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# Design Considerations for Mid-Air Interaction with Holographic Projections

**Sriram Karthik Badam**

Dept. of Computer Science  
University of Maryland  
College Park, MD, USA  
sbadam@umd.edu

**Niklas Elmquist**

College of Information Studies  
University of Maryland  
College Park, MD, USA  
elm@umd.edu



**Figure 1:** Holographic projection display from Avatar (2009).  
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## Abstract

Display technologies are rapidly evolving. We are ever closer to 3D holographic projections as envisioned in modern films including the Iron Man series, Pacific Rim, and Avatar. Interactions with holograms seen in these films share common design aspects such as direct manipulation and surrogate interaction. In this paper, we outline the design considerations for mid-air interaction based on popular films, and extend them using the current state-of-the-art in HCI for implicit and explicit interaction with displays distributed in a physical environment. These considerations can guide future holographic projection systems and promote discussion on mid-air interaction with holograms.

## Author Keywords

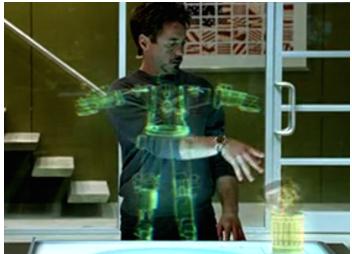
Mid-air Interaction; Direct Manipulation; Proxemics

## ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces—*Interaction Styles*

## Introduction

Popular science fiction has always inspired and influenced the public perception of future advances in modern technologies. Starting from holographic communication in the Star Wars movies to the advanced user interfaces seen in the Iron Man series, Her, and Avatar, futuristic tech-



**Figure 2:** Direct manipulation of a hologram and surrogate interaction using a trash bin in Iron Man.  
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**Figure 3:** Direct manipulation of a hologram in Iron Man 3 (2013).  
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**Figure 4:** Direct Manipulation of a hologram in Tron: Legacy (2010).  
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nologies and interfaces (Figure 1) projected in films (<http://www.noteloop.com/kit/fui/>) have created much enthusiasm regarding the future of HCI. However, these fictional interfaces orchestrate specific interactions that fall into the narrative of the movie, and therefore may not capture the underlying design aspects necessary to develop such interfaces. In this paper, we outline the design considerations for mid-air interaction with holograms based on the fictional interfaces and augment them with the design aspects and choices from current research in 3D user interaction.

### Design Considerations for Mid-Air Interaction

We often see appearances of reality-based interaction [4]—following the properties of the physical world—and fluid interaction models [1] in modern films. This includes,

**Direct manipulation.** Fictional interfaces often feature direct manipulation of holographic projections (Figures 2, 3, 4). For example, it appears in Iron Man (2008) when Tony Stark works with a 3D model of the Iron Man armor by rotating, scaling, and manipulating its hologram as if it is a real-world object (Figure 2). Furthermore, in Tron: Legacy (2010), Kevin Flynn repairs the damage to Quorra (an isomorphic algorithm in the Grid) by manipulating the hologram of her code structure resembling a DNA strand (Figure 4).

**Surrogate interaction.** There is often a gap between the physical world showing the holograms and the digital interface. While there are visual aspects that can be naturally turned into holograms (e.g., 3D visualizations), other UI elements require transformation into surrogate 3D objects to carry out their associated actions. For example, in Iron Man (2008), a trash bin appears beside the holographic model to enable surrogate interaction to delete components (Fig. 2).

These interaction design aspects are often reinforced by naïve physics providing a realistic visual feedback. How-

ever, there are more aspects that can be considered for mid-air interaction especially related to implicit interaction based on the physical relationships between the people and objects in an environment (proxemics [2]) and explicit interaction through gestures inspired by our social actions.

**Implicit interaction (proxemics).** Proxemics define the relationships between people (e.g., distances) as they interact with each other [3]. In HCI and UbiComp, there are five key proxemic dimensions—distance, orientation, movement, identity, location—for implicit interaction design [5], where the system automatically triggers actions without requiring the user's attention. Implicit interaction can add to the realism of holograms, for e.g., a hologram of a person can be more effective when it automatically reacts to the orientation of the users interacting with it.

**Explicit interaction (gestures).** Interaction with holograms can also be inspired by explicit social actions in the everyday world such as pointing, waving, and nodding. Gestures can be symbolic (e.g., a thumbs up), deictic (e.g., pointing), iconic (e.g., showing particular movement), and pantomimic (e.g., using an invisible tool) [6]. These design choices can improve the familiarity and naturalness of interaction with holograms and make it more effective.

**Cross-device interaction.** Beyond these aspects, using multiple handheld and portable devices can add more context-specific features to interaction with holograms. For example, they can act as temporary space to transfer information from one hologram to another.

### Conclusion

These design considerations offer a starting point to mid-air interaction design for holographic projection systems. During the workshop, we plan to provide more examples and promote discussion about these design considerations.

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