An Architectural Phenomenology of Metaverse Libraries

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Abstract

Purpose/Significance From the perspective of architectural phenomenology, this study interprets and examines the reading spaces created by the metaverse, thereby stimulating reflection and exploration on the construction of metaverse libraries within architectural discourse. Methods/Process Through a phenomenological approach, it investigates the architectural characteristics of metaverse libraries and proposes considerations and recommendations for their architectural design. Results/Conclusion Architectural phenomenology emphasizes that the meaning and value of architecture reside not merely in function and form, but more fundamentally in human perception and experience within it. Architecture and space constitute the foundation of library reading services; particularly under metaverse construction norms where perceptual mobilization occupies a significant position, the functionality of metaverse libraries is primarily realized through the perception and experience of virtual space. The exploration of space cannot be divorced from the substrate of architecture; even in virtual space, the design of virtual architecture plays a fundamental and regulative role. Metaverse libraries should integrate and unify environmental functions with subjective perception, utilizing technology for the concrete expression of conscious experience and reading culture, thereby achieving cultural signification of space.

Full Text

An Architectural Phenomenological Interpretation of Metaverse Libraries

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Abstract

[**Purpose/Significance**] This paper interprets and examines the reading spaces created by the metaverse from the perspective of architectural phenomenology, stimulating reflection and exploration on metaverse library construction within architectural discourse. [**Method/Process**] Adopting a phenomenological approach, we investigate the architectural characteristics of metaverse libraries and propose considerations and recommendations for their architectural design. [**Result/Conclusion**] Architectural phenomenology emphasizes that the meaning and value of architecture lie not only in function and form, but more fundamentally in human perception and experience within it. Architecture and space constitute the foundation of library reading services. Particularly under the construction norms of the metaverse, where perceptual engagement occupies a crucial position, the functionality of metaverse libraries is primarily realized through the perception and experience of virtual space. The exploration of space cannot be divorced from an architectural substrate; even in virtual realms, the design of virtual architecture plays a fundamental regulatory role. Metaverse libraries should integrate environmental functions with subjective perception, utilize technology to concretely express conscious experience and reading culture, and thereby achieve cultural meaning-making of space.

Keywords: Metaverse Library; Architectural Phenomenology; Perception; Reading

Introduction: The Metaverse—A New Paradigm for Smart Space Services in Libraries

Over the past two years, the metaverse has emerged as a phenomenal concept, attracting widespread academic attention. The library and information science field has explored metaverse applications in service innovation [1][2], resource management [3][4], spatial construction [5][6], and technical pathways [7][8], yielding preliminary practical outcomes in virtual spaces [9], VR panoramic reading [10][11], virtual tours [12], digital humans [13], and unified authentication [14]. Scholars have noted that the metaverse, together with Web3.0, will jointly advance libraries toward a smart "3.0" transformation, realizing human-centered smart libraries within the metaverse [15]. As a new form of future library development, metaverse libraries will provide readers with richer, more diverse methods of information access and knowledge dissemination, delivering entirely novel reading experiences. Fundamentally, these experiences derive from the more interactive, intelligent spaces created by the metaverse.

As technology and society evolve, libraries have increasingly emphasized spatial services. Grounded in effective reading, librarians continuously integrate emerging technologies for holistic spatial innovation, making "smart space" a developmental goal [16]. Evidently, spatial transformation will lead smart library construction in the next phase [17]. Generally, physical libraries are fixed, static

architectural spaces with services constrained by time and space and characterized by a certain passivity. Since the advent of virtual technology, using virtual spaces to supplement and display physical spaces has become an important pathway for enhancing spatial experiences [18]. In virtual worlds, libraries can deliver more interactive, immersive reading and learning experiences—readers can enter documents, converse with characters, gain deeper understanding of content, and enhance reading interest. Librarians can host virtual exhibitions and build virtual laboratories to facilitate learning. The metaverse represents an integrated application of virtual technologies; since its conception, "mutual generation between virtual and real" has become a new approach for library spatial services [5], making metaverse libraries the frontier of virtual space construction and the future direction of smart space development [19]. The metaverse unfolds multiple possibilities for library spatial design transformation, greatly enriching and expanding service objects, content, and levels, while making knowledge exchange and sharing more free.

Facing a potential new round of spatial construction revolution, in-depth research is clearly necessary for the library community. Moreover, library science has always maintained a perspective on architecture [20], with architectural theories offering strong practical guidance for enhancing user experience, optimizing space utilization, improving sustainability, promoting social interaction, and emphasizing cultural and historical elements [21]. As metaverse research becomes prominent in both library science and architecture, virtual architectural spatial experience has emerged as a hot topic. Combining virtual architecture research with metaverse libraries offers a new perspective on future library development oriented toward virtual-real integration, for which an important theoretical tool is available: architectural phenomenology.

1. Architectural Phenomenology and the Metaverse

Phenomenology profoundly influenced the entire humanities and social sciences field in the 20th century, exploring human sensory experience and the phenomenal world and inspiring an inside-out perspective on the essence of self and world. Architecture is a phenomenon of profound influence in human life and dwelling history, and the scope of phenomenological inquiry includes the relationship between thought and dwelling, dwelling and building [22]. On this basis, the phenomenological trend in architecture emerged. Architectural phenomenology has conducted valuable research on the existential meaning of architecture [23], architectural symbolism [24], spatial experience [25], architecture's shaping of people [26], and design practices for various building types including museums, vernacular dwellings, ancient towns, and cities. With the emergence of virtual technology and the metaverse, further reflection is needed on the connections and differences between physical architecture in the real world and virtual architecture in the metaverse, as well as on architectural elements, spatial layout, and tactile design within the metaverse.

1.1 From Phenomenology to Architectural Phenomenology

The origin of phenomenological thought lies in Husserl's questioning of Cartesian modern rationalism [27]. Unlike the pursuit of pure rationality through supersensory experience, phenomenology holds that human knowledge of the world is based on the perception and understanding of phenomena [27]. Following this line, architectural phenomenology, as an extension of phenomenology in the architectural domain, views architecture as an interaction between humans and space, emphasizing spatial perception, experience, and emotional resonance [28]. At a time when architects increasingly focus on people's subjective feelings and experiences, architectural phenomenology has gradually become an important theory in contemporary architectural design.

1.1.1 Main Ideas of Phenomenology Phenomenology has undergone multiple developmental stages, broadly divided into Husserl's consciousness phenomenology, Heidegger's phenomenology of "Dasein," Merleau-Ponty's body or perception phenomenology, and subsequent supplements, critiques, and developments such as Don Ihde's technics phenomenology, collectively known as "post-phenomenology." Husserl, the founder of phenomenology, believed philosophy should return to things themselves—that is, to phenomena—advocating that the essence of things be revealed through pure consciousness analysis. Consciousness is the foundation of our knowledge of the world and can be analyzed. Husserl's contribution lies not only in founding the phenomenological philosophical school but also in proposing a new philosophical method: pure consciousness analysis. His thought profoundly influenced later phenomenologists, particularly Heidegger and Merleau-Ponty.

Heidegger argued that the fundamental philosophical question is the question of being—the meaning and value of human existence. He advocated revealing the essence of being through its analysis. In his seminal work *Being and Time*, he approached "being" as a temporal phenomenon from the standpoint of "Dasein" [29]. As Husserl's student, Heidegger liberated phenomenology from Husserl's consciousness analysis, turning toward the question of being and providing phenomenology with a new research direction. Merleau-Ponty, deeply influenced by Husserl and Heidegger, advocated revealing the essence of the world through bodily analysis and proposed the concept of "body-world" [30], wherein body and world form an inseparable whole, and only through understanding the body can we truly understand the essence of the world. "Body-world" has importantly influenced the philosophy of the body and theories of perception, and has profoundly impacted post-phenomenology.

The core concepts of phenomenology include "phenomenon"—things people directly perceive, which can be material, spiritual, or social—as well as "consciousness" and "subject." "Consciousness" refers to human perception and cognition of phenomena, forming the basis of human experience. "Subject" refers to individuals with consciousness and self-awareness, constituting the core of phenomenological research. Phenomenology abandons the rationalist method of

observing the world long upheld in Western philosophy, especially the search for a single, fixed essence or any essentialist attempt to capture the true appearance of things. Instead of a top-down, macro-to-micro understanding of things or abstract thinking about concepts and theories, phenomenology studies the essence and characteristics of human experience and consciousness through direct experience and perception of phenomena. Based on this methodology, specific analytical methods such as phenomenological description, phenomenological hermeneutics, and phenomenological critique have emerged, offering guidance for understanding and interpreting the world.

After the phenomenological movement emerged in the early 20th century, architectural theory research was significantly influenced. Jäger introduced Husserl's exploration of human ability to contact the surrounding world into the domain of dwelling, creating space for consciousness phenomenology to function within architecture [31]. Thereafter, architectural phenomena—human feelings, emotions, and meanings within architecture—gradually became objects of architectural concern. However, scholars consistently trace architectural phenomenology's theoretical origins to Heidegger's existential concept of place spirit rather than Husserl's consciousness phenomenology [32], primarily because Heidegger more directly explored the meaning of building and dwelling. Norberg-Schulz inherited Heidegger's thought, offering deeper interpretation in *Genius Loci: Towards a Phenomenology of Architecture*: "Place is a space with unique character," "architecture means visualizing place spirit," "the architect's task is to create meaningful places" [33].

With the popularity of perceptual phenomenology, architects increasingly apply affective factors to architectural design; architecture requires users' personal feelings. Architectural phenomenology has rapidly developed within this theoretical context, producing many representative figures and ideas. Christopher Alexander, one of the founders of architectural phenomenology, proposed theories such as "the timeless way of building" and "pattern language," emphasizing that architecture should be organic and natural [34]. Aldo van Eyck, representative of the Dutch phenomenological school, proposed "human scale" and "playground" theories, stressing that architecture should be humanistic and social [35]. American scholar John Hejduk advanced theories of "architectural poetry" and "architectural stories," emphasizing that architecture should be emotional and imaginative [36]. Peter Zumthor, representative of the Swiss school, proposed "architectural sensibility" and "architectural atmosphere," stressing that architecture should be sensible and emotional [37].

Phenomenology's replacement of "a priori" with "direct experience" inevitably foregrounds bodily practice and subjective feeling. Architectural phenomenology extends phenomenology into the architectural domain, taking architectural phenomena—various phenomena generated when people perceive and experience buildings—as its core object. Through sensory description, formal analysis, spatial analysis, and other methods, it interprets architectural experience and meaning, providing support for architectural design, evaluation, urban plan-

ning, and cultural heritage preservation while enhancing architecture's humanistic quality. Currently, architectural phenomenology increasingly integrates with psychology, sociology, cultural studies, and other disciplines, focusing on architectural phenomena under different cultural and historical backgrounds to better understand human experience and feeling in architecture and promote cultural exchange and integration. Simultaneously, with the development of digital technology and virtual reality, architectural phenomenology is conducting more refined and in-depth research on digital technology applications, with the meaning, value, and pathways of virtual architecture construction gradually becoming major topics.

1.2 Phenomenological Significance of Metaverse Architecture

Architecture arises from human needs. In the pre-information age, architecture was merely civil structures satisfying human survival spatial needs, containing few technological elements. With technological progress, buildings integrating intelligent systems satisfy environmental comfort needs such as temperature, humidity, air, and lighting. In the digital information age, civilization develops alongside technology, generating new dimensions for architectural evaluation. Architecture as natural shelter gradually shifts from physical environmental needs to spiritual situational satisfaction regarding culture, experience, aesthetics, and emotion. While creating intelligent building environments, the architectural field also introduces virtual technology to achieve the combination of physical architecture and virtual space, triggering more and deeper spiritual experiences. The existential form of architecture has evolved from primitive "natural shaping," through "technical forming" in the modern industrial period, toward "virtual-real coexistence" in the metaverse era. Virtual spaces established through the metaverse possess "visual architectural sense, immersive usage, and interactive communication sense" [38], approximating the spatial feelings of physical architecture and capable of fulfilling physical architectural functions.

As a "cultural symbol" [39], architecture's meaning and value lie not only in practical function but more importantly in its symbolic significance and cultural connotation. The third technological revolution brought humanity into the information age, and cities are undergoing digital-intelligent transformation. With the birth of the metaverse, which aims for deep integration of virtual and physical spaces, the concept of physical space has been broken. Architecture is dissolved in material form and constructs a virtual form of living space at a new level, generating a new category of architecture. Compared to physical architecture, the design goals of this "virtual architecture" are no longer purely physical performance; cultural, aesthetic, emotional, and other soft factors are more integrated, and the symbolic meaning of virtual architecture becomes more clearly prominent. Architecture moves from environmental satisfaction to situational satisfaction, representing people's imagination and exploration of the future as well as the fusion and innovation of technology and culture.

The metaverse can be composed of multiple virtual buildings. Although not "real" physical entities, they are sensible and, in phenomenological terms, possess "intentionality"—we can use our perception to gain awareness of them and project ourselves into space. For example, when people wear virtual reality devices to enter the metaverse, they perceive spatial, formal, material, and other elements. Through sensory stimulation from text, images, sound, touch, and smell, a non-material virtual space is constructed in consciousness. Compared to screen-based visual virtuality, metaverse-created virtual architecture brings more comprehensive simulation capabilities and dynamic interaction—immersion. Real experiences in the virtual world can even influence cognition of the real world. The metaverse architecture's simulation of physical architecture also advances architecture's intelligence…

Experience is a key consideration in architecture. As a virtual form of existence, the metaverse is a direct perception and experience with higher demands for experiential quality. From the theoretical perspective of architectural phenomenology, the human-centered experiential dimension becomes more clearly prominent, and the meaning of architectural space is not merely the form and function of the architecture itself but rather people's emotional resonance with space.

2. Architectural Characteristics of Metaverse Libraries

Whether in the physical world or the virtual metaverse world, architecture constitutes the structural form and service foundation of libraries. Currently, the intelligence of library services is increasingly manifested through the design and configuration of library space. Future metaverse libraries will rely on virtual architecture for both presentation and comprehension. Following the logic of architectural phenomenology, metaverse libraries represent a new architectural form, for architecture is a narrative carrier organized by space and events—it is not merely material form but experiential form [40]. Metaverse libraries unfold subjective experience and creativity, representing virtual architectural complexes that embody reading culture and library spirit.

2.1 Virtual Architectural Form

Metaverse libraries are non-physical architectural forms constructed within digital virtual spaces, simulating libraries' appearance, structure, and function through computers. In environments provided by virtual reality and augmented reality, limitations of physical space-time are broken, and library buildings are no longer constrained by traditional building materials and structures. Theoretically, the metaverse can create buildings of any shape and size, allowing readers to encounter various extraordinary library forms such as libraries suspended in mid-air or integrated with natural environments. The metaverse can employ diverse architectural elements in type, shape, material, and color, forming different perceptions of various aspects and levels of the library through sensory

guidance. Standards for library spatial design will be reshaped, and human understanding and utilization of space will undergo revolutionary changes.

Obviously, the virtuality of metaverse libraries enables broader support for resources and reading. Readers can more conveniently access global book resources through digital means, and comprehensive, flexible interaction between librarians and readers becomes possible. The metaverse endows libraries' open-sharing goals with an architectural possibility—that of architectural openness and sharing. Libraries can achieve interaction and connection with other metaverse libraries or metaverse spaces, forming complex architectural networks that meet different needs and create richer experiences.

2.2 Dynamic Spatiotemporal Logic

Architectural phenomenology emphasizes displaying spatiotemporal order through changes in material elements [41]. In the physical world, people focus more on architectural space's form and structure, often overlooking the setting of internal events, yet the latter is also an important way to convey intentions. With the assistance of metaverse technology, the subjectivity of architectural experience can be amplified at low cost through event settings.

Architectural experience is jointly constituted by human perception, emotion, and behavior. Digital and virtual reality technologies subtly influence human consciousness, supporting the internal space of metaverse libraries. Consequently, libraries can more flexibly expand and transform, and their structure and design can be highly purposeful. The library is no longer a functional material container but a subject capable of interacting with people anytime and anywhere. Readers can interact with architecture through gestures, voice, and other means, observing various elements and details of the reading environment through movements, rotations, and scaling, making reading services that transcend the real world more compelling.

2.3 Embodied Reading Situation

Architecture is humanity's most direct and concrete spatial practice; within architecture, people form comprehensive perception centered on the body. This perception is not a sum of separate sensory organs but an integrated whole system. The metaverse is a highly interactive, comprehensive space concerning different sensory systems, possessing inherent perceptual phenomenological characteristics. Under the enhancement of virtual reality technology, rich visual, auditory, and tactile signals stimulate human senses, transferring consciousness to set virtual situations and gradually completing scene…

The library is the dwelling place of reading; the narrative of library architecture considers how to convey reading intentions through form and structure. The narrative that metaverse libraries provide for reading is entirely embodied—reading here is a sensory experience. Perception is the foundation of knowledge, and sensory experience lays the groundwork for knowledge construction. The

embodied narrative process of reading in metaverse libraries is the construction process of metaverse libraries.

2.4 "Readable" Architectural Space

Architecture carries information. With libraries' increasing attention to spatial services, the service value of library buildings is being excavated. In the physical world, library buildings are static; although interactive zones have been created and intelligent management methods integrated, architecture remains peripheral in readers' reading experience perception. Metaverse libraries are built according to perceptual experience. In the virtual world, the diversity and innovation of reading methods are flexibly presented precisely because of flexible architectural space design. Therefore, readers' feeling and experience of architecture have moved from periphery to center.

Metaverse libraries carry the resources of physical libraries; digital space and resources coexist and interact, making virtual space "readable." The building's resource value is more concretely demonstrated, making the metaverse building itself a "resource" embodying knowledge, ideas, and concepts. Virtual architecture conducts substantial cultural narrative and emotional conveyance through symbolic means.

2.5 Creative Libraries

As an extension of libraries in the virtual world, metaverse libraries guide people's reading experience toward broader horizons. Like physical libraries, readers entering metaverse libraries must also utilize space according to its regulations. Unlike physical libraries, however, in the metaverse people can both continue accepting spatial regulations and explicitly practice active reconstruction of space. Consequently, metaverse space is expandable and customizable—readers can flexibly customize building appearance, reading environment, layout, facilities, etc., according to their needs and preferences, and expand and modify them as needs evolve.

3. Design Principles for Metaverse Libraries Based on Architectural Phenomenology

The functionality of metaverse libraries is mainly achieved through the perception and experience of virtual space. Space cannot be separated from an architectural substrate; even in virtual space, architectural design plays a fundamental regulatory role. Architectural phenomenology provides an examination mechanism that improves human understanding of virtual space perception and behavior.

3.1 Scene Presentation: Integration of Environmental Function and Subjective Perception

Scene presentation is architecture's primary task. Metaverse libraries should present reading space scenes according to certain architectural paradigms. Although libraries in the metaverse are virtual, they should also be reasonable spaces referencing physical library construction, with realism as the primary design foundation. In recent years, virtual technology has continuously strived to perfect simulation of physical architecture and environments [42], designing relationships of high/low, far/near, primary/secondary, virtual/real, continuous/broken, deep/shallow for elements such as spatial volume, orientation, proportion, lighting, shadows, and gravity to enhance users' real experience. In metaverse libraries, what people first perceive are the building's texture and tactile qualities—shape, layout, color, texture, and other perceivable elements. Different materials create different perceptual experiences. Realism brings clear spatial perception that facilitates natural understanding of library structure and organization; for readers, a real three-dimensional space also makes reading and searching more convenient.

Architecture does not exist in isolation but interacts with its surrounding environment. Metaverse architecture similarly needs to interact with its surrounding virtual environment. Therefore, when designing metaverse architecture, the characteristics and features of the surrounding virtual environment must be considered to create adapted architectural forms. For example, incorporating virtual landscapes and weather elements in metaverse architecture can enhance building-environment interaction. The advantage of the virtual world is its ability to more easily display spatial changes and flows, forming unique spatial experiences. Appropriate lighting, temperature, humidity, and quiet, comfortable atmospheres are all environmental conditions that ensure reading concentration—conditions that are all settable in the virtual world. The body is the subject of feeling and the receiver of scene meaning. By creating various events for the body, the metaverse helps people freely move and explore in metaverse libraries, obtaining richer and deeper spatial perception.

Metaverse libraries are human-centered phenomenal spaces. Readers are not passive objects but active subjects seeking perceptual targets. The subject itself is a constituent element of virtual space; the subject's practice constitutes spatial events. Interaction methods between subject and space—such as gestures, voice, and touch—and the building's responsive methods are the pathways of scene presentation. Virtual reality technology can influence human visual, auditory, tactile, and olfactory feelings. Through interaction design that combines body posture, movement, and sensation, interactive scenes can be created. Metaverse libraries integrate interaction into spatial experience; readers immerse themselves in the reading process—reading poetry, appreciating scenery, pursuing legends, sharing and exchanging—enhancing reading interest and depth. In the process of combining scenes and events, subjects gradually generate new spatial activity patterns and cultural consciousness. The integration of environmental

foundational functions and subjective active perception constitutes the scene presentation mechanism of metaverse libraries.

3.2 Place Shaping: Concretization of Reading Culture and Consciousness Experience

Place is "a whole composed of concrete things with material essence, form, texture, and color. The sum of these things determines an 'environmental characteristic' "—that is, place spirit [33]. A library's place spirit is the cultural atmosphere displayed by its building space. As Heidegger contemplated space, the manifestation of place spirit is based on thinking and dialogue between subject and place [43]. The coexistence and interaction of readers, librarians, and library create place and sustain place spirit. The metaverse expands the traditional concept of "place," qualitatively transforming place's physical attributes, continuously creating scenes that break real-world limitations and shaping reading spaces with subjective spiritual atmosphere.

In the physical world, libraries often convey their cultural connotation and values through architectural image, symbols, and symbolism. Harris even stated that culture is "the product of architecture" [44]. Metaverse libraries should inherit this, finding concrete symbols that constitute reading space through cultural and historical elements, creating scenes with humanistic atmosphere that let readers feel the charm of reading. Place is a concrete "Dasein" [22]; place image results from bidirectional interaction between observer and environment. People perceive architectural space's form, color, and material characteristics through visual, auditory, and tactile senses, and perceive atmosphere, emotion, and meaning through personalized experience. Therefore, the metaverse can adjust atmosphere and emotional expression in virtual space through architectural elements, creating scenes with emotional resonance that allow people to achieve certain spiritual effects while perceiving space. When readers enter virtual reading scenes, they actively explore the scene, making the relationship between architecture and reading more prominent.

Libraries should be spaces with multicultural characteristics, and the cultural atmosphere in metaverse library generated spaces should also be diverse and personalized. Each person's perception and experience of architectural space is unique, and focusing on the meanings of specific events can promote cultural exchange and fusion, achieving cultural meaning-making, reconstruction, and interpretation of place. Metaverse libraries should create diverse spaces—such as dividing different functional areas and setting multiple types of reading areas, exchange areas, and rest areas—allowing people to more freely choose and customize their spatial experience. Personalization highlights humanization; meeting different reading needs through different architectural forms and interaction methods can create more interesting and meaningful reading experiences.

3.3 Space Meaning: Co-creation of Intelligent Technology and Smart Space

The metaverse is not a newly emerging technology but a collection of virtual reality, augmented reality, digital twins, artificial intelligence, and other technologies. In today's era of fast-food culture, under the guidance of these technologies that pride themselves on providing rich experiences, pursuing sensationalist "immersion" seems to have become the main direction of metaverse libraries. Over time, reading will lose its spiritual foundation on the track of rapid technological development. In fact, metaverse libraries should be a "service ecology integrating human wisdom and material intelligence" [45], using technology to assign meaning to virtual space and establishing an ecological model integrating architecture, systems, and resources.

The metaverse opens multidimensional possibilities for bodily perception, requiring the metaverse technology family to move toward refinement. On the one hand, refinement represents multiple representation methods that help combine space and information to achieve spatial intelligence. On the other hand, refinement leads to the quantification of spatial experience, helping increase experiential dimensions, enrich spatial continuity and layers, and upgrade scene presentation effects.

With the smartening of library services, many situations from physical libraries will transfer to virtual space—this represents an expansion of the library smart service model [15]. Future libraries may include both physical and metaverse components, forming a virtual-real integrated smart learning center. The virtual world is a projection of the physical environment, aiming to optimize spatial perception and experience. Virtual architecture's simulation of physical architecture is based on human perception of the physical world and also affects appreciation of the physical environment. Metaverse libraries should integrate and develop with the physical environment, achieving free switching between virtual and real spaces and providing richer and more diverse pathways for understanding.

Virtual space gives reading new forms and ecology, also giving the ideal of smart reading visual representation. As a future learning center, metaverse libraries should be high-tech spaces where people can feel the power of technology and future possibilities. Moreover, as physical space limitations are gradually eliminated, people's aesthetic consciousness in the virtual world becomes more complex, easily forming diverse spatial demands. Therefore, metaverse libraries should also contain the examination and expression of architectural beauty, creating spaces that conform to aesthetic values. In the process toward the metaverse era, both virtual and real spatial experiences are directions for library construction improvement. Technology and space should co-create, forming an internal organic whole that integrates physical and virtual library spaces in the metaverse. Only by properly handling the relationship between technology and space can libraries become living organisms where technology can grow and

space can expand.

Metaverse libraries are currently in a conceptual transformation process with few practical cases. Even though scholars have constructed a series of standards and specifications [46], specific implementation plans and pathways still have considerable room for exploration. Architectural phenomenology explores the relationship between space and experience and has enlightening significance for understanding virtual space perception and human behavior and emotion within it. It can serve as a theoretical tool for observing and experiencing the virtual world and provide guidance for metaverse library construction pathways. The virtual reading world affects the structure of reading and reading services. In the future, metaverse libraries may become the most important platform for smart libraries, gathering, exerting, and generating wisdom in libraries' different virtual and real situations.

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Note: Figure translations are in progress. See original paper for figures.