

# Adrift in the Virtuality Continuum

ALEX DAVIES

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This article explores the induction of presence upon individuals through illusion in mixed-reality installation environments, using the author's work "Dislocation" [2005] as a case study. The article reports on the design and production of "Dislocation," concentrating on the development of techniques for creating illusion. These approaches can be used to produce compelling works that are not only technically and aesthetically sophisticated, but also provide a sustained engaging experience for the user. It reflects on the effectiveness of these techniques from observations of audience interaction in gallery settings and examines future possibilities and developments.

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"Dislocation"<sup>1</sup> is a gallery-based interactive installation in which real-time video, audio, and audience locational data are employed to create the illusion of additional characters inhabiting the installation space.

Over the last few decades there has been considerable activity in the fields of mixed, virtual, and augmented reality research in both visual and aural implementations. Grau's examination of the field in *Virtual Art* indicates that there is a tendency towards immersing the viewers within the virtual world with a suggestive impression of "immersing oneself in the image space, moving and acting there in 'real time' and intervening creatively" [Grau 2003]. Such

<sup>1</sup>"Dislocation" was produced with the assistance of "Experimenta" through the New Visions Commissions.

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Fig. 1. “Dislocation,” FACT, UK, 2006. Installation view.

systems transport the user into an artificial realm distinctly removed from reality, or overlay artificial imagery over real physical space [Azuma 1997]. By contrast, “Dislocation” brings the virtual elements seamlessly into the physical reality of the participants, rather than transporting the audience into the virtual. In this sense the virtual and the real become indistinguishable. Although works such as Nigel Helyer’s “Sonic Landscapes” examine this approach in aural form, there has been little development in integrated audio-visual systems [Roberts 2004]. This shift of focus presents particular demands and challenges. How can such an illusion be successfully achieved? What is the significance of this shift in audience experience? Can the transition of virtual characters into the real world be used as a powerful and compelling emotional tool?

## 1. ILLUSION

There are two distinct forms of illusion that can be applied to create a fusion of the real and virtual. The first is evident in cinema and theatre, whereby the audience, through suspension of disbelief, can validate the presence of a fantastical creature inhabiting the same space as a human. Although the viewer is immersed within this fantasy world, this form of illusion takes place on a separate plane to the audience’s lived reality. Many models of interactive systems that rely on suspension of disbelief for immersion to occur, such as Char Davies’ “Osmose” [Wilson 2002] and CAVE-based VR [Shaw and Weibel 2003] also operate within screen space rather than reality.

“Dislocation” does not work with such cinematic or theatrical techniques, as the phantoms not only infiltrate the participant’s world but do so unexpectedly. This has more in common with the second form of illusion; that used in stage magic, whereby the audience is involuntarily made to believe in the impossible inhabiting physical reality. In order to bring phantoms into the real world of the audience, the element of surprise is critical, as Lokuge states:

The notion of willing suspension of disbelief applicable to theatrical performances is not apt in creating illusions. Since magic inherently relies on violating peoples expectation, asking audiences to willingly succumb to the effect of the illusion is purposeless. Lokuge [1995]

By violating expectations, destabilizing moments can be created in which viewers involuntarily exist within a hybrid world of physical reality and illusion.

## 2. “DISLOCATION”: INSTALLATION STRUCTURE

The exhibition space itself is empty, apart from the small inset screens at the front of the room (portals). Concealed from the participants, a camera is embedded in the rear wall, and an array of eight speakers is mounted within the walls around the floor of the room.

The empty room is composed to create a feeling of normality, without any preconceptions of what may occur. As a counterpoint to the visual minimalism, an eight-channel audio composition is presented in the room, enveloping the audience.

Over 100 phantom scenarios are available to inhabit the room with the audience via the portals and surrounding audio system.

Lizzie Muller provides an overview of audience experience:

In Alex Davies’s “Dislocation,” four small mounted monitors are set back in one wall of an enclosed installation space. You need to approach them closely to see what they are showing. It takes a moment to realize that what you can see is your own back, and those of your neighbors peering at the adjacent monitors. The screen flickers slightly, as if there is a minor disruption in transmission, and someone else enters the gallery, nearer to the camera, talking on a mobile phone. The sense of their presence behind you is spine-tinglingly palpable, as is the illicit feeling that you are eavesdropping on their conversation. But glance over your shoulder and you find the room is empty. The other presence was a phantom, a ghost in the machine.

Muller [2005]

## 3. DESIGN CONSIDERATIONS

In order for the work to succeed, a number of factors had to be addressed, that is, to

- create a seamless illusionary environment that looks and sounds real;
- control the audience within this environment for the illusion to succeed and be sustained; and
- inhabit this environment with suitable virtual characters and scenarios that could produce pronounced emotional responses within the audience.

### 3.1 Perceptual Shift

In a perfect world “Dislocation” would fulfill Sutherland’s ideas for the ideal computer display.

One must look at a display screen as a window through which one beholds a virtual world. The challenge to computer graphics is to make



Fig. 2. Example of image distortion utilized in collision-detection system.

the picture in the window look real, sound real, and the objects act real. Grau [2003]

Unfortunately, the world is not perfect (yet). Many endeavors in the field of mixed reality focus on the use of 3D graphics to allow unconstrained views of objects so they seem to “act real”. The primary goal for illusion in “Dislocation” was creating a tangible and realistic hybrid world that *looked* real. Prerecorded video sequences combined with spatial audio were used to achieve this. The work attempts to encompass what Lombard describes as social realism, in which the media portrayal is plausible or “true to life” in that it reflects events that do or could occur in the non-mediated world” and perceptual realism in which “the objects and people in the program look and sound as one would expect if they did in fact exist”. [Lombard and Ditton 1997].

The installation was designed so that the audience engaged with the work via an interface that was unencumbered by technology. This illusionary freedom enabled the viewer to inhabit and respond to the virtual world just as naturally as they inhabit real physical space.

### 3.2 Visual Systems

All aspects of the environment were designed to lead the viewers into particular situations, without conveying the feeling of being obviously manipulated. This subtle influence was utilized to instill in the viewer a sense of freedom within the space, reducing any sense of abnormality in the environment, with the aim of enhancing the illusionary impact. If the audience has the impression that they are being manipulated, then they will be more guarded and wary and not as susceptible or responsive to the illusion.

One challenge to the successful establishment of illusion was the intersection of phantoms and viewers within the physical space (when displayed through the portals). In an attempt to minimize collisions between phantoms and humans, several techniques were used. Many of the phantoms were recorded to inhabit the rear area of the room. The entrance was positioned in a way to lead individuals towards the portals, rather than having the audience enter

the space and wander around randomly, thus reducing the chance of collision with the virtual entities. The entrance was closely situated to the front of the room to encourage users to move directly to the portals, the prominent focus of attention within the minimal room.

The portals themselves were positioned beneath eye height and set back from the wall so that, to view the screens properly, the audience had to move quite close to the portals and lean forward. This provided two benefits: It further controlled the location of the live audience within the room and, additionally, by making the audience peer directly into the portals at such close proximity, removed much of the individual's peripheral vision. To this end, the portals acted as the viewers' only visual reference on reality within their surrounds, thus immersing them further into the mixed reality they inhabited.

Certain contingencies were also implemented, due to the fact that one can never fully predict or control the activities of the audience. In the instance when viewers did stray from the bounds of the portals, it was necessary to find a way to smooth over aberrations in the illusion when phantoms and humans collided.

Instead of the viewer seeing a phantom walking through an audience member, a tracking and collision detection system was designed in which the live visual feed presented on the screens was temporarily distorted at the moment of impact. This gave an impression of a glitch in the system or a breakdown in technology. The illusion is sustained, and the audience has the impression that it is inhabiting an unstable electronic environment.

### 3.3 Aural Systems

Sound is a powerfully emotive tool, and particularly well suited to the creation of illusion. Sound is a pivotal aspect in "Dislocation" on two levels. First, it sets the overall ambience; and second, it is used as a device to heighten the sense of the visual illusion that the viewer is experiencing. Multichannel atmospheric sound was used to create a low level of tension within the room and broadly shape the audiences initial emotional state. The ambient base also facilitated the blending of the live and phantom sounds within the room, acting as an intermediary acoustic zone in which both worlds fluidly combined.

Sound design techniques such as off-screen sound from conventional cinema were applied to the world of mixed-reality installation. The presence of the phantoms could be heard prior to their entry into the room, just as one would perceive the impending entrance of a live audience member. These initial spatial audio cues were utilized to set up the forthcoming visual illusion that was about to unfold. Upon visible entry into the environment, sounds generated by the phantoms were spatialized via the eight-channel speaker array, so that virtual footsteps moved around the room in conjunction with the phantoms' movements; mobile phones rang next to the participants as the phantoms reached for their phones; and shrieks, laughs, barks, and the sounds of kisses drifted spatially around with their virtual counterparts. Although the illusion could have succeeded without the use of spatial audio, there is no doubt that this added further depth to the illusion, ingraining the veracity of the situation deeper in the viewer's mind.



Fig. 3. View of live phantom/human image composite via portals (the phantom is present in the rear of the room with the audience member located at portal 2).

### 3.4 Virtual Presence

The framework of the system permitted a nearly limitless array of possibilities for developing the feeling of “presence” of the hybrid phantom. Given that human beings respond strongly to the presence and behavior of other humans in their immediate surroundings, developing an illusion of the presence of others was a powerful way of engendering emotional reactions in the participants. Emotional response could have been achieved via other means such as architectural changes to the space or even abstraction of the environment, but the ability of humans to readily connect with other humans (both real and virtual) appeared to be a logical starting point for these investigations.

A number of video sequences of virtual characters that appear in the space were developed to explore the potential resonance between the live subject and the virtual characters. Beyond the successful implementation of illusion, the choice of scenarios was the next most critical decision.

Several broad categories of emotion were considered as starting points for the development of the scenario. These encompassed curiosity, discomfort, happiness, confusion, and fear, manifested through over 100 prerecorded video sequences.

Two subsets of phantom interactions, active and passive, were developed with an aim of evoking such emotional responses in the audience.

Passive activities include phantoms simply inhabiting the same environment as the viewer (for example, a virtual gallery visitor passing through or a transient conversation between two phantoms). Active interactions are based around direct connections with specific audience members. For instance, if an individual were located at portal one, a phantom would enter and then address the viewer, begging for money, whispering, or acting aggressively and physically threatening. These virtual entities were critical in forming the substance of the hybrid world. They not only provide the initial perceptual shift but also sustain audience engagement through emotionally compelling situations and the construction of narratives.



Fig. 4. Production still. phantom Chroma key shoot.

#### 4. TECHNICAL REALIZATION: ILLUSION ON A SHOESTRING

“Dislocation” was developed with consumer-grade technologies and programmed in Max/MSP. For the illusion to succeed, the phantom overlay had to mimic the quality of the CCTV video feed being transmitted to the portals which functioned as the viewer’s reality. The composition was done via use of Chroma Keying. Actors were videoed within a green cyclorama and digitally separated from their backgrounds, ready to be composed within the live exhibition space. As the aim of the work was to create the most realistic and compelling illusion possible, approximately 130 scenarios and permutations were recorded and tailored to various audience situations within the exhibition space. A database and tracking system was then used to present the most appropriate scenarios for a given audience. For instance, if individuals were at portals 1,3, and 4, a phantom could be presented who, mimicking an audience member, would enter the room, walk up and peer into portal number 2, giving the impression that it was standing right next to the audience member and engaging with the work.

##### 4.1 Tracking the Real and Virtual

This form of basic intelligence within the software engine was developed through an analysis of the video images from the camera at the rear of the room. The camera not only provided the video stream that was processed and presented on the portals, but also provided critical data on the activities of individuals in the space that could be interpreted and applied to the system. Minor flaws in the visual system would cause the illusion to succeed or fail. An essential aspect of the development of the work was to have a clear understanding of the activities of the live individuals in the space and the subsequent location of the phantoms in the selected scenario. The reason was two-fold. It was necessary to ascertain the location of the audience at the portals in order to tailor specific scenarios to the immediate configuration of individuals in the space. It was also essential in identifying whether phantoms and humans would collide in the space, thus destroying the illusion. Without this level of environmental information, only a rather superficial sense of presence could be achieved, lacking the required depth necessary to create a sustained and engaging audience experience.



Fig. 5. Audience interaction, FACT, UK, 2006.

## 5. OUTCOMES: HUMAN INTERACTION IN A WORLD OF ILLUSION

“Dislocation,” like many practical investigations in the field was primarily developed in a speculative mode informed by prior research experience. The public, experimental phase of the research was undertaken in presentations at the “Experimenta Vanishing Point,” Blackbox, Melbourne, 2005 and “Experimenta Under the Radar,” FACT, Liverpool, UK, 2006. During these presentations, audience behavior within the installation was recorded to video, and provides the basis for the following observations.

### 5.1 Reflection

The first and most basic form of interaction is that of the viewers interacting with their own reflections, that is, their presence on the screens. Even in the absence of any manipulation of the image, viewers found this, in itself, compelling enough. This was accentuated in the case of multiple individuals being present at a given time, as will be examined later. A mere minor shift in perspective was enough of a transformation to provide the audience, as Rokeby states, with:

a wayward loop of consciousness through which one’s own image of one’s self and one’s relationship to the world can be examined, questioned and transformed.

Rokeby [1996]

Although this perceptual shift in the video system was incidental, it informs the subsequent viewer interactions with the phantoms. Some users reported that this rear perspective of their environment was in itself uneasy and disconcerting, thus placing the viewer in a receptive psychological state for the forthcoming arrival of the phantom.

### 5.2 Human and Virtual Presence

The second layer of interaction inherent in the work is that of the viewer and the phantom presences in the space. This takes several forms. Initially there

is a fleeting moment while seeing a phantom inhabit the space and hearing its movements within the room when that illusion becomes a reality.

Observation of user responses indicates that a significant proportion of individuals did a “double take” at this moment: looking in the portals, turning around to clarify their reference to reality, and then returning their gaze to the portals to verify what they thought they perceived. An interesting twist on this moment took the form of “triple takes” in which a phantom enters and the viewer establishes that it is a virtual entity within the space and continues to view the scenarios as they play out. Another audience member then walks in to the space and the initial viewer thinks that the first audience member is in fact another phantom, only to be even further astonished to turn around and see a physical form behind him or her. This unexpected phenomenon appears to demonstrate what Timmins describes as a form of “inverse presence,” when a nonmediated experience appears to be mediated.

When people experience presence they think (at some level) that the mediated world is “real,” while when they experience inverse presence, they think (at some level) that reality is mediated.

Timmins and Lombard [2005]

This blurring of the boundaries between the real and the virtual is the point at which viewers are particularly immersed in the work, their perception consumed by the system. “Dislocation” enables viewers to unexpectedly experience both a strong sense of presence and an inverse presence within the same environment, and within a very short space of time. Timmins identifies difficulties in the development of systems for studying inverse presence, hence further experiments utilizing the same foundation as “Dislocation” may provide an appropriate environment for exploring this phenomenon further [Timmins and Lombard 2005].

### 5.3 The Unexpected

Initially, I envisaged that the more psychologically intense scenarios such as direct and violent confrontation with the viewer would have the most significant emotional impact. However it became evident that this was often not the case. The scenarios that were surprisingly effective were the passive interactions, which were primarily based on phantom activities that took place within the space, but often had no direct link to the presence of individual viewers within the environment. In such instances, scenarios in which virtual gallery visitors enter and leave the space, phantoms walk into the space and their mobile phones ring, and other banal aspects of everyday life, had some of the most pronounced effects on the audience. The sheer normalcy of the situation and reflection of the everyday made the illusion more tangible and potent.

An unusual recurrent theme in audience interaction was, alarmingly, based upon violence. For a small proportion of the participants, the only form of expression or ability to connect with a virtual presence was limited to kicking and punching the phantoms. This was particularly popular with children, who are notorious for reacting violently in interactive arts; but witnessing adults

throwing punches at nonconfrontational phantoms or kicking their legs back from the portals as the phantoms approached was disturbing. This response was not caused by fear, but seemingly from an inability to connect in any other manner.

#### 5.4 Multiuser Interaction and Sustained Engagement

A clear distinction became apparent between single user behavior and the behavior of groups. Although the initial illusion achieved the same impact upon individuals and groups, subsequent impacts differed considerably. Individuals appeared much more likely to focus on the phantoms, remaining at the portals as the various scenarios unraveled. After the initial disbelief, the work was experienced more like a mutant form of cinema. When two or more individuals were present in the space, there was considerably more interaction between virtual phantoms and humans alike. Audience members, mediated through the screen-based environment, became more playful and performative. The portals provided a novel medium for viewers to stage their own undertakings. Viewers used the unusual visual perspective to run, jump, dance, kick, hug, and display nearly every other form of human exchange in between, to the scrupulous eye of the portals. Even in the absence of additional phantom presences, “Dislocation” provided a framework that was unorthodox enough to generate unexpected social interaction.

As the smoke and mirrors disappeared, the virtual world was unfurled. A distinct shift in the audience’s experience of the work became apparent.

I watched people dissolve in delight over and over again, drag in unsuspecting companions and relish the moment of being duped. Even after this moment of realization, the images of the ghostly others occasionally behaving in inappropriate ways remains compelling. The small audience shivers at each new arrival like ouija board conspirators.

Muller [2005]

Engagement and interaction are sustained after the illusion has faded through the playful and performative potential of the space. The addition of phantoms to the environment shifts the initial interactions between the viewers by providing additional playmates to interweave into the viewers’ own personal narratives. Individuals leave the portals for closer interchanges with the phantoms, while the other viewers watch on as the performance unfolds.

The ability of “Dislocation” to sustain audience interest beyond the primary illusion also lies in the anticipation of what will unfold. Viewers savor the charged tension of the unexpected and the momentary loss of control over the world they inhabit.

## 6. FUTURE DIRECTIONS

A mixed-reality environment, with the proposed public presentation phase taking place in 2011, is currently under development. Even through the work employs some of the core concepts underpinning “Dislocation” (primarily in

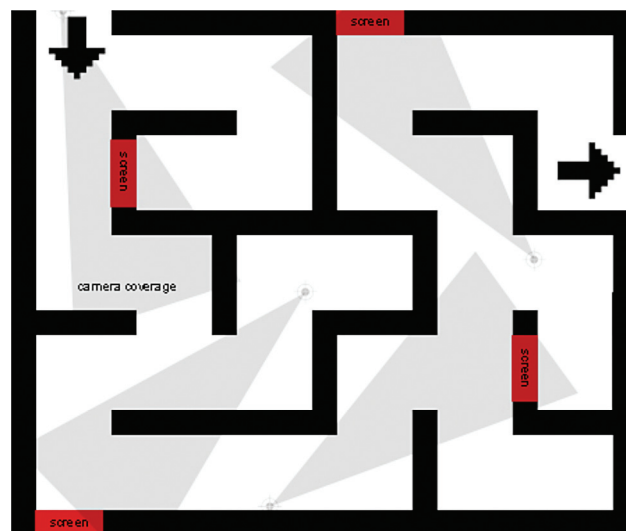


Fig. 6. Simplified overview of the installation structure.

the use of illusion), the overall design of the physical environment and avatar behavior are distinctly different. This will enable a complimentary set of concepts to be investigated.

### 6.1 Installation Overview

An installation environment taking the form of a maze will be constructed; Figure 6 shows an example layout. The maze will be augmented by sound and image technologies that will give the audience the impression that additional individuals inhabit the same physical space. In this sense, the work draws on the foundation developed in “Dislocation,” in which avatars inhabit physical space with the audience. In “Dislocation,” the audience has a reference to reality, that is, they can turn around and ascertain that the phantom presence does not really exist. In the scenario proposed above, the audience has no reference to *physical* reality at all. The physical environment is an inky black abyss, and hence the audience’s perception of their environment is based purely on what is present in the screens and the surrounding artificial sonic environment.

For example, looking in the screen, audience members see themselves via an infrared-sensitive camera mounted in the space (The IR cameras will be able to capture the environment as though it were well lit, even though it is in darkness.) In addition to the presence of the audience within the video image, another individual (avatar) enters the space (frame of the screen). The audience members will see this person move towards him or her and hear its footsteps, but when the audience looks around they are surrounded by darkness. They can still hear the activities of the phantom within the space, so experientially this entity is still present. Due to the loss of the primary sense of sight, I envisage this project will have considerably more scope than “Dislocation” for

the creation of a very palpable mixed-reality scenario in which social interaction with avatars can be explored.

## 6.2 Initial Speculations

The installation aims to provide a framework for a broad range of experimental situations to be examined by drawing upon the outcomes of “Dislocation”.

Although this form of immersive environment has considerable potential to evoke a deep sense of presence within the audience, certain aspects of “Dislocation” may prove to be more successful in engendering particular responses from viewers. “Dislocation” provided a very “normal” exhibition space; the room was a conventional exhibition/public space. When, subsequently, the avatars inhabit this “normal” space, it could potentially have a greater impact due to the disjunction between the real and virtual. This is in contrast to the very artificial environment created through the darkened maze. What is lost through this degradation of “normality” will be gained in different areas via the extended realism of the system and the increased scope of possibility for avatar/ human interaction.

This contrasting approach to environmental design and control will enable investigation into the extent of sustained human interaction with avatars, and aims to provide a longer, more consistent and palpable response from the audience.

Within the maze environment, avatars will be able to undertake a broad range of interactions with the audience. Behaviors will range from passive interaction, such as inhabiting a similar intimate space with a user, to active interaction, whereby a phantom may approach individuals at portals, talk to them, and attempt to lead them through the maze (either by the correct route or by leading individuals into dead ends). For example, an avatar approaches an audience member and says something along the lines of “follow me”. The audience member can see the phantom move through the maze via a portal. As the phantom exits the frame of view of the portal, the audience member can continue to follow them acoustically (via a spatialized audio system). When the audience member reaches another portal within the maze, they acquire another visual reference. By supplying the avatars with precise sonic locational attributes, complex interactive scenarios can be developed, drawing upon the audience’s loss of their sense of sight and their subsequent reliance on sound. I propose the following questions: What physical and emotive attributes make an avatar real and tangible? What methods can be employed to perceptively shift the avatar into the real environment of the user? To what degree can an individual’s physical actions be determined or influenced by an illusory presence?

This project aims to apply techniques of illusion to encompass what Lombard identified as the key factors in the induction of presence.

A medium that becomes invisible and produces a perceptual illusion of nonmediation analogous to an open window can provide rich verbal and nonverbal information for social interaction (presence as social richness); objects and entities in such a medium should appear

perceptually (if not socially) vivid and real (presence as realism); the illusion that there is no medium at work means there is no border between “this side” and “the other side” of the medium, so users can perceive that they have moved to the other side, that objects/entities from the other side have entered their immediate environment, or that they and other users are sharing a real or artificial environment (presence as transportation); the illusion of nonmediation will be more complete if the medium is perceptually and psychologically immersive (presence as immersion); and if we encounter people or entities within such a medium, even if there is no possibility of true social interaction with them, we are encouraged to respond to social cues they provide just as we would in nonmediated communication (presence as social actor within medium). Finally, when the medium itself presents us with social cues normally reserved for human-human interaction we are likely to perceive it not as a medium but as an independent social entity, a transformed medium (presence as medium as social actor).

Lombard and Ditton [1997]

Addressing all of these factors successfully could be considered the holy grail of interactive/immersive media arts in the creation of engaging and compelling work. “Dislocation” demonstrated some success in applying these various attributes of presence. It is hoped that the current project will provide further scope to employ these elements and demonstrate the effectiveness and potential of comprehensive media environments.

## 7. CONCLUSION

“Dislocation” attempts to create a mixed-reality environment in which the virtual world inhabits the viewers’ physical reality. By utilizing convincing techniques of illusion to distort the perception of individuals, compelling works can be created that encourage sustained user interaction and engagement on several levels. In light of the outcomes of public presentations, the work clearly succeeded, due to the pronounced and visceral reaction of audience members.

Further investigation into the nature of emotional response to virtual human presence in these environments (i.e., the unexpected success of the banal and everyday scenarios) will be pertinent for future progress. The phantoms not only provided individual narratives but also gave rise to unexpected social interactions between humans. The surprising ability of these virtual entities to mediate and influence the behavior of the audience clearly shows scope for further applications which the work initially did not set out to investigate, particularly in the ability to create a sense of inverse presence.

Although “Dislocation” succeeded in both looking and sounding real, there was a deficit in the ability of the virtual forms to “act real”. Due to the use of precomposed video sequences, only a superficial degree of audience interaction was possible.

This can be solved via use of 3D graphics, but to the detriment of “looking real”. Due to the current level of sophistication in computer technologies, further exploration into methods that provide a higher degree of exchange between realistic video representations and humans is necessary, and would extend the potential and depth of mixed-reality installations.

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