The Design of a Context-Aware Home Media Space: The Video

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ABSTRACT
Traditional techniques for balancing privacy and awareness in video media spaces have been proven to be ineffective for compromising home situations involving a media space. As such, we present the rationale and prototype design of a context-aware *home media space (HMS)*—defined as an always-on video media space used within a home setting—that focuses on identifying plausible solutions for balancing privacy and awareness in compromising home situations. In the HMS design, users are provided with *implicit* and *explicit control* over their privacy, along with *visual* and *audio feedback* of the amount of privacy currently being maintained.

Keywords. Casual interaction, video media spaces, privacy, telecommuting.

INTRODUCTION
A *home media space* (HMS) is an always-on video-based media space used within a home setting. It is designed specifically for the telecommuter who chooses to work at home, but who still wishes to maintain a close-working relationship with particular colleagues in remote office environments. Like all media spaces, the video provides the telecommuter with awareness information about their collaborator's availability for conversation, and a way to easily move into casual communication over the same channel.

Unlike office-based media spaces, a home media space has to pay considerably more attention to how the system appropriately balances privacy and awareness, because privacy concerns are far more problematic for home users. Homes are inherently private in nature, and appearances or behaviours that are appropriate for the home may not be appropriate when viewed at the office. As well, individuals in the home other than the telecommuter who gain little or no benefit from the HMS still incur its privacy threat.

These increased privacy risks suggest that home media space systems must incorporate techniques that somehow mitigate privacy concerns. One possibility is to simply adapt techniques already proposed for office media spaces. However, previous research [1] has shown that traditional image processing techniques do not suffice for home-based video conferencing situations. Image processing techniques are overly simplistic because they do not understand the context of their use. For this reason, our research focuses on designing a home media space using context-aware computing and dedicated physical controls.

OUR DESIGN PHILOSOPHY
Privacy regulation in real life is lightweight and transparent. We replicate this by providing lightweight and transparent privacy regulation in our HMS using context-aware computing as a tool for balancing privacy and awareness through implicit means. We enable one specific location—a home office/spare bedroom shown in Figure 1—with technology that senses who is around and then infers privacy expectations through a simple set of rules.

Context-aware systems can make mistakes and it is important that these mistakes do not increase privacy threats. As a result, we first warn users if an implicit action has initiated a privacy decreasing operation; and second, we provide an opportunity for users to override this operation. Continuous visual and audio feedback makes it easy to know how much privacy is currently maintained and users are able to fine-tune privacy and awareness levels with dedicated physical and graphical controls.

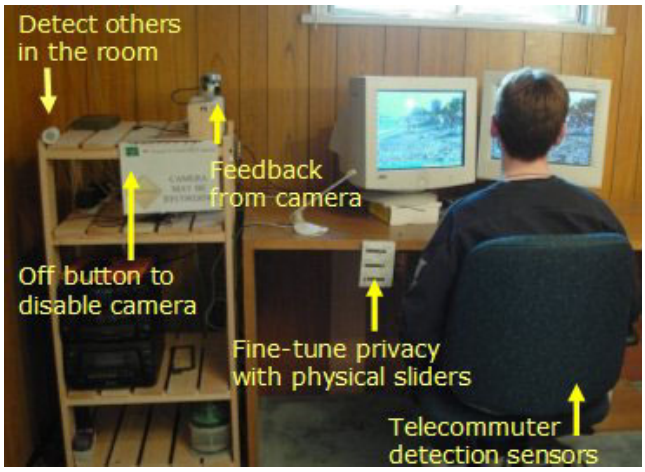

Figure 1: The context-aware home media space.

Cite as: Neustaedter, C. and Greenberg, S. (2003)
The Design of a Context-Aware Home Media Space: The Video. Video Proceedings of UBICOMP 2003 Fifth International Conference on Ubiquitous Computing.

1	2	3	4	5
Attribute Controlled	**Explicit Control**	**Implicit Control**	**Audio Feedback**	**Visual Feedback**
Camera State: Stop to Play	Click play button	None	Camera clicking; Camera rotating	LEDs on; Camera rotates to face you; Mirrored video
Camera State: Pause to Play	Click play button	Telecommuter sits in chair; Family/friend leaves room	Same as above; Camera Twitches	Same as above; Camera Twitches
Camera State: Play to Stop	Click stop button; Block camera with hand; Touch off button	None	Camera rotating	LEDs off; Camera rotates to face the wall; Mirrored video
Camera State: Play to Pause	Click pause button	Telecommuter stands up out of chair; Family / friend enters room	Same as above	Same as above
Camera State: Pause to Stop	Click stop button; Block camera with hand; Touch off button	Telecommuter leaves the room for an extended period of time	None	Mirrored video
Capturing angle	Adjust physical or graphical slider	Change in camera state	Camera rotating	Slider position; Camera position; Mirrored video
Video fidelity	Adjust physical or graphical control	None	None	Control position; Mirrored video
Audio link	Moves hand over microphone base	None	Own voice	None

Table 1: Control and feedback mechanisms found in the HMS

Elements of a Context-Aware HMS

Our design contains specific elements that can be used together to balance privacy and awareness:

Camera state. The camera can be in one of three states: Play (the camera is recording), Pause (the camera is not recording), and Stop (the camera is not recording and only an explicit action will move it out of this state).

Capturing angle. The camera, mounted on a rotating motor, is placed near the door and, given the desired camera angle, can capture any region of the room, except the doorway.

Video fidelity. Users can adjust the captured video's fidelity by explicitly adjusting the level of blur filtration used, the camera's frame rate, or the camera's frame size.

Gesture-activated blocking. Users can easily turn off the camera by explicitly blocking it with their hand.

Gesture-activated voice. Users can easily open an audio channel by explicitly moving their hand over a microphone.

Easy-off button. Users can instantly turn off the camera by touching an off button.

Telecommuter detection. We know if the telecommuter is present at the computer by detecting the implicit act of someone sitting down in or standing up from the desk chair. A radio frequency identity (RFID) tag in the pocket of the telecommuter identifies if the person sitting is the telecommuter.

Family/friend detection. We know if family/friends are present in the room by detecting the implicit act of walking into and out of the room.

Visual feedback. We use several visual cues to let the user know how much privacy is currently being maintained, e.g., a sign, LEDs, the camera's direction, mirrored video, and the position of physical and graphical controls.

Audio feedback. We also use audio cues to let the user know how much privacy is currently being maintained, e.g., the sound of a camera clicking and the sound of the camera rotating.

Table 1 summarizes how the design elements are either: controlled, used for explicit or implicit control, or used as feedback. Each row in the table describes how one media space attribute (column 1) is controlled either explicitly (column 2) or implicitly (column 3). The fourth and fifth columns describe the audio and visual feedback that indicate to the users that the attribute in column 1 has changed and what its current value is.

CONCLUSION

While we have concentrated on one specific use of video in homes, our research contributes ideas that have a broader significance for home-based videoconferencing in general. Irregardless of the specific use of video in a home, people need and desire methods to regulate their privacy; many video conferencing systems (e.g., Webcam for MSN Messenger, Yahoo! Messenger) ignore these user requirements.

REFERENCES

1. Neustaedter, C., Greenberg, S., and Boyle, M. Balancing Privacy and Awareness for Telecommuters Using Blur Filtration. Report 2003-719-22, Department of Computer Science, University of Calgary, January 2003.