Mediating Awareness and Communication through Digital but Physical Surrogates

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ABSTRACT
Digital but physical surrogates are tangible representations of remote people positioned within an office and under digital control. Surrogates selectively collect and present awareness information about the people they represent. By having them react to physical actions of people, surrogates can control the communication capabilities of a media space. This enables the smooth transition from awareness to casual interaction while mitigating concerns about privacy.

INTRODUCTION
Traditional methods for providing informal awareness and mediating casual interaction in distributed communities include media spaces [1], video glances [9], periodic video snapshots [4] and iconic presence indicators [6]. These methods channel awareness and communication through a single device, typically a computer, which raises several concerns [2]. First, awareness and communication displays compete with other computer applications. Consequently, they are often buried under windows or set aside. Second, people who are peripheral computer users cannot attend to awareness information in-between uses.

We are investigating an alternate "out of the box" approach to awareness and casual interaction that we call *digital but physical surrogates:* digitally controlled physical surrogates of distant team members positioned within a person's environment. Our goals are to design surrogates that:

- support the smooth transition from awareness to opportunistic and one-person initiated casual encounters, to conversation and work;
- mitigate privacy and distraction concerns endemic to most awareness systems.

Specifically, we use physical devices situated in one's environment [2,3,7] and separate from the computer to:

a) capture and embody a remote person's activities; and
b) serve as channels for video and audio communication.

In this paper and in the companion video we illustrate by example what we mean by digital but physical surrogates.

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Mediating Awareness and Communication through Digital but Physical Surrogates. ACM CHI'99 Video Proceedings (7 minute video) and Proceedings of the ACM SIGCHI '99 Conference Extended Abstracts (two page summary).

SURROGATES PRESENTING AWARENESS OF OTHERS
The first class of our surrogates illustrates how activities of a remote person can be embodied within a physical surrogate located in a local office.

The dragonfly surrogate is a motorized model altered so that its motor is under digital control. Its activity corresponds with bursts of activity by the remote person. When the remote person is inactive or absent, the dragonfly too is inactive. As a person becomes active, the dragonfly initially flaps its wings furiously and audibly for a few moments, but then slows to gentle and quiet wing motions.

The peek-a-boo surrogate combines a figurine and a servo motor (Figure 1). The surrogate faces the wall when the remote person is not present, but rotates to face the local person as a remote person's activity is detected. This also produces a slight sound, another awareness cue. One can sense another's activity level at any time by glancing at the surrogate's orientation. Unlike the dragonfly, the surrogate represents state information continuously by its orientation.

The light surrogate displays other's activities as moving light patterns across the ceiling of a room. This illustrates that surrogates can be abstract entities as well as figurines.

SURROGATES FOR INDICATING INTEREST IN OTHERS
The next class of surrogates illustrates how a person can explicitly express different degrees of interest in others by manipulating a surrogate.

The mutant ninja surrogate is a figurine that represents a distant person. It transmits rather than presents awareness information. When the local person holds the figurine (which is instrumented with a heat sensor), the remote person is notified about the other's interest.

The responding surrogate is a figurine whose position defines the degree of interest one has in the remote person. In Figure 1, if the local person explicitly positions their responding surrogate on the stage (facing the peek-a-boo surrogate), the remote person will be notified that the local person is interested in them. Moving it off the stage, or tipping it over, indicates progressively lesser degrees of interest (positions are detected via light sensors.)

SURROGATES FOR CONTROLLING A MEDIA SPACE
The final class of surrogates illustrates how they can be used to mediate communication.

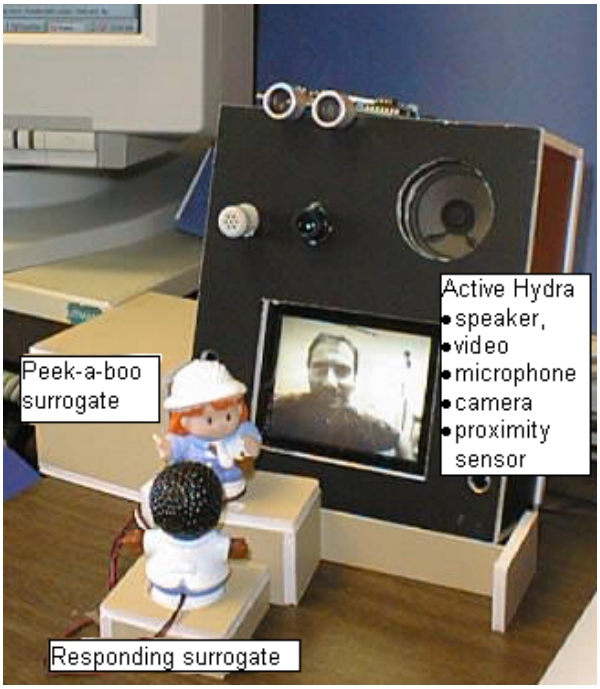

Figure 1. A variety of interacting surrogates

The Active Hydra surrogate (Figure 1) embodies a video/ audio connection to a single remote person. We instrumented Hydra units [2,3] with proximity sensors that measure how close a person is to it. Unlike the original Hydra [3], the presence or absence of the audio and the quality of the video [8] is controlled implicitly by a person's position relative to the surrogate. When both people are close to their Hydra units, they have a full audio/video channel. As one moves away from the unit, audio is disabled. Moving even further away degrades the video to occasional glimpses into each other's space.

Combining the Active Hydra and responding surrogate provides people with both implicit and explicit control over the media space. In this case, a full two way communication channel is established only when both people are close to their Hydras and when both have positioned their responding surrogates on the stage (Figure 1). When a responding surrogate is off the stage, the communication channel is restricted somewhat as at least one of the people has not expressed enough interest in the other. Thus the permeability of the communication channel is a function of both implicit personal proximity to the Hydra and explicit positioning of the responding surrogate.

AWARENESS, COMMUNICATION AND PRIVACY

It should be self-evident from the examples and the video how surrogates can lead from awareness of others (providing opportunities for conversation) to light-weight establishment of communication (necessary for casual interaction and work). Because these devices are located in the physical world, they attract one's attention through natural environmental cues (sounds, movement, etc.), are easily and naturally manipulated, and can serve as dedicated and responsive communication conduits.

Surrogates also balance (somewhat) the information provided for casual interaction against the risks of distracting others and violating their privacy.

First, awareness surrogates are caricatures with only limited ability to express information. Consequently, surrogates are best suited for portraying only limited notions of availability that abstracts one's activity: while still providing a general sense of availability, this lessen the risk of intrusion. Thus surrogate design includes the decision of what measure of activity is captured (e.g., via office instrumentation), and how those measures are mapped onto the surrogate (e.g., light, sound, or motion).

Second, surrogates are a natural way to control video and audio quality [8], which in turn preserves privacy and minimizes distraction. We described how the Active Hydra limits our direct view into another's space by combining both explicit control of the channel with implicit acts, such as proximity. To further guard against privacy and distraction, these are reciprocal acts, where view fidelity depends upon the state of both people's surrogates and proximity. This provides reciprocity, where mutual interest balances what is visible on the communication channel.

Third, surrogates can express different levels of salience, and thus can mitigate distraction. One example is the surrogate's position within a room [2,3]: when placed close by and within one's normal field of view, it is a foreground, highly salient display. If positioned further away and out of direct line of sight, it becomes an ambient less salient display [7]. As well, we can design surrogates to embody different salience levels. The furious beating of the dragonfly's wings almost always attracts attention, while the gentle flapping does not. Large visual changes within the light surrogate are noticeable, while subtle changes are not. With the peek-a-boo surrogate, salience corresponds with changes in state, where larger changes produce more salient movements and sounds.

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