Increasing Embodiment for Desktop-Based Participants in Mixed Desktop and Immersive Collaborative Virtual Environments

AUBREY SIMONSON and PATTIE MAES, MIT Media Lab, USA

For browser-based users, controls in systems like Mozilla hubs are much less embodied than they could be using all of the tools available in most laptops. A common control scheme involves a viewport moved using the mouse, no ability to point, and eye movement which is unassociated with the actual eye movement of the user. In this position paper, we propose a control system for browser-based users of virtual immersive environments which is more embodied, while also using only the affordances present in most laptop computers.

CCS Concepts: • **Human-centered computing** → **Virtual reality**.

Additional Key Words and Phrases: virtual reality, immersive experience, embodiment

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1 INTRODUCTION

With the introduction of WebGL-based virtual reality and applications like Mozilla Hubs, virtual environments which can be accessed either via head-mounted display (HMD) or via the browser have become increasingly popular event spaces [2]. For HMD-based users, experiences such as Mozilla Hubs in particular can be very immersive, and avatars can be very expressive. HMD-based users can control their viewport and the movement of their avatar's head using their own physical head. They also have the ability, if they have controllers, to point and gesture in a manner which is very expressive using their physical hands. Browser-based users lack this expressiveness. They generally have no hands or ability to point. The control scheme for browser-based users also isn't particularly embodied. The viewport and avatar head are moved by clicking and dragging with the hands, rather than by moving the head.

For both browser-based and HMD-based users, many virtual immersive environments use avatar idle movements, especially of the eyes, which are not driven by the user's actual body[2]. Other applications avoid showing eye movement by hiding and avatar's eyes, both for HMD-based and browser-based users. Arthur does this by adding opaque black sunglasses to all avatars[1]. While idle movements can help make an avatar seem more lifelike, they also provide false social cues which may not match with the actual body language of a user. This can be especially troublesome for browser-based users, whose avatars continue to blink attentively when the users they represent may be in a different tab, or away from their keyboards.

HMD ownership is not as common as laptop ownership. Therefore, in current virtual immersive environments for both HMD-based and browser-based users, many, if not most users tend to be

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browser-based. Until a potential future in which presence in these mixed spaces is HMD-based by default, it is essential to ensure that mixed browser and HMD based virtual immersive environments are an engaging experience for all of their users.

2 PUPPET AVATARS

While browser-based users in virtual immersive environments are not using a device which can track headpose and handpose, most personal laptops have many affordances which are not utilized by existing virtual immersive environments. Generally, a laptop computer has a 2DOF trackpad and a camera. We propose an alternate control scheme which utilizes the trackpad and camera to drive attributes of a simple avatar.

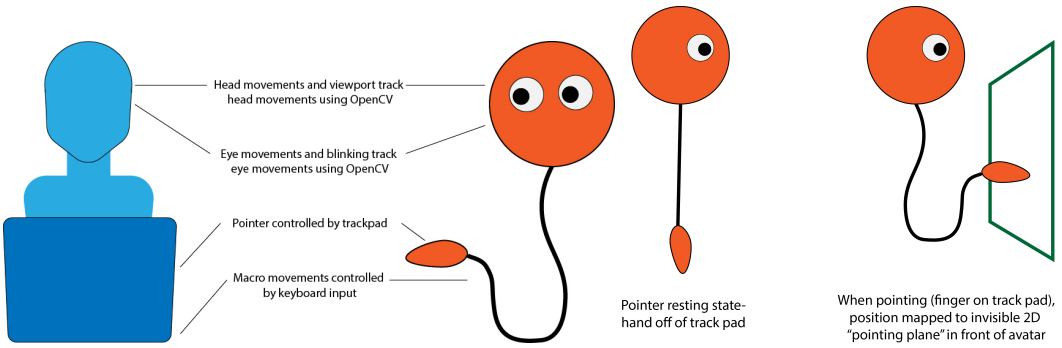

Fig. 1. A means of controlling an avatar in a virtual environment using a laptop computer which is more embodied than using the mouse to move the viewport. Using the webcam, the head and eye movements of the user control those of the avatar, and make adjustments to the viewport, allowing the user to look around in a limited range using their physical head. These simple avatars also control a hand-like "pointer", controlled using a trackpad, which allows for some ability to point and gesture.

We've called them puppet avatars because, while they cannot create the same level of embodiment as an HMD, we aspire to create a type and level of embodiment akin to that of manipulating a puppet.

Puppet avatars are very abstract. This is partially to reduce the strain on bandwidth involved in transmitting video data, and the computation involved in animating more complex avatars and interpreting facial expressions. It also avoids the deeply unsettling glitches which can occur when face or especially limb tracking mapped to an avatar on a computationally limited device fails. This is just one possible configuration in what we hope to be an ongoing discussion of browser-based avatar embodiment. Potential expansions on the mappings shown in 1 include facial rigging mapped to the user's own facial movements, especially of the mouth, or mapping the avatars limbs to the user's limbs via skeleton tracking, thereby allowing them to gesture with their physical arms [3].

For reasons related to both privacy and accessibility, each feature of this control scheme is conceptually modular, and able to be turned off without affecting other features. For example, a user who does not want to turn their camera on or does not have a functional camera would not be able to move their avatar's head by moving their own, but this should not prevent them from pointing using the trackpad.

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