RockemBot Boxing: Facilitating Long-Distance Real-Time Collaborative Interactions with Limited Hand Tracking Volumes

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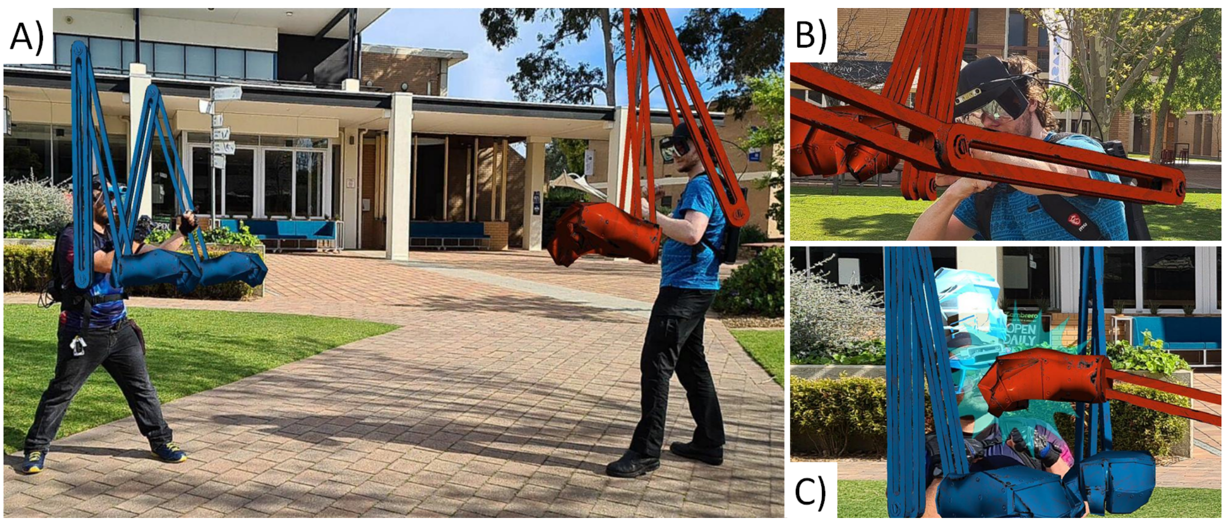

Figure 1: We present RockemBot boxing, a social-distancing safe Collaborative Augmented Reality Game. A) A visualization of gameplay. Two user's stand at a distance greater than 2m apart. B) The right user throws, and lands a virtual punch. C) Causing the left user's virtual head to bounce back, away from the user's real head position. The interesting game design of RockemBot boxing allows for beyond arm length interactions between multiple users.

Abstract

This demonstration showcases a boxing game that facilitates interactions between two users over a larger-than-arms reach distance. In RockemBot boxing, users stand two meters apart, and use virtual fists as a means of knocking the opposing player's virtual head in an intense matchup. By first re-mapping the user's hand tracked input to a virtual model, and representing the user's in the collaborative space as a semi-attached avatar, we allow real-time high fidelity interactions.

Keywords: Augmented Reality, Human Computer Interaction, Games and Entertainment Design

1 Introduction

Recent years saw an explosion in Augmented Reality (AR) experiences for consumers and with recent global events enforcing the need of social distancing, especially in shared collaborative spaces. Most peripheral input (hand tracking, controllers, ect.) is tied to our arm reach, requiring a means of engaging with objects at a distance by either projecting cursors from the tracked peripheral into the AR environment [6], or by zooming objects towards users [2]. Since games, especially in AR have higher fidelity requirements [4] one also needs to consider that sharing tracked head poses and peripherals in a shared collaborative space can lead to errors in addition to the temporal latency issues caused by networking connections over long distances.

In this demo, we present a collaborative AR game that utilizes hand tracking as a means of peripheral input. However, we facilitate interactive distances beyond the users reach without impacting the game's flow. We additionally focus on utilizing unattached virtual representations of players in the AR environment to allow actions performed to be seamlessly oriented towards targets of interest. This allows us to present high fidelity AR interactions without providing too much assistance, making the game more engaging.

This demo presents a novel application of game design techniques to overcome the technical limitations of Project Esky [1]. While input remapping has been explored before in the Go-Go interaction technique [3] for extending a user's reach within Virtual Reality spaces, it was employed as a direct and instantaneous interaction technique, which can become difficult when co-located experience exhibit temporal or spatial distortions [4]. Our technique overcomes these limitations.

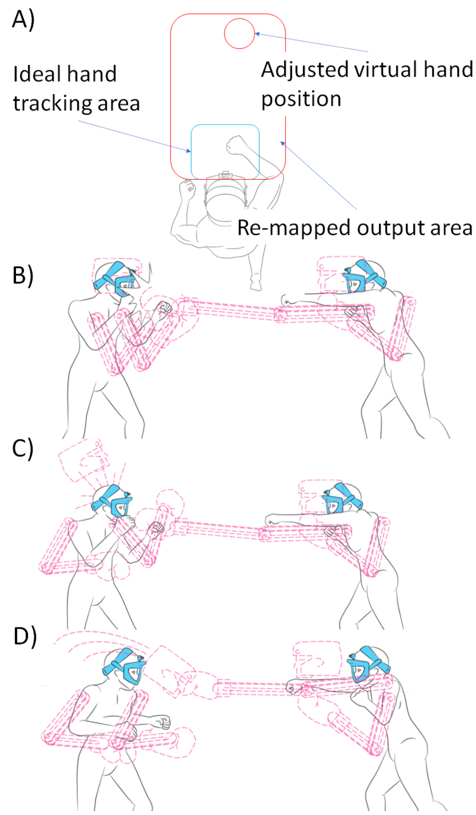

Figure 2: Example gameplay of RockemBot Boxing and it's input. A) How we extend the virtual fists beyond the limitations to allow longer-than-arm-reach interactions. B) The right user throws, and lands a virtual punch C) Causing the left user's virtual head to bounce back, away from the user's real head position D) Since the virtual heads are attached to a spring joint, the left user's virtual head swings forward, exposing it to the right user's followup counter punch. The spring heads also move as the user bobs and weaves, restricting them to smaller movements.

2 Our deployed platform

We develop RockemBot Boxing using Project Esky [1] using the following hardware:

- PC 1: HP Z VR G2 Backpack PC. 2.6 GHz Intel Core i7-8850H, 32 GB RAM, Nvidia GeForce GTX 2080
- PC 2: MSI VR One 7RE Backpack PC, 3.8 GHz Intel Core i7-6820HK, 16GB RAM, Nvidia GeForce GTX 1060
- Displays: Project North Star [5]
- Hand Tracking: Ultraleap Leapmotion device
- 6DOF tracking: Intel Realsense t265 tracking module

For software, we utilize the Unity Game Engine along with Mirror API networking to share pose information, and game states between users. We do this using the prediction, reconciliation and interpolation techniques for the poses of all involved actors [4]. For an example of expected gameplay, see Figure 2.

3 RockemBot Boxing

RockemBot Boxing is a game specifically designed around bypassing the limited hand tracking area of Project Esky. By extending the reach of the virtual fists beyond the limited hand tracking volume we allow longer-than-arm-reach interactions. As a user extends their arm, a remapped translation occurs on the spring attached controller, moving the virtually attached robotic arm. Repeated back and forth movements will cause the robotic arm to fully extend towards the opponent. If the attack is successful, the opponent's virtual head will pop out and bounce back, away from the user's real head position. The spring like motion of the virtual robotic gloves allow indirect interactions between two users over a large distance. Since the virtual heads are also attached to a spring joint, they also sway as the user bobs and weaves, limiting the player's movement through game design. The game ends after 3 rounds, or a knockout occurs, with a winner decided based on the remaining stamina if a knockout does not occur. This translation of input also works well across other peripherals that include 6DoF tracking mapped to the users hands. Figure 1 shows an example of an interaction between participants.

4 Viewer Participation

Since the conference will be held virtually, we intend to demonstrate RockemBot boxing as a live online streamed demonstration. While two live actors play the game, viewers can preview the demo with through-the-lens and video see-through previews of the action occurring.

We also have ported and released the software as a hybrid AR and VR system, to allow participants in VR to play boxing matches against our live actors. With spectators watching and cheering for the live actors/participant. The idea is that spectators virtually crowd around the two fighters, then hot-seat to select a spectating user at random (who has flagged themselves as a willing participant) and add them as the participating boxer. VR users will be represented as robotic avatars within the virtual collaborative environment. The VR port can be found here:
https://hyperlethalvector92.itch.io/rockembot-boxing

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