

Rationales for the Metaverse and Its Applications in Design Disciplines

Yung-Hsun Cheng

Postgraduate Program of Creative Design, Chienkuo Technology University, jamesyscheng@gmail.com

Abstract

The purpose of this study is to explore the theoretical foundation of the Metaverse research and its potential applications in the field of design. In the field of design, the Metaverse can provide designers with a broader and more creative design space, enabling them to better explore and realize various design concepts and ideas. Designers can design and simulate various products and environments in the Metaverse, such as architecture, urban planning, interior design, fashion design, etc., and achieve more realistic visual and spatial experiences through virtual reality technology. However, the development of the Metaverse also faces some technological and legal challenges, such as high technical barriers, knowledge copyright issues, and information security issues. Therefore, designers and developers need to pay attention to the management of technological and legal risks, and actively apply Metaverse technology and tools to promote the development of the design discipline.

Keywords: Metaverse, design discipline, rationale, virtual reality

1. Introduction

1.1 History and development Metaverse

The term "Metaverse" refers to a new type of virtual world based on virtual reality technology that allows users to experience interactive and immersive experiences. The concept of the Metaverse has existed for a long time, but it has recently received widespread attention and discussion. In 1984, William Gibson introduced the concept of "cyberspace" in his novel *Neuromancer*, becoming one of the pioneers of virtual reality (Gibson, 1984, cited in Featherly). In 1992, the first 3D multi-user online virtual world, *Habitat*, was launched, paving the way for the Metaverse (Bartle, 2004). In 2003, Linden Lab released *Second Life*, an online social platform based on virtual reality technology that allows users to create their own virtual

world and interact with other users (Rymaszewski, 2007). In 2014, Facebook acquired Oculus VR, a virtual reality headset developer, marking the beginning of major tech companies' attention to the development of the Metaverse (Schwartz, 2014). In 2020, the Metaverse became a hot topic, and due to the impact of the COVID-19 pandemic, people began to pay more attention to virtual reality and online social platforms (Mac, 2020). In 2021, several major tech companies announced increased investment in the Metaverse field, such as Facebook's launch of *Horizon Workrooms* (Wagner, 2021). In conclusion, the development history of the Metaverse can be traced back to the 1980s, and with the continuous development of technology, the Metaverse has received increasing attention and investment, and may become an important component of the future digital world.

1.2 Research gap of Metaverse

The Metaverse is an emerging field that is still in its development stage and requires in-depth research and exploration in various areas to realize its potential and value. Despite being a highly-anticipated new field, there are still some research gaps and unresolved issues in the Metaverse. Here are some examples of Metaverse research areas (Hernández, Menéndez, & Gómez-Barroso, 2020; Jiang, et al., 2021; Babaoglu, et. al., 2021; Taylor, 2019):

(1) Economic and business research: The Metaverse will become a platform for new digital economic and business models, and in-depth research is needed to understand its commercial and economic potential and provide better business and market strategies.

(2) User experience research: The success of the Metaverse depends on user acceptance and participation. Therefore, in-depth research is needed to understand user needs, preferences, and behaviors and provide better design and user interfaces.

(3) Legal and policy issues in the Metaverse: Due to the virtual nature of the Metaverse, legal and policy issues related to virtual assets and identities remain somewhat vague. The Metaverse will involve multiple countries and regions, requiring an understanding of different countries' laws and policies to avoid legal conflicts and inappropriate behavior.

(4) Privacy and security in the Metaverse: As the data and information involved in the Metaverse continue to increase, security and privacy issues become increasingly important.

(5) Social, cultural, and ethical issues in the Metaverse: The development of the Metaverse will also bring a series of social and cultural issues, such as social and interpersonal relationships in the virtual world, virtual economies and currencies, and more. The Metaverse

is a new type of social, cultural, and economic space that may involve various social, cultural, and ethical issues. For example, privacy, security, and virtual property rights need to be deeply researched and resolved.

(6) Technical infrastructure of the Metaverse: The development of the Metaverse requires massive computing and storage resources, and the current technical infrastructure may not be sufficient to support the Metaverse's scale and needs. The Metaverse requires powerful computing and storage technology to support its complexity and scale. Existing technology may not meet the Metaverse's needs, requiring further technical innovation and development.

To summarize, there are still many aspects of the Metaverse that need to be explored, requiring interdisciplinary and global cooperation to solve these issues.

2. Literature study

2.1 Research trend of Metaverse

The history of the Metaverse can be traced back to the development of virtual reality technology in the 1980s and 1990s. At that time, researchers and scientists began exploring how to create a virtual environment that could simulate the real world. These early virtual reality technologies were primarily applied in military and aerospace fields, but soon began to be used for entertainment and gaming (Ellis & John, 2002). In the future, the Metaverse will also play an important role in the digital economy and digital world, serving as a platform for new business models and marketing strategies, as well as important application scenarios for artificial intelligence and machine learning. In recent years, it has generated increasing research interest. The following are some trends in Metaverse

research:

(1) Technological development and innovation: With the development of computer and virtual reality technology, the Metaverse will continue to innovate and progress. For example, using blockchain technology to achieve security and transparency in the virtual economy (Wang, 2019).

(2) User experience research: The success of the Metaverse depends on user participation and experience. Therefore, user experience research is an important direction in Metaverse research. For example, researching how to enhance user immersion and engagement through virtual reality technology (Abawi, 2020).

(3) Social, cultural, and ethical issues: The Metaverse involves various social, cultural, and ethical issues.

For example, how to protect user privacy and virtual property rights (Kim et al., 2020).

(4) Economic and business research: The Metaverse will become a platform for new digital economy and business models. Therefore, economic and business research is an important direction in Metaverse research. For example, researching how to innovate digital marketing and business models through the Metaverse (Johnson et al., 2021).

(5) Legal and policy issues: The Metaverse will involve multiple countries and regions, requiring an understanding of different laws and policies. For example, how to establish a globally unified mechanism for protecting virtual property rights (Blair & Sokol, 2020).

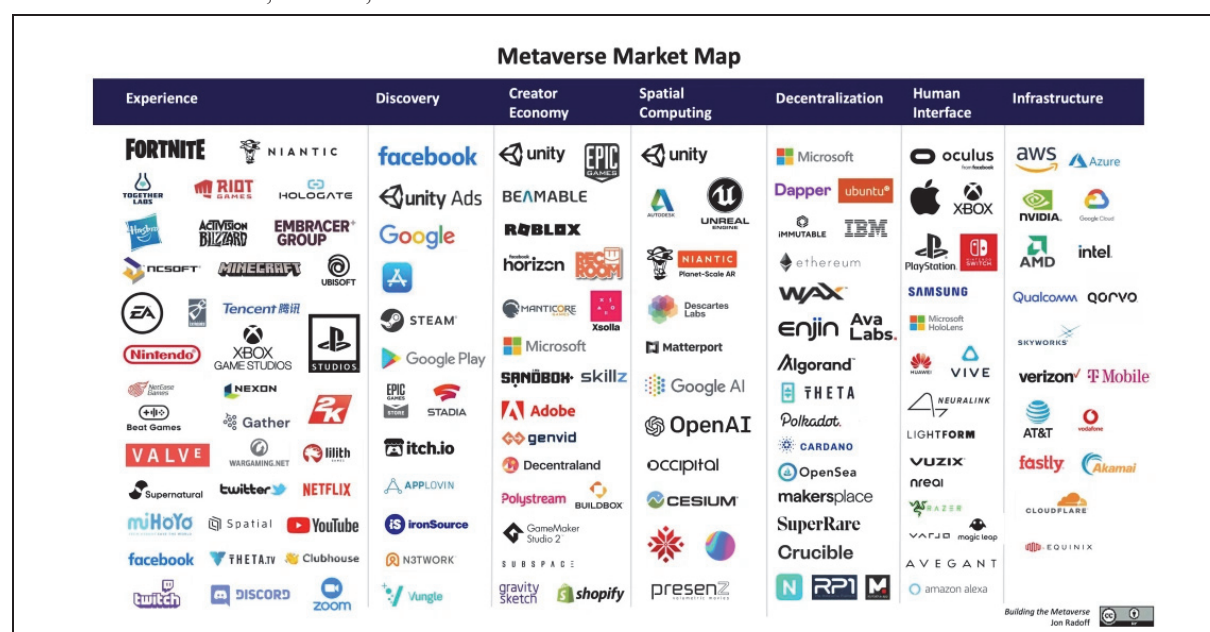


Figure 1 The Metaverse market map

Sources : Hussain. W. A. (2022). The Metaverse market map – the ecosystem of our emerging virtual worlds

Overall, the trends in Metaverse research are diverse and cover technological development, user experience, social, cultural and ethical issues, economic and societal issues, among others.

2.2 Principle of Metaverse

The Metaverse is a virtual internet space composed of various digital resources, scenes, applications, and services. Its construction is based on various

technologies, including virtual reality, augmented reality, artificial intelligence, blockchain, and more. Here are some principles of Metaverse implementation:

(1) Application of virtual reality technology: The construction of the Metaverse cannot be separated from the application of virtual reality technology. Virtual reality technology can bring users into a virtual internet space, allowing them to experience a sense of immersion. The application of virtual reality technology includes head-mounted displays, handheld controllers, motion capture devices, and more.

(2) 3D modeling and rendering technology: The Metaverse requires a large amount of 3D modeling and rendering technology to create and present a virtual world. The Metaverse is a concept of a virtual reality network that contains multiple virtual worlds and virtual reality environments. These virtual worlds can be used for gaming, social interaction, virtual commerce, education, and more. Metaverse virtual reality technology includes virtual reality, augmented reality, 3D modeling, cloud computing, and other technologies, allowing people to interact and create in a virtual environment.

The application of virtual reality technology in the gaming field is very extensive. For example, virtual reality technology can allow players to experience game scenes in a realistic manner, and augmented reality technology can merge virtual game items with real-world items to give players a more realistic feeling. In addition, the Metaverse can also be used for social interaction, such as virtual gatherings, virtual concerts, and other events. The Metaverse can also be used for virtual commerce, such as virtual product displays, virtual shops, and more.

Furthermore, the adult entertainment industry has the

potential to achieve a larger economy scale in the virtual space than in the real world, but the development of body sharing technology in the Metaverse is challenging. However, future technological advancements may catch up to meet the demand, and both the Metaverse and VR have the ability to compress time. It may be possible to achieve surpassing real-life body sharing in the Metaverse by 2029 (Emi, 2022).

Integration of Digital Resources: Metaverse is composed of various digital resources, including 3D models, virtual scenes, audiovisuals, and more. These resources come from different platforms and applications, and the principle of Metaverse is to integrate these digital resources through technical means to form a virtual cyberspace (Sun & Li, 2021). Metaverse is a virtual 3D environment that allows users to participate in activities and communication in a virtual form, including virtual reality (VR) and augmented reality (AR) technologies. The integration of digital resources in Metaverse refers to the integration of different types of digital resources, such as 3D models, sound effects, animations, text, images, etc., to create a complete virtual environment. In Metaverse applications, the integration of digital resources can help developers quickly build virtual environments, thereby saving time and resources. At the same time, it can also improve the realism and interactivity of the virtual environment, thus enhancing the user experience. The integration of digital resources is widely used in areas such as gaming, social media, online shopping, education, and training (Chen, Zhao, & Wu, 2022).

(3) Artificial Intelligence (AI) is a broad field that involves the ability to mimic human intelligence, including language understanding, image recognition,

natural language processing, decision-making, and more. Artificial intelligence involves multiple sub-fields, such as:

a. Artificial Intelligence and Machine Learning: Metaverse requires artificial intelligence and machine learning capabilities to automate the generation and management of virtual objects and scenes in a virtual environment (Lee, Kim, Park, & Kim, 2020). Artificial intelligence (AI) is a broad field that involves the ability to mimic human intelligence, including language understanding, image recognition, natural language processing, decision-making, and more. Artificial intelligence involves multiple sub-fields, such as:

b. Machine Learning: It enables computer systems to learn and improve automatically from experience through data analysis and algorithm design. Machine learning can be divided into supervised learning, unsupervised learning, and reinforcement learning, etc.

c. Deep Learning: It is a machine learning technique that uses a multi-layer neural network to perform high-level abstraction and feature learning, thereby improving accuracy. Deep learning has been widely used in image recognition, speech recognition, and other fields.

d. Natural Language Processing (NLP): It studies how to make computers understand, generate, and operate human language. NLP involves text classification, machine translation, text generation, and more.

e. Computer Vision: a field of study that focuses on how computers can understand and analyze images and videos. Computer vision has been widely applied in areas such as image retrieval and facial recognition.

f. Reinforcement Learning: a machine learning technique used to develop autonomous learning systems that can learn behaviors by interacting with

the environment to maximize cumulative rewards. Reinforcement learning has been widely applied in fields such as games and robotics.

(4) Blockchain Technology: The Metaverse requires the use of blockchain technology to support virtual economies and virtual currencies. Blockchain technology provides a trusted way to manage and exchange digital resources and assets in the Metaverse. It provides a mechanism for trustworthy authentication and transaction of digital assets (Roumani, Parlikad, & McFarlane, 2021). The Metaverse refers to a virtual world consisting of multiple virtual reality spaces where users can engage in various activities such as gaming, socializing, commerce, and education. Blockchain technology can enhance the credibility and reliability of the Metaverse by providing decentralization, transparency, and immutability. Currently, the applications of blockchain technology in the Metaverse include:

a. Asset Trading: Blockchain technology can be used to facilitate virtual asset trading in the Metaverse, such as virtual currencies, items, and properties.

b. Identity Authentication: Blockchain technology can be used to establish identity authentication in the Metaverse, such as real-name registration and credit rating.

c. Data Storage: Blockchain technology can be used to store data in the Metaverse, such as virtual maps and records of virtual currency transactions.

(5) Network communication technology: The Metaverse requires high-speed and stable network communication technology to support a large number of users interacting online simultaneously (Huang, Yang, Yang, Wang, & Zhang, 2021). The Metaverse refers to a virtual world composed of multiple virtual reality spaces, where users can engage in various

activities such as gaming, socializing, business, education, and more. Network communication technology plays a crucial role in the Metaverse, as it can provide efficient communication methods that allow users to interact and collaborate more smoothly. Currently, the applications of network communication technology in the Metaverse include the following aspects (Lin & Chen, 2021; Park, Kwon & Lee, 2021):

- a. Voice communication: Voice communication is one of the most commonly used communication methods in the Metaverse, where users can communicate with others through voice chat rooms or voice conference rooms.
- b. Video communication: Video communication is another commonly used communication method in the Metaverse, where users can communicate through video conference rooms or virtual reality glasses.
- c. Collaborative work: Network communication technology can support collaborative work in the Metaverse, such as multiple users editing a virtual object or completing a task together.
- d. Social interaction: Network communication technology can support social interaction in the Metaverse, such as friend lists and private messaging functions.

To sum up, the realization of the Metaverse requires the support of various technologies and methods, including 3D modeling and rendering, artificial intelligence and machine learning, blockchain technology, and network communication technology. Through the application and integration of these technologies, the principles of the Metaverse can be realized, providing a highly realistic, interactive, and open virtual world. It offers a digitized space where people can engage in various virtual experiences, communication, and transactions.

2.3 Rationale of Metaverse

As a virtual reality technology, the Metaverse has theoretical foundations that involve multiple fields of study. The following are some of the theoretical foundations and related references for the Metaverse:

- (1) Computer graphics: Computer graphics provides the fundamental graphics processing techniques and algorithms for the Metaverse, such as 3D modeling, lighting, rendering, animation, etc. (Foley, van Dam, Feiner & Hughes, 2013).
- (2) Human-computer interaction: Human-computer interaction is an important discipline for realizing the interaction and feedback between users and virtual environments in the Metaverse, including virtual reality devices, gesture recognition, speech interaction, etc. (Dix, Finlay, Abowd & Beale, 2004).
- (3) Computer networks: Computer networks are the foundation for realizing multiplayer online interaction, data transmission, and communication in the Metaverse, including network topology, protocols, routing, etc. (Kurose & Ross, 2012).
- (4) Social psychology: The social functions of the Metaverse need to consider human social behavior and psychological characteristics, such as social cognition, identity management, emotional expression, etc. (Fiske, 2010).
- (5) Economics: The virtual economy in the Metaverse needs to consider the principles and laws of economics, such as currency, transactions, supply and demand, etc. (Varian, 2010).

In addition, there is great potential for the application of Metaverse in the field of education. Metaverse applications can help students better understand and learn knowledge, improving learning outcomes and efficiency. Here are a few examples of Metaverse applications in education (Barrios, 2021; Sheehy,

2019; Zaphiris & Zacharia, 2020; Dumova, 2018):

- (1) Virtual classrooms: Students can participate in virtual classrooms within the Metaverse and interact with teachers and classmates. This can improve students' focus and engagement, leading to better learning outcomes.
- (2) Simulated experiments: Within the Metaverse, students can engage in various simulated experiments, such as chemistry, physics, and biology. This can help students better understand scientific knowledge and improve learning outcomes and efficiency.
- (3) Virtual museums: Students can visit virtual museums within the Metaverse to learn about culture, art, history, and other subjects. This can help students understand knowledge in a more vivid and interactive way.
- (4) Virtual demonstrations: Teachers can conduct virtual demonstrations, such as lectures, presentations, and teaching, within the Metaverse. This can improve students' focus and engagement, leading to better learning outcomes.

In conclusion, the theoretical foundation of Metaverse involves multiple disciplines, such as computer graphics, human-computer interaction, computer networks, social psychology, and economics. The theories and methods of these disciplines provide a foundation and support for the realization of the Metaverse.

2.4 Critiques and concerns of the Metaverse

The Metaverse refers to the fusion of virtual and real worlds, creating a networked space that contains a large number of virtual characters and objects, using technologies such as virtual reality and augmented reality. In recent years, the development of the Metaverse has received increasing attention, but there

are also some critiques and concerns raised about it. The following are some critiques and concerns of the Metaverse (Golumbia, 2018; Hashemian & Vafadar, 2021; Kietzmann & Hermkens, 2021):

- (1) Social inequality: Accessing the Metaverse may require high costs, and those who can afford to enter may become a small privileged group, which may exacerbate social inequality.
- (2) Mental health issues: For some people, spending long periods of time in a virtual world may have negative effects on their mental health, such as loneliness, depression, and anxiety.
- (3) Personal data and security issues: In the Metaverse, users' data may be monitored and collected, which may affect their privacy and security.
- (4) Lack of creativity and realism: Although the Metaverse can create a virtual world, it may lack creativity and realism compared to the real world.
- (5) Environmental issues: The Metaverse requires a lot of energy and resources, which may have negative impacts on the environment.

Moreover, the Metaverse is a virtual world typically composed of multiple virtual realities, augmented realities, and online games. While the Metaverse provides people with many entertainment and social opportunities, it may also bring some negative effects. The following are possible negative effects (Castronova, 2005; Kuss & Griffiths, 2012; Dibbell, 2006):

- (1) Social isolation: People may spend a lot of time in the Metaverse, ignoring their family and friends in the real world, leading to social isolation.
- (2) Addiction: Like other online games, people may become addicted to activities and tasks in the Metaverse, neglecting their daily responsibilities.
- (3) Mental health issues: Interactions in the Metaverse

may lead to social anxiety, depression, and other mental health issues.

(4) Economic issues: The cost of trading and purchasing virtual assets in the Metaverse may be high, leading to economic problems.

(5) Crime and fraud: Like other online platforms, the Metaverse may also become a target for crime and fraud.

In summary, the Metaverse offers new possibilities while also bringing new impacts. Professionals in various fields need to be aware of these impacts and take early measures to avoid unexpected consequences caused by the rapid development of the Metaverse.

3. Possible research methods for the design discipline in the Metaverse

Research methods in the Metaverse involve various aspects, including virtual reality technology, social science surveys, experimental design, and data analysis. Here are some relevant references for Metaverse research methods:

First, virtual reality technology: Metaverse's virtual reality technology is the foundation for realizing the Metaverse. Relevant research methods include 3D modeling, animation production, lighting technology, etc. (Sherman & Craig, 2018). Second, social science surveys: As a social platform, the Metaverse needs to consider user behavior and psychological characteristics. Relevant research methods include questionnaire surveys, interviews, observations, etc. (Babbie, 2016). Also, experimental design: To evaluate the user experience and effectiveness of the Metaverse, experimental design is needed. Relevant research methods include single-factor experimental design, multi-factor experimental design, etc. (Kirk, 2013). Finally, data analysis: Metaverse research

requires analysis and mining of massive data. Relevant research methods include data preprocessing, data modeling, data visualization, etc. (Han, Pei, Kamber & Tan, 2011).

In addition, focusing on possible research methods for the design discipline, the Metaverse is a comprehensive application of advanced technologies such as virtual reality, blockchain, and artificial intelligence. It involves multiple disciplines, including the design discipline. In Metaverse design, the following research methods are commonly used:

(1) Using virtual reality technology for simulation and testing

Virtual reality technology can provide a highly realistic environment and can be used to simulate Metaverse scenes for testing and optimization (Azuma, 1997). For example, designers can use virtual reality technology to create a Metaverse scene and allow users to enter and experience it to test whether the Metaverse design meets user needs (Väljamäe, 2015).

(2) Using blockchain technology to protect design copyrights

In the Metaverse, design works created by designers may be plagiarized or infringed upon by others. Blockchain technology can provide a decentralized protection mechanism to protect the copyrights of designers. For example, designers can upload their works onto the blockchain to ensure the authenticity and uniqueness of their works (Swan, 2015).

(3) Using artificial intelligence technology for intelligent design

Artificial intelligence technology can achieve intelligent design by learning the design style and thinking of designers, and help designers improve design efficiency and quality. For example, designers can use deep learning technology to train a model to

generate design solutions that meet user needs (Chen, Wang, Wang & Bai, 2018).

In conclusion, the research methods of the Metaverse involve multiple aspects such as virtual reality technology, social science investigation, experimental design, and data analysis. These research methods provide a foundation and support for the realization and evaluation of the Metaverse.

4. The application of Metaverse in design discipline

Metaverse can be seen as a virtual reality technology that goes beyond gaming, as it is not only limited to entertainment and games, but can also be used in education, work, and social aspects. In the future, Metaverse is expected to become a new digital world that can be accessed through various devices, including smartphones, tablets, smart glasses, and head-mounted displays. Metaverse will provide users with realistic virtual experiences, including highly realistic visual, auditory, and tactile experiences, where users will be able to engage in various activities such as shopping, learning, socializing, and entertainment. The study of Metaverse involves multiple disciplines, including design discipline (Schroeder, 2018). Here are some potential applications of Metaverse in the design discipline:

(1) Human-Computer Interaction (HCI) technology for wearable glasses: mainly using VR glasses (Oculus) to enhance the viewer's immersion in data. However, the viewer also loses the ability to operate the keyboard with both hands. Therefore, a new mode of operation is needed to enable viewers to perform data analysis smoothly in the virtual reality world. The commonly used operation method in traditional systems is the Gaze method, which involves establishing a central point in the middle of the screen

and moving the central point's position using the three-dimensional gyroscope. By using the central point, users can select the target they want to operate. However, this operation method cannot meet the viewer's requirements when performing complex manipulations of data such as scaling, rotating, and extracting. To provide users with a better operation experience, Leap Motion sensors can be added. Leap Motion is a sensor that uses infrared and grayscale cameras to capture the user's hand movements in the real world. Its detection range is between 25 millimeters and 600 millimeters above the sensor, as shown in the Leap Motion gesture recognition detection space

(https://www.youtube.com/watch?v=bNIRPpei_N8&t=210s). Without physical controllers, viewers can operate with both hands placed in the Leap Motion-recognizable space, which can be attached to the front of the VR glasses, reducing the accessories required during use and freeing the user's hands, thus complementing the VR glasses. Leap Motion can capture relevant information including both hands, palms, fingers, and handheld tools in every frame. The data generated from each part includes the information shown in the table below. Developers can use these values in combination with VR scripts to assist users in performing manual tasks in virtual worlds such as pushing, pulling, pressing, and manipulating objects, which is more convenient than traditional mouse manipulation methods and enhances the usability of 3D objects (Coelho & Verbeek, 2014).

Furthermore, achieving natural movement in human-computer interaction research in virtual environments is crucial for the immersion of virtual reality. However, VR technology still cannot overcome the limitations of movement in virtual environments, as users do not

have the ability to scan the surrounding environment, restricting their physical activities. Users usually have a first-person view, and their movements are relative to the background, which is moving at a walking or vehicle speed. Another way to handle movement is teleportation, which can be seen as an example of exploring virtual environments. However, pressing a physical button destroys the immersive virtual experience (Alger, 2015). Teleportation is also an example of poorly designed interactive effects in VR, as it destroys users' sense of direction (Bowman & Hodges, 1997; Jerald, 2016), making them lose spatial orientation when they are suddenly thrown into a new environment (Bowman & Hodges, 1997; Jerald, 2016). These issues related to the cognitive and sensory aspects of virtual environment movement are important research topics in human-computer interaction usability.

(2) Application of Metaverse in Product Design: Metaverse can provide a virtual display and interactive environment for product design, helping designers and users communicate and understand products better. Relevant research methods include 3D modeling, animation production, and virtual reality technology. Therefore, Metaverse can provide a virtual environment for designers to create virtual prototypes of products, test and optimize them. This can save time and costs, while better understanding the actual effects and user experience of products. The application of Metaverse in product design also has great prospects. Designers can create virtual product prototypes in the Metaverse, test and optimize them, and collaborate with team members in real-time (Gupta & Agarwal, 2019). In addition, designers can also showcase virtual products to customers and users through Metaverse, achieving more intuitive and vivid

display effects.

(3) Application of Metaverse in Urban Design: Metaverse can provide simulation and visualization tools for urban design, helping planners and policy makers better understand the complexity and impact of cities. Relevant research methods include 3D modeling, spatial analysis, and data visualization. Therefore, Metaverse can provide a virtual building scene, allowing architects to design and evaluate the appearance and interior structure of buildings. This can improve the accuracy and efficiency of design, while better understanding the actual effects and spatial experience of buildings. Metaverse can also provide a virtual city environment, allowing urban planners to simulate various situations of cities, such as pedestrian flow, traffic flow, and green space (Chen & Zhang, 2020). This can help urban planners better understand the current status and future development trends of cities, while designing better urban spaces. Designers can create virtual buildings in Metaverse and conduct real-time roaming and interactive operations through virtual reality technology, achieving more precise and effective design. In addition, designers can also collaborate across borders through Metaverse to complete architectural design projects.

The Application of Metaverse in Fashion Design: Metaverse can provide virtual fitting and display environments for fashion design, helping designers and consumers better understand and experience clothing. Relevant research methods include 3D modeling, animation production, virtual reality technology, etc. (Kim & Lee, 2021). As a virtual space, Metaverse can also play a role in fashion design, providing designers with more creative inspiration and design tools. The following are the applications of

Metaverse in fashion design (Gao & Wu, 2021; Yao & Huang, 2021):

a. Design concept verification: Metaverse can be used to verify design concepts. Designers can design their clothing designs in a virtual space, evaluate their actual effects and user experience, and optimize their design plans.

b. Design tools: Metaverse can provide designers with more abundant design tools, such as virtual drawing boards and virtual fitting rooms. Designers can use virtual reality technology to design and test, improving design efficiency and accuracy.

c. Design display: Metaverse can be used to display design works. Designers can display their design works in a virtual space, allowing more people to appreciate and evaluate them, and thus attracting more potential customers.

d. Design education: Metaverse can be used for design education. Designers can learn and share fashion design knowledge and skills through courses and workshops in a virtual space, improving their design level and professional literacy. In conclusion, the application of Metaverse in fashion design has great potential and prospects, providing designers with more creative inspiration and design tools, while also improving design efficiency and accuracy.

The Application of Metaverse in Interior Design: Metaverse can provide virtual display and interactive environment for interior design, helping designers and users to better communicate and understand design schemes. Related research methods include 3D modeling, animation production, virtual reality technology, etc. (Lee & Kim, 2019). Metaverse also has great potential in the application of interior and landscape design. Designers can create virtual spaces in the Metaverse for interior and landscape design and

conduct real-time roaming and interactive operations through virtual reality technology. In addition, Metaverse can also be used to display and evaluate different design schemes, helping designers make better decisions.

Furthermore, the methodology of Metaverse research is a crucial issue. In the field of design, Metaverse research requires the integration of knowledge from multiple disciplines, thus requiring the application of various methods for research. The following are some possible research methods (Brackin & Liskov, 2019; Davis & Lin, 2019; Festa & Di Benedetto, 2020; Liu & Zhao, 2021; Zadeh & Jafari Navimipour, 2021):

(1) Qualitative research methods: Collect and analyze the experiences and feedback of Metaverse users through in-depth interviews, observation, and literature analysis to understand user behavior, expectations, and needs. This information can be used to improve Metaverse design and user experience.

(2) Experimental methods: Study the effects of different Metaverse designs on user behavior and experience using controlled variables. For example, an experiment can be designed to compare the impact of different Metaverse interface designs on the efficiency and satisfaction of user task completion.

(3) Data analysis method: Using big data technology to collect and analyze user behavior data in the Metaverse, in order to understand the relationship between user behavior and Metaverse design. For example, analyzing the time and resources users spend in the Metaverse can help understand which activities and functions they are most interested in.

(4) Design method: Using design thinking and human-centered methods to study how to design a Metaverse that better meets user needs. For example, conducting user research and creative workshops, designing more

user-friendly and easy-to-use Metaverse interfaces and functions from the user's perspective.

(5) Simulation method: Using virtual reality technology to simulate the usage scenarios and experiences in the Metaverse, in order to understand the impact of different designs on user experience. For example, designing virtual reality scenes to simulate the process of communication and collaboration among users in the Metaverse, in order to understand the impact of different interface and function designs. In summary, these are possible research methods, and of course, there are other methods that can be applied to the Metaverse. The Metaverse has broad application prospects in design disciplines, involving multiple fields such as product design, urban design, fashion design, and interior design. These applications provide designers and users with more intuitive and rich interactive and experiential methods, and provide new ideas and tools for design innovation and sustainable development.

5. Conclusion

The Metaverse, a rapidly developing and exploratory field, holds immense potential for a wide range of applications and development prospects in the future. However, it also faces challenges and issues that necessitate attention and resolution. Researchers have introduced numerous meaningful concepts and applications across various fields, providing extensive possibilities and opportunities for the future growth of the Metaverse.

In the realm of design, the development of the Metaverse will yield numerous impacts and trends, alongside potential concerns and challenges. The following are some conceivable impacts and trends:

1. **Uncharted creative space:** The Metaverse presents designers with the ability to design and create within a virtual realm, unlocking novel possibilities and creative spaces for their work.
2. **Abundance of design tools:** The Metaverse offers a plethora of design tools, including virtual reality technology, 3D modeling tools, animation production tools, and more. These tools enhance design efficiency and precision, infusing design processes with technological advancements and intelligence.
3. **Realistic design experiences:** The Metaverse facilitates richer and more realistic design experiences, such as virtual fitting rooms and virtual exhibition spaces. This allows consumers to intuitively engage with design works, offering a heightened sense of immersion.
4. **New horizons for design education:** The Metaverse can introduce fresh methods and tools for design education, such as virtual courses and virtual workshops. These innovations can enhance interactivity and practicality within design education.

However, the development of the Metaverse in the design field also encounters challenges and potential risks:

1. **Elevated technical threshold:** Metaverse technology necessitates extensive professional knowledge and complex technical capabilities, demanding designers and developers to possess high-level technical expertise.
2. **Intellectual property concerns:** Within the Metaverse, copyright issues pertaining to design

works and materials may encounter new challenges and risks. Hence, the establishment of more rigorous copyright management and protection mechanisms becomes imperative to safeguard the rightful rights and interests of designers and creators.

3. Information security risks: The Metaverse introduces concerns regarding data and information security, such as virtual currency theft and breaches of personal privacy. Consequently, the Metaverse requires the establishment of a secure and dependable system architecture, as well as robust security mechanisms to ensure the appropriate protection of users' information and data.

To summarize, the development of the Metaverse within the design field will bring forth new trends and challenges. Designers and developers must remain vigilant in managing technical and legal risks while actively leveraging Metaverse technology and tools to advance its progress.

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