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Moving Towards Natural Interaction Between Multiscale Avatars in Multi-User Virtual Environments

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Abstract

Multiscale collaborative virtual environments (MCVEs) are interesting for many application domains as they allow multiple users to interact with virtual worlds and themselves at different scales. However, natural interaction in such environments is often quite difficult, since the natural relations between humans and the environment in terms of body size, capabilities, affordances, personal space and interpersonal space are changed. In this poster we describe this penomenon and present an experimental setup with multiscale avatars in a shared virtual world that supports full-body awareness. We indicate first impressions of the perception of one's size relative to the scale of the environment and the scale of others.

Categories and Subject Descriptors (according to ACM CCS): H.5.1 [Information Interfaces and Presentation (e.g. HCI)]: Multimedia Information Systems—Artificial, augmented, and virtual realities I.3.3 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual reality

1. Introduction

The concept to explore an environment at different scales has been well covered in fiction literature and movies such as *Alice in Wonderland* and *Gulliver's Island*. Multiscale collaborative virtual environments (MCVEs) realize this idea by presenting a shared virtual environment (VE) to multiple users at different scales. MCVEs also often provide interaction techniques to change the scale of the environment, such as zooming in or out [KNBP06]. This is useful for exploring objects at different scales, such as the human body from blood vessels to a one-to-one representation.

Considering the different scale levels at which users explore the environment, MCVEs need to provide a consistent representation of them reflecting their different scales. Usually this means that avatars in MCVEs are represented at a scale that matches their current minification or magnification level of the environment, such as avatars growing bigger when the user zooms out or getting smaller when zooming in [ZF02]. Hence, from an *exocentric* point of view (POV), an avatar seems to change scale when the user is zooming in or out of the environment. However, from an *egocentric* POV this scaling operation is actually ambiguous: When zooming into the environment, the user might either interpret the world as growing relative to herself, or she might interpret a scale change as *herself* shrinking relative to the world (as in Alice in Wonderland). During such a scale change, it is her impression of the world or her impression of herself that is changing. This interpretation depends on whether the world or the body are perceived as invariant.

While virtual reality (VR) setups are well capable of inducing body scale illusions [EKS*05], natural interaction by moving with our fully articulated body through the environment usually contradicts the perception of being an ant or a giant. In particular, mass and gravity of our body as well as the pitch of our voice still match our true scale in the real world, which would not be the case if our scale had actually changed. While it is difficult to change this sensory feedback from the real world for oneself, it is possible to change the appearance of other users. For instance, we can give users that are smaller than oneself a higher pitched voice during interaction to support the perception of them being smaller. Additionally, one might change the perception of mass inertia, e. g., by using mean value filters to introduce higher latency to movements of tall avatars, thus making it seem that they have more intertia with longer movement onset times.

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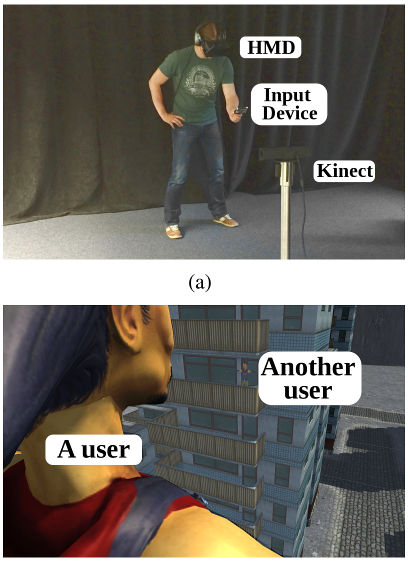
Conveying a realistic sense of scale in other users is a major difficulty in MCVEs. In these environments it is not sufficient just to know the place of other users during interaction, but it is also necessary to understand at which scale they are seeing the environment. A large scale difference between users reduces the ability to see the same artifacts in the scene and perceive the same affordances, which means that natural interaction and communication becomes a serious challenge.

Experimental Setup We built an MCVE in which we use Microsoft Kinects to track the body of multiple users and immerse them into a shared virtual world with Oculus Rift DK2 head-mounted displays (HMDs) as shown in Figure 1. While previous work evaluated MCVEs with static scaled avatars [ZF02], to our knowledge, interaction in MCVEs has not been evaluated with fully-articulated tracked body representations, supporting basic gestural interaction such as pointing and waving. Users are wearing wireless headphones with microphones, allowing them to communicate with each other by speech using spatial 3D audio. The visual stimulus consists of a building model with several floors and an urban area around the building rendered in Unity3D. We chose an architectural design context since architects are well experienced exploring building models at different scales during design, evaluation and decision making processes.

Subtle Scale Modifiers The perception of one's size and the scale of others is an important factor for natural interaction in MCVEs, which we aim to support with subtle manipulations. We implemented different approaches to convey a sense of scale in the user and in other users:

- In photorealistically rendered physics-based VEs it is not the same to scale the world or to scale the user. While both operations produce similar impressions of a scale change in terms of interpupillary distances, other factors differ, such as depth of field (cf. [HCOB10]) etc.
- We compare three approaches to subtly indicate scale differences between users:
  - c_0 Feedback (mass, gravity, voice, etc.) from users is not changed (baseline).
  - c_1 Feedback from users at one's own scale is not changed, whereas feedback from smaller/larger users is changed (user-centric manipulations).
  - c_2 Feedback from users at true scale is not changed, whereas feedback from smaller/larger users is changed (world-centric manipulations).

Approach and Impressions We ask users to estimate the height of themselves in the VE, the size of the building and the size of other avatars. Additionally, we ask users to estimate their egocentric distance to the building and to the other avatars. Users might either interpret themselves to be upscaled or downscaled with a building at true scale, or interpret themselves to be at true scale with a downscaled or upscaled building. Considering the size-distance relation, both size and distance measures should indicate similar effects of the stimuli, indicating how one relates oneself to the environment. First impressions suggest that the real-world size of the building is dominating spatial impressions. Moreover, initial feedback suggests that subtle manipulations of the verbal and non-verbal feedback from users at different scales can help to understand scale differences, and can increase their sense of feeling present [Sla09]. While strong manipulations, such as extremely high pitched voices, seem to distract users during interaction, it seems that subtle manipulations with barely noticeable differences have the potential to provide a useful addition to MCVEs.



(a)

(b)

Figure 1: *Experimental setup: (a) user standing in front of a Kinect, wearing an Oculus Rift DK2 and an audio headset, while interacting with the virtual world using a hand-held device, and (b) screenshot showing two users interacting in a shared virtual architectural space at different scales.*

References

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