



Editorial

Special Issue on New Frontiers in Virtual Reality: Methods, Devices and Applications

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1. Introduction

Virtual reality (VR) has the potential to dramatically change the way we create and consume content in our everyday life. This technology has the ability to unlock unprecedented user experiences by enabling an increased sense of presence, immersion, and engagement. In the last few years, we have witnessed astonishing progress in technological developments, such as capture and display technologies, accompanied by a steady advance in the understanding of cognitive factors regarding perception and cognition in this new medium. This, in turn, has enabled many applications in education, entertainment, training, medical and psychological therapy, design, communication, or advertising, to name a few.

For virtual reality to become commonplace and realize its full potential, various aspects of capture and display technologies, computer graphics, computer vision, visualization techniques, and applied perception play a crucial role. This Special Issue collects the latest research on relevant topics addressing interdisciplinary research challenges towards generating complete, engaging VR experiences. It contains seven papers that can be categorized into three main streams: interaction, user experience, and applications.

2. Interaction

The way we perceive and interact with the outside world is defined by our five senses: sight, hearing, touch, smell, and taste. The two most dominant senses are sight and hearing, which are typically already integrated into virtual reality devices, although they still require further research. Interaction metaphors involving the sense of touch are still in an exploratory phase and have attracted extensive research in the last few years.

The first paper, titled *A Multi-Object Grasp Technique for Placement of Objects in Virtual Reality*, authored by Fernández and colleagues [1], presents a technique that enables users to grasp multiple objects in one hand and release them in a controlled way. Their results show that this method outperforms existing approaches in terms of task completion time, distance traveled, and subjective experience. This is a timely article since there is not yet much research proposing solutions to allow users to grasp multiple objects in one hand in a realistic way.

The second paper in this stream is *Hands-On Deformation of Volumetric Anatomical Images on a Touchscreen*, by Torres and colleagues [2]. The authors provide a novel metaphor to interact with volumetric anatomical images. This work addresses three major challenges of working with this type of data in touchscreens: selecting anatomical elements in volumetric images, mapping the gestures performed in 2D to 3D transformations, and applying the deformation of the volumetric images in real time.

3. User Experience

In order to improve the overall virtual experience of the user, there are several factors that need to be taken into account. Both improving the visual experience and reducing



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cybersickness have a large impact not only on the perceived realism, but on increasing the feeling of presence.

The first paper in this stream, titled *Impact of View-Dependent Image-Based Effects on Perception of Visual Realism and Presence in Virtual Reality Environments Created Using Multi-Camera Systems*, published by De Dinechin and colleagues [3], analyzes different image-based methods for creating immersive virtual environments from photographs of real-world scenes. This is an important and timely topic: captured 360° content does not allow head motion, since the content is typically captured from a single point of view. In recent years, multiple methods have been proposed to alleviate this problem. This work provides a user-centered evaluation of such methods, assessing the viewers' perception of visual realism and the sense of presence, and shows that rendering view-dependent effects enhances the perception of visual realism and elicits a stronger sense of presence.

Sickness in virtual reality is a major issue that is receiving a lot of attention since it has a strong impact on the final experience. In this field, the article presented by Won and colleagues [4] titled *A Study on Visually Induced VR Reduction Method for Virtual Reality Sickness* analyzes a new visually induced method to reduce sickness. In their work, the authors study different sizes and positions of visual guides, and derive insights for reducing sickness while increasing immersion.

The last article in this stream, titled *Calculating and Analyzing Angular Head Jerk in Augmented and Virtual Reality: Effect of AR Cue Design on Angular Jerk*, by Van Dam and colleagues [5], proposes a method for calculating and analyzing *jerk* in real time based solely on orientation data from head-worn displays in AR. This is an interesting method for future research, since *jerk* is an important metric in usability and user behavior studies.

4. Applications

Virtual reality is a new medium with unprecedented capabilities for training and communication, among other applications. In particular, it has great potential for developing applications for everyday assistance and support, particularly for schools and the elderly.

The work of Lin and colleagues [6], titled *A Test Platform for Managing School Stress Using a Virtual Reality Group Chatbot Counseling System*, addresses the problem of stress-building in student life. In a world where psychological counseling services suffer from a shortage of professionals, the goal of this work is to provide a tool for students to receive immediate help when dealing with stress. This paper presents a test platform for an immersive virtual reality chatbot that has been developed using professional psychological counseling knowledge to provide students with individual or group counseling sessions.

Last, the concept paper of Fu and colleagues [7], titled *Conceptual Design of an Extended Reality Exercise Game for the Elderly*, presents a conceptual design for a VR rowing game that can help provide home exercise to the elderly to benefit both their physical and mental health. This design has been particularly adapted to the particular needs of elderly users, and the final design includes the system architecture, activities and tasks, patterns and roles, mechanics, and UI examples.

5. Future of Virtual Reality

This Special Issue is just a sample of what is to come. More extensive research in virtual reality methods, devices, and applications is expected in the future. It can be anticipated that new devices based on the latest advances will appear in the market soon, and new applications that can exploit the vast potential of this new medium will be developed.

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