Project No.	Project Title	
2021-01-014	Pull-Push in Telepresence robots	
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Abstract

The world's population is growing rapidly particularly in the number and proportion of older persons in the population. This change, along with the lack of caregivers has exposed the need for technological advances to provide solutions for eldercare. Mobile robotic telepresence (MRP) has emerged in recent years as a possible solution. In certain circumstances, some tasks such as health monitoring, prediagnosis, delivery of food, drug or samples need to be performed remotely if the caregiver cannot get near the patient. This could be due to various challenges such as risk of infections, task load or other difficulties which have intensified the need for further development of MRP systems.

The use of MRP systems reveals the need to develop interfaces that will allow effective and efficient control of the robot. The interface should be convenient and allow multiple tasks to be performed simultaneously to save time, manpower and money. The interaction between the human and the robot is greatly affected by the level of interaction (LOI) at which the robot communicates with the operator. One of the critical factors in this interaction is the feedback. We defined two levels of interaction via the type of feedback: push and pull. Push feedback is an LOI where information is continuously generated to the user even when it is not demanded. The information is 'pushed' to the user by the robot without the user requesting it. Pull feedback is an LOI where information is given only when demanded. The robot will provide information to the user only when the information is 'pulled'.

This research examined the performance and interaction between MRP systems and users. We investigated the influence of different LOI on different aspects of performance and user perception. We developed an experimental system that simulated a hospital environment in which a participant teleoperates a mobile robot, delivers medication with other supplies to the patient and receives samples from him. The experiment investigated two levels of interaction (pull, push) with the teleoperator to determine the most suitable for an MRP system in a telenursing task with a secondary task. The secondary task involved attending to some health record demands. 40 industrial engineering students (20 females, 20 males) from Ben-Gurion University participated in the experiment (mean=25.87 years, SD=1.7). The interaction was measured in terms of objective performance (efficiency, effectiveness and understanding) and user perception (satisfaction, perceived workload, usability and situation awareness).

We found that the performance and situation awareness were better when the push LOI was used compared to the pull LOI. In addition, we also found that the workload was lower when pushing the information. However, in terms of the satisfaction, usability and understanding, the difference in the LOIs was not significant. These results highlight several insights and issues which can be further investigated as more complex user interfaces are developed in MRP systems. These can be applied for other task types, with different populations, while further examining the effects of LOI in the teleoperation for one or more robots in other environmental settings.

Keywords: level of interaction, MRP systems, feedback, pull, push, teleoperates.