The Future of Robotic Telepresence: Visions, Opportunities and Challenges

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Abstract
This panel will bring together experts on robotic telepresence from HCI and related fields. Panelists will engage the audience in a discussion of visions, opportunities and challenges for the future of telepresence robots.

Author Keywords
Telepresence, robots, remote collaboration, CSCW.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction
Telepresence robotics is a sophisticated form of robotic remote control by a human operator that leverages videoconferencing and networked connectivity to facilitate geographically distributed communication. Although telepresence robots have existed since the late 1990s [9], high-definition video transmission and remote navigation use a great deal of bandwidth, and it has only become feasible to deploy such robots in real-world contexts since fiber optic technologies expanded internet bandwidth in the mid-2000s. In the past few years, however, affordable telepresence robots have started to become commercially available, and the pace

Fig. 1. The Beam+ and BeamPro (Suitable Technologies)

Fig. 2. The VGo

of research and development has accelerated accordingly (see [13] for a review).

In this panel, experts in robotic telepresence will share key insights from their recent research and engage in a discussion of fruitful and promising lines of research about robotic telepresence looking towards the future. At least one panelist and one audience member will participate via telepresence robot, to give the audience experience with how this type of technology can shape interaction.

Panel Moderators

Susan C. Herring is Professor of Information Science and Linguistics and Director of the Center for Computer-Mediated Communication at Indiana University Bloomington. She received her M.A. and Ph.D. in linguistics from UC Berkeley. A pioneer in language-focused study of computer-mediated communication, she is a past editor of the *Journal of Computer-Mediated Communication* and currently edits the online journal *Language@Internet*. She has been studying telepresence robots for three years, with a focus on applications in academic contexts by disabled users [2, 16]. As a Visiting Researcher at UC Santa Cruz this year, she is part of a team investigating how language and social interaction vary in telepresence robot-mediated communication according to users' metaphor for the robot (as machine, as the human operator, as a disabled human [cf. 14]). More information on Dr. Herring can be found at http://info.ils.indiana.edu/~herring/

Susan Fussell is a Professor in the Department of Communication and the Department of Information Science at Cornell University. She received her B.S. degree in psychology and sociology from Tufts University, and her Ph.D. in social and cognitive psychology from Columbia University. Dr. Fussell's primary interests lie in the areas of computer-supported cooperative work and computer-mediated communication. Her current projects focus on telepresence robots for remote teamwork, intercultural and multilingual communication, collaborative intelligence analysis, public deliberation, and tools to motivate people to reduce their energy usage. More information on Dr. Fussell can be found on her website http://sfussell.hci.cornell.edu

Panelists

Invited panelists are all top scholars in robotic telepresence research in the CHI community. They have looked at telepresence robots in a variety of domains, including the workplace, conferences, and healthcare. They also take a variety of approaches to the study of telepresence, some focusing on technical implementations and others on social and behavioral dimensions of telepresence. A number of the panelists were participants in a highly successful workshop on telepresence at CHI 2015 [10].

Brief biographical sketches and proposed panel statement topics for each panelist appear in alphabetical order below.

Annica Kristoffersson, University Lecturer, Center for Applied Autonomous Sensor Systems, Örebro University

Annica Kristoffersson is a Post Doc in computer science at the Center for Applied Autonomous Sensor Systems (AASS) at Örebro University, Sweden. Dr. Kristoffersson received her Ph.D. in Information Technology in Örebro in 2013 on the topic "quality of

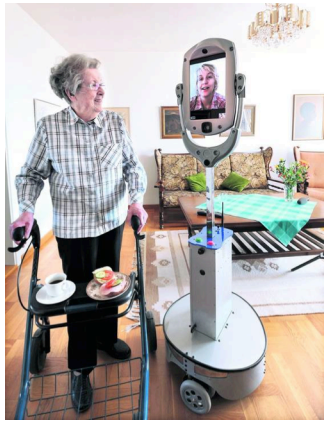

Fig. 3. The Giraff

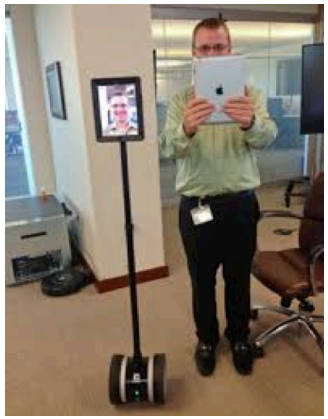

Fig. 4. The Double

interaction in mobile robotic telepresence systems." From 2012-2014, she was the assistant project manager of the FP7 GiraffPlus project. She has conducted longitudinal evaluations of the Giraff robot (AAL Project ExCITE), sensor networks (A Method to Measure a Sensor Network's Impact on Perceived Safety and Security), and combinations of the two (GiraffPlus) in the home environments of elderly people. Currently, Dr. Kristoffersson is working with user evaluations and project management in the Swedish Knowledge Foundation project "E-care@home." More information on Dr. Kristoffersson can be found at http://aass.oru.se/~akn.

Dr. Kristoffersson's panel presentation will address (a) how difficulties in maneuvering the robot may result in spatial formations inappropriate for human-human interaction [7]; (b) how the elderly perceive, and adjust to, inappropriate spatial formations [6]; and/or (c) how rotating the camera in order to limit the horizontal field of view may result in the creation of more appropriate spatial formations [5].

Bilge Mutlu, Associate Professor, Department of Computer Science, University of Wisconsin-Madison

Bilge Mutlu directs the Wisconsin Human-Computer Interaction Laboratory. His research program focuses on building human-centered methods and principles to enable the design of robotic technologies and their successful integration into the human environment (e.g., [4][10][11][12]). Dr. Mutlu has an interdisciplinary background that combines design, computer science, and social and cognitive psychology and a Ph.D. in Human-Computer Interaction from Carnegie Mellon University. He is a former Fulbright fellow and recipient of the NSF CAREER award. More information on Dr. Mutlu and his research program can be found at http://bilgemutlu.com and http://hci.cs.wisc.edu.

Dr. Mutlu's panel presentation will address (a) the design space for telepresence robots and (b) the emergence of social norms in robot-mediated communication.

Carman Neustaedter, Associate Professor, School of Interactive Arts and Technology, Simon Fraser University

Dr. Neustaedter specializes in the areas of human-computer interaction, interaction design, and domestic computing. He is the director of the Connections Lab (http://clab.iat.sfu.ca), an interdisciplinary research group focused on the design and use of technologies for connecting people through technology. Dr. Neustaedter's recent research focuses on the use of next-generation telepresence systems to support domestic, leisure, and work activities. He has designed and built eight next-generation telepresence systems for families. As a Telepresence Co-Chair for Ubicomp/ISWC 2014, CSCW 2016, and CHI 2016, Dr. Neustaedter has led efforts to support telepresence attendance at major ACM international conferences through telepresence robots [9]. He has also examined telepresence robotics in the classroom [3].

Dr. Neustaedter's panel presentation will address (a) reactions and experiences of telepresence robots at academic conferences; (b) success and challenges for identity representation in telepresence robots; and (c) the future of telepresence robots at ACM conferences.

Katherine Tsui, Assistive Robotics Researcher and Postdoctoral Associate at Yale University

Dr. Tsui specializes in robotics and human-robot interaction as an assistive technology researcher [15]. Over the last 7 years, she has worked with clinicians and end-users from several special populations, including children with Autism Spectrum Disorder, teenagers and young adults with Cerebral Palsy, and adults and seniors with Brain Injury. In her role at UMass Lowell's Robotics Lab, she and her collaborators at the University of Central Florida developed vision-based control of a whelchair-mounted robotic arm for users with cognitive impairments to pick up an object (2006 through 2009). Dr. Tsui's dissertation research focused on developing telepresence robots for people who have disabilities and are socially removed from their families and friends due to medical reasons. In 2004, she graduated from the University of Massachusetts Lowell with her B.S. in computer science. She interned at Yale University in 2008 and Google in 2010. She received her M.S. in computer science in 2008, HCI certification in 2010, and Ph.D. in computer science in 2014, all from UMass Lowell under Dr. Holly Yanco.

Dr. Tsui will address the transparency of the interaction between the remote operator and the person physically present with the telepresence robot, including the design of the remote operator's interface and how social cues are transmitted [1].

Panel Format and Audience Engagement

The panel will begin with brief (3-4 minute) position statements from each of the panelists focusing on what he/she sees as the key challenges and opportunities for telepresence robotics. During the presentations, we plan to allow the audience to live tweet the event, and the Twitter feed will be projected on the front wall. There will also be a live Q&A session in which members of the audience can pose questions to the entire panel. If resources permit, there will be an opportunity for audience members to interact with a remote participant attending via telepresence robot.

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