

# Applied VR/AR - Immersion, Accessibility, and Emerging Trends

Nicholas H. Müller, Gerhard Hube

Technical University of Applied Sciences Würzburg-Schweinfurt

Würzburg, Germany

e-mail: nicholas.mueller@thws.de

e-mail: gerhard.hube@thws.de

**Abstract**— This paper summarizes three papers for the special track Applied VR/AR – Immersion, Accessibility, and Emerging Trends (AVRAR). The papers address the Uncanny Valley, software to train the spatial sound localization skills of children with cochlear implants, and the differences in digital learning scenarios. These examples highlight the importance of the special track as a venue to present and discuss new developments within the VR/AR development space.

**Keywords**-Virtual Learning Environments; Cochlear Implants; Uncanny Valley

## I. INTRODUCTION

The Applied VR/AR - Immersion, Accessibility and Emerging Trends special track at ACHI 2024 represents a concerted academic effort to critically engage with the rapidly evolving fields of virtual and augmented reality. As scholars and practitioners, we aim to deepen the understanding of VR/AR technologies not only as tools for innovation, but also as catalysts for paradigm shifts in human-computer interaction, educational methodologies, and digital accessibility. This track is dedicated to fostering rigorous academic discourse, promoting empirical research, and encouraging theoretical advances that explore the multifaceted dimensions of VR/AR technologies. We are committed to scholarly inquiry that examines the implications, challenges, and potentials of these technologies in diverse societal contexts.

At the heart of our academic inquiry is the issue of accessibility in VR/AR. This has a dual focus: firstly, ensuring that these technologies are accessible to a wide range of users, including those with different abilities; and secondly, exploring how VR/AR can be used as tools to improve accessibility in different domains. We aim to bridge the gap between technological advances and social inclusion by encouraging research that addresses the usability, adaptability and ethical considerations inherent in the use of immersive technologies. This track encourages papers that provide critical insights into how VR/AR can be used to create more inclusive and equitable digital environments.

Emerging trends in VR/AR provide fertile ground for academic exploration, and this track aims to be a part of identifying and analysing these developments. We invite scholarly contributions that not only present the latest innovations, but also critically assess their implications for the future of technology, society, and individual user experience.

By bringing together a diverse range of academic perspectives, we aim to build a comprehensive understanding of the evolution of VR/AR and anticipate future challenges and opportunities. Our goal is to cultivate an academic environment at ACHI 2024 where interdisciplinary dialogue is encouraged, leading to a more nuanced understanding of VR/AR's role in shaping our digital future. Within this panel, three research projects will be discussed.

## II. SUBMISSIONS

### A. *Uncanny Valley*

First, Arda presents the work he and his colleague Henneberger from THWS conducted regarding the uncanny valley effect [1]. The Uncanny Valley effect, coined by robotics professor Masahiro Mori in 1970, describes the discomfort people feel when encountering human-like entities that are almost, but not quite, convincingly realistic. Research, such as the study by Kim et al. using the Anthropomorphic RoBOT (ABOT) database, supports this phenomenon, revealing a "trough" of discomfort when robots exhibit moderate human resemblance.

The researchers identified three dimensions of human-like appearance: surface features (skin, hair, clothing), body manipulators (torso, arms, legs), and facial features (eyes, mouth, face). Understanding these dimensions can improve the design of virtual avatars, which currently lack a systematic, evidence-based approach to categorising human likeness.

Challenges in avatar research include the lack of a quantitative system to compare human likeness across studies, the oversimplification of 'human likeness' as one-dimensional, and the need to consider different types of avatars. Previous studies, such as Schwind et al.'s work on atypical features (e.g. large eyes) in high-fidelity characters, show that consistent realism can mitigate negative perceptions. In particular, realistic eye rendering is crucial for avoiding the "dead eyes" effect that makes characters feel uncanny.

To address these issues, a new avatar database has been developed based on the findings of Phillips et al. to facilitate more systematic and repeatable research on virtual human-like avatars.

### B. *Qawqa'a*

Next, AlMashari presents Qawqa'a [2]. Qawqa'a is a VR-based game designed for accessible and engaging auditory

habilitation in Arabic, specifically for children aged 8-12 with bilateral cochlear implants. It functions as a digital home training kit with two components: a game for the child to improve auditory skills in sound localisation and speech perception, and a web-based platform for habilitation centre administrators to monitor and track the child's progress and skill development within the game.

Qawqa'a holds great promise in addressing the challenges families face in accessing regular habilitation sessions. By providing a convenient, cost-effective and engaging habilitation experience, it aims to improve compliance with treatment protocols, thereby maximising the benefits of cochlear implants.

### C. Learning Environments

The third paper by Hube & Müller [3] is about the continued effort regarding different media in relation to their learning experiences. This paper builds on studies published in 2022 and 2023 in the International Journal on Advances in Systems and Measurements, titled "2D Virtual Learning Environments for Tertiary Education" and "Comparison of 2D Virtual Learning Environments with Classic Video Conferencing Systems for Tertiary Education." The original plan included a 3D desktop environment, but Zoom was used instead. The 3D environment is now scheduled for winter term 24/25.

Online learning research, particularly involving Learning Management Systems (LMS) like Moodle and video conferencing tools such as Zoom, has highlighted issues like "Zoom fatigue." This underscores the need for alternative, less immersive online learning environments like Gather Town. Reviews of Gather Town studies indicated a lack of research outside computer science courses and suggested longer-duration studies.

This paper descriptively and statistically compares 2D Virtual Learning Environments with classic video conferencing systems, incorporating a second seminar strategy. The goal is to analyze differences in learning environments to enhance online tertiary education.

### III. CONCLUSION AND FUTURE WORK

In conclusion, the AVRAR special track at ACHI 2024 underscores the transformative potential of VR/AR technologies across various domains, emphasizing their role in reshaping human-computer interaction, education, and accessibility. Our panel discussions and research presentations reflect a commitment to advancing knowledge in these areas through empirical studies and theoretical explorations.

Hakan Arda and Andreas Henneberger's investigation into the uncanny valley effect provides insights into the design of virtual avatars, addressing the nuances of human-like appearance to enhance user experience. Their work underscores the importance of systematic approaches in categorizing and rendering human likeness in virtual environments.

Leenah Al Mashari's innovative VR-based game, Qawqa'a, exemplifies the intersection of technology and accessibility. By focusing on auditory habilitation for children with cochlear implants, Qawqa'a not only offers an engaging and effective training tool but also addresses significant barriers in traditional habilitation methods. This project highlights the potential of VR in creating inclusive digital solutions that cater to diverse needs.

Hube and Müller's comparative study of 2D virtual learning environments and traditional video conferencing systems offers valuable perspectives on enhancing online education. Their findings on the effectiveness of alternative learning formats contribute to the ongoing discourse on optimizing digital learning experiences for tertiary education.

As we move forward, the AVRAR special track remains dedicated to foster interdisciplinary dialogue and collaboration. By bringing together a diverse array of academic perspectives, we want to deepen our understanding of VR/AR technologies and their implications. Our goal is to discuss and present innovative research and practical applications that have the potential to shape the future of these immersive technologies, ensuring they are accessible, effective, and beneficial for all members of society.

### REFERENCES

- [1] Evaluating digital avatars in VR - A systematic approach to quantify the Uncanny Valley effect. Arda, H. & Henneberger, ACHI 2024, The Seventeenth International Conference on Advances in Computer-Human Interactions. May 26-30, 2024, Barcelona, ISSN: 2308-443X, ISBN: 978-1-68558-133-6, URL: [www.thinkmind.org](http://www.thinkmind.org)
- [2] Qawqa'a: Auditory Habilitation System For Cochlear Umplant Using VR. AlMuammar, N., AlSaif, M., AlHoti, H., AlDawsari, R., AlMashari, L. & AlJandal, S., ACHI 2024, The Seventeenth International Conference on Advances in Computer-Human Interactions. May 26-30, 2024, Barcelona, ISSN: 2308-443X, ISBN: 978-1-68558-133-6, URL: [www.thinkmind.org](http://www.thinkmind.org)
- [3] Further Comparison of 2D Virtual Learning Environments with Classic Video Conferencing Systems for Tertiary Education. Hube, G. & Müller, N., ACHI 2024, The Seventeenth International Conference on Advances in Computer-Human Interactions. May 26-30, 2024, Barcelona, ISSN: 2308-443X, ISBN: 978-1-68558-133-6, URL: [www.thinkmind.org](http://www.thinkmind.org)