Human-Machine Interaction in Virtual Environments – Recent Developments and Industrial Applications

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Virtual Reality (VR) has seen a major shift since its first public appearance in the beginning of the 1990s. What started as a vision, overloaded with expectations on how it would shape the way we will live and work has now found many applications mainly in the fields of medicine, assembly, design review, training, and also military applications. Many companies and academic research groups are working in the field, some on basic research and others developing systems which benefit from VR technology.

The picture of VR has been that of people wearing heavy Head Mounted Displays (HMDs) and cumbersome data gloves, leaving the user fully immersed and often lost in the virtual environment. While this is still the case in some fields, usability has also become an important issue in VR, for reasons of sheer survival. User acceptance for traditional wired VR boxes has been low. But as new technologies have emerged over recent years, which now allow lightweight systems that are easy to use, together with trends to merge real and virtual environments (Augmented and Mixed Reality, AR, MR) which include natural interaction, VR is spreading and entering new domains, such as tourism, business applications, and end user operating systems. The emerging field of Digital Human Modeling builds a bridge between VR and human factors engineering, applied ergonomics, and computer-aided engineering design, allowing questions to be addressed which relate to the early phases in the product development process.

VR does not necessarily mean immersive stereoscopic visualization. In fact, many emerging VR applications are desktop or table based and not stereoscopic. Thanks to the computer gaming industry, almost every personal computer now has a powerful graphics card so that it could act as a desktop VR instance. Cheap video projectors,

HMDs and digital humans will do the rest to bring VR into everyday live and work. This raises ethical issues of how we will live with or in virtual environments in the future. The ongoing discussion about the online VR game Second Life shows how relevant these questions are also for our social structure.

This special issue attempts to show different views of where we are with VR today and to present exemplary work and research in the field. In the first article, Bauckhage, Thurau, Gormand & Humphrys present a novel approach to naturally acting artificial agents in virtual environments. By applying machine learning techniques to recordings of network traffic of distributed games, they aim to generate "human-like" behavior of artificial characters. As the results show, their approach generates a significantly more human-like impression than traditional ones.

Herbon & Rötting describe mechanisms of detection and processing of visual information in three-dimensional space. They present a theoretical model of 3-D spatial interaction and give an overview of fundamental research on spatial attention and applied studies in the fields of aviation and car driving. These studies concern the location of information presentation in three-dimensional space for the completion of different types of tasks. Herbon and Rötting integrate this research in the model of 3-D spatial interactions and discuss resulting research challenges.

Naumann & Rötting discuss the use of Digital Human Modeling for design and evaluation of human-machine systems. They describe the advantages of the application of digital human models in product design and manufacturing and give an overview of current research on digital human modeling. Consequences of a wider application of digital human modeling in the area of Human Factors are being discussed. Up to now, the use of anthropometric models dominates. In contrast, the authors see the main research challenges in combining anthropometric and cognitive models.

A tabletop system for displaying large geographical scenes is introduced by Peinsipp-Byma, Eck, Bader & Geisler. It provides seamless integrated zoom functionality and is currently being used in the context of surveillance tasks. The seamless integration of physical tools and virtual imagery makes it a prominent example for non intrusive Mixed Reality systems.

This edition's community section has two articles. Amditis, Bimpas, and Blach describe the INTUITION network of excellence funded under the 6th EU Framework which aims towards networked and structured VR in industry. The prime objective of INTUITION is to promote and facilitate the development and application of VR/VE technology in industrial domains, establishing European excellence in this area. Amditis, Bimpas, and Blach give an overview of barriers to applying VR in industry, drivers for change, and resultant research challenges. The second community article by Israel gives a short summary of the 2007 IEEE VR conference and highlights main trends and developments.

We would like to thank all authors and reviewers for their contributions and their cooperation. All articles of this special issue are available online at www.useworld.net.

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