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Discussion on the transformation of human-computer interaction in virtual reality and mixed reality

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Abstract: *This paper discusses the transformation of human-computer interaction in virtual reality and mixed reality, including the upgrade of interaction mode, the enhancement of perceptual experience and the progress of information interaction. This paper also analyzes the application of these technologies in education and training, games and entertainment, industrial design and other fields, and puts forward the challenges and future development trends.*

Keywords: *Virtual reality; Mixed reality; Man-machine interaction; Perceptual experience; Information interaction*

1. Introduction

In the tide of the information age, human-computer interaction technology is constantly innovating, and virtual reality and mixed reality are its latest manifestations. Both of them provide users with a brand-new and immersive interactive experience, which makes the human-computer interaction change from the traditional interface operation mode to a more natural and intuitive way. This change not only changes the way we interact with technology, but also deeply affects our cognition and perception of the world. This paper will deeply discuss the internal motivation, technical basis and the possibility of future development of this change, in order to provide useful reference for us to understand and apply the latest technology of human-computer interaction.

2. The transformation of human-computer interaction in virtual reality and mixed reality

2.1 The transformation of human-computer interaction mode

In the environment of virtual reality (VR) and mixed reality (MR), the way of human-computer interaction is undergoing profound changes. The traditional user interface is being replaced by more intuitive and immersive interaction, which provides users with an unprecedented experience. First of all, we need to understand the core concepts of virtual reality and mixed reality. Virtual reality creates a completely computer-generated environment in which users can devote themselves wholeheartedly. Mixed reality is more advanced. It combines computer-generated information with the real environment to form a semi-virtual and semi-realistic world. Both technologies emphasize the importance of immersive experience, thus changing the way of human-computer interaction. Traditional user interfaces are usually based on screens and two-dimensional graphics, such as mouse and keyboard operations. But in VR and MR, the user interface has jumped from two-dimensional to three-dimensional. Through the headset, users can move freely in three-dimensional space and interact with objects in virtual or mixed reality[1]. This kind of interaction is not only more intuitive, but also provides a more real experience. In addition, the progress of tactile feedback technology has also brought revolutionary changes to human-computer interaction. In the past, users could only interact with machines through vision and hearing, but now, touch has also been included in the category of human-computer interaction. For example, in VR games, players can feel the texture and shape of objects through vibration feedback, which greatly enhances the immersion of the game. Generally speaking, virtual reality and mixed reality are promoting the transformation of human-computer interaction from traditional two-dimensional interface to three-dimensional space. This transformation has brought more rich and real experiences to users, and also provided unlimited creative space for designers and developers[2].

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2.2 Enhancement of perceptual experience

In the human-computer interaction between virtual reality and mixed reality, the enhancement of perceptual experience is one of the core elements of transformation. With the continuous development of technology, users' perceptual experience in human-computer interaction is undergoing unprecedented changes. First of all, virtual reality technology enables users to immerse themselves in it and experience an unprecedented sense of reality by creating a three-dimensional virtual environment[3]. This sense of reality not only comes from visual simulation, but also involves the integration of hearing, touch and even smell. For example, through vibration feedback and tactile technology, users can feel the weight and texture of objects in the virtual environment, further enhancing the authenticity of perception. In addition, the mixed reality technology combines the virtual world with the real world, providing users with a richer and more diverse perceptual experience. By integrating virtual elements into the real scene, mixed reality breaks the boundaries of traditional human-computer interaction, enabling users to interact naturally with virtual objects, thus obtaining a more intuitive and immersive perceptual experience. In a word, the enhancement of the perceptual experience of human-computer interaction in virtual reality and mixed reality not only enhances the immersion of users, but also opens up new possibilities and potentials for the development of human-computer interaction. With the continuous innovation and improvement of technology, we have reason to believe that the future human-computer interaction will be more natural, intuitive and perceptive[4].

2.3 Upgrade of information interaction

Under the background of virtual reality (VR) and mixed reality (MR), the information interaction level of human-computer interaction is undergoing a profound upgrade. Traditional ways of information interaction, such as text, image and sound, are merging with new ways of interaction to create a richer and more immersive user experience. First of all, we need to understand the core concepts of virtual reality and mixed reality. Virtual reality is a three-dimensional environment completely generated by computer, and users can interact with it through special equipment. Mixed reality goes a step further, combining the elements of the real world and the virtual world, providing users with an interactive experience beyond the traditional screen[5]. In this context, the upgrading of information interaction is mainly reflected in the diversification of perception methods. Traditional text and image interaction can no longer meet the needs of users, and sensory information such as touch, smell and even taste has become a new interaction point. Through advanced sensor technology and physiological signal processing, the current technology has been able to adjust the perceptual feedback of the virtual environment through the user's physiological response. In addition, the upgrading of information interaction is also reflected in the deepening of cognitive level. Through advanced machine learning and artificial intelligence technology, the current system can recommend and adjust personalized content according to users' habits and preferences, so that users can feel more personalized service while obtaining information.

3. The concrete application of human-computer interaction in virtual reality and mixed reality

3.1 Application in the field of education and training

The specific application of human-computer interaction in virtual reality and mixed reality The field of education and training is one of the early users of virtual reality and mixed reality technology. This new mode of human-computer interaction has brought unprecedented changes to education. In traditional education and training, limited by physical space and resources, many practical training contents are difficult to realize[6]. Virtual reality and mixed reality technology break this limitation and make the learning experience more immersive and interactive. First of all, virtual reality technology creates a real and immersive learning environment for students. Through the head-mounted equipment, students can be exposed to various virtual scenes, such as simulated ancient markets and outer space planets. This not only enhances students' interest in learning, but also makes abstract knowledge points vivid and easy to understand. Especially in some practical disciplines, such as medicine and engineering, virtual reality technology can simulate the extreme environment that is difficult to achieve in practical operation, so that students can train in a safe environment. The mixed reality technology further expands the possibility of education and training. Mixed reality combines virtual content with real environment, and students can interact with virtual objects in the real world. For example, in architecture education, students can put virtual design models in real space through mixed reality

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technology for intuitive evaluation and modification. This teaching method is intuitive and efficient, which greatly improves the quality and effect of education and training. To sum up, virtual reality and mixed reality technology have brought revolutionary changes to the field of education and training. They not only enrich teaching methods, make learning more interesting and efficient, but also reduce teaching costs and provide quality education opportunities for more people. With the further development of technology, we expect it to play a greater potential in the field of education and cultivate more outstanding talents for the society.

3.2 Application in the field of game entertainment

The field of game entertainment is one of the important scenes in the application of virtual reality and mixed reality technology. With the support of these emerging technologies, the game and entertainment industry is undergoing unprecedented changes. In traditional game entertainment, human-computer interaction mainly depends on input devices such as gamepad, keyboard and mouse. Players need to interact with the game by operating these devices, so as to complete the game tasks, control the movement of characters or issue attack instructions. However, the emergence of virtual reality and mixed reality technology has completely changed this situation. In virtual reality games, players can track head and hand movements through sensors in head-mounted devices, and interact with the game in a more natural way. For example, players can shake their heads, nod their heads or gesture to control the direction, actions or give instructions of the characters, so as to gain a more immersive game experience. In addition, virtual reality technology can also make players feel more realistic game scenes and effects by simulating the environment, sound effects and touch. The mixed reality technology further expands the application scope of the game entertainment field. By combining the virtual elements with the real environment, the mixed-reality game allows players to interact with virtual objects in the real world, thus creating a richer and more diverse game experience. For example, players can interact with virtual characters in their living room, explore the virtual world together, or overlay virtual decorations or effects on their bodies by wearing augmented reality glasses. In a word, virtual reality and mixed reality technology are profoundly changing the way of human-computer interaction in the field of game entertainment. With the continuous progress of technology and the continuous expansion of application scope, we have reason to believe that the future game entertainment will become more abundant, diverse and immersive.

3.3 Application in the field of industrial design

In the field of industrial design, virtual reality (VR) and mixed reality (MR) technologies are changing the traditional product design process. Designers are no longer limited to the production of physical models, but use advanced software and equipment to conceive, design and optimize products in a virtual environment. With the help of VR technology, designers can enter an immersive three-dimensional space and view the appearance and performance of products in different environments in real time. This interactive experience enables designers to evaluate the design scheme more intuitively and find and correct the defects in the design in time. At the same time, VR technology can also simulate the use situation of products and provide designers with feedback when real users use products. Mixed reality further expands the application scenarios of industrial design. Through MR technology, designers can combine the virtual model with the real environment to realize the interaction between reality and virtuality. For example, designers can superimpose virtual design elements on the actual product prototype and preview the modified effect in real time. This real-time and interactive design method greatly improves the design efficiency and shortens the time period from concept to actual launch of the product. In the field of industrial design, the transformation of human-computer interaction is not only reflected in the progress of technology, but also lies in the reshaping of design thinking and process. Virtual reality and mixed reality technology provide designers with broader creative space and more efficient working methods, which makes industrial design enter a brand-new era.

4. Challenges and future prospects

4.1 Technical Bottlenecks and Solutions

In virtual reality and mixed reality, the transformation of human-computer interaction faces a series of technical bottlenecks. First of all, the limitation of perception technology hinders the naturalness of

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human-computer interaction. Although the existing sensor technology has made some progress, there is still a big gap to realize the interactive experience of seamless docking with human perception. In addition, the limitation of computing power is also a big challenge. With the increasing complexity of virtual environment, the demand for computing resources is getting higher and higher. How to improve computing efficiency and reduce delay is an urgent problem to be solved. To overcome these technical bottlenecks, a series of solutions are needed. First of all, in terms of sensing technology, we can improve the accuracy and real-time performance of human-computer interaction with the help of new sensors such as bioelectrical signals and EEG signals. In addition, through deep learning and artificial intelligence technology, the algorithm can be continuously optimized and the recognition rate of perceptual technology can be improved. In terms of computing power, new hardware accelerators, such as GPU and FPGA, can be used to improve computing efficiency. At the same time, the development of cloud computing technology also provides the possibility for large-scale computing. Generally speaking, the transformation of human-computer interaction in virtual reality and mixed reality faces many technical challenges. However, through continuous technological innovation and optimization, we are confident to gradually overcome these bottlenecks and realize a more natural and efficient human-computer interaction experience.

4.2 Optimization direction of user experience

In the development of virtual reality and mixed reality, the optimization of user experience is very important. With the continuous progress of technology, the optimization direction of user experience mainly includes the following aspects: First, enhance the sense of realism: realism is one of the important factors of user experience in virtual reality and mixed reality. An important direction of user experience optimization in the future is to improve the realism of virtual environment through technical means, so that users can feel things in virtual world more naturally and truly. Second, the improvement of interaction mode: Human-computer interaction is one of the core issues in virtual reality and mixed reality. Another direction of user experience optimization in the future is to improve the interaction mode, and interact with the virtual environment in a more intuitive and natural way, so that users can operate things in the virtual world more easily and freely. Third, the satisfaction of personalized needs: With the continuous improvement of users' personalized needs, meeting users' personalized needs is also an important direction of user experience optimization. By providing users with more customized virtual environment and services, users can customize their virtual experience more freely. Fourth, the enhancement of social interaction: Social interaction in virtual reality and mixed reality is also an important direction of user experience optimization. By strengthening the communication and interaction between users, users can participate in the virtual environment more deeply and improve their participation and satisfaction.

4.3 Future development trends and prospects

When discussing the transformation of human-computer interaction in virtual reality and mixed reality, we can't ignore its future development trend and prospect. With the continuous progress of technology, human-computer interaction will face many challenges, but also indicates a series of exciting future development. First of all, with the continuous improvement of perception technology, human-computer interaction will pay more attention to the real feelings of users. For example, through more accurate tactile feedback technology, users can get more realistic tactile sensation in virtual environment, making human-computer interaction more natural and immersive. In addition, the rise of multimodal interaction will also change the way of human-computer interaction, enabling users to interact with the virtual environment through voice, gestures, eye movements and other ways, greatly improving the user experience. With the integration of cloud computing and edge computing, the computing performance of virtual reality and mixed reality will be significantly improved. This will not only reduce the delay and improve the response speed, but also make it possible for a more complex and large-scale virtual environment. In addition, the development of artificial intelligence will also have a profound impact on human-computer interaction. AI technology can learn and adapt to users' habits and provide users with a more personalized interactive experience. In the future, we expect to see a more intelligent, natural and efficient human-computer interaction environment. Through continuous innovation and technological breakthrough, virtual reality and mixed reality will exert their great potential in various fields and bring more possibilities to human life and work.

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5. Conclusions

This paper deeply discusses the transformation of human-computer interaction in virtual reality and mixed reality. From the transformation of human-computer interaction mode, the enhancement of perceptual experience to the upgrading of information interaction, these changes are profoundly changing our way of life and work. In the fields of education and training, game entertainment and industrial design, the application of human-computer interaction has achieved remarkable results. However, we are also facing the technical bottleneck and the challenge of user experience optimization. In the future, with the continuous progress of technology, human-computer interaction will be more natural and efficient, bringing more convenience and innovation to mankind.

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