such interactions indicate that virtual architecture can yield spatial experiences comparable to those of physical architecture.

IV. NOTABLE EXAMPLES OF VIRTUAL ARCHITECTURE

Several digital platforms provide examples of architectural environments that exist entirely in virtual space.

The Second Life is a user-generated environment where architecture reflects social interaction and identity. Spaces are designed for expression and community rather than mere function. Users, existing as avatars, expand the notion of presence beyond physicality. Architectural forms respond to social behaviors instead of physical limitations, creating fluid and symbolic spaces that evolve with user interactions. Thus, architecture serves as a medium for identity construction, emphasizing relationships and experiences over material permanence.

Fortnite Creative creates an event-driven environment blending architecture with gameplay and temporality. It presents space as a dynamic stage for actions, emphasizing adaptability, interactivity, and narrative in design. The immersive, often temporary environments are shaped by player engagement, making architecture performative and focused on experiences, challenges, and storytelling rather than static forms.

Minecraft presents a block-based environment where all elements are reduced to discrete units (blocks), mirroring basic architectural principles. It emphasizes structural logic and encourages users to engage hands-on in spatial creation, thus enhancing their understanding of form and architecture. The game effectively connects digital and physical architecture by simulating construction processes, illustrating how architecture can arise from fundamental rules and components.

V. ONTOLOGICAL QUESTIONS IN DIGITAL ARCHITECTURE

The emergence of digital and virtual architecture raises several important ontological questions. One fundamental question concern whether architecture must be physically constructed in order to exist. If architecture is understood as the organization of space for human experience, then digital environments may qualify as architectural spaces despite lacking material substance.

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Another question concerns the nature of architectural authenticity. Virtual architecture may replicate physical architectural forms, but it may also create entirely new spatial experiences that have no physical counterpart. This challenges traditional definitions of architecture based on materiality and construction.

Digital architecture also raises questions about the concept of place. In physical environments, places are typically defined by geographic location and physical boundaries. In contrast, virtual environments exist within digital networks and may be accessed from multiple locations simultaneously making it something good to apply even in Nigeria.

VI. IMPLICATIONS FOR ARCHITECTURAL PRACTICE

The rise of digital architecture has significant implications for architectural practice and education. Architects increasingly use digital tools not only for representation but also for generating complex design solutions and simulating spatial experiences before construction.

Virtual environments also provide opportunities for architects to design spaces that exist exclusively within digital platforms. As these environments become more integrated into social and economic activities, architects may play a key role in designing digital cities, virtual workplaces, and immersive cultural environments.

Furthermore, digital architecture offers opportunities for experimentation that may not be feasible in physical construction due to structural or financial constraints.

VII. CONCLUSION

The ontology of digital and virtual architecture challenges traditional understandings of architecture as a purely material discipline. Digital environments demonstrate that architecture can exist as an immaterial construct that still produces meaningful spatial experiences.

As digital technologies continue to evolve, virtual architecture is likely to play an increasingly significant role in shaping future architectural practice. Architects may therefore need to reconsider the boundaries of their discipline and explore new forms of architectural expression within digital environments.

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