

Preface

Although the term virtual reality (VR) was coined around 1989, similar researches have been carried out since the early 1980s in various fields such as computer interface, computer-aided design and manufacturing, simulation and simulators, interactive art, communication, and robotics.

Since the Engineering Foundation Conference on Human Machine Interfaces for Teleoperators and Virtual Environments was held in Santa Barbara in 1990, such researches have been discussed collectively, and this field of research has been recognized as VR.

The three basic components of VR are life-sized three-dimensional space, real-time interaction, and self-projection.

While the gaming applications of VR were identified early, industrial applications such as car design tools or medical care have been keenly pursued only recently. Following this trend, exhibitions presenting industrial developments, such as the industrial VR show (IVR), have flourished year after year in Japan.

In addition, academic conferences such as the International Virtual Reality Conference hosted by the Computer Society of IEEE, the world's most authoritative academy, are conducted every year, and VR research has occupied the principal focus of the emerging technologies presented at SIGGRAPH, the world's largest conference and exhibition on computer graphics and interaction techniques. Moreover, the Virtual Reality Society of Japan has made advancements every year since it was established in 1996, and VR has been established as a solid research area and discipline in Japan.

In the USA, the potential for advancements in the field of VR is extremely high. On 20 February 2008, for example, the National Science Foundation (NSF) selected VR as one of the "14 grand engineering

challenges for the 21st century” that could improve the quality of human life around the world.

In 1980, the author conceptualized and proposed the concept of “telexistence” that enables a highly realistic sensation of existence in another remote place without any actual travel and demonstrated its feasibility through the construction of alter-ego robot systems such as TELESAR, which was developed under the national large-scale project on “Robots in Hazardous Environments,” as well as the HRP super-cockpit biped robot system developed under the “Humanoid Robotics Project” of the Ministry of Economy, Trade and Industry (METI).

Thereafter, the author and his team have researched and developed a mutual telexistence system TELESAR II, which can generate the effect of a person in a remote place as directly appearing in local space using a combination of the alter-ego robot and the retro-reflective projection technology (RPT). Furthermore, full-color 360-degree panoramic and autostereoscopic system TWISTER has been developed using a rotating parallax barrier and LED arrays; it does not require any special eyewear such as shutter glasses. Based on the results, the feasibility of mutual telexistence has been demonstrated.

Furthermore, the author has aimed at developing a system that enables recording, communicating, and reconstructing tactual sense. This is required in addition to the visual and auditory senses in order to re-create realistic sensations. The author and his team have pursued this line of thought through the development of a distributed vector-type sensor called GelForce and an electrocutaneous display.

Moreover, augmented reality based on RPT (retro-reflective projection technology), which represents a projection of informational space onto real-world space via the RPT, has been developed for the purpose of improving real-world environments, for example, providing optical camouflage using RPT.

While the majority of the VR researches have focused on the computer-generated world, the author’s research is individualized by a fusion of VR and robotics, which is always directed at the real world as exemplified in telexistence.

Telexistence is fundamentally a general technology that enables a human being to have a real-time sensation of being at a place other than where he or she actually exists and being able to interact with the remote environment, which may be real, virtual, or a combination of both. It also refers to an advanced type of teleoperation system that enables an operator

at the control to perform remote tasks dexterously with the feeling of existing in a surrogate robot working in a remote environment. Telexistence in the real environment through a virtual environment is also possible. The author believes that telexistence has the potential to release human beings from the restrictions of their cognitive limits and physical constraints.

This book introduces this concept of telexistence, explains how the concept can be realized as a technology, precisely illustrates real examples of the realization of the telexistence technology, and lists prospects and future advancement of telexistence.

A complete review book on the telexistence technology has not been published yet. This is the first book on this emerging technology of telexistence written by the inventor of telexistence.

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