INTERACTION IN VIRTUAL REALITY

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Introduction

Virtual reality, which is one of the most promising application fields of computer science, cannot be defined with a single and concise definition. People define virtual reality with different terms. Some researchers refer to it as telepresence, in which a user is immersed in a remote environment. Others have named it as augmented reality, where certain computer graphics or text is overlaid on top of real images. Some have referred to it in terms of the tools it uses and not its purpose and function. Another important term, which is often used in VR definitions and is confused with VR, is cyberspace. The term cyberspace is first used by Gibson in his famous book Neuromancer [1]. According to Sherman and Craig [2], cyberspace is a virtual environment that is mediated with the help of different technologies, which brings different people around the world together enabling them to interactively communicate with each other. Besides these descriptions, many researchers have noted that the term virtual reality is an oxymoron, in which two terms with opposite meanings are combined. The word virtual essentially means 'not real'. According to Sismondo [3], virtual reality is real in effect but not in fact. But, what is virtual reality?

Sherman and Craig define virtual reality as being immersed in an interactive virtual world [4]. According to Brooks [5], virtual reality is an experience in which the user is effectively immersed in a responsive virtual world. Prof. Grigore Burdea, in his book Virtual Reality Technology, describes virtual reality as a simulation in which computer graphics is used to create a realistic looking world, which is not static but responds to user inputs [6]. All these descriptions define a key feature of virtual reality, which is real-time interactivity, the ability to detect user inputs and modify virtual world instantaneously. These interactions involve not only 3D images but also the incorporation of 3D sound, artificial smell generation and force-feedback. Another key feature in these definitions is immersion, which is defined as the feeling of being part of the action in the virtual world. According to Heim [7], who defined VR with 'three I's', the third characteristic of VR is information intensity. Virtual world sends constantly updated information to users supporting immersion and interactivity. This knowledge transfer is referred as information intensity, which is the third I of VR, after immersion and interaction.

Dimensions of Interaction

Interaction, one of the three I's of virtual reality, is a term that is discussed frequently in communication studies. Some researchers define interaction as the process of exchanging the roles of sender and receiver in the communication process. According to Geray [8], defining interaction as the exchange of roles in a communication model does not precisely explain the concept and defining interaction as feedback broadens the concept unnecessarily. In the light of new media technologies, interaction is a process that enables the receiver to undertake the role the sender and to control the content of the medium.

Lunenfeld defines interaction in two categories [9], extractive interaction and the immersive interaction. When the user accesses information via hyperlinks, this is called extractive interaction. When the user is immersed in a 3D world, this is called immersive interaction. Both interaction categories rely on large databases that contain massive amounts of data. Immersive environments' aim and presentation are different than extractive environments but it is

possible to use extractively interactive components in an immersive environment. But users can only move within and explore the virtual world in immersive simulations.

Interaction in virtual reality is often described as the ability of the user to move within the virtual world and to interact with the objects of the virtual world. If the user can explore the virtual world and move objects within, the environment is interactive. Since this definition is ineffective in describing multi user environments and virtual characters created by AI, it is replaced by action-reaction approaches [10]. Virtual objects and characters within the virtual world must react to users actions and interactively communicate with them.

Straaten defines interaction in virtual environments with four components [11]. These components are purpose, participant, medium and content. In this model, purpose relates to the goal of the virtual experience. Participant is the person involved in the virtual simulation. Medium is the mediating technology such as trackers and data gloves. Content is the VE that consists of virtual objects, characters and events. The purpose of the simulation affects the degree of interactivity in a virtual world. A battle simulation is more interactive than a simulation in which users explore a virtual garden and relax. The personal characteristics of the participant also affect the degree of interactivity experienced by the users. Some people interact with virtual objects and characters, but some others do not. Medium also affects interactivity since it determines the degree of immersion experienced by the users. When people use special hardware such as HMD's and stereo headphones, they are almost totally immersed in a virtual world. This sense of 'being physically there' increases the interactivity of the mediated environment. The content, which represents the information intensity of the virtual environment, also affects the degree of interactivity since it defines the vividness of the medium.

One of the most important and comprehensive works about interaction in virtual environments is Steuer's article that defines interactivity as a dynamic simulation. According to Steuer [12], interactivity in virtual reality is composed of three elements. These are speed, range and mapping. Speed is the response time of the virtual world. If the virtual world responses to user actions as quickly as possible, it is considered an interactive simulation since immediacy of responses affect the vividness of the environment.

Range represents the number of attributes that can be manipulated by the user. If the user can change and interact with a large number of objects, the degree of interactivity is higher. Mapping defines the interconnection between the actions of the user and the actions within the virtual world. Mapping is a function of the types of controllers used to interact with the mediated environment. The degree of interactivity is quite different when the user controls virtual objects with a mouse and when the user picks up a data glove to interact with the virtual world. Both a mouse and a HMD maps real human actions to virtual actions of the simulated environment but the vividness of the actions and the degree of interactivity is different.

Conclusion

The concept of interactivity discussed above, is the most important aspect of virtual reality and many researchers try to determine its characteristics and components in different ways. The components of interactivity discussed are not sufficient to describe interactions within a virtual world. There are two important terms that must be considered before determining the characteristics of interaction. These are immersion and presence. Immersion defines how much the user is immersed in the virtual world and it is sometimes referred as physical presence, the sense of being physically there. Presence, which is the sense of being there, is a mental concept. Interactivity cannot be examined thoroughly without determining the factors that affect presence and immersion. If the user does not feel himself in the virtual world, both physically and mentally, it is probable that he will not interact with the virtual objects regardless of their range, speed and mapping. The descriptions given above determine the characteristics of interaction in a virtual world if the user believes that he existed in the virtual

environment and if the user is immersed with virtual objects that are not static, but responsive to users actions. Without immersion and presence, it is not possible to make a single and concise definition about interactivity in virtual environments.

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