Don't listen to the Light: Critical Interaction Design in a Tangible Narrative System

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Abstract
Interactive Digital Narrative (IDN), as a form of expression that blends storytelling with participation, has been widely adopted across many fields. Examples include scenario-based interactive games in theme parks and story-driven dining designs in restaurant settings. In such narrative systems, the audience is not just a task performer, but also an active participant in a branching, multi-ending story experience. In the past, most digital narratives depended on screen-based interaction. However, in recent years, the HCI community has recognized the benefits of physical interaction, leading to the rise of Tangible Narrative (TN). This project proposes and implements an interactive narrative device based on Mixed Reality (MR), which uses critical design to present an art piece. By merging physical interaction with an immersive virtual narrative, this work encourages viewers to reflect on the central themes of its artistic expression.

Author Keywords
Interactive Digital Narrative, Tangible Narrative, Mixed Reality, Critical Interaction Design**,** Storytelling

CSS Concepts
• **Human-centered computing~Interaction design**; *Systems and tools for interaction design*

Introduction
Storytelling is widely applied in education, psychology, and even business [14, 13]. A good storyteller and a compelling story can easily draw people from different backgrounds into a state of immersion, empathy, and reflection. With the rise of multimedia and interactive technologies, narrative forms have evolved beyond text and film to include digital games [1], web-based stories [16], and interactive applications [15]. Meanwhile, storytelling structures have progressed from a single, linear ending to interactive narratives, in which users'

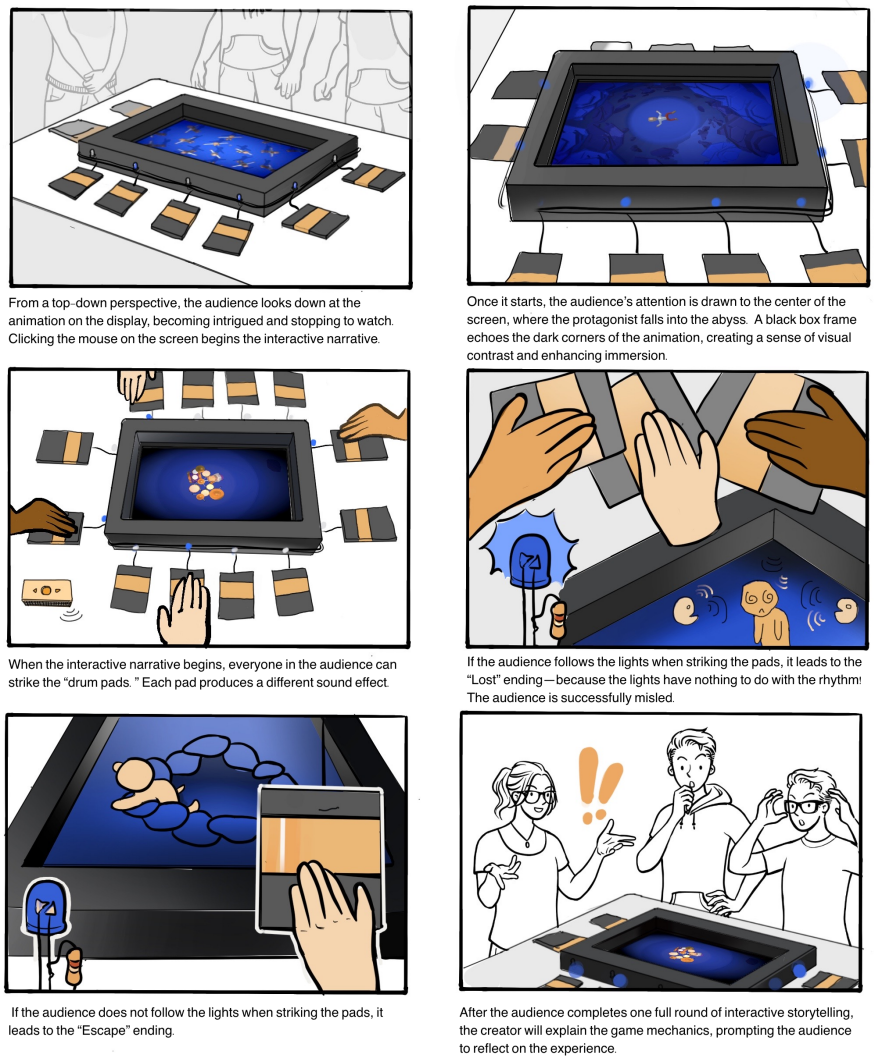


Figure 1: User Journey Storyboard

choices or actions dynamically influence how the story unfolds [4].

Interactive Digital Narrative (IDN) is "a form of narrative expression implemented and defined by digital media [7]", using technology to expand storytelling possibilities. However, Tangible Narrative (TN) emphasizes physical media-based interaction, leveraging touch and movement to strengthen the audience's sensory bond with the narrative [7]. In this study, TN is interpreted as a mixed reality (MR) storytelling mechanism [10], where the audience interacts with tangible objects to influence the direction of the virtual story, thereby achieving multiple layers of immersive experience. To realize this approach, a MR-based interactive narrative system has been designed and implemented, combining digital narratives with physical interaction. In this system, the audience not only watches the story on a screen but also uses hardware operations to affect the story's progression (see Fig. 1).

In terms of narrative content, apart from using an interactive narrative framework, the system also applies a critical design method, deliberately introducing "bias" to prompt audiences to rethink the value of "authenticity". Through the use of lighting cues and touch feedback—tapping into the common perception that "lighting usually indicates guidance"—the system misleads viewers to follow the lights, leading to a negative outcome that encourages reflection on rules. This project aims to deliver an immersive visual and auditory experience along with a sense of participation, inspiring philosophical contemplation among its audience.

Background

Interactive Digital Narrative

Over the past 50 years，interactive storytelling has matured significantly, evolving from early text-based and hypertext-based adventures to the immersive and highly realistic experiences seen in recent years [4]. This rapid evolution presents unique opportunities

Figure 2: Liu J et al. developed an MR-based aquarium system to support cognitive training in young children with ASD by combining real aquatic environments with interactive virtual content.

Figure 3: Disney's MR projection: The upper image show the set under normal room lighting conditions, while the lower image includes the projected augmentation.

for designers and researchers in the field of interaction design, with the aim of enabling technology to support more immersive and seamless narrative experiences [4]. Interactive narrative enables the storyteller to convey ideas to an audience while allowing that audience to participate in ways that influence the story's direction, prompting reflection on the story's themes [2]. Currently, some interactive art projects use this form of narrative to reflect questions such as identity, control, and power structures [12, 5]. By engaging with the narrative, participants can "personally experience" the protagonist's situation and outcome, thereby stimulating critical thought. Like traditional storytelling, interactive narratives also involve a variety of design strategies. One topic is how the narrative point of view affects the audience's emotions. For example, when users view and make decisions from a "god's-eye view," they typically maintain some emotional distance, and this more detached form of involvement can spark philosophical reflection—giving it unique importance in narrative expression. Therefore, interactive narrative serves as a bridge between the audience's subjective experience and the artist's intent, making art not only something to "look at" but also to "participate in," "feel," and "reflect upon." In light of this, the project aims to undertake an exploration of how embodied MR interactive storytelling and artistic expression might be realized.

Interactive Narrative in a MR Environment

In the field of HCI, various technologies have been employed to enhance storytelling experiences, including Virtual Reality (VR), Augmented Reality (AR), and MR [10]. This project is regarded as an MR interactive design because it uses real-world, physically based interactions to enhance engagement. Typically, in MR, participants interact within a real physical environment without the direct use of computers or standard interaction devices [10]. For example, Liu J et al. developed a smart fish tank using MR technology for educating children with autism about fish, where users can touch the tank to interact with digital fish (shown in Fig. 2) [8]. Meanwhile, in multi-user scenarios, MR interaction enables seamless face-to-face collaboration among participants. For instance, Disney Parks have applied projection-based augmented reality in "The Storytellers Sandbox" and "Goofy's Paint 'n' Play House" (shown in Fig. 3) [9]. In short, designing interactive narratives in MR involves complex sensory mechanisms, yet its primary goal is to make interaction feel as natural as possible.

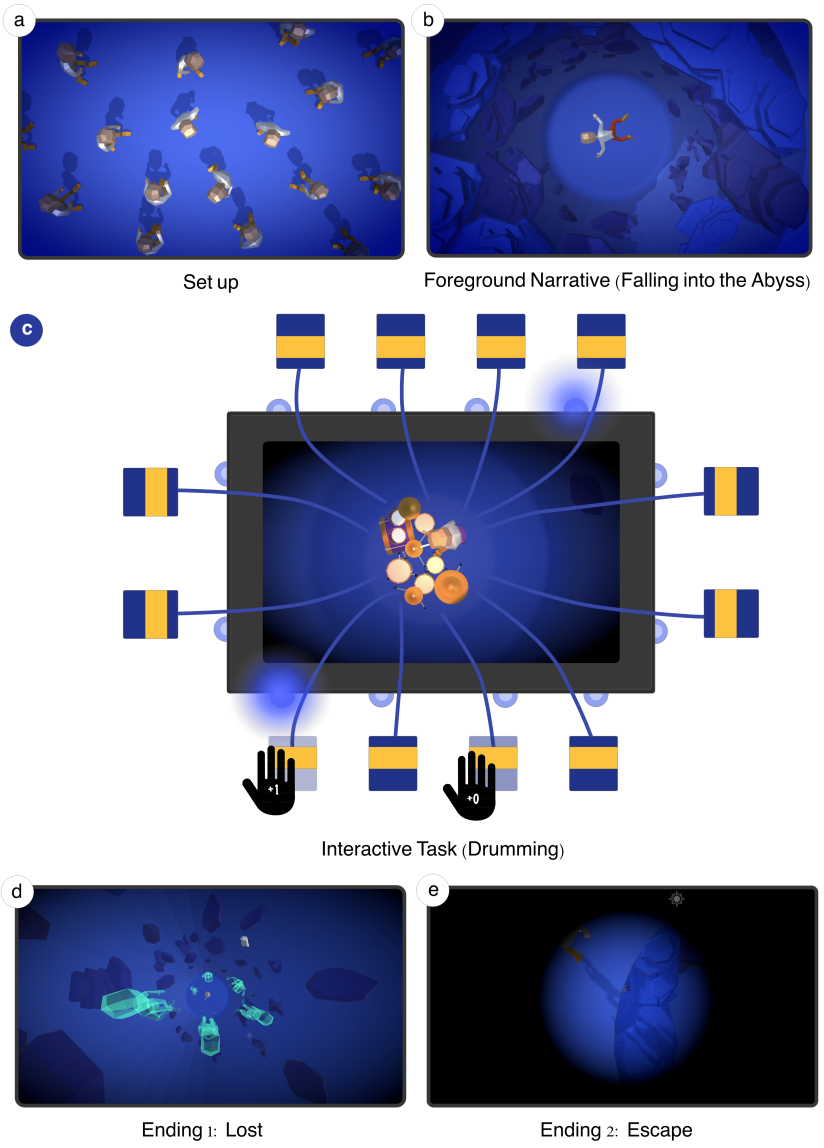
Figure 4: "Coffeepot for Masochists" is a famous piece of critical design by Jacques Carelman. The coffeepot has both the spout and the handle on the same side.

Critical Design

The intention of critical design is to use design as a way of engaging with social, cultural, and technological critique, transforming products from mere "problem-solving" tools into mediums for "raising questions" and "sparking discussion" [3]. For instance, James P et al. developed ten digital cameras were deliberately redesigned with reverse features (such as ultra-low-resolution displays or one-time-use settings) to explore new possibilities for digital constraints [11]. This approach can turn something familiar into objects that are "strangely bizarre," "strangely problematic," or "strangely useful". A few design pieces illustrate this idea, including Jacques Carelman's "Catalogue of Impossible Objects-Coffeepot for Masochists" (see Fig. 4). A coffeepot that coffee cannot be poured smoothly. It is not intended for convenience, but rather for prompting reflection on society's "efficiency-first" mindset regarding everyday appliances. This raises questions such as: Why must every product be "useful"? Who decides what is "user-friendly"?

Experience

This project focuses on using an MR-based interactive narrative installation to prompt audiences to reflect on the value of "Authenticity". Authenticity here means doing something out of genuine personal desire rather than for external rewards, respecting and showcasing individual uniqueness. Typically, lights are considered supporting visual aids in interaction design. However, in



this project, lights are misleadingly designed. When they flash in a regular pattern, users are easily inclined to follow the lights' guidance to interact with the system. If users follow the lights' guidance, they are actually led to a failing outcome. Building on this concept, I designed an interactive narrative game:

This interactive narrative art installation invites the audience into a multi-sensory experience that unfolds across a series of symbolic scenes. Fig. 1 presents the audience's experience throughout the interactive narrative in the form of a storyboard. From a top-down, "God's-eye view" perspective, viewers observe a virtual representation of themselves engaging with music in various forms—playing guitar, drumming, dancing, and performing on the piano—each act signifying the infinite creative potential of the individual (see Fig. 5 (a)),.

At the beginning of the experience (see Fig. 5 (b)), during the first 20 seconds, the audience witnesses their avatar falling into a deep pit. In an attempt to call for help, there is no response. The silence is soon broken by the eerie sound of drums and the growl of a lurking creature, suggesting that only by completing a musical composition can the character escape. This segment metaphorically represents the moments in life where one feels lost and is confronted with the necessity of making a personal choice.

In the subsequent 60-second interactive segment (see Fig. 5 (c)), the audience is prompted to perform a drum sequence. They may choose to follow a pre-programmed visual guide, represented by flashing lights, or improvise freely, responding with their own rhythm and tempo. This choice places users in an active decision-making role within the system, emphasizing responsiveness and agency.

As the interaction progresses, it becomes apparent that the visual guidance is misleading—the lights are not synchronized with the music. Following them without question results in dissonance and confusion, symbolizing the loss of individual direction when one succumbs to external influences. This path leads to a "lost" ending, where the character remains trapped, consumed by the noise and expectations of others (see Fig. 5 (d)),.

Alternatively, if the audience discards the deceptive visual cues and instead follows their internal sense of rhythm—creating unique and self-directed beats—they unlock the "escape" ending. In this version, the avatar climbs out of the abyss, symbolizing the rediscovery of authentic self-expression and liberation from imposed constraints (see Fig. 5 (e)).

Conception

In this section, I will present my concept through the primary components of interactive narrative: plot and visual layout design, MR–based immersive design, music and interaction design, character and environment design, and color scheme.

Plot and Visual Layout Design

In designing the plot and visuals, this work makes extensive use of metaphors to build associative bridges for the audience. First, throughout the entire narrative, a "Set up" page is used to draw the audience into the story with a positive, calm opening. Accordingly, the "Set up" page features mysterious overhead lighting and a loose, relaxed scatter composition (see Fig. 5

Figure 6: Physical Prototype

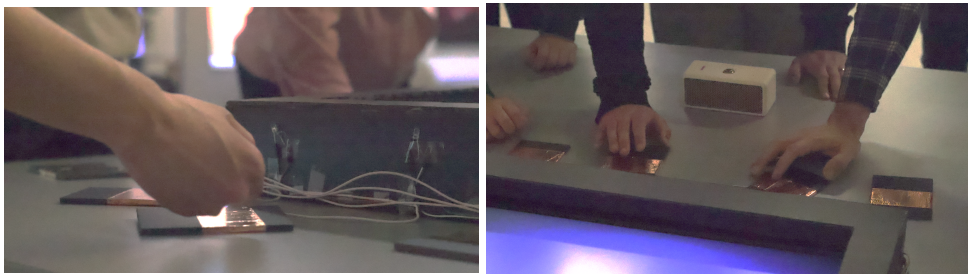


Figure 7: The audience is striking the “drum pads”.

(a)). Next comes a 20-second “falling into the abyss” animation (see Fig. 5 (b)), which not only symbolizes “descending into danger” but also serves as a prologue to the main narrative and game mechanics, creating a transitional link. At this point, the scene shifts to central composition, placing the primary animation in the middle of the screen and immediately capturing the viewer’s. Both the “Interaction” and “Ending” sections also adopt a central composition to keep the audience focused.

Finally, whether the ending is “Escape (see Fig. 5 (d))” or “Lost (see Fig. 5 (e))”, it employs the strategy of "leaving blanks" to blur fate. In the “Escape” ending, the protagonist’s destination is not shown (encouraging the audience to think, “Where would I go if I follow my own heart?”). In the “Lost” ending, the character stands up, but their ultimate outcome (success or failure) is not revealed (inviting the audience to wonder, “Where would I end up if I blindly follow others?”).

MR–Based Immersive Design

An immersive experience can enhance both audience engagement and the overall experience. Therefore, I chose a 3D approach. First, since making 3D objects appear to pop out of the screen requires specialized equipment (like VR), I opted to make the visuals sink instead, as if there is a “hole” on the table (see Fig. 6). The audience then views the action from a top-down “God’s-eye view,” allowing their physical behavior to seamlessly connect with the digital narrative environment and reinforcing immersion. Second, I applied vignette effects to intensify the visual illusion and guide the viewer’s attention. This simulates gradually fading light, making the hole seem deeper. Third, I employed an artistic technique of manipulating size and clarity, rendering objects near the edges blurrier and larger. This approach, without distracting the audience, further enhances the visual illusion. Finally, I incorporated animated camera push-and-pull transitions at narrative junctures to further heighten the immersive quality.

Figure 9: The screen displays the Miro interface running on the computer located beneath the table.

Music and Interaction Design

In this artwork, playing percussion is the main narrative task. The audience can choose to follow the misleading lighting cues to tap the "drum pads, (see Fig. 7)" or trust their own instincts. Each time a viewer triggers a pad, a short sound effect is played in the software. The main electronic drum track comes from George Michael Brower & Jonathan Baken [17], featuring surreal sound effects, straightforward drum rhythms, and a moderate tempo. It can provide a fresh auditory experience while remaining accessible and easy for novice audiences to follow. The audio was edited to include ten-second fade-ins and fade-outs before and after the main track, ensuring a smooth transition between different sections of the narrative.

Character and Environment Design

Most of the 3D models, animations, and material designs were guided by the author's experience in 3D animation. A low-poly style was chosen to enable quick development. The character is gender-neutral, with movements designed to reflect the plot, and clothing kept simple so that the audience can focus on the narrative itself, which is the central task of the work.

Color Scheme

From a color perspective, large areas of blue serve as the background because blue evokes a sense of calm, mystery, and stillness. Orange, blue's complementary color, is used on focal objects that require emphasis, creating a clear visual center. A small amount of white (achromatic) fills in less important details to avoid color clashes. Meanwhile, certain environmental objects use a transparent glowing material for highlights, making the scene richer and more engaging overall.

Implementation

Technical Implementation

The hardware for this project is divided into two parts (see Fig. 8): a lighting system and a touch-input system. The lighting system is an independent setup based on an ESP-32S3 microcontroller. 12 LED bulbs, each paired with a resistor, are connected to the ESP-32S3's 12 channels. Using an adapted Arduino light-control sample code, three channels are set to blink every 0.5 seconds, making audience more likely to

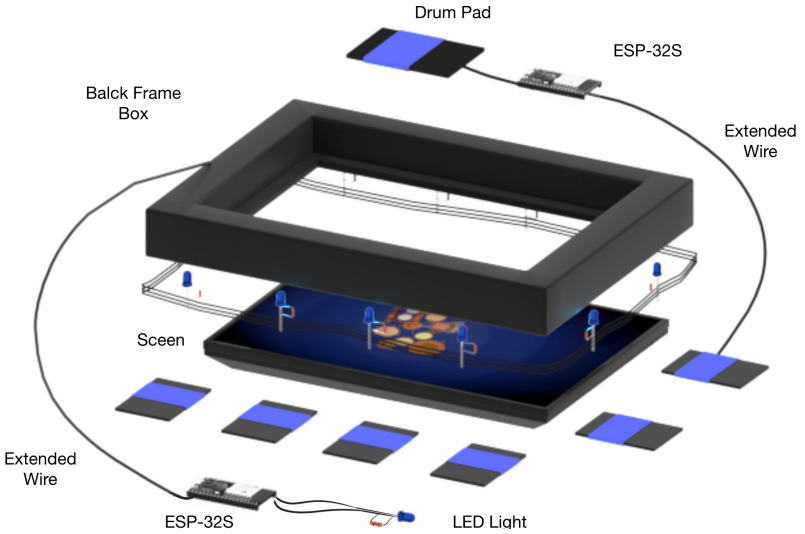


Figure 8: Technical Architecture of the Prototype: This diagram illustrates the overall logic of the system implementation.

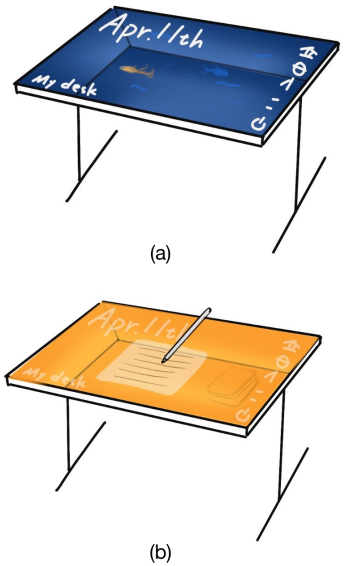


Figure 9: "Extending Downward" Immersive Design — The Desk of the Future. (a) illustrates the concept of using a display as the desktop surface, where an animated fish tank is shown. When viewed from above, it creates the illusion of a "sunken aquarium." In (b), the setup allows users to write directly on the desktop using a digital pen, with their notes saved seamlessly "inside" the screen.

follow the lights and tap the "drum pads." The remaining nine channels flash randomly every four seconds, masking the misleading effect of the first three LEDs. These LEDs and resistors are mounted on one side of a black frame box via extended wiring. The touch-input system uses another ESP-32S3 to receive data from 12 "drum pads," which is then sent to the Unity game engine in real time. Each "drum pad" is a piece of conductive copper attached to black cardboard and wired to an ESP-32S3 touch channel. When a person touches the copper, the change in capacitance is detected, and the ESP-32S3 sends that data to a computer on the same Wi-Fi network through a UDP protocol. Because attempts to receive this data directly in Unity were not successful, a third-party software, Max-MSP, is used to receive the signal and forward it to Unity. Each of the 12 "drum pads" triggers a different sound effect in Unity. These "drum pads" are also attached to the black frame box via extended wiring. During the 60-second drumming segment, if Unity detects signals from the channels corresponding to the misleading LEDs, it awards one point per hit. Accumulating more than 20 points within 60 seconds indicates that the user is following the misleading light, leading to the "Lost" ending. Fewer than 20 points triggers the "Escape" ending.

Design Implementation

In the design, all UI elements were removed to give users a more cinematic experience of interactive "Set up" page to begin the game, after which the other four scenes run automatically and eventually return to the "Set up" page. The environment 3D model was created in Cinema 4D, imported into Unity, and assigned materials. Owing to time constraints, most of the 3D models for characters and objects, as well as materials, were freely downloaded from the Unity Asset Store. Each character animation file was downloaded from Mixamo, then integrated with the 3D character model in Unity, and sequenced to fit the story. Audio such as yelling, gasping, and demonic roars was recorded by the author and modified using AI to achieve a more neutral tone; other sounds, such as various drum hits and footsteps, were downloaded from SoundFree.

Discussion

How Does MR Technology Create Immersion in Interactive Storytelling?

A major advantage of MR is that it blurs the boundary between the physical and digital worlds, guiding users to interact with digital products in a more natural and non-intrusive way. In this project:

A black frame box is used in the physical environment to decorate the screen, corresponding to the black vignettes and "deep hole" in the digital world. Blue LED lights match the blue color scheme in the digital world. Meanwhile, the user's action of striking physical "drum pads" parallels the on-screen character's drumming during the interactive portion. The audience is positioned to view the screen from a top-down perspective, aligning with the top-down view in the digital environment. These elements aim to immerse the user in the story from three angles: environment, interaction, and user. Overall, the MR approach here is employed to tell the story, and all hardware interactions support specific narrative tasks—creating a more immersive interactive experience.

Additionally, I noticed many immersive technologies focus on "extending upward"—making 3D objects pop out (e.g., VR, AR, holograms). Far fewer interactive technologies and artworks focus on "extending downward," as in this project's approach of leveraging

MR to produce a visually immersive "depth" effect. These "upward" technologies typically require specialized, often expensive equipment. Given today's advanced displays, "downward" approaches could also be promising. For instance, a table with a built-in display could be set up as if it were a sunken fish tank (see Fig. 9 (a)); or a table with a display capable of storing notes "beneath" (see Fig. 9 (b)) the surface—arguably more convenient than wearing a heavy VR headset for office work.

Did Critical Design Mislead the Audience?

In this work, *"the lights and the drum track are unrelated."* During the exhibition, over half of the audience followed the misleading lights and were surprised when they learned of the deception. It appears the project successfully provoked reflection on its narrative content. However, some audience stated they did not notice the lights at all because *"they're mounted off to the side and are quite inconspicuous."* Others said, *"I wasn't actually following those lights; I just liked the sound effect from that particular 'drum pad'... I needed it."*

To be honest, half of the viewers appeared confused the first time they interacted with the system—possibly because the introduction and the interactive task were too short. They had little time to become immersed in the story before it was over. However, I want to note that existing human factors research has long examined how buttons and materials can accommodate human usage habits. Products that violate normal usability standards can be deployed in specialized scenarios. For instance, most bottle caps open clockwise, but certain medications have caps that open HCI research might not only explore how new generations of users effectively operate machines but also how deliberately non-intuitive designs could be applied in certain contexts.

Limitation and Future Work

As an artwork, this project currently provides only a short interactive narrative experience, so future iterations could focus on optimizing details such as the transitional scenes and a more complete storyline. Additionally, owing to time and workload constraints, the digital character's drumming animation during the primary interactive task is limited to a single motion rather than matching each individual drum sound. A next step might include more nuanced sampling and skeletal rigging to improve realism. From the perspective of interaction research, this work does not yet offer a complete interactive framework for others to build upon; researchers could explore various narrative themes and develop a mixed reality–based interactive storytelling toolbox. Finally, the piece achieves immersion in part by surrounding a computer screen with a black frame, but future enhancements might incorporate reflective surfaces on or around the screen to create a more three-dimensional effect.

Acknowledgements

The character in the teaser image of the title was generated by ChatGPT-4o, so no privacy processing is required. The model is a 3D rendering and not a real photograph. Similarly, Figure 8 is also a rendered model and not a real image.

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