AIBO Surrogate—A Group-Robot Interface

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ABSTRACT

New generation media spaces let group members see each other and share information, but are often static and separated from the physical world. To solve this problem, we propose the *AIBO Surrogate*—a robotic interface for a media space group, allowing members to extend their group interactions into the physical, real world. Distributed group members see a first-person view of what the robot sees and can control its walking direction, gaze and actions. For members physically collocated with the robot the *AIBO Surrogate* provides physical presence and awareness: a tele-embodiment of the distributed group.

1. INTRODUCTION

Robots can be viewed as computers with an active presence in the physical world. We propose using robotic capabilities to enhance a distributed group's casual interaction, which in turn can have crucial impact on the quality and effectiveness of the work of small groups [13]. While casual interaction is natural in co-located physical settings it is difficult when group members are separated by distances. Several groupware mechanisms have been suggested in an attempt to support informal awareness and casual interaction between distributed members. A common approach is to create a virtual space that is shared by all group members, e.g., Instant Messengers [6], chat rooms / MUDS [2], and video-based media spaces [1]. However, these systems are separate from the real world; participants cannot see beyond the computer, or engage people outside of it.

We suggest using a mobile robot as a substitute for the distant group. We believe robots can enable a distance-separated group to extend their media space interactions into the real world, creating a tele-embodiment that is *many to one*, where all see, hear and collaboratively control what the robot does as it interacts with group members in the real world. To explore this premise we added group-robot interaction capabilities to the Community Bar media space [5] via a new media item we call *AIBO Surrogate.*

2. RELATED WORK

Our work builds on several themes of interaction between humans and robots. One related HRI research topic addresses the interaction between a robot and a group of humans. Often with complex robots such as unmanned aerial vehicles a group needs to collaborate in order to control a single robot [3]. In other cases an uncoordinated group must interact with a single robot, such as when a group orders food from a single robotic waiter [10].

Another theme is users' tele-embodiment in a remote space, such as the Personal Roving Presence (ProP). ProP is a mobile robot that includes two-way video and audio, allowing a remote person to control the distant robot's movement and see and hear via the robot's video and audio channels [10]. A screen on the robot shows a live video feed of the remote controller. Building on these HRI themes we look at a robot as a controllable social entity, a surrogate of the media space group within the physical world, representing selected aspects of the group's shared being, presence, awareness and tasks.

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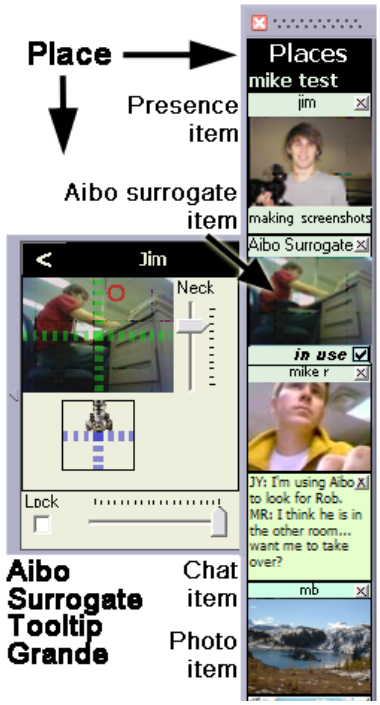

Figure 1. Community Bar and the AIBO Surrogate.

Our implementation is based on Community Bar (CB)—groupware media space software intended to support causal interaction within small distributed groups (Figure 1, [5]). CB is designed so that all media items within a virtual place are publicly visible to all users within this place. In practice CB is a peripheral sidebar display divided into *Places*. Figure 1 shows a place called '*mike test*'. Each place represents a group and displays their communication, tools, and shared information. These are shown through a number of *media items* presented at three levels of granularity. The *tile* view is always visible in the sidebar, and represents themes like users' presence (e.g., live video or names), public conversations (e.g., chats or sticky notes), or public information (e.g., interesting web links and photos).

3. THE AIBO SURROGATE

The *AIBO Surrogate* bridges the CB into the real world through group-robot interaction. The non-threatening AIBO is located in physical spaces occupied by CB users such as a shared laboratory or office; multiple robots can occupy multiple spaces. The robot is a controllable physical surrogate for the group, where it can wander and interact with people in a space.

3.1 Tile View

The *AIBO Surrogate*'s *tile view* (Figure 1, right side) provides the CB group with a real time low-resolution streaming video of what

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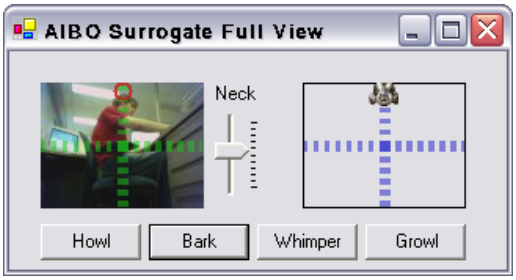

Figure 2. Full Window view of the AIBO Surrogate Item


Figure 3. The AIBO Surrogate in the real world

the robot sees, giving the distant group a first-person view and awareness of robot activity, informing the group when the robot is moving and when it's looking around. If a group member is currently controlling the robot, the *in use indicator* is checked. The Figure 1 tile view shows that the robot is currently being controlled. The CB chat supports this, where one person says "I'm using the *AIBO Surrogate* to look for Rob", and the other suggests where to find him. The group sees the robot's view as it moves towards Rob's desk and looks up at Rob. Figure 3 shows that in the real world the AIBO is behind Rob looking up at him.

3.2 Tooltip Grande

The *AIBO Surrogate*'s *tooltip grande* (Figure 1, left side) displays a higher resolution video stream and adds a *neck tilt control*, an *interactive look control* and a *walk control*. The *look control*, shown on the video stream as green crosshairs, allows the users to point the robot's head in a given direction by clicking within. The center of the image looks straight ahead and the top right corner looks to the extreme top-right. The red dot indicates current look direction. The video provides valuable feedback to the controller, letting him/her adjust motion and gaze direction on the fly. The *walk control*, the blue crosshairs with the dog icon, controls the robot's movement: clicking left or right turns, above or below goes forward and backward and the center means to stop moving.

3.3 Full View

The *full view window* (Figure 2) gives a larger walk control for fine-grain manipulation and adds *notification* buttons that direct the robot to emit sound: a howl, bark, whimper or growl. These are used to attract attention and to communicate intent. For example, the howl indicates urgency, the bark is a simple and neutral way to get attention, the whimper indicates a plea or request, while the growl indicates anger or annoyance.

3.4 What People in the Physical World See

The robot acts as a surrogate for the distant group in the physical space, and ideally, people in the real world would also see the robot as a social extension to the group. The robot's movements represent the distant group as an entity: if one sees the robot looking at them, they should realize that the group can see them. A person may notice the robot's behavior and may respond by going onto CB to find out who it is and what they want.

4. IMPLEMENTATION AND EVALUATION

The AIBO ERS 7 is a programmable robot dog produced by Sony. The *AIBO Surrogate* item communicates with and controls the robot using the Tekkotsu framework software [8]. The *AIBO Surrogate* was developed using CB plug-in capabilities [5], and has both an *owner* and an *audience*: the owner posts the item, all other users are the audience. This separation allows for the owner to be the one to communicate with the robot while the audience relays information and commands. There is no difference from the user's perspective, as all have the same capabilities.

The *AIBO Surrogate* is a fully functional proof of concept. While the robot moves too slowly to be practical, we have used and evaluated it informally in the laboratory. The distant members managed to use the interface without instruction, including simultaneous control, commenting that it is not only easy to control, but fun to use. The wish list included a higher resolution video and scene construction as the AIBO looks around.

Co-located users gave mixed responses: some noticed the AIBO and treated it as a social surrogate while others disliked it for privacy reasons. This is typical of media spaces, where benefits of group awareness are tempered by privacy concerns.

5. CONCLUSION

We presented the *AIBO Surrogate*—a robotic dog used by a media space group that offers dynamic physical awareness to all members. Users co-located with the *AIBO* acquire a physical awareness of the robot's (and thus the group's) actions within their space by simply watching, listening and touching the physical dog. The distributed group can explicitly contact others in the physical world by controlling the *AIBO*'s movement and sounds. The current implementation demonstrates its effectiveness as a physical two-way awareness tool shared between members of a distributed group.

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