Düzce Üniversitesi Bilim ve Teknoloji Dergisi

Araştırma Makalesi

Examination of Projects Produced in the Metaverse as an Opportunity for Architecture

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ABSTRACT

The study questions the role of the metaverse universe in the field of architecture. In this context, the article aims to determine this new field's potential, understand its boundaries and analyse what kind of projects have been produced in the architectural field to date. Descriptive analysis, one of the qualitative research methods, was used in the study, and the analysis data was obtained from Archdaily's database, a popular architectural platform. All of the studies obtained from here are current, and the oldest project dates back to 2020. The evaluation of projects was evaluated according to the criteria of different space types (Hyper Reality, Abstracted Reality, Hybrid Cyberspace, Hyper Virtuality), smart city/building, creative-innovative design, social value creation, interaction-socialization, new spatial experiences, digital art, and cultural value creation. Among the projects analyzed, there are projects developed by architects and designed by video and game developers. As a result, in the metaverse universe, futuristic, free designs are developed, and historical and cultural structures are revitalized and passed on to future generations. Complex 3D visualizations can be easily produced in the metaverse instead of using various software. In the future, the metaverse is expected to radically change and transform the discipline of architecture in education, design, and practice.

Keywords: *Metaverse, Architectural Design, Digital Architecture, Artificial intelligence, Augmented Reality, Virtual Reality.*

Metaverse'de Üretilen Projelerin Mimarlık İçin Bir Fırsat Olarak İncelenmesi

ÖZ

Çalışma metaverse evreninin mimarlık alanında nasıl bir rol oynadığını sorgulamaktadır. Bu bağlamda makalenin amacı, bu yeni alanın potansiyelini belirlemek, sınırlarını anlamak ve günümüze kadar mimari alanda ne tür projelerin üretildiğini analiz etmektir. Nitel araştırma yöntemlerinden betimsel analizin kullanıldığı çalışmada analiz verileri popüler bir mimarlık platformu olan Archdaily veri tabanından elde edilmiştir. Buradan elde edilen çalışmaların tamamı güncel olup, en eski proje 2020 yılına uzanmaktadır. Projelerin değerlendirmesi, farklı mekan tipleri (Hyper Reality, Abstracted Reality, Hybrid Cyberspace, Hyper Virtuality), akıllı kent/bina, yaratıcı-inovatif tasarım, toplumsal değer yaratma, etkileşim-sosyalleşme, yeni mekansal deneyimler, dijital sanat ve kültürel değer yaratma kriterlerine göre değerlendirilmiştir. İncelenen projeler içerisinde, mimarlar tarafından geliştirilmiş çalışmalar olduğu gibi video ve oyun geliştiriciler tarafından tasarlanmış projeler de yer almaktadır. Sonuç olarak metaverse evreninde fütüristik, sınırların zorlandığı özgür tasarımlar geliştirilmekte, tarihi ve kültürel yapılar yeniden canlandırılmakta ve gelecek nesillere aktarılmaktadır. Karmaşık 3D görselleştirmeler çeşitli yazılımlar

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yerine metaevrende kolaylıkla üretilebilmektedir. Gelecekte metaverse'un mimarlık disiplinini eğitim, tasarım ve uygulama alanlarında radikal bir şekilde değişime ve dönüşüme uğratması öngörülmektedir.

Anahtar Kelimeler: *Metaverse, Mimari Tasarım, Dijital Mimarlık, Yapay Zeka, Artırılmış Gerçeklik, Sanal Gerçeklik.*

I. INTRODUCTION

Today, there is an extended world experience where real and virtual spaces coexist [1]. Innovations in computer science play an important role in daily life as they change and enrich human communication, interaction, and social relations. The introduction of personal computers, internet, and mobile devices has brought many technological innovations [2], [3]. From this point of view, this rapid evolution in the digital age leads to the shaping of the world with new concepts brought by technology and the emergence of new paradigms. The concept of metaverse, which stands out as one of the most remarkable and promising elements of today's digital transformation, draws attention with its potential to offer a holistic digital experience that combines the interaction of virtual and physical worlds. In this context, the metaverse is a concept that expands the boundaries of today's digital age and attracts more and more attention [4]. Basically, this term refers to an environment where the virtual and physical worlds interactively merge, and users can connect in a digital space. In addition, this world is a post-reality universe, a continuous and persistent multi-user environment that combines physical reality with digital virtuality. The metaverse enables multisensory interaction with digital objects and people through virtual environments enabled by technologies such as virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and blockchain [5], [2]. This comprehensive digital universe has a wide range of applications, from entertainment to education, business, architecture, and social interactions. The rise of the metaverse offers new opportunities by profoundly transforming the interactions between technology, culture, and society. In addition, the metaverse is changing everyday interactions, and as this metaverse expands, social relations and interactions are being reshaped [6].

The potential of the metaverse concept in the field of architecture goes beyond traditional boundaries and has the potential to affect the design and construction processes [7] deeply. Recently, many studies have been carried out in the literature addressing the concept of metaverse in architecture. In the international literature, [8] has produced studies on smart building operation and maintenance, [9] on efficient emergency evacuation scenarios, [10] on BIM applications, [11] on the relationship between the physical environment and metadatabase, [12] on the design and nature of virtual space, [13] on the sustainability of cultural spaces, and [14] on the possibilities of use in the built environment.

However, if it is necessary to elaborate on the studies produced on the metaverse in Turkey, [15] discuss the position of architects and interior designers in the metaverse universe through asset production, ownership, and commercial activities. The research includes opinions and suggestions on the current state of the metaverse. In Karyağdı's study examining the interiors in the metaverse, comparisons were made through digital games, virtual reality applications, and photo-realistic space designs in three-dimensional programs [16]. In Aydoğdu and Toy's study in 2023, six (6) building designs of six (6) brands in Decentraland, one of the most well-known platforms of the metaverse, were examined [17]. The study variables are form, color, texture, material, light, and animation. As a result of these analyses, the designs were evaluated and classified according to their closeness to the visual design language in the physical world or the way of perception in the virtual universe. Kurtuluş & Tekin studied "Metaverse Chronology and Metaverse in the Context of National Architecture" from past to present and evaluated the metaverse publications in Turkey by content analysis [18]. This study examines how the concept of metaverse is represented in architecture with different sub-themes. In Arslan's study in 2023, the future evolution of urban services in the metaverse was analyzed with examples from Turkey and the world. The study determined that cities started to apply metaverse technologies in tourism, local development, culture, health, and education [19].

Studies in the literature address different aspects of the relationship of the discipline of architecture with the metaverse. This study focuses on what can be produced in architecture in the metaverse universe. From this point of view, the study targets physical productions in the metaverse universe. The difference between this research and other studies is that it analyses architectural projects produced for the metaverse in the Archdaily database [20], one of the current architectural platforms. The aim is to evaluate how these examples address/transform architecture in the metaverse world.

A. THE TYPES OF METAVERSE SPACES

Since the 1990s, different forms of spatial production have been realized in cyberspace. Hyper Reality, Abstracted Reality, Hybrid Cyberspace, and Hyper Virtuality are four different types of spaces that can be created in the Metaverse [7], [21]. Hyper Reality tries to imitate the physical world in great detail. Hyper Reality is defined by its attention to solving constraints revolving around the "Laws of Nature" such as gravity, wind, weather, sunlight, natural materials, touch, smell, dust, dirt, and aging of materials and surfaces. Hyper Reality environments are also used to recreate historical sites that no longer exist or never existed. It can also provide virtual access to physical environments in the world [22].

In Abstracted Reality, objects and textures are abstracted and recreated in the best possible way. However, efforts are made to prevent disorientation or a sense of unfamiliarity. For example, in this Reality, one cannot pass through walls, and accessing different floors requires elevators or stairs to maintain orientation and familiarity. Abstracted Reality generally offers more artistic freedom compared to Hyper Reality. Additionally, Abstracted Reality allows for the stretching or emphasis of spatial creation qualities such as scale and time. Within Abstracted Reality, advantages exist for simple texture mapping and lighting requirements, as photorealism is not the primary objective [21].

Hybrid Cyberspace freely merges 'real' and 'virtual' experiences without violating natural laws. Within this Reality, characterized by an unlimited range of artistic expression, it is easily transformed into a surreal state. Other participants can appear as realistic or unrealistic avatars or even in symbolic representations such as talking chess pieces or game cards. Objects can behave in unusual ways; dimensions, textures, and forms can change over time. There can also be significant mismatches between form and material. The most important challenge for designers in creating these environments is finding the right balance between the real and the unreal [23].

Finally, Hyper Virtuality severs all relations with the physical world and the laws of nature. The uniqueness and innovation of the experience are emphasized by consciously steering away from the known. Common construction elements such as walls, doors, windows, or floors hold no significance in this realm. In this environment, users can exist not as object-based avatars but as a point of light, a liquid, or an expanding gas form. However, by rejecting the physical spatial metaphor, Hyper Virtual Reality also loses any sense of familiarity and its derived social cues [7].

II. METHODOLOGY

The descriptive analysis technique, one of the qualitative research methods, was used in the study. Descriptive analysis is a deductive research method in which the findings are defined and interpreted by examining qualitative data based on a predetermined analysis framework of the conceptual structure of the research [24]. The steps of the qualitative method used in the study and how these steps were followed are shown in Table 1. In the examination conducted with this method, the historical development of metaverse studies was reviewed and analyzed, and thus, the development of this subject was revealed. New directions for research on this topic are then presented. The types of spaces defined for the metascape universe and the evaluation criteria of "The 1st STELSI International Metaverse Architecture Competition" held in 2023 were used to evaluate the projects examined in the study.

Table 1. *Flowchart of the study*

Step	The analysis step	To the Topic
1	Identifying the initial research question and the area of investigation	The role the metaverse universe plays in the field of architecture is questioned. The aim is to identify this new field's potential, understand its limits and analyze what kind of projects have been produced in the architectural field to date. What is the current state of the metaverse universe? How is the metaverse universe shaped in architectural databases and current studies? Sample area: Architectural databases (Archdaily)
2	Identification of limitations	Scope of the research: Identification of space types and architectural criteria defined for the Metaverse universe
3	Clarifying the research question to reflect the scope	How does the Metaverse universe reflect in architectural productions regarding space type, smart building, creativity, social value, interaction, spatial and cultural experiences, and digital art parameters?
4	Developing a literature review strategy	What are the current architectural works produced in the Metaverse universe? Identifying architectural projects in databases
5	Performing the analysis	Do current architectural works help to answer the question posed? Evaluation criteria Identifying similarities/differences between projects
6	Interpretation of the results	Presentation of subjective discourse Evolution of the Metaverse universe in the field of architecture and future assumptions

The dataset analyzed in the study was obtained from the Archdaily architecture platform. Archdaily is an international website where current architectural projects and articles, competitions, biennials, and other events related to the discipline of architecture are shared [25]. All projects accessed by searching the keyword "Metaverse" on the search button on this website were analyzed. As a result of the search, a total of 25 architectural projects related to the concept of "Metaverse" were found. In the evaluation of the projects, the space types defined by John Marx [21] for the metaverse universe and the criteria of "The 1st STELSI International Metaverse Architecture Competition" were taken into consideration [26]. The evaluation criteria of the study are as follows: space types (Hyper Reality, Abstracted Reality, Hybrid Cyberspace, Hyper Virtuality), smart building/city in the metaverse, creative and innovative architectural design in the metaverse using future building technologies, and new building materials, creating social value through architectural design, design for public, interactive and social connectivity in cities, new spatial experiences in the metaverse, innovative spatial design from a new perspective, architectural design with cultural elements, design with cultural elements to integrate with society, digital art spaces in the metaverse, innovative spatial design combining digital art, residential, commercial and workspaces.

III. EVALUATION OF ARCHITECTURAL DESIGN WORKS PRODUCED IN THE METAVERSE

A. EVALUATION OF METAVERSE PROJECTS

This part of the study analyzes 25 architectural projects produced for the "Metaverse" world obtained from the Archdaily database. First, descriptive information about the design of the buildings is given. Then, each project was evaluated according to the criteria of metaverse space types (Hyper Reality, Abstracted Reality, Hybrid Cyberspace, Hyper Virtuality), smart building/city, creative and innovative design, social value creation, interaction-socialization, new spatial experiences, cultural value creation, and digital art.

A. 1. Liberland Metaverse City

Liberland, developed by Zaha Hadid Architects, stands out as a micro-national entity embracing libertarian political ideology. In this design, urban residents can purchase plots around the city center.

Additionally, city dwellers can access these plots as avatars. The fundamental factors underlying the Liberland Metaverse design encompass its advantages of global accessibility and cohesive adaptability. This design, effectively combining virtual and physical environments, holds significant potential for future physical implementation [27] (Figure 1).

Figure 1. *Images of the Liberland City design, 2022 [27]*

A. 2. Make Room For Us

This architectural proposal, designed by Ezequiel Pini and his team, encompasses designing and visualizing an envisioned home within the metaverse universe [28]. According to the project's designers, this proposal not only suggests harmonizing architecture with nature but also serves as a means through the Metaverse to convey a kind of remorse for the damages inflicted on the physical world. This project explores ways of harmonizing with what has always existed. An architectural system that interacts with nature in an imaginary ecosystem is proposed. This exploration is depicted as a narrative translated into visual concepts to reconstruct the home (Figure 2).

Figure 2. *Images of the Make Room for Us design, 2022 [28]*

A. 3. The Winter House by Andrés Reisinger and Alba de la Fuente

Designed by Argentinian designer Andrés Reisinger and architect Alba de la Fuente, this is a residential project inspired by the coldest season of the year. Comprising serene colors and evoking a sense of tranquility, this design stands out as a virtual and independent residence with distinct geometric lines—architects aimed to create a winter shelter by integrating interior and exterior spaces. Combining different architectural movements, this project is inspired by Dieter Rams designs of the early 1960s to create a large concrete structure. The floating slab is combined with floor-to-ceiling glass panels that allow natural light to enter the interiors. Architects have translated feelings of serenity, tranquility, and comfort associated with winter into a residential form within the metaverse environment [29] (Figure 3).

Figure 3. *Images of the Winter House design, 2022 [29]*

A. 4. Neo-Chemosphere by ZYVA Studio and Charlotte Taylor

It was designed by Anthony Authié and Charlotte Taylor and was inspired by John Lautner's striking spaceship house in Los Angeles in 1960. In response to the COVID-19 crisis and climate change, Authié and Taylor have created a post-anthropocentric world by locating their residence in the archaeological site of the sea opposite the Marseille Canyons. The designed residence occupies an area of 145 square meters and consists of an octagon measuring 14 meters in diameter, positioned on a concrete pillar wedged between rocks. To evoke a sense of tranquility and comfort for users, the interior was coated with white resin, creating a stark contrast with the surrounding pink stones. This project blurs the boundaries between interior and exterior spaces, addressing a contemporary perspective regarding withdrawing from society and reconnecting with nature. In this project, the designers aim to establish a metaphysical relationship between the architecture and the user. While balancing modernism with science fiction, the design also references the cinematic visual effects of the 1970s [29] (Figure 4).

Figure 4. *Images of the Neo-Chemosphere design, 2021 [29]*

A. 5. Gluon

Gluon, a digital consulting firm based in Japan, has launched the "3D Digital Archive Project" to preserve the iconic Nakagin Capsule Tower in Tokyo. The main goal of this project is to record the tower in 3D and use various measurement techniques to recreate it in the Metaverse. The Nakagin Capsule Tower does not comply with current earthquake regulations and is threatened with demolition due to lack of maintenance and deterioration. In this context, the metaverse project developed by Gluon aims to digitally record the Nakagin Capsule Tower building and preserve it for future generations. Based on the detailed measurement data of the Nakagin Capsule Tower Building, the digital archive aims to build a space in the Metaverse where people can come together again. This project aims to preserve historical and cultural heritage by using technology to preserve it for future generations and to keep it alive in a virtual environment [30] (Figure 5).

Figure 5. *Images of the Gluon design, 2022 [30]*

A. 6. Crystal City

Crystal City's metaverse destination comprises a high observation terrace, an ice-covered market area, and a snow gallery, housing the Crystal Tower, Decentraland's tallest multi-purpose tower. Ecuadorian architect Felipe Escudero, who hosts offices, stores, galleries, and various events, designed this 6-hectare area. The Crystal Tower, situated at the heart of Decentraland, is designed as a 167-meter-tall metal tower. Crystal City aims to transcend the boundaries of the contemporary physical world by disregarding gravity and material properties, intending to provide a unique transcendental and interactive experience in the digital realm. This platform aims to cater to a broad user base by offering companies and artists affordable leasing options within the tower, market, and event spaces. This supports Crystal City's aim to provide an accessible digital space in a place where buying land is costly [31] (Figure 6).

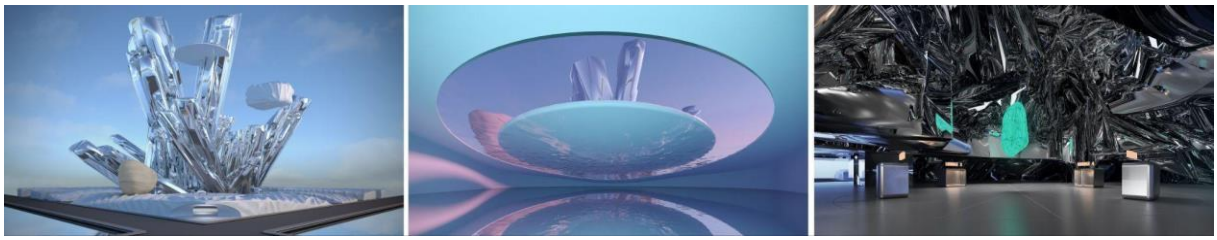

Figure 6. *Images of the Crystal City design, 2022 [31]*

A. 7. The Ares House by Daniel Arsham

The Ares House is conceived as a space aiming to render the colossal statue of the Greek god of war and courage, Olympus' symbol, in a detailed and habitable scale. The artist's "out-of-time" aesthetic and approach are shaped around the concept of "fictional archaeology," which combines the past, present, and future. Specially designed for The Row, the Ares House is imbued with a sense of enigmatic presence, aiming to evoke a sensation of existing in both ancient and modern worlds. Artist Daniel Arsham created the artwork through five different variations. Each designed variant exhibits a unique crystalline feature rendered in amethyst, quartz, pyrite, and volcanic ash. Arsham states that this project aims to encourage users to reflect on the concepts of time and age of materials [28] (Figure 7).

Figure 7. *Images of the Ares House design, 2022 [28]*

A. 8. Virtual architecture by Andrés Reisinger

This virtual building, designed by Andrés Reisinger, is a visual manifesto of digital architecture free from reality's spatial constraints and limitations. Traditional architecture is the fundamental unit where the house is concretized for long-term existence within the Metaverse and is accepted as a permanent entity. However, according to Reisinger, this permanence challenges the traditional understanding of housing and becomes obsolete within the Metaverse. This glass house possesses a solid geometry and is surrounded by non-existent green areas. The transparency of the structure aims to counteract 'meaninglessness, distress, existential fear, and emptiness. This design combines the most stimulating conditions with a transparent architectural atmosphere, sharp aesthetics, and the fuzzy texture of the space. By focusing on the untouchable density of time and illusion, the design emphasizes a non-existent residence experience. Reisinger's virtual architecture challenges traditional norms, creating a new aesthetic language within the Metaverse [28] (Figure 8).

Figure 8. *Images of the Virtual Architecture Design, 2022 [28]*

A. 9. Quagmire's Karst by Misha Kahn

Misha Kahn, an American designer known for his montage and sculpture works, has developed a creative and original project in the metaverse universe. Kahn has used various digital tools in his creations, from Ad-Hoc programming techniques to virtual Reality and other high-tech devices. Kahn's 'Swamp' series has been shaped around utilizing grids to create depth within an environment. By combining low-tech with high-tech, these designs aim to push the boundaries of space with virtual Reality [28] (Figure 9).

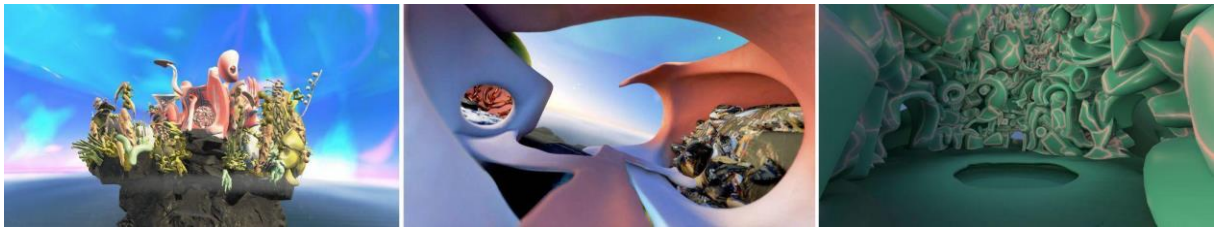

Figure 9. *Images of the Quagmire's Karst design, 2022 [28]*

A. 10. The Mirage by Alexis Christodoulou

The Mirage, designed by Alexis Christodoulou, stands out as the Metaverse's first personal levitation center. This project is designed to facilitate individuals' transition into the digital realm. Each Mirage version mimics the sun's position while floating in the air at various moments throughout the day. Christodoulou sees this project as a place of escape and purification from the real world [28] (Figure 10).

Figure 10. *Images of the Mirage design, 2022 [28]*

A. 11. The Pearl by Hard

Designed by Hard Architects, The Pearl combines the creative side of the digital landscape with avant-garde designs. The project's main form, a giant pill, sits atop salty rock formations. The design offers a perspective that explores the 'luxury desire and the need for belonging' nurtured through an inner journey. Alexander Team describes this design as a critique of the visually indulgent lifestyle [28] (Figure 11).

Figure 11. *Images of the Pearl design, 2022 [28]*

A. 12. Metajuku Shopping Center

Republic Realm, a metaverse real estate developer and investment platform, has developed Metajuku, a new shopping district for the Metaverse. As the name suggests, Metajuku references Tokyo's famous Harajuku shopping area. The project is developed around a 16,000-square-meter atrium. The stores surrounding the atrium sell digital wearable products for metaverse users. The shopping district is in Decentraland, a virtual social platform supported by the Ethereum blockchain. Designed by Martin Guerra, this project was brought to life by Republic Realm's 3D real estate and game developers. The virtual shopping experience is crafted explicitly for Web 3.0, entirely constructed to exist independently of gravity [32] (Figure 12).

Figure 12. *Images of the Metajuku Shopping Center design, 2022 [32]*

A. 13. Courtesy of Townscaper

Townscape is a new city-building game that allows users to create their towns. With elements rising from a digital sea, users build unique towns as they click. According to the game's developer, Oskar Stalberg, Townscaper is primarily conceptualized as more of a toy. The design is inspired by the architecture of Scandinavian cities and the concept of children's books. Depending on the context, algorithms process the details by adding many features, such as terraces, arches, bridges, gardens, stairs, etc. In the game, which utilizes colorful bricks and stones, spaces are developed with details like mailboxes, seagulls on rooftops, and tiny boots on doorstep thresholds [32] (Figure 13).

Figure 13. *Images of the Courtesy of Townscaper Design, 2020 [32]*

A. 14. Virtual Gallery by Zaha Hadid Architects

Zaha Hadid Architects introduces a virtual art gallery named 'NFTism' at Art Basel Miami, providing a platform to explore architecture and social interaction within the Metaverse. The gallery features spatial designs created by ZHA, focusing on user experience, social interaction, and "dramaturgical" compositions. The gallery combines virtual architecture with technologies utilized in virtual spaces designed by ZHA, providing interactive technologies and services supported by MMO (massively multiplayer online) for users. The project focuses on virtual areas that enable communication between people through computer networks. Using MMO video game technologies, high-speed networks, and clouds, virtual spaces are socially enriched and accessible from various devices [33] (Figure 14).

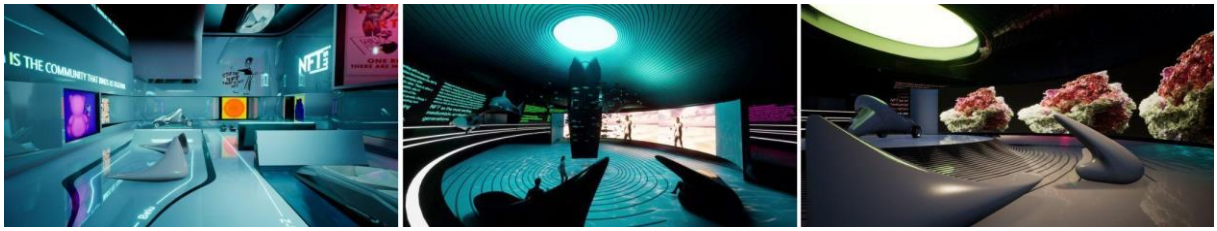

Figure 14. *Images of the Virtual Gallery design, 2021 [33]*

A. 15. Tequila Distillery

The design, developed by Rojkind Arquitectos, emerged as a design exercise to explore how objects can respond to human needs. Rojkind Arquitectos collaborated with a group of designers and experts in the digital field to design a distillery in the Metaverse. The structure, designed as a space for social interaction, is surrounded by a familiar urban context [32] (Figure 15).

Figure 15. *Images of the Tequila Distillery design, 2022 [32]*

A. 16. Red Hill House

This housing project, designed by the Australian architecture firm SOFA, is conceptualized as an NFT (Non-Fungible Token). It has a deliberately minimal and straightforward aesthetic that appeals to a broad audience and can be applied to many environments and locations worldwide. Through NFTs, SOFA makes architecture and design products unique, rare, and transferable. It offers various benefits in both the digital and physical realms, presenting long-term investment potential. SOFA aims to democratize architectural designs using NFTs and reduce the consumer's entry cost by providing the opportunity to own a limited collection [34] (Figure 16).

Figure 16. *Images of the Red Hill House design, 2022 [34]*

A. 17. Mars House

Mars House, designed by artist Krista Kim in 2020, is the first digital NFT house sold in the world. Beyond being a functional home, Mars House attracts investors to the Metaverse with a sale price of half a million dollars. The house is built with the Unreal Engine software used for video games and can also be used in Virtual Reality (VR) and Augmented Reality (AR) applications. Mars House has a structure created with light and offers a healing atmosphere accompanied by the music of Jeff Schroeder, guitarist of The Smashing Pumpkins [35] (Figure 17).

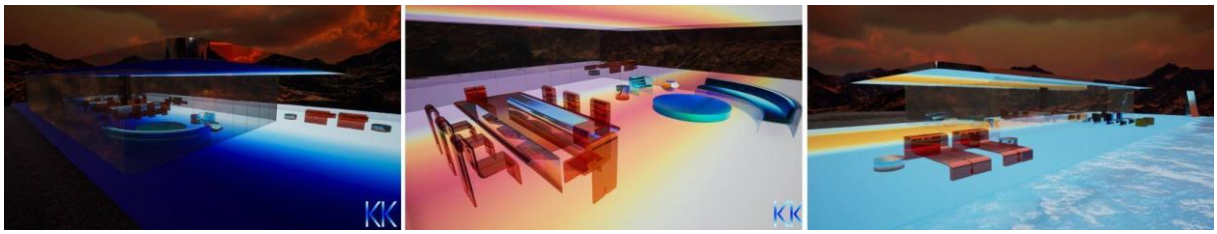

Figure 17. *Images of the Mars House design, 2020 [35]*

A. 18. Decentraland

Decentraland is conceptualized as a 3D-based virtual world browser platform. Users can purchase NFTs (Non-Fungible Tokens) and virtual lands via the Ethereum blockchain. Decentraland provides access to various virtual events, such as buying clothing for avatars and attending concerts, fashion shows. Furthermore, items purchased through the platform can be delivered to the user's physical address in the real world. The platform, launched to the public in February 2020, is overseen by the non-profit Decentraland Foundation [36] (Figure 18).

Figure 18. *Images of the Decentraland Design, 2020 [36]*

A. 19. MetaMundo's 3D NFT Villa

MetaMundo has proposed a virtual interactive space in its second three-dimensional NFT, situated along the ocean. Designed by American architect Luis Fernandez, the structure encompasses spaces such as an NFT gallery, meditation pavilions, and entertainment areas. MetaMundo aims to transform this interactive space into a socializing, gaming, and relaxation platform. Various historical references inspired the architect in the design of the villa. The main entrance is reminiscent of the arcades of ancient Greek temples. The project references Frank Lloyd Wright for the relationship between architectural design and landscape and Mies van der Rohe for using natural materials [34] (Figure 19).

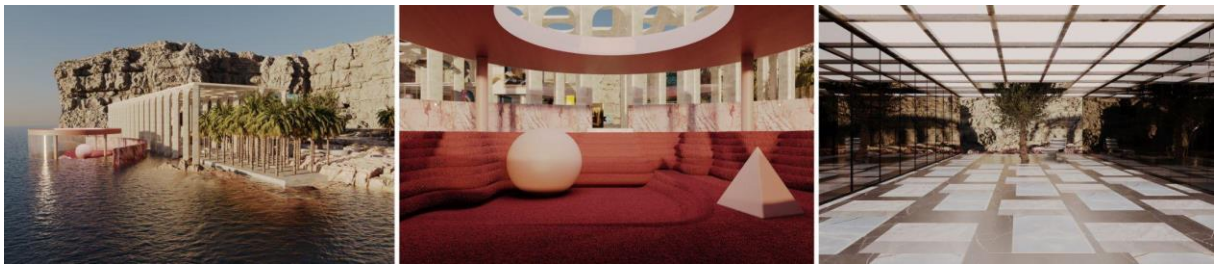

Figure 19. *Images of the MetaMundo's 3D NFT Villa design, 2022 [34]*

A. 20. Fengyuzhu Metaverse Digital Art Museum

The Fengyuzhu Metaverse Digital Art Museum is designed as a virtual cultural facility on Baidu's Xirang Metaverse platform, targeting M-generation users. Users can purchase digital art collections and enjoy interactive exhibitions, entertainment, social networking, and other features. The Fengyuzhu Metaverse Digital Art Museum is intended to lead in the creation of a cultural landmark in the Xirang Metaverse [37] (Figure 20).

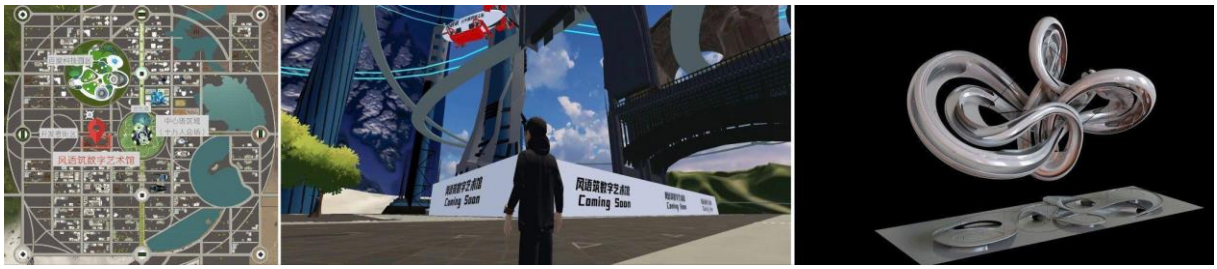

Figure 20. *Images of the Fengyuzhu Digital Art Museum design, 2022 [37]*

A. 21. Grimshaw Metaverse Social Hub

The structure, inspired by architectural elements of a caravanserai, relies on a simplistic design comprising a central courtyard surrounded by water droplets. The cube shape gives it a floating appearance in its position. Visitors can reach desired locations through openings because they lack a physical connection to the ground. This ever-changing architecture aims to reflect human interaction at a scale and speed impossible in a physical environment [38] (Figure 21).

Figure 21. *Images of the Grimshaw Social Hub design, 2023 [38]*

A. 22. HWKN Metaverse Social Hub

Designed by HWKN, the project is a multi-layered, open hexagonal structure inspired by the physical world but transformed by the digital freedom of the Metaverse. Located in a surreal desert, it offers a variety of experiences, from concerts in the large theater to wall-less galleries, meeting rooms open to the sky, and exercise facilities in the rooftop garden. Its familiar yet futuristic appearance aims to create a relaxing, inviting, and exciting meeting point [38] (Figure 22).

Figure 22. *Images of the HWKN Social Hub design, 2023 [38]*

A. 23. Farshid Moussavi Architecture Metaverse Social Hub

This design proposal deeply explores the architectural office's commitment to social values. The project emphasizes efforts to promote inclusivity, diversity, and richness. The building is planned to be a meeting point and to encourage interaction. Different event spaces are placed around three large circular courtyards, creating a strong connection between indoor and outdoor spaces. This central arrangement achieves coherence by interconnecting the courtyards. The exterior surface of the building is clad in mirrors. The underlying reasons for this choice are stated to reflect the outdoor environment continuously, influencing the arrival visitors' perspective and altering their approach to the building [38] (Figure 23).

Figure 23. *Images of the Farshid Moussavi Social Hub design, 2023 [38]*

A. 24. WHY Metaverse Social Hub

Resembling a caravanserai, this space is shaped around a public square. Natural materials are preferred in the design, and a holistic harmony is achieved with waterfalls, sky windows, and vegetation scattered throughout the landscape. The objective is to create an experience that evokes visitors' positive emotional and even physiological responses. The central courtyard connects underground rooms,

islands, great halls, and meditative restrooms. The building is designed to allow for a wide range of programming and different events [38] (Figure 24).

Figure 24. *Images of the WHY Social Hub design, 2023 [38]*

A. 25. SOLIDS

SOLIDS is an initiative developed by FAR, an architect and engineer working in digital environments, utilizing a generative process to design metaverse-compatible buildings. This project generated 8,888 different SOLIDS buildings through generative algorithms to create NFTs compatible with metaverse platforms, game engines, and modeling software. This productive architectural form has initiated a discussion about the changing role of architects and the possibilities offered by digital environments. SOLIDS offers algorithmically generated architectural elements. Although it is based on parametric design, it preserves the architectural logic and ensures the integrity of the design. This initiative offers twelve different Archetypes with varying functions. Structures in the form of flexible containers that can be used to house galleries, meetings, or different experiences are among the possibilities SOLIDS offers [39] (Figure 25).

Figure 25. *Images of the SOLIDS design, 2022 [39]*

IV. RESULTS AND EVALUATION

The projects examined within the scope of the study were evaluated within the scope of Hyper Reality (HR), Abstracted Reality (AR), Hybrid Cyberspace (HC), and Hyper Virtuality (HV) according to the types of space and presented in Table 2.

Table 2. *Evaluation of Metaverse Projects*

No	Building Name	Space Type	Smartness	İnnovation	Social value	Interaction	Spatial experience	Digital art	Cultural value
1	Liberland City	HC	+	+	+	+	+		
2	Make room for us	HR		+					
3	Winter house	HR							
4	Neo-Chemosphere	HR							+
5	Gluon	HR			+				+

6	Crystal City	HC		+		+	+		
7	Ares House	HR		+			+		
8	Virtual Architecture	HR		+					
9	Quagmire's Karst	HV		+			+		
10	The Mirage	HR		+					
11	The Pearl	HC		+		+	+		
12	Metajuku Shopping Center	AR				+			
13	Courtesy of Townscaper	AR	+	+					
14	Virtual Gallery	HR		+	+	+	+	+	
15	Tequila Distillery	HC		+		+	+		
16	Red Hill House	HR							
17	Mars House	AR		+					
18	Decentraland	AR	+	+		+	+		
19	3D NFT Villa	HR		+	+	+	+		
20	Fengyuzhu Museum	AR		+	+	+	+	+	
21	Grimshaw Hub	HC		+		+	+		
22	HWKN Hub	HC		+		+	+		
23	Farshid Moussavi Social Hub	HC		+		+	+		
24	WHY Social Hub	HC		+		+	+		
25	SOLIDS	HV	+	+					

When the projects obtained from the Archdaily database are evaluated, it is understood that each project develops a different architectural discourse. The analyzed projects have different architectural concerns and offer a different perspective within the architectural paradigm. In the analysis, studies are designed at different scales, such as city, region, building, and interior space. In this context, it has been determined that urban designs focus on different ideas. For example, the Liberland City Project, developed by Zaha Hadid Architecture, aims to establish a free and liberatian country. This new country is presented as a better version of the real world. Cortesy of Townscaper also aims to build a city. However, this city stands out entirely for entertainment and game purposes. Another urban design proposal is the Decentraland project. This study focuses entirely on the commercial use of space. In addition to urban designs, housing designs such as Make Room For Us, Winter House, Ares House, Virtual Architecture, The Mirage, Red Hill House, and Mars House aim to reveal emotional interaction with nature and the individual's inner self. In these designs, the design fiction is developed with modern architectural elements, and historical references are used to familiarise the virtual space.

In addition, designs are developed to protect and preserve historical and cultural values in the Metaverse universe. Neo-Chemosphere, Gluon, and various museum spaces are essential cultural and historical initiatives. Neo-Chemosphere involves the recreation of a spaceship designed in the 1960s. Gluon is a life-like recreation of the Nakagin Capsule Tower. There are also many projects that allow social interaction in the metaverse environment. For example, Crystal City is a multi-purpose high-rise complex. Liberland City and Decentraland are smart cities, and SOLIDS generative designs are smart building projects. Virtual Gallery is a virtual art gallery; Tequila Distillery is a distillery; 3D NFT Villa is a multi-purpose event venue; Fengyuzhu Digital Art Museum is a virtual cultural facility. Grimshaw Social Hub, HWKN Social Hub, Farshid Moussavi Social Hub, and WHY Social Hub are social interaction spaces where different activities can be organized. Quagmire's Karst project develops an unusual approach to the metaverse, proposing a bog space. Mars House, Red Hill House, and SOLIDS projects can be bought and sold as an architectural commodity. In other words, these projects are offered to users as paid NFTs.

As a result of the analyses made, it is seen that Hyper reality, that is, projects that imitate the physical world to a great extent, are in the majority. Although they are entirely free and independent from the

constraints of the physical world in the metaverse environment, it is seen that designers tend to refer to historical or modern architectural elements. Creative and free designs, interaction-socialization areas, and new spatial experiences are the prominent features of the projects developed in the metaverse environment.

V. DISCUSSION AND CONCLUSION

Metaverse serves many different fields such as tourism, education, entertainment, labour-business sector, medical-health sciences, communication, engineering, art, and architecture with different components such as augmented reality, virtual reality, mixed reality, artificial intelligence, blockchain technology, web 3.0 and internet of things [40].

The activities carried out in the metaverse affect individual behavior, city identity, and urban memory [41]. Urban and architectural studies in the Metaverse universe offer essential approaches to improving architectural structures, preserving urban memory, and transferring it to new generations. According to Assmann, spatialisation is a fundamental tool of memory technique [42]. The transfer of space to the metaverse also activates the relationship between space and memory. Thanks to the advancing technological developments, the metaverse concept will develop together with different disciplines and provide new areas of use and potential [43]. It is predicted that it may become a new business model for architects and the architecture sector in the near future. The fact that virtual versions of all kinds of physical spaces will be needed in the metaverse universe shows that architects and designers will play an active role in the metaverse universe [18].

In this study, in order to contextualize the metaverse, important developments shaping the historical development of this subject are explained. Then, an evaluation of how the metaverse works in the Archdaily database can be interpreted is presented. The current state of these studies shows that architectural productions in the metaverse universe are gradually increasing and gaining popularity. The study analyzed different types of spaces and evaluated them in four categories: Hyper Reality (HR), Abstracted Reality (AR), Hybrid Cyberspace (HC), and Hyper Virtuality (HV). The results show that projects that mimic the physical world (Hyper Reality) are the majority. In the Metaverse, designers are inspired by historical or modern architectural elements, although they work independently of the physical world's limitations. Creative designs, interaction spaces, and new spatial experiences are prominent features of metaverse projects.

In this study, a model for the evaluation of architectural projects in the metaverse is developed. The metaverse universe is a very complex, multidimensional and undefined universe compared to the physical world. The production of architectural projects in this universe also involves complex processes. With the model produced, it is aimed to be a guide for architects, designers, employers and other stakeholders in the design phase. In future studies, the scope of the model can also be developed for the implementation stages of architectural projects. The seven-stage model is presented in Figure 26.

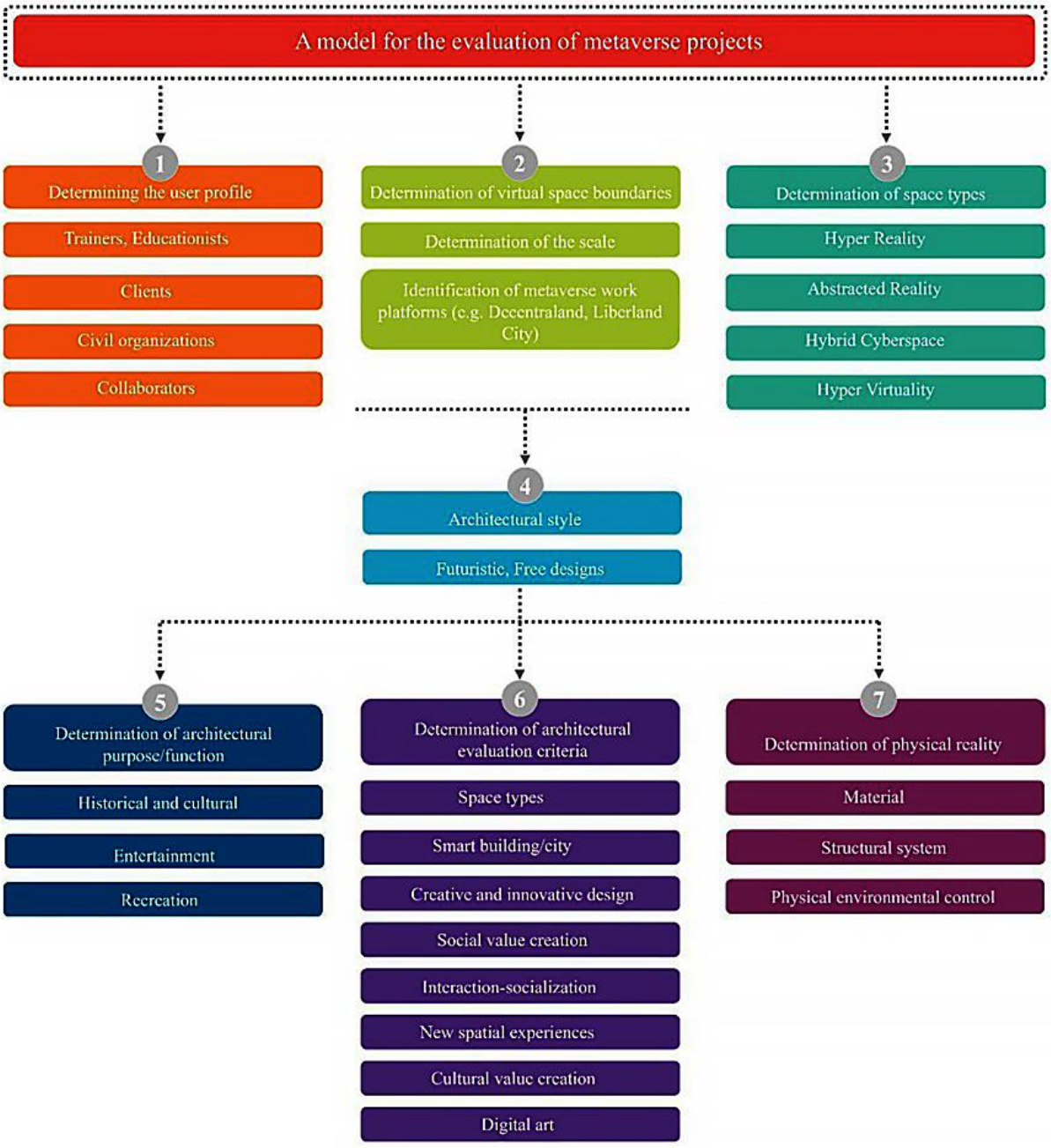

Figure 26. *A model for the evaluation of metaverse projects*

As a result, metaverse, which is a new field, serves various purposes in architecture and is becoming increasingly widespread. In this field, futuristic, free designs and historical and cultural structures are revitalized and transferred to future generations. 3D visualizations can be easily produced in the metaverse instead of various software. In the future, the metaverse is expected to radically change and transform the discipline of architecture in education, design, and practice.

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