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The *Interactions* website (interactions.acm.org) hosts a stable of bloggers who share insights and observations on HCI, often challenging current practices. Each issue we'll publish selected posts from some of the leading voices in the field.

From Stereoscopes to Holograms: The Latest Interaction Design Platform

Shortly before photographs became widely available in the first three decades of the 19th century, stereoscopes appeared. We've been flirting with portable, on-demand three-dimensionality in experience ever since.

From Sir Charles Wheatstone's 1838 invention of a dual display to approximate binocular depth perception (Figure 1) to the ViewMaster fad of the 1960s, people have long been captivated by the promise of a portable world. Viewing two-dimensional images never seemed enough; three-dimensional images of Confederate dead at Gettysburg or a unique naval vessel helped connect people with something more real.

Lately I've been experimenting with Microsoft's HoloLens, an augmented-reality (AR) headset that connects to the Internet and also hosts standalone content. Similar to other wearables such as Google's now-defunct Glass, HoloLens requires the user to place a device on their head that uses lenses to display content. As an AR device, it also allows the user to maintain environmental awareness—something virtual reality (VR) devices don't.

Many other folks have written reviews of these devices; that's not my purpose here. Instead, I've been thinking about the interaction promises and pitfalls that accompany AR devices. I'll use the HoloLens as my platform of discussion.

The key issues for interaction in AR revolve around discoverability, context, and human factors. You have to know what to do before you can do

Figure 1. This image of the original U.S.S. Monitor shows what a typical stereoscope card looked like.

it, which means having a conceptual model that matches your mental model. You need an environment that takes your context into consideration. And you need to have human factors such as visual acuity, motor functions, speech, and motion taken into account.

Discoverability. We talk of affordances, those psychological triggers that impart the enablement of action. Within an augmented world, however, we need to indicate more than just a mimicked world.

Once the device sits on a user's head, the few hardware buttons on the band enable on/off and audio up/down. Because the device is quick to turn on or wake from sleep, it

provides quick feedback to the user. This critical moment between the invocation of an action and the action itself becomes hypercritical in the augmented world. Enablement needs to appear rapidly.

For HoloLens users, the tutorial appears the first time a user turns on the unit. It's easy to invoke it afterward as well. Yet there is still a need for an in-view image that enables discoverability.

Context. Knowing where you are within the context of the world is critical to meaning. As we understand from J.J. Gibson, cognition is more than brain stimulation: It's also a result of physical, meatspace engagement.

So a designer of an AR system must understand the context in which the user engages with that system. Mapping the environment helps from a digital standpoint, but awareness of objects in the space could be clearer. Users need to know the proximity of objects or dangers so they don't fall down stairs or knock glasses of water onto the floor.

Human factors. Within AR systems, the ability to engage

Cognition is more than brain stimulation: It's also a result of physical, meatspace engagement.

The author using the HoloLens.

physically, aurally, and vocally entails an understanding of human factors. Designers need to show concern for how much physicality the user needs to address.

In the HoloLens, users manipulate objects with a pinch, a grab, and a “bloom”—an upraised closed palm that then becomes an open hand. A short session with HoloLens is comfortable; too much interaction in the air can get tiring.

Voice interfaces litter our landscape, from Siri to Alexa to Cortana. HoloLens users can invoke actions through voice by initiating a command with “Hey, Cortana.” They can also engage with an interface object by saying, “Select.” Yet too often these interfaces smack of marketing- and development-led initiatives that don’t take context, discoverability, or human factors into account. (The recent movie *Passengers* mocks voice interfaces a little, through scenes in which the disembodied intelligence doesn’t understand the query.)

We’ve all had similar issues with interactive voice response (IVR)

systems. I’m not going to delve into IVR issues, but AR systems that rely on voice response need to take human factors of voice (or lack thereof) into account. A dedicated device such as the HoloLens seems to be more forgiving of background noise than other devices, but UX designers need to understand how the strain of accurate voicing can impact the user’s experience.

Back to basics. User experience designers working on AR must understand these basic core tenets:

- Factor in discoverability of actions into a new interaction space.
- Understand the context of use, to include safety and the potential nuisance to neighbors.
- Account for basic human factors such as motor functions, eyestrain, and vocal fatigue.

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