Vuja De: Interactive Playback of Recorded Virtual Environments

Meet Arora
Kritika
meet16055@iiitd.ac.in
kritika17295@iiitd.ac.in
Weave Lab, IIIT-Delhi

Ayush Kushwaha
Aman Parnami
ayush17033@iiitd.ac.in
aman@iiitd.ac.in
Weave Lab, IIIT-Delhi

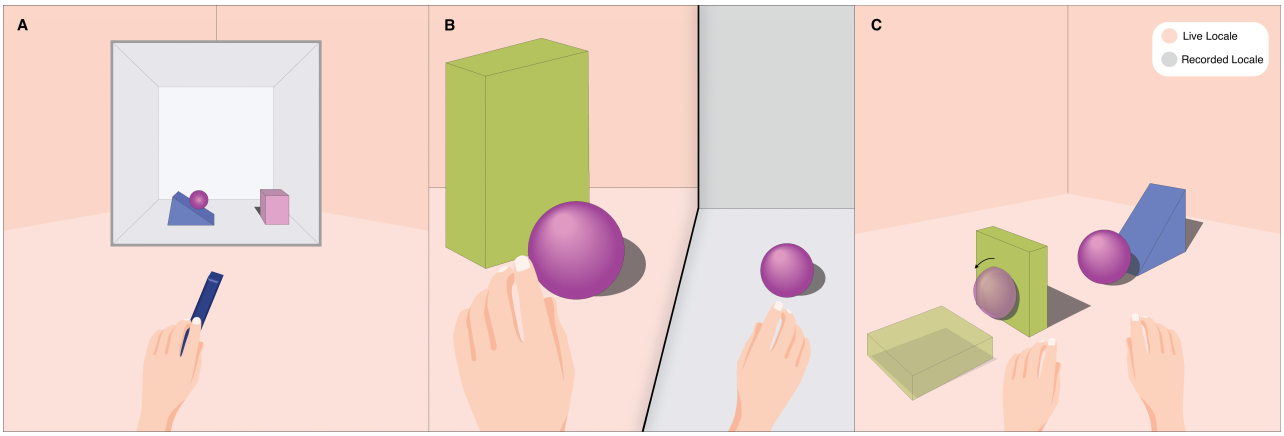

Figure 1: Interaction Scenarios: A) Holographic Projection, B) Inside the Holographic Projection, C) Parallel Universes (translucent shapes represent recorded objects)

ABSTRACT

Unlike playback of a video where a user can only interact by altering the video's playback, a recorded Virtual Reality (VR) experience when played back in VR allows unprecedented avenues for interaction, including alteration of the content. Thus, we present *Vuja De*, the propensity of finding novelty in familiar experiences. It enables re-experiencing VR recordings anew each time because of the multiple interaction outcomes made possible. Subsequently, we discuss comprehensive interaction scenarios demonstrating the utility of interactive recordings in realizing diverse possibilities.

CCS CONCEPTS

• **Human-centered computing → Virtual reality**.

KEYWORDS

recording, manipulable playback, interaction, virtual reality

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1 INTRODUCTION

Virtual Reality (VR) is known for its potential for creating simulations and powerful immersion. With VR recordings as an interactive tool, we initiate the exploration of diverse interaction avenues. For instance, one can not change the past in the physical world; however, similar endeavours can be realized in the virtual world through interactive recordings. Interactive virtual recordings bring immense potential to applications in Media and Entertainment, Arts, Gaming, or Simulations and can inform new, more intriguing interactive narratives. With this insight, we demonstrate how detailed recordings of a virtual environment are thus, a compelling interaction medium by exploring the ability to manipulate components of a recording while it is playing back.

2 INTERACTIVE RECORDINGS

Works such as [Greenhalgh et al. 2000] introduce virtual recordings that enable manipulating spatial, temporal, and presentational attributes of recordings; these alterations pertain to playback-related control. We delve deeper and introduce *Vuja De* that enables such manipulations at a finer level, i.e. allows explicit interactivity with the recordings' components as well. It establishes a mechanism to reform previously recorded scenes, turning them into an excellent tool for applications in Simulation Analysis, Training, Gaming, Storytelling, and Animation [Greenhalgh et al. 2002].

To put things into perspective, one can create a parallel with more conventional forms of media such as two-dimensional (2D) videos. Think of a traditional 2D video as playback of memory or a set of captured events that allow for limited interaction: generally, temporal manipulation (playback control). In contrast, a replay of

a virtual environment in VR due to its intrinsic nature of allowing complete programmable independence can be thought of like a Deja Vu. As when having a Deja Vu, one senses familiarity with a prior experience but still has the choice of doing things differently. Interactive recordings provide this flexibility where one may modify recordings during playback, on the fly, to achieve divergent outcomes. However, this kind of analogy explains one of the different possibilities.

To further understand what more is possible, let us go through a simple example. A user throws a ball at a cube which then topples over. This interaction is recorded, and during its playback, the user displaces the cube from the ball's trajectory; thus, averting the potential collision. This type of interaction involves manipulating object-level properties during playback. There are two ways to employ such interactions. First, allowing the rest of the recording to play as is despite the manipulation. The second is to equip the recording with a form of *adaptive ability*. In the given example, this can be implemented by preprocessing the collision data and only allowing the collision if the precomputed conditions meet. Both these approaches would find uses in different kinds of applications.

2.1 Virtual Interactions

We define *interactive bodies* as the components of a virtual scene that participate in virtual interactions. All these components have a live and recorded form. The live form is what one encounters when one first enters a virtual world, whereas the recorded form had been recorded in the past, and the user has the choice to explore and interact with it again.

Object. *Live Objects* and *Recorded Objects* are the material components present in the live environment and recorded environment, respectively.

Actor. An actor is the virtual manifestation of the user in the virtual world, usually with an avatar. A *Live Actor* can not only view the recorded scene and its constituent elements, but also partake in interactions of all complexities. Some can be as simple as the actor placing a new object inside the recorded scene, or composite in nature, i.e. involving interactions between recorded and live scenes. On the other hand, a *Recorded Actor* is an exception because once a scene is recorded, the relationship between the user and its recorded virtual avatar is no longer existent. Thus, the recorded actor behaves like any other recorded object. However, interactions with the recorded actor (object) should adhere to the kinematic principles at all times.

Locale. A locale comprises a virtual scene with its constituting objects, the resulting interactions, as well as the scene's physical properties. A *Recorded Locale* can be interpreted as analogous to a *planet* which has its own properties like gravity, light, and physical laws. Any inhabiting element in the planet will be subject to those properties. A *Live Locale* comprises all other interactive bodies.

2.2 Interaction Scenarios

We classify interactions with virtual recordings into three broad *metaphors*. These metaphors represent distinct scenarios illustrating the usage of Vuja De.

2.2.1 *Recorded Scene as a Holographic Projection.*

In this scenario, the recorded scene is visualized as a holographic projection (Fig. 1A). Besides only viewing and controlling the playback of the projection, we allow a range of exploratory interactions, such as interacting with the locale's projection directly or from a distance. An example of a composite interaction in this context is a live actor throwing an object from the live scene towards the projected locale. The live object thrown, may enter the locale, scale relative to the locale, and be subject to the locale's physical properties. If the recorded locale had gravity in the upwards direction, the live object's trajectory would deviate accordingly. Finally, it can leave the projection or stay confined in it depending upon which behaviour is deemed more suitable for the application. Moreover, the live actor can also choose to step inside the projected locale to explore and interact with it further, as described in the next sub-section.

2.2.2 *Actor inside the Holographic Projection.*

In this scenario, the live actor is already inside the recorded locale or enters as a consequence of choosing to *step in* from the previous scenario. As the live actor enters the locale, it conforms to the locale's spatial properties (Fig. 1B). The actor can then interact with the recorded locale, as it would with a live one. Coherently, all hyper-natural interactions possible in a VR world such as spawning a new object (analogous to bringing something inside the recorded locale) or removing an object (analogous to taking something out of the locale) are plausible.

2.2.3 *Recorded Locale and Live Locale as Parallel Universes.*

In this scenario, the recorded locale is present at the same scale and spatial location as that of the live scene. Thus, there is substantial overlap between the two and their constituents, especially when the recorded scene is a prior version of the live scene. We demonstrate this case in Fig. 1C. Here, the solid and the translucent forms represent the live and recorded objects, respectively. The scenario, naturally, is like a parallel universe where both the worlds (live and recorded) function independently and their constituents interact with each other but not with those of the other locale. Moreover, by allowing both the worlds to co-exist and interact with one another, it is possible to create an *interworld*, a fusion of both worlds.

3 FUTURE WORK

We are exploring the design space of virtual interactions to impart salient design insights pertinent to developing VR experiences using virtual recordings as an interactive tool. We aim to provide a comprehensive perspective to designers and VR developers inclined towards innovating in this domain.

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