

Exploration on human computer interaction technology based on Mixed reality

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Absrtact: With the development of virtual reality and augmented reality technology, the way of human-computer interaction is also changing, and is no longer subject to the limitations of the physical world. Mixed reality technology can display the mixture of real and virtual objects in a single display, and support users to interact with it, creating a virtual world interacting with the real world. It has a wide application prospect in the fields of education, health, entertainment and so on. Among them, human computer interaction (HCI) is one of the important supporting technologies of mixed reality, which is of great significance to promote the wide application of mixed reality and enhance user experience. This paper reviews and discusses the research results and development trends of human-computer interaction tasks in mixed reality technology, summarizes the current challenges, and gives some problems that need to be further studied and solved based on human-computer interaction technology in mixed reality environment.

Keywords: Mixed reality; Human computer interaction; Multi channel interaction; User interface

Introduction

Mixed reality (MR) is a further development based on Virtual Reality (VR), augmented reality (AR) and augmented reality (AV). This paper proposes the concept of “reality – virtuality continuum” based on Milgram and Kishino (Figure 1), Mixed reality technology is regarded as a computer technology that integrates the real world and the virtual world and interacts with it in a new visual environment. In the virtual reality unity, the left end represents the completely real world, and the right end represents the fully virtual visual environment, while mixed reality can simultaneously present the real object and virtual object between the two extremes, emphasizing the seamless integration of the real world and virtual environment in the same visual space.

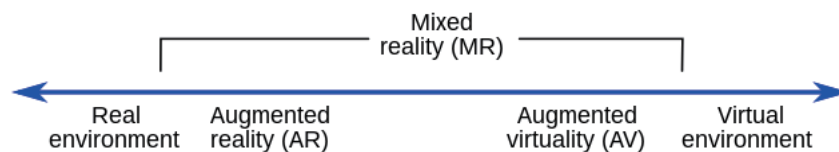


Figure 1 reality – virtuality continuum

When discussing mixed reality, There is always a question “what is the difference between augmented reality, virtual reality and mixed reality? From the above figure, we can see that augmented reality (AR) is closer to the real environment space, and AR technology can superimpose virtual information such as computer-generated images, 3D models, video streams and so on into the real environment, which has been widely used in games, education, medical treatment and other fields. Virtual reality (VR) is located at the right end of enhanced virtual reality (AV). VR technology uses computers to generate a virtual world isolated from the real world. Through the head mounted display device, all perceptual connections from the real world are cut off, so that users are completely immersed in the virtual world.

Mixed reality technology provides users with a new 3D visualization environment. Combined with augmented reality and virtual reality technology, users can interact between virtual space and the real world, so as to achieve a more realistic experience. And compared with the simple projection overlap of AR, the virtual picture projected by MR can be closer to the real object according to the continuous change of angle of view. In recent years, with the development of multimodal human-computer interaction technology and the enhancement of computing power of mobile devices, mixed reality technology has broad application prospects in education, medical treatment, industrial manufacturing, cultural communication and other fields. Whether in MR, AR, AV or VR, human-computer interaction is an important research field that can not be ignored.

Human computer interaction (HCI) has built a bridge for information transmission and exchange between users and computers. Mixed reality also improves the interaction between human and computer through human-computer interaction model and usability evaluation method, so as to better meet the needs of users. On the other hand, with the continuous maturity of mixed reality technology, new problems have emerged in the actual user experience, such as the lack of new interactive interface, interactive behavior and interactive paradigm. The traditional graphical user interface has been unable to adapt to the interactive scene in the mixed reality environment, and more and more researchers began to seek a more natural and humanized human-computer interaction mode.

1. Human computer interaction in mixed reality technology

1.1 Human computer interaction in mixed reality

With the development of computer vision, sensor technology, cloud computing and other information technologies, the human-

computer interaction interface is developing from the traditional command-line interface and graphical user interface to multi touch, multi-modal fusion and multi-channel interaction interface. In an ideal mixed reality environment, users can use any combination of auditory, visual, tactile and even olfactory modes to complete input behavior, and do not need to use mouse, keyboard, glasses and other devices to realize information transmission and exchange. They can interact with virtual objects only by natural perception. However, due to the limitations of technology, the mixed reality technology is still in the development stage. If we want to integrate the virtual and real world, and extend human perception to the mixed reality space to achieve immersive immersion, we need to make a comprehensive breakthrough in technology.

At this stage, the implementation elements of mixed reality technology include but are not limited to environmental input, perception, holographic images, etc. As a bridge connecting the real world and the virtual world, perception technology uses computers to perceive the environment and obtain input information from different sources such as cameras, sensors, GPS, etc., which can realize environmental modeling and provide support for tracking real-time positions. And the holographic image is projected into the real world through the display system, so that users can see the performance of the virtual world in the real world in real time. At present, most applications are realized through head mounted devices, and some devices can support interaction with objects, events and environments in the real world, such as by recognizing gestures and voice, mixed reality applications can recognize users' intentions and achieve more intelligent interactive operations. In addition, more visual operation can be realized through vision and touch recognition technology. Therefore, in order to build a direct connection between human perception and computers, mixed reality technology is required to build an interactive feedback information loop between the virtual world, the real world and users, creating a complex environment of virtual and real fusion.

Based on human's natural perception, mixed reality technology pursues more natural instinctive interaction, and strives to liberate human from the shackles of complex computer user interface and return to human's original sensory channel. Therefore, the interactive interface in mixed reality needs to naturally integrate the virtual and real world based on the user environment. In addition, it also needs to provide users with richer environmental information to help them integrate more quickly, and the development of multi-channel interaction is providing an effective way for this.

1.2 Multi channel interaction technology in mixed reality

Multimodal interaction makes full use of human perception, enabling users to interact with computers through input information from multiple action channels (such as expression, gesture, sight, etc.) and sensory channels (such as vision, touch, hearing, touch, etc.). Compared with traditional single channel interaction, multimodal interaction can improve the efficiency of user input and make interaction more natural and efficient. It has broad application prospects.

At present, the motion channel is mainly based on human motion capture and face capture technology. It can capture the user's posture, expression, motion and other data through camera or other sensor technology. It can be used to control the virtual content in mixed reality, such as controlling the movement and zooming of virtual objects. In the sensory channel, the visual channel is an important part of combining the mixed reality content with the real world objects. At this stage, headwear devices supporting mixed reality are needed to support information input. Tactile channel mainly uses wearable devices to provide tactile driven virtual content. Users can feel different objects in the mixed reality environment. Tactile driven virtual content can be realized through tactile devices, vibration devices and other forms. Audio channel is usually realized by voice recognition, machine learning and other technologies. It can be used to play the voice of virtual content, or capture the voice of users to realize voice control. In the mixed reality environment, in order to achieve the best interactive experience, multi-channel interaction usually combines two or more input channels in a system. Users can achieve natural interaction in the virtual reality fusion environment through gestures, voice and other multi-channel. Multi channel interaction needs to synchronize multiple inputs, such as gestures and voice, and process and synthesize the input to obtain higher-level commands, such as moving objects, scaling objects, etc. But at present, few technical frameworks can meet the requirements. The traditional development environment has been difficult to support the latest interactive mode and data processing, let alone the processing of multi-point and multi-user applications. Therefore, it can be considered that the mixed reality oriented human-computer interaction interface is one of the important research fields in the next few years.

1.3 Problems in multi-channel interaction

Since the proposal of "virtual continuum" in 1994, the discussion on mixed reality has become more and more difficult. In particular, the progress of hardware and information technology makes the wide application of mixed reality technology possible. Different from the design of traditional graphical user interface, the development of multimodal interface for mixed reality involves the combination of software and hardware. Such as tangible user interface, digital enhancement pen, audio and video input and gesture interaction, but only combining these hardware and technology can not provide a humanized system for end users. In many cases, a set of multi-channel human-computer interaction system needs a variety of recognition devices to realize together, involving a variety of platforms, devices and frameworks. And some development environments only support a small number of input devices and modes. Researchers must deal with different hardware platforms, operating systems, programming languages and software frameworks. In addition, the traditional interactive device composed of two-dimensional display, keyboard and mouse can no longer meet the needs of mixed reality oriented experience. Therefore, it is an inevitable trend to build a platform integrating multiple device toolkits and frameworks, and it also needs to provide an integrated visual user interface to achieve multimodal interaction of multiple perception channels, so that users can interact with data naturally and effectively.

Nowadays, more and more scholars begin to explore new interaction paradigms, design principles and evaluation methods to meet

the needs of this emerging field. However, only a few achievements can go out of the research room and face the public. A large part of the reason comes from the limitation of software and hardware technology. Mixed reality technology combines various technologies such as computer graphics, visual design and physics. It is faced with the problems of integrating a variety of different technologies and how to coordinate among them. And the mixed reality technology is limited by the physical space to some extent, it can only be applied in real space, so its application scope is limited, and it can not be designed and implemented and popularized in a large scale. In addition, through the research and testing of some mixed reality applications currently on the market, it is found that many applications pursue the update and iteration of technology and ignore the impact of human factors on interaction efficiency. Such as low interaction efficiency caused by large amount of information and complex manipulation, and low social acceptance of interaction technology behavior and methods. We still need to make efforts on the innovation of interactive technology and the consistency of humanized design principles, and try to apply it to different variable environments to better improve the user experience, for example, from the use of single or multiple users, the same or different environment, different degrees of immersion and other factors.

2. Multi channel interaction technology in mixed reality faces challenges

The above briefly summarizes the current research status of mixed reality human-computer interaction technology, and puts forward the diversified requirements for the realization of mixed reality applications, and discusses the user centered design principles, usability evaluation and design methods in mixed reality technology. Based on the current state of the art, there are also the following challenges to solve this problem:

- (1) Whether the traditional human-computer interaction interface design principles and usability evaluation and design methods are suitable for mixed reality.
- (2) The hardware devices involved in mixed reality are quite different, and whether the design principles can be universal.
- (3) For users, how to interact more effectively and naturally in mixed reality.

3. Conclusion

Therefore, in the future, we expect that with the in-depth study of interaction paradigm and the construction of interaction model, we can better understand users' information needs and experience needs in the mixed reality environment combined with cognitive psychology theory. By analyzing the individual psychological characteristics in human-computer interaction, combined with the mixed reality scenario, a multi-dimensional interaction model for users and resources is proposed to support the construction of user model, so as to better meet the needs of users. Secondly, it is expected to build a software architecture platform, which can quickly adapt to the flexibility required to build the prototype, and provide the integration of various heterogeneous input devices and signal processing, so as to promote the standardization of the interface supporting mixed reality software and hardware and network access. Finally, a new concept of visual user interface is introduced to reduce the complexity of vision and technology, support a high degree of interactivity, and bring high-quality interaction to users.

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