A Pilot Study about Remote Teaching by Elderly People to Children over a Two-way Telepresence Robot System

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***Abstract*—Work support for elderly people is gaining importance in an aging society. To this end, telepresence robots are expected to provide a promising solution as it could enable people even with some physical difficulties to work from their home. This paper reports our exploratory field trial in which an elderly person gave a lesson about a traditional paper craft to elementary school students over a two-way telepresence robot system. Ongoing development for the system after the trial is described.**

I. Introduction

In an aging society with fewer children, work support for elderly people and maintaining the quality of childhood education are both significant issues. In fact, Japanese government recently announced a policy guideline [1] that stated these two issues and called for solutions. To compensate the dwindling workforce due to a declining population and to energize people after their mandatory retirement age, work support for elderly people is crucial from both technological and policy aspects. On the other hand, maintaining the quality of childhood education is also becoming a significant social issue due to the decrease of teacher population. Again, it requires solutions from both technological and policy aspects.

Telepresence robot could be a technological solution for the above-mentioned two issues. Studies were conducted for the purpose of connecting elderly people and children [2] that showed the potential of this solution in these domains. With respect to the use for remote education, there have not been reported any trial of remote teaching by elderly people to children over the telepresence robot. It was known that sometimes video-conferencing makes children freeze during the context of remote education but a telepresence robot could resolve the issue due to the availability of physical interaction between remote locations [3]. This benefit could be expected in the situation in which elderly people gives a lesson to children from a remote location using a telepresence robot.

In this paper, we report an exploratory field trial in which an elderly person gave a lesson about a Japanese traditional paper craft, *origami* [4] to elementary school students over a two-way telepresence robot system. The telepresence robot system was set up in a two-way, meaning that two identical robots were connected over the internet and users in both sides could interact with one of the robots placed in front of him/her respectively. Similar to other telepresence robots, the robots here had a video-conferencing monitor that displayed the real-time videos taken from a remote camera by which people could see the face of their partner in a remote location. However, the robot here also had its face, and thus it was designed to be a mixture of a remote avatar and an autonomous robot entity. The goal of this field trial was to explore the use of the telepresence robot system in the remote teaching scenario and to find crucial requirements and research questions. This paper reports the late-breaking status of the trial.

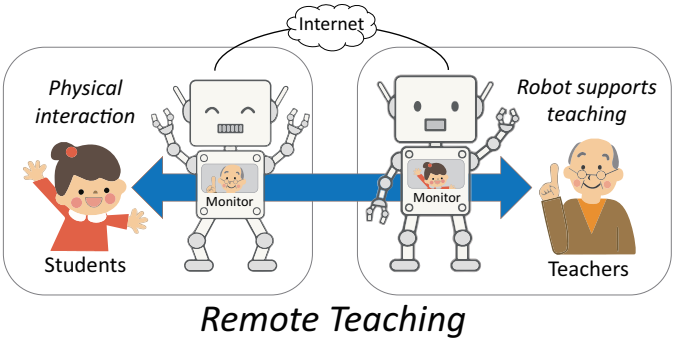

Fig. 1. Remote teaching mediated by a two-way telepresence robot system.

II. Two-way Telepresence Robot

Fig.1 illustrates the remote teaching targeted in this study. Elderly people who have a teaching skill on some subjects give a lesson from their home through a telepresence robot. The robot is connected to another telepresence robot that is deployed at a remote classroom in an elementary school or a kindergarten. Children are able to participate in the lesson with physically interacting with the robot. We use Pepper [5] developed by SoftBank Robotics Corp. as the base platform of the telepresence robot. The robot is equipped with a chest display that is connected with a remote camera mounted on the robot in the remote side. The display can also

provide useful information for people in front of the robot. For example, we are currently developing software modules that search over the internet in real time and extract some useful information that could promote the mutual communication between the elderly people and the children. A study suggests that a (one-way) child-operated telepresence robot enhanced remote teaching [3]. It was reported that physical interaction mediated by the telepresence robot played a significant role in an educational context in which a teacher taught English to Japanese children from a remote location. There is also another study suggesting that bidirectional remote physical interaction enhanced social telepresence [6]. Following these previous works, it is expected that the two-way telepresence robot system with features implemented on the robots in both sides that assist and enhance the remote communication between the elderly people and the children is effective in remote teaching.

III. Pilot Study

A pilot study was conducted in connecting a home of an elderly couple and four elementary school children in a remote room. The telepresence robot system explained in the previous section was tested and the elderly participant gave a lesson of origami to each of the child participant. To explore appropriate robot behaviors, the operator controlled the robot. This Wizard-of-Oz exploration has been commonly introduced in HRI researches (for example, [7]). Each session continued for about 15 minutes. From a total of four sessions conducted, we identified the following requirements.

- Both participants mentioned a need for switching the viewpoint of the remote camera. In this study, we introduced such a switching function by allowing the participants to touch the back of the Pepper's hand; however, this function has hardly been used. Switching the viewpoint was a crucial requirement and more natural interface is needed to satisfy the requirement.
- As reported in previous literatures [3], [6], haptic interaction played an important role in our study. For example, handshakes and high-five between the participants mediated by the robot interface were quite effective to promote the remote communication. In this study, these opportunities were offered through a human operator's control, i.e., in such situations the operator intervened and remotely controlled the movements of the robot, which should be automated.
- In addition, most of the robot's speech was remotely controlled by the operator. During the sessions, there have been observed a lot of opportunities in which some kinds of utterances given from the robot were needed. For example, children tended to become silent and just keep listening to the elderly participant's instructions even if the children could not follow the instructions. In such situations, the operator often utilized a text-to-speech function and made supportive speeches from the robot, which should also be automated.

IV. Development in Progress

Based on the findings described in the previous section, the following functions are currently under development.

- Semi-automatic camera switching: we are exploring the uses of (1) simple voice instructions (recognizing such instructions automatically), (2) tracking critical visual segments such as human hands in making origami or human faces when the person delivers some keywords, and (3) holding eye contact between humans in remote locations. Together with each development, we are exploring how to switch these functions appropriately.
- Automatic high-five function: we are testing some sensors that are embedded on the palm of the robot hand. For example, a photo-reflector can detect the human hand approaching and then the robot can push its hand forward, making high-five between the human and the robot. The robot should also be able to prepare for making high-five by detecting human hands as such and raising its own hands.
- Automatic speech generation is not an easy task because it deeply relates with scene understanding which is fundamentally very difficult. However, we observed some common patterns in which the communication became one-way from the elderly participant and children became silent. We are now trying to identify key features of such patterns and automatically detect them.

V. Conclusions

This late-breaking report described our new research project involving elderly people and young children. A pilot study was conducted and some preliminary research elements were reported. We will keep presenting the progress of the project at future publications.

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