A Mirror Metaphor Interaction System: Touching Remote Real Objects in an Augmented Reality Environment

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Abstract

We propose a real-world-oriented interface called the "Mirror Metaphor Interaction System". The display shows a mirror image from a camera facing a user, and the user can "touch" objects without making direct contact with the display. The "touched" object displays a menu or works directly. Objects can be placed in a remote room as well as in the user's room, and can also be moved around in a room. The user can therefore control equipment or interact with objects anywhere through the display of the system by combining images from local and remote places translucently. Our demonstration shows how the interface makes it easy to establish contact with movable objects in a remote room by "touching" them in the display.

1. Introduction

In the home environment with ubiquitous computing, people have many opportunities to interact with various objects and types of equipment with hidden computing resources. But each object or piece of equipment often has an inconsistent interface, so a user must learn how to use many interfaces individually. Moreover, such interfaces are very difficult for people with low information literacy to manipulate.

Some contactless human interface techniques for command extraction from user motion or gestures have been studied to establish easily learnable interfaces. In these techniques, a real-time self-image is often used as a feedback to the user for pointing to objects [1]-[3]. Examples are VIDEOPLACE [1] and Action Interface [2], which combine video images and CG images and extract the overlap between images to detect a virtual touch. However, only touch detection between the user shape and CG images is possible, because of a lack of links to the real world.

Here, we demonstrate a system that allows one to "touch" not only CG icons but also real-world movable objects that can be seen in the display. The visualized real object images and the virtual touch of them are expected to be more intuitively understood, even by people with low information literacy, than conventional remote controllers. The demonstration shows how effectively such interface facilitate users' operations.

2. Mirror Metaphor Interaction System

The method features two structures considering real application scenes. One is the local mode, the other is the remote mode. In the local mode, only one camera captures an image of the user and user's room. In this case, objects in user's room can be controlled [4]. The remote mode, which is newly introduced and demonstrated here, allows

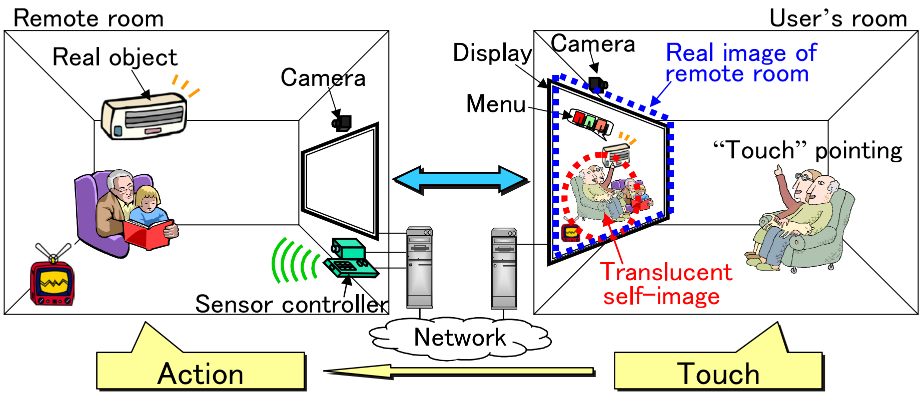

Figure 1. Remote interaction using the Mirror Metaphor Interaction System.

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the user to interact with objects in a remote room. Figure 1 shows an example of the remote mode.

The user's room image from the local camera is made translucent and reversed, and is combined with the remote room's camera image to generate the user room's display image. Therefore, remote room objects are overlapped by the self-image. It is not necessary to prepare a special colored (ex. blue) background. The user can "touch" an object in the combined image. "Touch" means that user puts the image of a marker held in the hand on the target object image; there is no direct contact with the display. When the user "touches" an object, a command menu pops up from just the target object's position. The commands can be hierarchical, and the direction in which they appear is controlled by the motion of the hand; that is, the user can extend the menu list any desired in direction.

In the remote room, a sensor system is utilized. The sensor system attaches an IR sensor tag and RF tag to each object [5]. The IR sensor tag is used for object position recognition. Therefore, when an object is moved, the menu in the user's room also pops up from a new location in real time. Then, the user can "touch" the movable object anytime. The RF tag is used as an actuator for action from the user to an object, for example, for switching the LED or vibrator in the actuator on or off.

3. Demonstration

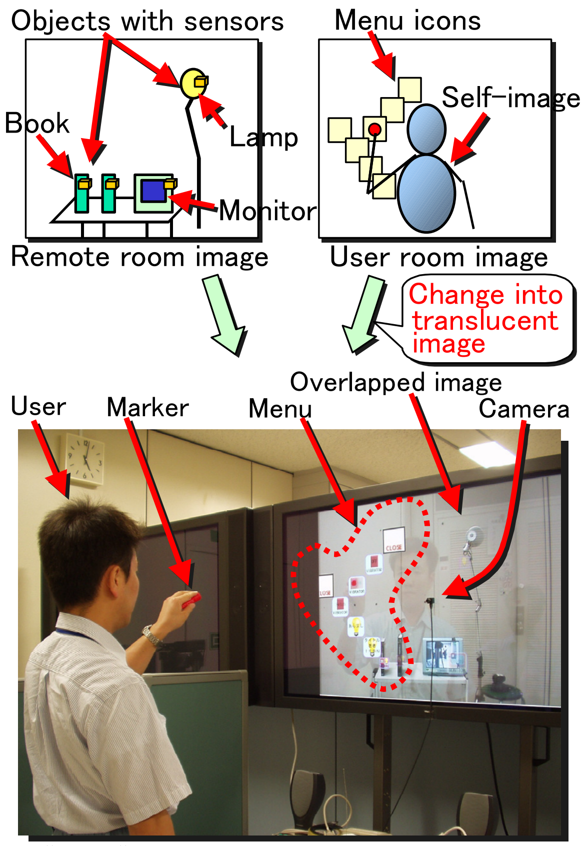
The configuration of the demonstration system is shown in Fig. 1. The system consists of two color cameras for local and remote rooms, a large-screen display, a PC, and the sensor system with its IR camera, network environment, and tags.

The user stands facing the display and logs in using a face recognition system [6]. On the display to which the self-image is reflected, marker position recognition by color detection allows the user to select menu items and execute commands by manipulating the marker. All positions of real objects are seen on the display by IR tags, and a real object is specified by "touch" operation using the self-image in the screen. The actuators of the sensor system worked when the user selected a function for equipment like the LEDs or vibrators attached to the target objects. This system works at about 5 fps.

Figure 2 shows a demonstration image. Books, a TV monitor, and a lamp are tagged and placed in the remote room. Thus, the demonstration requires two areas of 6.5ft x 6.5ft size for each.

4. Conclusions

We presented a real-world oriented interface called the "Mirror Metaphor Interaction System". The user can "touch" a movable object without directly contacting the display. Therefore, the user can get an intuitive feeling of touching and operating the functions directly. The system



1. "Touch" the real object on the remote room image.
2. Display the command menu.
3. Perform the selected function.

Figure 2. Interacting with a remote object using a displayed menu.

is robust for the background image because it uses a translucent image. The system was demonstrated in one direction in this paper, but a bi-directional system can be easily implemented using two systems. Evaluation and examination of a concrete application are planned.

References

[1] M. W. Krueger, T. Gionfriddo and K. Hinrichsen, "VIDEOPLACE An Artificial Reality, " Proc. CHI'85 Human Factors in Computing Systems, pp.35-40, Apr. 1985.
[2] Y. Shibuya, H. Tamura, "Interface Using Video Captured Images," Human-Computer Interaction: Ergonomics and User Interfaces, Vol.1, pp.247-250, 1999.
[3] O. Morikawa, J. Yamashita, Y. Fukui and S. Sato, "Soft initiation in HyperMirror-III," Human-Computer Interaction INTERACT'01, pp.415-422, 2001.
[4] E. Hosoya, M. Kitabata, H. Sato, I. Harada, H. Nojima, F. Morisawa and S. Mutoh, "A Mirror Interface for Real World Interaction," Interaction 2003, pp.95-96 (in Japanese)
[5] F. Morisawa, S. Mutoh, J. Terada, Y. Sato and Y. Kado, "Interaction with remote objects using Stick-onCommunicator," Interaction 2003, pp.223-224 (in Japanese)
[6] Miros, Inc., "Programmer's Manual for TrueFace."

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