

Applying telepresence robot to interpersonal communication: implications and applications

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Abstract

This paper discusses applying telepresence robot to interpersonal communication. First the “user” and “people” connected by a telepresence robot in the interpersonal communication are defined. This paper then describes telepresence research literature from the framework of projection-immersion (from the user’s perspective) and observer-dialogist (from the people’s perspective). The design elements in telepresence systems in research literature are identified and classified.

The development of a telepresence robot for interpersonal communication with the elderly in the Gerontechnology Research Center, Yuan Ze University is presented. The design elements included in this telepresence robot are discussed. In particular, how to implement proper autonomous behaviors in the telepresence robot to increase the user’s capability of projection to operate the telepresence robot and to increase the interactive capability of the people as a dialogist is emphasized. The concept of transferring the control authority of the telepresence robot from the user to the environment, and further to the people interacting with the telepresence robot is discussed.

Keywords--- **Telepresence, interpersonal communication, autonomous behavior.**

1. Introduction

“Telepresence” is an interesting field that includes virtual reality implementations with human-system interface, communication technologies and robotics. Telepresence provides a connection between a user and distant people or environment (real world or computer generated world), to perform social interactions (user-telepresence-people) or specific tasks (user-telepresence-environment). This paper focuses on the application of telepresence in communication and interaction between the “user” and “people.” In such applications, “people” are not only “observers”, but also participants or “dialogists” in the interpersonal communication.

There are two views in telepresence application in interpersonal communication: the user’s view and the people’s view. From the user’s view, telepresence enables

the user to project herself/himself to another place by controlling the telepresence robot or system. In the meantime, the user perceives immersion from the sensory feedback from the remote environment created by telepresence. As discussed above, “people” may have two roles in telepresence application in interpersonal communication: observers or dialogists. From the people’s view, telepresence provides necessary elements to the teleoperator, and the telepresence robot, so that people recognize it as a representation of the user. Telepresence also enables dialogue between people and the user by sending audio, video, gestures, and other environmental information helpful for effective communication.

This paper tries to describe telepresence research literature from this framework of projection-immersion and observer-dialogist. The design elements in telepresence systems in research literature are identified and classified. Then an on-going project conducted by the Gerontechnology Research Center of Yuan Ze University (Taiwan) for developing a telepresence robot is described. This robot is for interpersonal communication with the elderly in a home environment. The development road map and current design elements are reviewed. Finally, the necessary design elements for such telepresence application in interpersonal communication are concluded, and future development of this telepresence robot is outlined.

Table 1. Design elements and related technology details for telepresence

| Design elements | Related technology details |
|--------------------------|---|
| data transmission | RF, Internet, time-delay algorithm |
| modify environment | teleoperation, master-slave, simultaneous operation, robotic embodiment |
| supersensory | dexterity, maneuverability, scaled motion, zoom |
| anthropomorphic elements | facial expression, body motion, humanoid |
| stereoscopic | binocular, panoramic, autostereoscopic, image processing |
| stereophonic | HRTF, stereo audio |
| eye contact | camera and screen with specific placement |
| autonomous behaviors | navigation, mapping, localization |

2. Design elements in telepresence systems in research literature

This paper surveys the application-oriented telepresence literature which describes the development of a telepresence system. The design elements emphasized in these studies are extracted and summarized in Table 1. These design elements are fitted into the framework of projection-immersion and observer-dialogist described in the previous section. A discussion of the eight design elements in Table 1 is given below.

3. Developing a telepresence robot for interpersonal communication with the elderly

The Gerontechnology Research Center of Yuan Ze University in Taiwan has been developing a telepresence robot for interpersonal communication with the elderly in a home environment. Figure 1 shows the development road map.

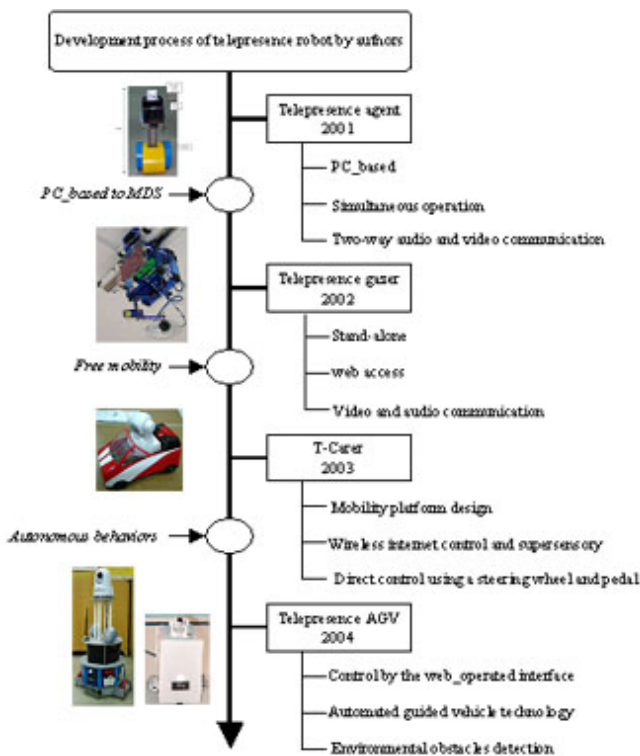


Figure 1 Development process of telepresence robot

Discussion and future work

The fifth generation telepresence robot, the “Telepresence InterComm”, for interpersonal communication with the elderly is being developed. Telepresence InterComm aims to be a low-cost home robot.

The total material cost of telepresence InterComm (not including the IP cam) is estimated to be about USD 400.

Table 2 shows the design elements already implemented or planned. As in the previous generations, the core of Telepresence InterComm for control and data transmission is the MDS. The design element “to modify the remote environment” is not essential for the communication telepresence robot. Only the fundamental mobility control is implemented. Supersensory is reflected in the zooming of IP cam and various sensors for environment detection installed on Telepresence InterComm. With the limited processing ability of the MDS, the user’s face cannot be displayed (so eye contact is not possible on Telepresence InterComm). Instead, mechanical facial expressions are planned to include an anthropomorphic element. Sophisticated stereoscopic and stereophonic elements are not planned either.

Table 2. Design elements included

| Design elements | Related technology details |
|--------------------------|--|
| data transmission | MDS |
| modify environment | mobility control |
| supersensory | zooming of IP cam, various sensors for environment detection |
| anthropomorphic elements | mechanical facial expression |
| stereoscopic | not included |
| stereophonic | not included |
| eye contact | not available |
| autonomous behaviors | major emphasis |

The major emphasis of this research will be on how to implement proper autonomous behaviors in the telepresence robot to increase the user’s capability of projection to operate the telepresence robot and to increase the interactive capability of the people as dialogists.

As discussed earlier, in principle, a telepresence robot is operated by a remote user. The user possesses the complete control authority. From the user’s view, adding autonomous behavior to the telepresence robot shares the control authority with the environment. This autonomous behaviour will allow the AGV to identify an obstacle in the environment, so that the user can operate the telepresence robot safely and reliably in dynamic environments.

From the people’s view, to increase the interactive capability with the people as dialogists, the control authority of the telepresence robot has to be shared with the people it is interacting with. For example, the telepresence robot will turn to the person/people who are speaking and turn to the direction the people are pointing so that the user and people share the same view. In other interpersonal communication scenarios, the telepresence robot may follow the people’s guide to move around. The detailed development of Telepresence InterComm emphasizes sharing the control authority with the people in various interpersonal communication scenarios.