

Scenario Empowerment—Metaverse Scene Applications and Future Prospects

Xuezhi Zhou*

School of Software, Henan University, Kaifeng475001, China

* Corresponding Author: 2553208430@qq.com

Abstract. From the creation of virtual and augmented reality to the newly introduced wearable devices such as Oculus, Quest, and Hololens, the development of interactive technologies between real and virtual has allowed access to multi-dimensional and immersive experiences for consumers. This paper provides notes on the concept of metaverse, acting as a profound integrator between virtual and physical scenarios for the creation of the new experiences. The paper also analyzes technological foundations associated with extended reality and blockchain, providing understanding about applications to VR gaming, telemedicine, and digital education. Metaverse supports these use cases, and at the same time brings the corresponding disruption for traditional industries to agitate future technological development. The present paper puts forward the ambitious vision for the metaverse in transforming digital interaction and economic frameworks.

Keywords: Metaverse, Scenarios, Applications.

1. Introduction

Technological progress has made the blending of real and virtual worlds possible. What at present is gaining wide popularity actually is the "metaverse." This has gained inspiration from fiction writing, turning into a compelling paradigm for virtual experiences either to replicate reality or to surpass it. Driving the metaverse were technologies for virtual, augmented, and mixed realities, powered by new breakthroughs in artificial intelligence, blockchain, and extended reality. With all these, mainstream adoption is not very far off. Consumer has been exposed to new changed virtual interaction with the trend which definitely blurs the difference between the real world and the digital one with devices from Oculus to Quest and Microsoft Hololens. The breakthrough is of paramount implication not only to the entertainment and gaming industries but also to education healthcare and business sectors.

This paper will attempt to define the metaverse as a new and transformative digital space consisting of both virtual and real-world elements. It will map the landscape of concept and technology on which the metaverse will stitch away toward creating immersive, interactive experiences. More particularly, in this paper, an in-depth try will be made to understand the application of metaverse technology in three such important domains as VR gaming, telemedicine, and digital education-wherein each subsequent system is able to tap into its most innovative possibilities for interaction, creativity, and productivity. By delineating the current status of metaverse technologies and their future impact, the study will cast in relief how near the metaverse might disrupt traditional industries and give birth to new forms of social and economic engagement.

2. Literature Review

The word "Metaverse" comes from the description of science fiction writer Neil Stephenson in *Avalanche* that human beings can live in a virtual three-dimensional space through digital avatars. This virtual space is parallel to the real world and is named Metaverse. With the change of the name of Facebook company Mark Zuckerberg to Meta in 2021, the concept of "Metaverse" was officially ignited. He believes that the Metaverse is an immersive Internet that allows users to be in it - not just the screen, but more devices to achieve immersive experience of the virtual world through linkage [1]. He created his own Oculus VR head display and touch Products such as sleep gloves, with



immersive experience enhanced virtual reality technology and intelligent interactive technology, present consumers with a new 3D virtual world, Bring a personal experience and a brand new feeling. In the future, an "oasis" level numerical universe will be formed, similar to Spielberg's film "Ready Player One". Virtual and real worlds are difficult to distinguish, with a huge user base and duration. A new civilization will be built in the virtual world, which will have a wide-ranging and profound impact on the human world. Therefore, 2021 is also regarded as the "Year of the Metaverse".

At present, there is no unified definition and ultimate form description of the term "meta universe", but the meta universe has a clear scientific and technological attribute, and related research is more from the perspective of technology and industry. Shenyang believes that the meta universe is based on extended reality, digital twins and blockchain technology, integrating the virtual and real world in the economic, social and identity systems, and allowing users to produce content on the Internet applications and social forms [2]. Chen Gang and Dong Haoyu define the meta universe as a virtual world that uses technology to map and interact with the real world. At the same time, the digital space has a new social operation system [3]. The New Media Research Center of Tsinghua University in China points out that the metaverse is not just a virtual world, but a virtual world multiplied by the real world [4]. Domestic scholars Pu Qingping, Xiang Xiang, and others believe that the "metaverse" will profoundly influence and change human society [5]. In summary, the metaverse is an integration of many cutting-edge technologies in the 21st century. Using 5G communication technology, AI chips, IDC data centers as the basis, and building a Web3.0 platform, it can establish multiple applications such as virtual space scenes, interactive social networking, virtual digital humans, and games [6].

3. Scene characteristics and technological foundations of the metaverse

3.1. Scene characteristics of the metaverse

3.1.1. Immersive experience of virtual and real fusion

By wearing hardware interactive devices such as AR and VR, consumers can immerse themselves in a set virtual world scene space. The intersection and fusion of the real world and the virtual world make it difficult to distinguish between true and false. These scenes can concretize abstract things, visualize them, and immerse consumers in them. At the same time, they can complete various complex tasks in a way guided by their brain consciousness. This kind of scene can immerse consumers in it, obtain an infinite sense of closeness to reality, have a deeper understanding and a new sense of experience. In addition, through virtual technology, interaction between the real world and the virtual world, as well as interaction and communication between consumers, can be achieved, solving sensory experiences that are difficult to reach in the real world.

3.1.2. Rich, colorful and diverse

The metaverse can construct different virtual fusion spaces, in which both the virtual world of digital twins designed by manufacturers and the world created by consumers can be displayed. There are different virtual characters, assistants, NPCs in this virtual world, involving virtual natural environments, various items, and the entire virtual social system. In the world of the metaverse, there are infinite possibilities for creation, and its system content is diverse and colorful.

3.1.3. Connecting creates interactivity

With the development of artificial intelligence, 5G technology and the metauniverse, the integration of scenarios has deepened the connection in breadth and depth in various fields. Consumers carry out unlimited creation in the virtual world of the metauniverse, and interact and communicate through Internet technology links. In other words, through multi terminal and multi form integration, users can interact and connect in a multi-dimensional manner to maximize the use of scene ecology, break the traditional world boundary barriers, and eliminate the sense of boundary and presence. The metauniverse is a projection attribute with the form of real world civilization, and consumers can experience different tastes of life and career in the metauniverse. It blurs the boundary between

virtuality and reality. In the virtual world, the metaverse can be unrestricted by objective reality, and manufacturers can design new consumer content, scenario construction, and research paradigms for consumers to fully experience.

3.2. Fundamentals of Metaverse Technology

3.2.1. Computing power (Network) - the driving force behind the metaverse

Computing power is not a new concept, but it has been widely mentioned and applied in the past two to three years. To interpret the computing power of the metaverse, all things in the metaverse world, including operating rules, should be presented in code form, ultimately manifested as the comprehensive ability to process all data generated by the metaverse and smoothly analyze all data, which is called computing power. It is difficult to calculate exactly how much computing power is needed for the metaverse, including the complete presentation of the virtual world and the rendering of scenes, as well as the interaction between virtual characters. However, the world created by the metaverse will heavily rely on computing power architecture, and the size of computing power determines the most intuitive feelings such as the size and experience speed of the metaverse world,. At present, the iterative upgrading of network and computing technology has ensured the transmission and computing power of information, and 5G and even future 6G communication technology and computing chips have greatly improved, laying a solid foundation for application and innovation. When data becomes the means of production in the digital age, computing power will also be an energy source. Like water, electricity, and fuel in our daily lives, computing power will become an indispensable resource.

3.2.2. Basic technical foundation

The infrastructure of metaverse technology includes two aspects: underlying architecture and backend infrastructure. Specifically, it includes the underlying architecture of IDC data centers, blockchain technology, NFT or artificial intelligence technology, backend infrastructure such as 5G networks, GPUs, cloud computing and other network devices, interactive technology, visualization and digital twin technology platforms. Infrastructure is the pillar that supports the development and prosperity of the virtual world, and the bridge that connects the real world and the virtual world. On this technology platform, manufacturers and consumers can create in the metaverse virtual world, which can infinitely expand the layout of virtual space scenes, write and design richer content, interact and collide with more sparks of ideas, presenting colorful scenes for the metaverse world.

At present, NFT is essentially a trusted digital equity certificate with unique characteristics in the blockchain network, which is a data object that can record and process multidimensional and complex attributes on the blockchain. It can provide technical support for the generation, ownership confirmation, pricing, circulation, and traceability of digital assets in the metaverse. Every consumer's digital assets held in the metaverse in the future will be recorded by NFTs, and with the help of metaverse and blockchain technology, related NFT platforms are developing rapidly. For example, OpenSea is a metaverse trading platform for virtual art and collectibles, where users can conduct virtual transactions by purchasing Ethereum. In addition, Decentraland is currently a rapidly developing virtual world based on cryptocurrency, where users can purchase virtual land that appears to be real estate, but its core essence is data, which cannot be separated from storage. In addition, NFTs are of great significance in the virtual world, as they apply blockchain technology to basically eliminate the problem of virtual items being easily copied and pirated. At present, NFT applications are mainly focused on the field of art sales. Due to decentralization, virtual items on NFT trading platforms do not need to be authenticated by centralized authorities.

3.2.3. Front end device platform

Metaverse technology is a collection of cutting-edge technologies, with front-end device platforms including computer hardware, intelligent wearable devices (VR, XR), brain interface devices, tactile devices, voice-controlled devices, etc; The current hot topic is the competition between VR (virtual

reality) and AR (augmented reality), using VR as a completely virtualized space to deeply immerse users. The benchmark enterprise is Oculus Quest, a subsidiary of Facebook in the United States, while AR provides auxiliary virtual objects in real environments, essentially extending the real world within the user's field of view, represented by Microsoft's HoloLens headset. Brain computer interface (BCI) is expected to become the next generation of human-computer interaction, establishing direct communication and control channels between the human brain and computers, with Musk's Neuralink team as a typical representative. The metaverse uses many emerging front-end technologies and hardware support to build VS (virtual scene) and IS (fusion). The application scenario of the scenario aims to ultimately achieve a consumer experience.

Overall, the development trend of artificial intelligence is irreversible. The blockchain, DeFi, and NFT tracks are rapidly emerging and replacing each other, connecting the real world and building virtual worlds. As NFTs become increasingly popular as important virtual assets, VR offers a new experience, and display technology is evolving from 3D to fully realistic.

4. Metaverse application scenarios: present and future

4.1. VR games are pioneers of the metaverse wave

The metaverse game fully embodies three "I" characteristics: Immersion, Interaction, and Imagination, possessing immersive viewing, interactive experience, and novel imagination. Together, they design and create "game scenes" that make the world of the metaverse conform to reality, even making it impossible to distinguish between virtual and real.

In the first VR blockbuster "Help" produced by Google and others in 2016, consumers can immerse themselves in sensory experiences such as explosions, monster invasions, and gunfights that can only be obtained in games when wearing VR glasses. The HTC Vive headset, jointly developed by HTC Electronics and Valve during the same period, is a leading VR virtual reality gaming device brand in the industry. It combines passion, talent, and innovation, and achieves the promise of virtual reality through high-tech technology and content. Specifically, players can experience the thrill of the game by clicking, touching, attacking, or even fully immersing themselves; Secondly, more and more games emphasize the texture effect of "movie game interaction", which is no longer a simple animated 3D game, but more about building a virtual reality world under a grand narrative, such as the action game "Red Dead Redemption" with the theme of American Western Cowboys, which has audio-visual effects such as movie effects (shown in Figure 1). In this game scene, consumers can virtually embody their personalities and interact in a task mode to directly obtain various information during the game process. Through the task mode set in the game, real-time physical feedback from consumers is obtained, and different scene effects are directly generated. Firstly, by creating a highly realistic virtual gaming world, it can stimulate consumers' sense of presence and excitement, enabling them to generate proactive cognition during the gaming process, creating a completely different boundary sense from current videos. Secondly, metaverse gamification can create real interactive situations, allowing consumers to create diverse virtual human character incarnations to create personalized characters, providing various aspects of scene design, and having infinite possibilities for exploratory experience. There are four characteristics of gamified scenes: first, they are highly entertaining, with colorful scenes that enhance consumer interest, enhance on-site experience, and create a sense of urgency, making consumer feelings more lasting and strengthened; The second is diversified interaction. Consumers in the metaverse gamified scene can freely create personalized characters, randomly select interaction objects, and interact with a certain number of times. Through the diversified design of game tasks, consumers can follow the contextual elements in the game to complete the game process, collaborate with other consumers to set game content, and seek the help of AI assistants. The interactive experience is tailored to reality; The third is to demonstrate personalized creative ability. Metaverse gamified learning has more game autonomy. Consumers can choose different game characters with different characteristics, create their own characters, and set different difficulty game characters in different styles of game scenes, as well as self selected or

randomly generated game storylines. They can use game characters to personalize and creatively complete designated game tasks. According to personal preferences, they can either stay in a certain game stage repeatedly, or quickly browse the entire game content. Moreover, by adding various elements to guide or interfere, consumers can have different scenes and random events in each game, greatly increasing their sense of presence and urgency. During the game process, consumers can adjust their physical senses such as hands and feet, provide feedback through voice, action, and gesture, respond to the game, and achieve their goals. " Experience the virtual world and gain a sense of realism and excitement in the gamified learning scenarios supported by the metaverse.



Figure 1. Screenshot of VR Red Dead Redemption

4.2. Mixed reality technology and telemedicine are pioneers in the application scenarios of the metaverse

In the United States, Case Western Reserve University and Cleveland Clinic have jointly developed a metaverse based solution, the HoloAnatomy solution. Firstly, the metaverse application scenarios can be visualized using virtual reality technology. Doctors can use HoloLens2 equipment to present a holographic projection of a patient's organ before, during, and after surgery, and real-time detect and analyze various indicators and data of the patient's body to effectively respond to risks; The second is the virtualization of metaverse application scenarios. In reality, when performing some difficult and dangerous surgeries, traditional doctors rely on magnetic resonance imaging results to confirm the patient's condition, which basically relies on the doctor's rich surgical experience and on-site performance. Combined with current metaverse technology, small protrusions, fluid accumulation and other elements can be observed in 3D. Under the conditions of metaverse technology, doctors can conduct repeated simulation experiments in the virtual environment and provide targeted guidance and training. Performing virtual surgery first, followed by real surgery after the virtual surgery is completed, not only greatly reduces the risks associated with the surgery, but also significantly saves costs such as equipment and specimens during training, greatly improving the surgical outcome. The third is the conditioning of metaverse application scenarios, simulating the surgical process, and evaluating and testing surgical strategies before surgery, providing targeted guidance for ongoing surgeries. Through the metaverse telemedicine scenario, under the remote guidance of clinical experts, grassroots clinical doctors can also perform complex surgeries. In a fully virtual simulated operating room, and the metaverse is very suitable for training high-risk emergencies, traditional simulations usually use human models or corpses for training, which cannot feel the same situation as reality and lacks immersion. Its limitations are significant. In the virtual world, doctors will face great pressure, not only to cooperate closely, but also to constantly respond to various emergency situations set by patients, race against time, and make decisions. In this low-cost and multiple training, doctors can become skilled in technology, calmly respond to emergencies, and conduct scientific medical decision-making and behavioral experiments and evaluations in various indicators of metaverse medical training. This provides the possibility for further digital and intelligent transformation of the medical system (see in Figure 2).



Figure 2. VR Medical and VR Virtual Medical Laboratory

4.3. Digital transformation education is a practitioner of metaverse scenario applications

The application scenarios of metaverse have formed a new stage and level of educational informatization. Firstly, it breaks through the original teacher student face-to-face education model and reflects the direction of digital transformation in education. In education, it can introduce gamified learning, design learning modes, personalized displays, digital equipment, and other content to design new educational content, scenario construction, and research paradigms. Ensure the comprehensive integration of teaching scenarios and teaching content. Realize the characteristics of comprehensive and seamless connection between schools and society. Metaverse education breaks through the traditional educational barriers and has great value implications. Surprenant proposed the idea of designing an artificial environment in the library, allowing users to interact with the artificial environment and integrate with virtual scenes [7]. Metaverse technology can also provide digital transformation in library construction, changing traditional book retrieval and consultation, and offering new experiences such as immersive reading scenarios and multi person interactive community spaces. By building interactive community scenes in libraries. Students can transform into virtual characters of different roles, communicate and discuss with each other, share their reading experiences and insights. In terms of personalized learning support, different forms of community gatherings can be held in this community scene, such as virtual concerts, school graduation ceremonies, etc (shown in Figure 3).



Figure 3. Library, Virtual Concert

The "metaverse" is roaring towards us, and the academic library community, as one of the earliest fields to pay attention to the development of the metaverse and keep up with its latest frontiers, has conducted rich theoretical research and practical exploration. The metaverse technology has built an immersive library construction platform, and many university libraries in the United States have set

up VR studios or maker spaces. For example, the Clemson University Library uses geographic information system services to explore every corner of the school in a fully three-dimensional virtual space; Li Yansong, President of Shanghai International Studies University, proposed that smart libraries are an important cornerstone for the high-quality development of universities in the new era. In smart libraries supported by metaverse related technologies, learning is flexible and personalized. In a cross connected learning environment, teachers and students can communicate and interact throughout time and space., It is an effective supplement to traditional libraries, enhancing the user experience and strengthening the influence of libraries.

5. Conclusion: Future Prospects

In short, the "Metaverse" integrates various cutting-edge technologies and can be used in many industries for corresponding application scenario design. Through 3D visualization and diverse interactive experience technologies, it replicates real scenes, enhances reality scenes, and helps enterprises upgrade and innovate industries. With the continuous innovation and breakthroughs of 6G technology, artificial intelligence, and interactive technology, the Metaverse will soon enter the popularization stage and become an indispensable part of people's daily work and life. While allowing more people to fully enjoy the benefits brought by high technology, it ultimately promotes deeper economic development.

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