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Mobile Remote Presence Robots for Medical Consultation and Social Connectedness

Christopher LUEG[a,1] and Valérie JUNGO[b]
[a] *Bern University of Applied Sciences, Switzerland*
[b] *Junexus Consulting, Switzerland*

Abstract. We demonstrate that Mobile Remote Presence systems (MRP) aka telepresence robots can be successfully used in certain types of medical consultation such as consultation from a distance with residents of nursing homes. We argue that MRP afforded media richness also allows for supporting social connectedness during medically recommended isolation regimes similar to the ones that are implemented in residential care homes around the world during the SARS-CoVID-2 pandemic. Specifically, our research found that MRP are perceived as a more natural medium compared to typical telephones or videoconferencing via computers or tablets. MRP allow conversations to become more dynamic and engaging since remote participants are able to adjust their remote position and perspective during a conversation. Participants in our experiments reported they would be willing to engage even in difficult or emotional topics when using MRP however there are also certain types of situations that would still ask for face-to-face conversations.

Keywords. Medical consultation, remote presence, human computer interaction

1. Introduction

Due to economic and ecological considerations and, more recently, infection control and quarantine requirements, business people and researchers have begun to question the need to be physically present at business meetings or academic conferences. One of the more promising alternatives to physical travel is the use of telepresence robots. The designated purpose of such systems is to improve communication between individuals [1]. Unlike traditional video teleconferencing systems that require all interaction to take place in a specific location and from a single viewpoint, mobile remote presence (MRP) robots aka telepresence robots allow participants to control a physical representation of themselves that is present at a remote location. Unlike traditional video conferencing systems, MRP enable participants to move around and adjust their viewpoints.

Among early reports on using MRP in everyday settings are Lee and Takayama [2] and Strickland [3]. Based on interviews, observations, and survey results from people who had used MRP for several months, Lee and Takayama concluded that MRP enabled remote workers to live and work with local coworkers almost as if they were physically there. An important aspect of that was the mobile embodiment of the remote worker

[1] Christopher Lueg, Medical Informatics Division, Department of Engineering and IT, Bern University of Applied Sciences, Höheweg 80, 2502 Biel/Bienne, Switzerland; E-mail: cplueg@fastmail.com.

being able to evoke perceptions of the MRP both as a person and as a machine which also lead to the formation of new usage norms among remote and local coworkers. Strickland reported on her experience of attending a medical conference via one of five Beam telepresence robots that were provided by the conference organizers. Rae and Neustaedter report on such conference experiences at scale [4]. These and other studies suggest that MRP can be a viable alternative to travel to some extent even when participants have to deal with what Rebola and Eden call Remote Robotic Disability [5]. Other documented MRP uses include learning settings where telepresence robots allow lecturers or students to participate in class activities even when they are temporarily unable to attend in person because of health conditions or travel restrictions [6].

Interest in the use of MRP surged during the 2020 SARS-CoV-2 pandemic since MRP offer a way of keeping in touch with loved ones in situations where physical co-location would introduce unacceptable risks of transmitting infectious diseases.

2. Mobile Remote Presence to Ease Isolation in Nursing Homes

Countries around the world responded to the SARS-CoV-2 pandemic by introducing legislation that required nursing homes to ban external visitors from entering the premises. This was seen as a necessary restriction to reduce transmission of the virus to at-risk populations. In certain compassionate cases, such as end-of-life situations, visits were still allowed but visitors would have to wear personal protective equipment (PPE) including masks and their presence would be limited to dedicated visitor rooms [8][9].

While isolating at-risk populations such as the elderly is widely accepted as a necessary means to minimize the spread of SARS-CoV-2 to these groups, the measure also introduces its own risks such as social disconnection. Armitage and Nellums argue that older adults are at greater risk of depression and anxiety especially if nursing home residents need to self-isolate during outbreaks on the premises [10]. Rahn discusses ethical challenges of isolation regimes by highlighting that aged care quality standards enshrining consumer dignity and choice do not become obsolete during pandemics [11]. Especially elderly persons affected by early dementia may struggle to understand the nature of changes to their routines due to isolation regimes.

Research into the use of MRP specifically in the context of isolation regimes is scarce. Beer and Takayama looked into the acceptance of such systems by the elderly and possible use cases [1]. Socialization and reducing social isolation was identified as a potential benefit but isolation due to infection risks is not mentioned specifically.

3. Field Testing MRP Mediated Care in a Swiss Nursing Home

The idea of using MRP in medical consultation at home emerged from our long-standing interest in the perils of both social and physical distance. Physical distance as a challenge to care delivery is a prominent issue in small but mountainous Switzerland where the current research team is based but also in vast, continent-size countries like Australia where the first author lived for two decades. We are interested in how MRP can be used to ease some specific issues, such as medical practitioners having to drive long distances in cases where voice-only consultation would not be sufficient but being physically present may not be required either.

The use case that we developed in collaboration with medical professionals was consultations of an elderly person with a medical practitioner. The medical professional would not be required to be physically present. Examples include first consultations in non-emergency situations as well as follow-ups to past consultations. We envisioned that the benefit of reduced travel time for the medical practitioner could enable tangible benefits for residents since the medical practitioner would be able to spend more time in conversation with the resident, often seen as a key aspect of meaningful consultations. A second use case is that the medical practitioner is able to ascertain from a distance (e.g., visual impression) that a major medical intervention is likely required thereby significantly reducing the turnaround time between the patient calling the medical professional and the medical professional calling an ambulance.

The focus of this part of the research was on exploring specific differences between communicating face-to-face and via MRP, the overall quality of respective interpersonal interactions as well as the sense of presence in MRP mediated communication [12]. The experiments were designed to not require any actual medical information to be shared which we left as an option to be explored at another time. Ethics approval was obtained.

For the MRP experiments we utilized a Beam remote presence bot by SuitableTech (suitabletech.com/products/beam), locally nicknamed *BrönniBot*. Before deploying the MRP at *Lakeview*, a residential care home in Biel/Bienne we trialed the equipment and likely engagements in the Bern University of Applied Sciences Medical Informatics Living Lab in Biel/Bienne. A unique feature of the lab is a fully furnished 1-bedroom apartment that serves as a testbed for research into home care delivery. The apartment is inhabited by imaginary elderly personas Mrs. Brönnimann and her husband.

We recruited as volunteers a local elderly person and a local registered nurse familiar with Lakeview and the type of consultations that we were interested in. We seated the elderly person in Mrs. Brönnimann's living room with BrönniBot waiting in the nearby bedroom. The nurse on the other hand was seated in the mock surgery that is situated on a different level in the main part of the Living Lab. Once the researchers involved had left the premises the nurse used a tablet computer running the MRP control app to activate BrönniBot and pilot the bot from its bedroom location to the elderly person seated in the living room. The nurse then commenced a typical albeit improvised conversation about the elderly person's well-being. The feedback that we received from the participants was both insightful and encouraging. Both the elderly person and the nurse experienced the interactions via BrönniBot as positive and, in the words of the elderly person, unexpectedly engaging. Being able to see the remote person was mentioned as a highlight. Neither of the participants experienced any technical issues affecting the experience. A few weeks later we set up at Lakeview for the in situ experiments. This time participants consisted of two medical doctors (GPs) practicing in the greater Biel/Bienne area and two actual residents of the Lakeview nursing home. All participants were aware that the improvised conversations should not cover any actual health concerns, due to privacy considerations. The medical doctors also received prior training in using the Beam app. Members of the research team transported the Beam MRP to Lakeview and helped Lakeview staff with the technical setup including wireless network configuration. The experimental protocol was that participating doctors would participate from their actual surgeries away from Lakeview and the participating Lakeview residents would be seated in a dedicated room right there at Lakeview.

We conducted two sessions that both followed the same protocol as the trial that we conducted in the Medical Informatics Living Lab. In each session, one of the doctors sitting in their respective surgeries used the Beam app to connect to BrönniBot located

on the premised at Lakeview. Then they piloted BrönniBot from its away location to the room where the Lakeview resident was waiting for the consultation. Once there the doctor and their patient improvised a realistic conversation about the patient's well-being.

We organized debriefings with all the participants involved and this time we also conducted formal interviews with participants. The interviews were conducted on site at the doctors' surgeries and in the participants' own rooms at Lakeview, respectively. The interview questions focused on the experience of the BrönniBot mediated consultation. The interviews were recorded and subsequently transcribed and analyzed [12].

The findings from the in situ experiments at Lakeview affirmed the findings from the previous trial that took place in in the Medical Informatics Living Lab. The most relevant findings include the following:

None of the participants perceived the Beam MRP aka BrönniBot as a robot but more like a 'machine' or 'device' which seems to align with the purpose of MRP as being about improving communication between individuals [1].

The quality of the conversation in terms of turn-taking, flow of speech etc. was perceived as positive with no major differences to face-to-face conversations. Participants did note some differences in the way people respond though in the sense that looking at a person face-to-face tends to trigger some kind of response while this is not necessarily the case when communicating via MRP such as BrönniBot.

Both of the medical professionals reported having used less body language which was partly due to the technical setup using iPads but also because of the MRP built-in screen showing only participants' heads. This was not perceived as a barrier though since they considered body language less important in mediated conversations anyway.

A key finding that is relevant to maintaining social connection during isolation regimes is that both Lakeview residents reported they would be willing to engage in difficult or emotional topics when using the MRP however they also stressed that there would also be situations where they would prefer face-to-face conversations.

Three of the four participants noted they engaged in less small talk compared to what they would probably do in face-to-face conversations which would likely change if participants know each other socially as would be the case in primarily social settings.

All four participants agreed that while conversations did not resemble face-to-face conversations they were not perceived as artificial either. Participants felt the conversations were "the same but different". When trying to explain the phenomenon participants referred to some notion of perceived 'distance'.

The MRP was perceived as a more natural medium compared to telephones and videoconferencing via computers or tablets which is a valuable insight for both remote consultation and social connectedness. The reason is that the MRP wasn't fixed in certain a location and perspective which allowed for conversations to become more engaging. On the Daft und Lengel media richness scale, we would argue MRP communication would not only be media-richer than voice-only telephone but also media-richer than standard fixed-setting videoconferencing.

In terms of physical characteristics of the MRP the participants felt that the screen size was sufficient. Participants did not experience any issues recognizing facial expressions of the remote person. The Lakeview residents were also happy seeing only the faces of the medical professionals they were talking to. The medical professionals on the other hand criticized that they were not able to see the residents eye-to-eye since the MRP did not allow to adjust the height of the screen or that of the camera that 'looks' at the remote person. This technical limitation had the unfortunate effect that the medical professionals literally looked down on their patients.

4. Conclusions

Mobile Remote Presence systems (MRP) have not yet reached projected acceptance levels which may be due to considerable costs involved and setup and maintenance issues. There are specialty areas where the use of MRP is promising though. As we have demonstrated in this paper this includes the use of MRP in certain types of medical consultation over distance, such as consultation with residents of nursing homes. The generally positive responses to communicating via MRP and especially the finding that MRP conversations can be more engaging than telephone and regular videoconferencing due to MRP support for location and perspective changes suggest suitability for supporting social connectedness during isolation regimes like the ones implemented in residential homes around the world due to the SARS-CoVID-2 pandemic.

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