

# Metaverse, HCI, and Its Future

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## ABSTRACT

With the development of the times, scientists have been looking for a balance between the virtual world and the real world. This means that many things in the real world will also be reflected in the virtual world. In this virtual world, people can interact and socialize with others and can do a series of operations such as shopping and consumption. Metaverse is a large online computing platform composed of large-scale individual users and their devices and different platforms. The achievement of this goal depends to a large extent on the application of human-computer interaction (HCI) in the development of the Metaverse, that is, how to feed the user's actions into the virtual world. HCI is a process of information exchange between a human and a computer in a certain way to accomplish certain tasks. Moreover, since many technology companies such as Microsoft and Facebook have started to develop Metaverse, a living space with a new social system, its existence has brought some questions and controversies, therefore its future is not smooth. This paper briefly discusses the basic principles of Metaverse and HCI, analyzes the application of these two concepts in video games, and analyzes the possible future development direction of Metaverse and its problem. This paper will refer to several articles and reports in recent years and conclude that although the metaverse is an emerging industry with good growth prospects, there are still many critical issues.

**Keywords:** *Metaverse, HCI, VR, AR, MR, Online Community*

## 1. INTRODUCTION

Since the concept of the Metaverse was introduced in the science fiction novel *Snow Crash* in 1992[1], the computer community has been increasingly interested in this concept. In the novel, Metaverse consists of two words Meta and Verse, Meta means "beyond" and Verse means "universe"[2], which together mean the concept of "beyond the universe": it is an artificial space parallel to the real world, the next stage of the Internet, a networked world supported by AR, VR, 3D, etc. It is the next stage of the Internet, a virtual reality network world supported by AR, VR, 3D, and other technologies. All the operations people do in the real world can be fed back accordingly. Based on these basic concepts, Metaverse can be applied to different fields, like education, games, business, etc.

Games, communities, and relative supporting services related to games currently have a huge development prospect. Although hundreds of millions of players worldwide and many game communities of various types exist, overall, players do not use a more complete Metaverse community, and most communities

only have some qualities of Metaverse. Currently, major technology companies and corporations are developing their Metaverse gaming communities and applications, and each of these different Metaverses has its characteristics to attract users. For HCI, the level of development and use of this project varies from company to company, but this difference may directly lead to a significant difference in the number of users and players, or even to the mainstreaming of a particular game Metaverse. This paper will introduce the basic principles of the Metaverse, analyze how HCI works with the operation of the Metaverse, and make a brief prediction about the future of the Metaverse. The meaning of the research of this paper is to help the reader understand the Metaverse and the applications and issues surrounding it.

## 2. CONNECTION BETWEEN METAVERSE AND HCI

### 2.1. Metaverse Basic Principles

The basic principle of the Metaverse is mainly to blur the boundaries between the virtual world and the real world, making it possible for users to accomplish everything in the real world through technological

devices in virtual space. It is based on human-computer interaction and then developed into an online network of virtual worlds. The characteristics of Metaverse allow it to be used in massively multiplayer online scenarios, such as multiplayer games, multiplayer video chat, distance learning, remote work, etc.

2.2. HCI in Metaverse

Metaverse is a concept and technology that is a synthesis of many of today's interactive technologies. It requires HCI-related technology support, as it entails passing human actions to the computer and feeding them back into the virtual world. One of the more critical is Extended Reality (XR), which encompasses Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) technologies for interacting with wearable devices. Based on XR, real-time user actions are fed back to the host computer and generated on the web platform through a network connection, so that many users can perform real-time actions on the platform and interact with other users to form a network community. Based on this condition, VR and AR technologies and devices are

particularly important.

First is VR, which is a technology that creates a completely computer-generated environment that gives the user the feeling of being fully immersed in a virtual environment. It provides a way to replace the perception of the world around you with an artificial computer-generated 3D environment. This virtual experience is usually provided through a head-mounted display (HMD). [3] VR technology allows the user to enter the virtual world visually and auditorily, allowing the user to see and hear everything in the virtual world. For example, there are many different VR headsets on the market today, and these are used in different ways, with entertainment and gaming applications in particular. Users can use the headset to watch movies, and videos or play VR games. Figure 5 shows 4 features of Virtual Reality and 360-degree Panoramic Video.[4] VR videos are based on 360-degree panoramas, aggregating multiple panoramas to form a live view. the core features of VR videos are interactivity and immersion from an active perspective of creation. VR currently involves mainly 360-degree panoramic experiences and simple interaction.









	Virtual Reality	360-degree Panoramic Video
•Image	 <ul style="list-style-type: none"> <li>•A 360-degree panoramic image which is integrated by multiple panoramic images is provided. Interactive elements are included.</li> </ul>	 <ul style="list-style-type: none"> <li>•Actual view images are provided. These images are only for appreciation, not interaction.</li> </ul>
•Experience method	 <ul style="list-style-type: none"> <li>•A pair of VR glasses is required for immersive experience.</li> </ul>	 <ul style="list-style-type: none"> <li>•Players that can display 360-degree videos are required, such as YouTube clients on PCs or mobile phones.</li> </ul>
•Flexibility	 <ul style="list-style-type: none"> <li>•Immersive experience is provided. Users can walk around and actively create visual angles.</li> <li>For example, you can walk around or choose to go upstairs or choose which room to enter into as you like.</li> </ul>	 <ul style="list-style-type: none"> <li>•A 360-degree visual angle can only be obtained by moving the director's camera.</li> <li>For example, when you shoot a scene for entering into a house, you can only follow the camera to enter the rooms in sequence, but you cannot choose which room to enter into.</li> </ul>
•Timeline	 <ul style="list-style-type: none"> <li>•The timeline is flexible. It can be extended based on the visual angle which is independently explored by users.</li> </ul>	 <ul style="list-style-type: none"> <li>•A movie can be displayed according to the timeline for the movement of director's camera.</li> </ul>

Figure 1 Features of VR [4]

In contrast to VR, AR is more about interacting with the real world, focusing more on the haptic sensation of the user, and is a technology that can superimpose digital information on the real environment - in real-time and in the right spatial location - to enhance or augment the real environment. [5] In other words, AR enables digital objects and/or information to be viewed through a head-mounted display or a handheld device with a camera, such as a smartphone or a tablet. AR can reflect the user's actions in the real world into the virtual world through different applications, and wearable devices can assist in doing this. In addition, some of the technologies of AR

can also be implemented on VR devices.

MR is a more complex concept that is more like a collection of VR and AR, with the nature of both VR and AR. It allows users to see and immerse themselves in the virtual world and interact with it through their senses, whether it's basic vision and hearing, or more advanced voice recognition and motion analysis, all reflected in the virtual world. If there are relevant devices such as computers, cell phones, and wearable devices, such as VR eyes and motion recognition devices, the user can enter the virtual world. [6]

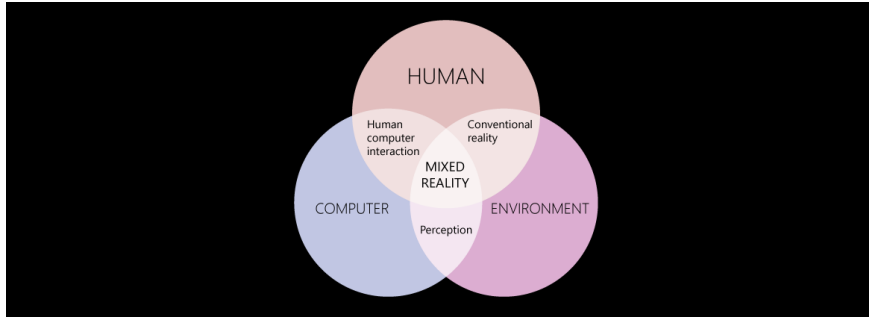


Figure 2 The interactions between computers, humans, and environments. [6]

Extended reality is a superset of VR, AR, and MR, and includes the nature of these virtual technologies. XR is not only about user sensory input, but also about using motion sensors to interact with the virtual world. These devices can track the user's actions and reflect these actions into the virtual world.

### 3. GAME, HCI, AND METAVERSE

#### 3.1. Immersive Gaming Experience

Metaverse, where there is a very important stage, is the immersive gaming experience. The so-called immersive gaming experience is the use of wearable devices through the game. With generally bring VR glasses and headphones, use the handle or wrist device to play. And many game manufacturers have developed a large number of VR games in recent years, some are original development, and some games are from the original PC platform through the implementation of interactive design ported to the VR platform. Resident Evil 7 VR version, for example, the game is Capcom based on Resident Evil 7 ported to the VR platform. [7] Players enhance the sense of fear, tension, and excitement when playing the game through VR devices. Compared

with the traditional keyboard and mouse, the VR version will enhance the player's interaction with the game scenes and non-player characters (NPCs), as the player needs to use the game motion grip to operate and interact. And the in-game perspective will be very different from the screen's perspective. When using VR equipment, the player's perspective will be closer to the real perspective in the real world, so the outside interference will be significantly reduced, the player's attention will be more focused on the game scene, and the player's sense of presence will be enhanced.

#### 3.2. Online Community

Metaverse also plays a pivotal role in the creation of large gaming communities. Components of Metaverse have already been developed in some online games. In 2003 the virtual world game 'Second Life' was developed, which in a sense is considered to be the first Metaverse-like game. Players can design their 3D appearance in the game, and then they can enter the game and play it. In the game, players can interact with other players through social interaction, like talking, trading and other social activities can be realized in the game.



Figure 3 Second Life [8]

However, since it is an early meta-universe game, the interaction design on HCI is not very perfect. Players cannot immersive game experience, and cannot use VR/AR devices to operate. So, with time, players may perhaps choose other new types of 3D virtual world games. In recent years, other excellent games like Second Life have emerged, such as VRChat, which plays similarly to Second Life, both of which can customize the player's virtual image, but with more options, even choosing their favorite game or movie characters. Also

due to the use of VR equipment, the game supports the synchronization of facial expressions and body movements, the player's movements and expressions can be scanned into the game and get corresponding feedback on the 3D character. VRChat allows players to use the keyboard or microphone and other players to interact and communicate. In addition, players can create rooms to interact or play with specific players. Game options are also very rich, such as horror games, truth or dare, and even bank robbery. In short, Metaverse is a platform that

is capable of building a large gaming community and can theoretically withstand millions of simultaneous users and social and gaming activities as long as conditions allow.

#### 4. METAVERSE AND ITS FUTURE

##### 4.1. Possible Future

As a relatively new topic, Metaverse has been hot for several years, and technology companies around the world have devoted some or even all of their resources to the development of Metaverse. Microsoft and other major companies have invested hundreds of millions of dollars in Metaverse development projects, and Facebook has directly announced that it has changed its name to Meta in the term Metaverse to develop Metaverse and related technologies. This shows that there is a growing feeling that the concept of Metaverse, a virtual world, will be the core of future development and can also bring huge benefits. Like the previously mentioned games, social networking, Metaverse can also be used in education, business, medical, and many other fields. Virtual classrooms, virtual offices, and virtual business centers are all possible in the future with the development of Metaverse-related technologies. Although it seems that

the concept of the Metaverse is still very far from the public, based on the above, it is foreseeable that Metaverse is likely to be popular, convenient, networked, and light in terms of required accessories in the future.

##### 4.2. Problems of Metaverse

Although the topic of Metaverse is very hot, there are controversial issues about it. The first is the most critical issue of privacy. Because there may be a large number of users in Metaverse, a large amount of user data will be generated, and the security of this data is a big issue. Because the development company may be able to wear augmented virtual reality devices and user biometric data to collect personal information data for other uses. For example, before Facebook changed its name, it was revealed that Facebook used users' personal information to send targeted advertisements. At the time, it triggered a lot of fear among users about the security of their personal identity information. It was pointed out that the volume of data collected on Metaverse was unmatched by the volume collected on the Internet before. Figure 4 shows the number of leaked or lost personal information from 2012 to 2021.[9] Based on the chart, it is clear that the amount of information leakage is extremely large, and the amount still increases each year.



Created by Nippon.com based on data from Tokyo Shōkō Research. nippon.com

Figure 4 The number of Information leaked in Japan. [9]

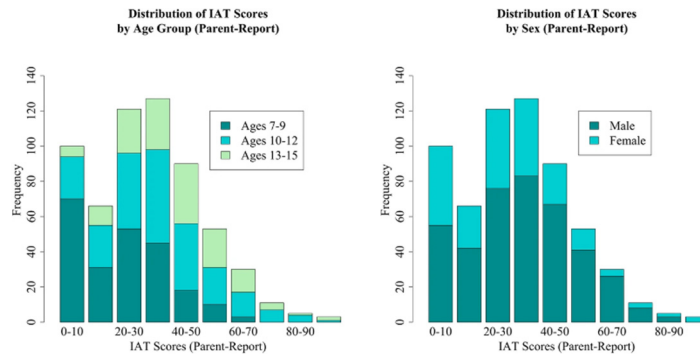


Figure 5 Distribution of IAT Scores (Parent-Report) and Parent-reported IAT score distributions broken down by participant age group and sex. [10]

The next problem is the addiction to using Metaverse. Because Metaverse is a social media presence, it will have the same problem as other social media, which is addiction. This addiction can have both physical and psychological effects on a person. On the physical side, sedentary use may lead to obesity and a range of cardiovascular diseases, while on the psychological side, long-term use may lead to symptoms such as depression and anxiety. Figure 5 illustrates the distributions of the Internet Addiction Test (IAT) scores broken down by age group and sex. Based on the chart, it shows that, the frequency of IAT scores was highest in the 20-30 and 40-50 intervals, and in terms of gender, the frequency of Problematic Internet Use (PIU) was higher for men than for women. [10] Most importantly Metaverse is likely to be used as a way to escape from the real world.

## 5. CONCLUSION

In a nutshell, this paper briefly describes some basic principles of the Metaverse and how human-computer interaction works in the Metaverse project. Metaverse is a new industry chain, and its development and exploration will continue, including the controversy over Metaverse. To date, most Metaverse-related projects around the world are games, which shows that the development of Metaverse may take another decade or even two and will require much larger software and hardware development. Metaverse would have a better future if the world solves the problems that exist at this stage and allows each component to run and interact smoothly.

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