Designing Interactive Avatars for Mixed Reality Applications

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ABSTRACT

Mixed Reality (MR) increasingly gained importance over the last decade leading to the commercial breakthrough in recent years. At the heart of MR systems is the avatar—the user's virtual representation within the virtual world. Avatars are not only necessary to interact with the virtual world but have also a large number of profound effects on the interaction as well as on the user. Muscular avatars can, for example, not only make users feel stronger but also increase their physical performance. Designing avatars that do not fall into the uncanny valley is, however, challenging. In this tutorial, we will therefore introduce attendees to the basics of avatars and their effects. We will provide guidelines for the avatar design. In addition, we will walk attendees through the practical task of designing avatars and putting them into interactive applications.

KEYWORDS

Mixed Reality, Virtual Reality, Avatars, Proteus Effect, Uncanny Valley

1 INTRODUCTION

For years, MR has continuously gained significance in the field of human-computer interaction (HCI). Counting the number of publications in leading HCI conferences using MR technologies, such as Virtual Reality (VR) and Augmented Reality (AR), indicates exponential growth in the last years [1, 11, 15]. Furthermore, recent sales of VR consumer-headsets has increased rapidly. According to IDC the market for AR and VR grew 92.1% in 2021 with shipments reaching 11.2 million standalone headsets [17]. These trends clarify that MR is no longer only an object of research, but on its way to becoming an everyday technology.

At the heart of any immersive experience is the *avatar*—the virtual representation of the user. In accordance with the real world, where the human body is a vehicle for interacting with the environment, avatars are used to provide users with a body allowing a natural and intuitive interaction. Previous work found that avatars enhance depth perception [16] and the sense of presence [2]—a crucial quality attribute of VR applications. Accordingly, Slater and

Wilbur [14] stated that immersive applications necessitate avatars representing a "being that is doing the perceiving" from a first-person perspective to create embodied experiences that feel natural and familiar to users. Despite the importance of avatars, it is surprisingly little known about the practical process and workflow of designing virtual characters for MR applications. To contribute to the progress of advanced MR applications and take it to the next level, it is crucial to democratize the technological as well as the design-based knowledge and skills of creating aesthetic and effective avatars.

In this tutorial, we share our in-depth expertise on designing and implementing full-body avatars for MR applications to allow attendees to build immersive applications and create embodied experiences. We will introduce attendees to terms and concepts relevant for the avatar creation process. We provide guidelines for avoiding the uncanny valley when designing avatars and highlight the effects avatars have on the user. Using examples and application scenarios, we then practically show how avatars can be designed and used in MR applications.

2 TUTORIAL STRUCTURE

The tutorial will comprise a theoretical and a practical part. First, we will provide an overview of the fundamentals of avatars and virtual characters in games and immersive applications. Second, we will guide a hands-on avatar design process where participants learn a tool chain for creating interactive avatars.

2.1 Content

In the theoretical part, we will discuss what avatars are and why they are important for MR applications. We will introduce relevant terms and concepts by providing an overview of current research on this topic and the technological state-of-the art. We then address important design theories and phenomena (e.g., the uncanny valley [3, 12, 13] and the Proteus effect [4–10]) to provide the foundations for the practical part.

In the practical part, attendees will be guided through an avatar design process by using state-of-the-art applications. We will introduce a tool chain to teach attendees a basic understanding of each application. We will showcase how to design avatars using a character editor (Daz3D[1]) and a 3D-modeling software (Blender[2]). To animate the avatars, we will use Mixamo[3]. Finally, attendees will

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[1]https://www.daz3d.com/
[2]https://www.blender.org/
[3]https://www.mixamo.com

learn how to incorporate avatars into a game engine (Unity[4]) and to make them interactive full-body avatars using inverse kinematics. We will provide a virtual environment in Unity to allow attendees to interact with the designed avatars.

2.2 Requirements

The tutorial has no special requirements beyond curiosity about virtual reality and the design of avatars. We will bring the necessary hardware to showcase interactive avatars in virtual reality. In particular, we will bring an HTC Vive with additional Vive trackers to rendering full-body avatars using inverse kinematics. Hence, attendees will get the chance to experience the avatars in an immersive virtual world.

2.3 Participants

The tutorial targets beginners and does not require any prior knowledge of developing MR applications and avatars. While we expect around 15-20 participants to allow an in-depth discussion, we are open to a larger audience.

2.4 Schedule

While we are happy to adapt to the conference schedule, we propose to hold the tutorial on Sunday, September 4th, from 15:00 to 18:00.

Welcome (15:00 − 15:15): Opening presentation to outline the tutorial motivation and learning goals.

Theoretical Part (15:15 − 16:15): Avatars in MR - Theory and Design

Coffee break (15 min)

Practical Part (16:30 − 17:45): How to Design Avatars for MR Applications. This is the main part of the tutorial. Attendees will be guided through the process of designing avatars and putting them into practice.

Closing and wrap up (17:45 − 18:00): Tutorial results, including best practices, and experiences from the tutorial will be documented. Remaining open questions will be summarized and possible follow-up activities will be discussed.

2.5 Organizers

Martin Kocur received his PhD from the University of Regensburg. His research focuses on the design and creation of virtual avatars and digital humans in the context of VR and HCI. His dissertation is titled "Utilizing the Proteus Effect Using Avatars to Improve Performance in Virtual Reality" and explores the effects of virtual avatars.

Jessica Sehrt is a PhD candidate at the Frankfurt University of Applied Sciences. Her research focuses on physiological sensing in MR and the design and implications of using bio-feedback in immersive environments.

Valentin Schwind is professor on Human-Computer Interaction at the Frankfurt University of Applied Sciences. His research focuses on immersive user experiences, physiological and perceptual sensing, virtual avatars and gaming.

Niels Henze is professor for Media Informatics at the University of Regensburg. He is interested in using and understanding

mixed reality to build better user interfaces. In particular, he is interested in connecting human-computer interaction with underlying psychological phenomena.

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