Challenges for Telepresence: Design, Evaluation, and Creativity

Carman Neustaedter

Simon Fraser University

102 – 13450 102nd Avenue

Surrey, BC, Canada

carman@sfu.ca

Abstract

This position paper reflects on a range of studies of video communication and telepresence systems to put forward a series of challenges that I see as being broadly applicable for telepresence researchers in the field of human-computer interaction. These challenges focus on issues related to design, evaluation, and the overall creativity of telepresence solutions.

Author Keywords

Domestic video communications, always-on video, outdoor activities, family leisure

Introduction

Over the past decade, my research group, collaborators, and I have been exploring the design and use of video communication and telepresence systems for a number of different work, domestic, and learning settings. This has included explorations related to:

Telecommuting: The maintenance of workplace awareness and interactions through video-based media spaces by those working at home and connecting into a remote work environment (e.g., [1][11]).

Family Communication and Connectedness: The study and design of video communication systems for providing remote presence, awareness, and interaction for various family and friend relationships, including parents and children [7], grandparents and

grandchildren [3], long distance partners [4], teenagers [2], families in developing countries, pet owners [5], and those participating in major life events (e.g., weddings, graduations) [10]. We designed several systems that focused on always-on video for the home and while mobile (e.g., [8][9][12]) and differing display sizes [14].

Leisure Activities: The study and design of mobile video communications systems to connect people over distance while they perform outdoor activities such as geocaching [15], hiking, and bicycle riding. This has explored the use of wearable video streaming devices along with mounted mobile cameras.

Remote Conference Attendance: Attendance at academic conferences using telepresence robots [16]. We studied how people attended the Conference on Ubiquitous Computing 2014 using Suitable Technologies' Beams. This included those who could not travel because of time restrictions, health challenges, and accessibility needs.

Remote Classroom Attendance: The use of human proxies or surrogates for remotely attending a university class when one cannot attend in person. For example, imagine a person wearing Google Glass and attending class on another person's behalf. The remote student can instruct the proxy to ask questions, interact in class, etc. As part of this work, we have studied questions around surrogate identities, technical constraints, and social challenges.

Telemedicine: The use of synchronous video communication systems for physician consultation

between rural and urban areas, along with remote viewing of diagnostic data.

Reflecting across these research projects, I have drawn out a series of key challenges that have created difficulties for our research in the past and will likely continue to be issues moving forward. I would find great value in discussing them as part of the workshop.

Challenges
The following challenges are certainly not mutually exclusive. Many overlap and are affected by one another. Yet I feel that each reveals particular nuances and difficulties.

1. Overcoming technical constraints. Simply put, a great number of systems we have created have been very difficult to build and took a large amount of time and student training (e.g., [8][9][14][15]). Similarly, the design ideas we have for future systems face a challenging array of technical constraints that will be difficult to overcome in a timely manner. This will likely include, for example, data bandwidth limits (in particular with cellular networks), the integration of multiple cameras, and high-speed activity and person detection within video frames. As a result of the aforementioned technical challenges, we often t turn to ways that we can include existing commercial systems or devices within our design work rather than building our own systems. Yet it is not always possible and they too sometimes suffer from the same limitations. Overall, this challenge is particularly problematic because it means we are limited in the design ideas we are able to explore. Rather than 'inventing the future,' we are trying to figure out how to 'get around' the

limitations of today's technology to do something creative.

2. Staying ahead of the curve. The number of companies that are designing innovative telepresence systems and releasing them to the public seems to have increased over the last decade. This includes a large number of startup companies that are able to utilize mobile device app stores to quickly and broadly disseminate their products. This is both highly beneficial for the field, yet it also presents a challenge. On one hand, it provides a great many new avenues to see interesting telepresence ideas emerge for consumers to actually try out. On the other hand, it forms a type of competition for research where it becomes increasingly difficult to create novel designs.

I find this especially challenging as an academic researcher who is training undergraduate and graduate students. Projects are often done by a small number of students and the ability to produce systems that are robust enough for consumers to test takes a lot of time. This amount of time is easily far longer time than what it would take a startup company with a dedicated team of developers. The result is that we are often behind the curve and unable to create new designs that are truly novel. Our designs also typically compete with commercial products, which are faster, more robust, and suffer from fewer bugs. The overarching result is that we have tended to shift our research approach from one of 'building systems' to an approach focused on 'studying existing systems.' This is not inherently bad, but it does mean that we do not get the opportunity to learn through the making and building process. We are also constrained to study the features that are available in commercial products.

3. Evaluating telepresence systems to understand their actual real world usage. As researchers, we are increasingly facing the challenge of not knowing how to properly and thoroughly evaluate our telepresence designs. This has been posed as a general problem for HCI research [6], and it certainly exists for telepresence research. Frail prototypes have meant we cannot conduct a study over a long period of time like we would like to (e.g., [8][9]). We have also found it difficult to recruit participants for studies because of the long term or detailed commitment needed (e.g., using a technology daily over several months). This has meant we have decided to *not* pursue some design work because we knew the impending evaluation would be too difficult to conduct. It has also meant we have begun to apply newly documented design and evaluation methods that focus on the researcher as user of the technology [13]. While extremely beneficial for our understanding, such techniques are not without their qualms by conference paper reviewers who often want to see objective, third party accounts of technology usage.

4. Exploring creative design spaces. Telepresence has been a topic of study for a long period of time in the fields of Computer-Supported Cooperative Work and HCI. Looking across the vast amount of research available, it is clear that there are a great many theories and systems that have been created. While there are certainly many new avenues to explore, new theories to develop, and new designs to create, at times it is very difficult to understand what has been done, what has not been done, and when you are 'reinventing the wheel.' Sometimes this has meant that we have explored 'old' design ideas in new contexts, such as explorations of always-on video in

home situations (e.g., looking at ideas from the workplace in the domestic setting [8][9]). Other times it has meant that we performed work and only after the fact found out that similar theories or systems existed already. Thus, it can be challenging to know 'what is out there' and explore creative and novel design spaces and ideas.

Conclusion

Overall, it is not clear to me that all of these challenges need to be solved per se. Some are indicative of doing research in general and 'it is what it is.' Others may simply reflect the changing nature of research as technology design and its role in society increases. In the least, I feel that the challenges serve as interesting discussion points where other researchers may share similar sentiments or have strategies that have worked well for them to overcome some of the challenges.

Acknowledgements

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