Ethical Issues and Practical Considerations in the Use of Teleoperated Robots as Social Interfaces

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Abstract—Social relationships are at the core of human life and play an important role in promoting physical and psychological well-being. For this reason, researchers have been developing new and innovative ways to tackle the problem of emotional and social isolation. Recent advancements in embodied technology present a promising opportunity to reduce social isolation and loneliness by either (a) developing social robots that can keep company and entertain the user or (b) by providing users with robotic teleoperated interfaces through which the individual can interact remotely with others. With the latter option becoming increasingly more widespread, we believe that there is the need to address its’ practical considerations for social relationships and discuss how the specificities of this type of HRI translate to a new and revised set of ethical guidelines.

Index Terms—Social Robots, Teleoperation, Tele-presence, Ethics

I. TELEOPERATED TECHNOLOGY: WHAT IS, WHAT FOR, WHY IS IT USEFUL?

Teleoperated embodied technology is important because it allows people to control and communicate through physical robotic interfaces, thus increasing their level of social participation, reducing isolation and increasing individuals’ level of real-life world actuatin [1], [2]. This type of technology differs from other branches of (social) robotics because it does not aim to create socially intelligent fully autonomous robots, but instead, it aims to create technology that can serve as an interface for individuals that are physically impeded from engaging in social interaction [1]–[3].

While many areas of Human-Robot Interaction (HRI) still remain in the realm of experimental testing and advancement, teleoperated platforms are a common tool currently being used in many settings. For example, many conferences, such as the HRI conference, offer remote attendance devices 1 that allow attendees in other countries to assist and interact with other attendees at the site of the event. Also with the goal of reducing distance and increasing social presence, companies like the Japanese Ori Laboratory have been focused on the development and implementation of teleoperated embodied platforms that allow users with ALS (Amyotrophic Lateral Sclerosis) to remotely control and participate in social events.

In addition, some authors have also pointed out that because today’s robots are still far from achieving full autonomy, teleoperation still presents (and will likely endure) as a promising alternative to maximize the potentials of HRI [4]. These authors also point out the different nature of teleoperation for navigation activities and for engagement in social tasks (see table 1 in [4]), thus emphasizing the importance of human factors of teleoperation and the need to take them into consideration when designing teleoperated social robots.

In this context, although the social consequences of teleoperation and remote social presence are still poorly grasped in the current existing literature, the use of teleoperated robots as interfaces for social communication seems to be a beneficial approach due to its’ potential to reduce loneliness and social isolation [3], [5], [6].

This is important because being socially connected plays a major role in the promotion of psychological well-being and increased longevity [7]–[9]. On the other hand, the lack of this social embeddedness can have adverse consequences for well-being with a degree of risk comparable to other well-established causes for mortality (for an extensive review, see [7]).

Despite presenting exciting new opportunities, we believe that there is a significant gap in the discussion of the possible negative practical outcomes of the use of teleoperated robots, as well as in the discussion of the ethical guidelines that should be taken into consideration when dealing with these negative outcomes. In this paper, we will discuss what are the deleterious situations that can result from the use of teleoperated embodied robots and provide some ethical guidelines and future paths of research in this area.

II. WHAT CAN GO WRONG IN THE USE OF TELEOPERATED ROBOTS AS SOCIAL INTERFACES?: SOME PRACTICAL CONSIDERATIONS

A. The Limits of Immersion

Teleoperation of embodied technology presents the potential to create an immersive experience for the user. The feeling of immersion stems from the known feeling of losing the track of time or getting lost while being engaged in an immersive experience [10], [11].

1In 2018, this conference made available two BeamPro telepresence devices from Suitable Technologies.
Individuals that are engaged in long-distance relationships might see in this form of technology a precious tool to increase their contact and presence in their loved ones’ lives. However, this immersion might come at a cost in the sense that engagement in teleoperation and remote control of robotic devices can result in long periods of physical inactivity. This is because some remote control systems work by having the user controlling a still interface (such as a computer or a tablet), thus requiring only minimal physical effort to be operated. Although exceptions to this can be found throughout the multitude of different control systems (both in the case of teleoperated robots and virtual reality), the use of tablets or computers as control interfaces for teleoperated robots still presents a cost-effective alternative that can put users at risk of increased periods of physical inactivity.

The dangers of the lack of physical activity are well documented and include, among others, the increased risk of several diseases [12], [13], a lowered level of quality of life [14] and well-being [15]. Although these adverse effects might only be severe in cases of extended use, technology addiction (facilitated in this case by the level of immersion of the experience), is a real phenomenon that must be taken into consideration when developing new social technological platforms [16]. Furthermore, recent advances in teleoperation control systems, seem to support the possibility and usefulness of direct integration with the nervous system, thus enabling the user to feel the robotic device as part of their own body [17] and possibly increasing the level of immersion.

B. Closer together but further apart

While technology has done an impressive job at bringing people from different parts of the world together, some would argue that it has also contributed to the decay of interpersonal relationships in one’s immediate geographical space [18]. Indeed, in a circular fashion of events, loneliness seems to be both the bi-product and the motivating force behind the use of some technologies [19]. In the case of teleoperated embodied robots the caveat is that one can not be fully psychologically present in two places at the same time. Alienation from those geographically close to us and a reduction in less meaningful forms of social interaction might be a risk for those opting to use this technology. Research also suggests that presence is a subjective phenomenon and interpersonal one-on-one experiences are still the golden standard in judging all other forms of communication and presence [20].

Indeed, some studies examining the effects of the use of teleoperated platforms have reported that users often perceive this type of technology as a physical extension of their body [21], comparing the sensation to the known rubber hand illusion (see [22]). Other studies, comparing the effectiveness of communication through an embodied robot versus a disembodied avatar, show that participants in the embodied remote platform condition feel as if they were talking to the other person face-to-face [5]. Also from the perspective of the user, the use of teleoperated robots can have consequences resultant from the limitation of sensorial input set by the nature of the teleoperated platform. In particular, we, as humans, experience the outside world through a myriad of senses (e.g., sight or smell) that, together, constitute what we call reality. The use of robotic teleoperated platforms, through the limitation in sensory experience, might affect the user’s sense of fulfillment with the social and physical scenario in which he/she is participating in.

While results like those mentioned demonstrate the extraordinary potential of these teleoperated platforms, at this point in the current state of the art, it is still unknown the full extension and consequences of this phenomenon on this domain of HRI. Further research is necessary to explore, for example, aspects pertaining to emotional engagement and presence.

C. A Human in a Robot’s Clothing

When placed in human environments, robots have been observed to be the target of negative behaviors such as bullying. It still remains somewhat unexplored if people’s responses to teleoperated agents are closely related to the way they generally respond to other people or to the way they respond to robots. The embodiment of the robot and its ability to act with transparency might play an important role.

Furthermore, the ability of the robot to physically interact in ways that are natural and congruent with the operators emotional and psychological state is also worth considering. This is important because it foments the development of teleoperated platforms that can better induce a feeling of social presence, not only by physically being there but also by being able to comfort and interact with people in ways that are socially and emotionally effective. In this regard, telepresence medicine seems to be a good example of how this type of technology can affect human interactions. Considerations regarding the remote practice of medicine are already taken into consideration in the code of ethics of the World Medical Association [23]. They raised questions regarding issues such as doctor-patient confidentiality, how to handle sensitive issues, diagnosis and the possible effect of this type of technology in fomenting the migration of services from doctors in disadvantaged areas. These issues are also valid in other areas of actuation and provide this technology with the potential to revolutionize the work market by breaking distance barriers.

D. Privacy, Legal and Societal Issues

Privacy and legal considerations are issues transversal to most forms of technology. These concerns are usually proportional to the level of invasiveness associated with each technological platform and are particularly important in the case of teleoperated platforms. In particular, we must consider that the presence of embodiment for means of social interaction might (unintentionally or not) open a range of possibilities not present in other types of technology. Distraction or malicious intentions by the user operating one of these robotic platforms might result in serious harm to other people or their property. If we add the fact that users’ can control from home embodied

\*This title is an allusion to the popular english expression A wolf in sheeps’ clothing.
platforms in other countries, a new level emerges of legal complexity that demands discussion [23]. In the case of legal consideration, the medical context is one that is frequently evoked as an example of the potential of teleoperated platforms. However, it is also one frequently used to illustrate the problem or remote control, legal accountability and the need to establish adequate worldwide legislation and standards. Moreover, if we take a step back and look at the possible practical considerations of the wide-spread implementation of this type of technologies, we must also consider both the need to create user-friendly command interfaces and, in some areas, the need to create induction trials and training programs. The increased reliance on technology observed in many professional areas, although outside of the scope of this paper, is no news and one must consider the costs and resistance involved in the implementation of this type of technology.

III. HOW CAN WE PREVENT POSSIBLE NEGATIVE CONSEQUENCES?

However hard we try, negative consequences resulting from the misuse of technological platforms can never be completely avoided. Nonetheless, its’ risks can be minimized by putting in place adequate ethical and accountability models and guidelines. This has been a transversal pursuit to different fields of technology innovation and development as demonstrated recently, for example, by the efforts undertaken by IEEE (Institute of Electrical and Electronics Engineers) to crowd-source a set of general ethical and conduct guidelines from the community of experts working in technological advancement fields [24]. In the same line, this interest in the development of ethical guidelines for new technology is also reflected in the growing number of papers, workshops and discussion forums in the arena of researchers working on these topics. It should be recognized here, nonetheless, that these guidelines are inherently temporary at best and should keep being updated and revised as technology progresses and new needs and issues arise. The specific case of the use of teleoperated technology as an interface of the social and relational world, while presenting peculiar challenges and risks, seems to be one still underrepresented in this wider discussion about ethics.

A. Guidelines for Ethical Research and Future Endeavors

1) Minimize the risk of misuse and addiction: While there are many real-life examples readily available that demonstrate the perils of technology addiction, none appears to be more striking than the one of Lee Seung Seop, a 28-year old Korean man who died of cardiac arrest after completing a 50 hours long binge gaming session, during which he neither ate nor slept [25]. Experiences of technological addiction appear commonly in the literature and in everyday life and seem to be related to the level of immersion of a technological stimulus (e.g. in the case of video games, [11]). Because teleoperated robots offer a physical platform for remote social interaction, we believe they present the potential to generate highly immersive experiences and thus, are at greater risk of inducing addiction-related problems. Thus, it is important, in these contexts, to conduct research on the addiction potential of these platforms as well as onto the human and robotic factors that can be leveraged to ensure that the risk of misuse is reduced. This might include, on one hand, embedding the robot with a certain degree of autonomy to act on its’ own³, despite the user’s instructions, while also making sure that the robot is capable of following a pre-defined set of ethical rules. This approach of divided control (between the autonomy of the robot and the commands of the user) might, however, lead to an increase in the level of complexity of the debate of accountability and legal framing of teleoperated social platforms. A similar argument can also be raised in the case of other teleoperated technologies, such as drones. In particular, recent incidents with drones in airports support the need to both create safety measures that make it more difficult for people with malicious intent to access drones and to embed the drone with autonomy to avoid certain environments that might present a risk to the user and to other bystanders (for example, by embedding the GPS coordinates of airports or other unsafe locations into the drone, so that it can avoid those areas)

Moreover, despite the existence of some proposals to tackle the issue of technology addiction (e.g. [26], [27]), the first issue to consider should be prevention. In this instance, although it is unclear if these results are directly applicable to teleoperated robots, findings regarding prevention of technology addiction should be taken into consideration, both in the development of new teleoperated robots and in guiding future research (e.g. [28]).

2) Transparency: Transparency is an important topic that has become woven into the fabric of nearly all branches of HRI and refers to the ability of the robot to successfully communicate it’s actions and processes to the human users. The case of teleoperated technology adds a layer of complexity to this discussion to the extent that involves transparency in the communication of its’ teleoperated nature and of the actions and intentions of the human controller. How that transparency can be achieved and improved to an optimal state is certainly an issue for further research. Although research on HRI has consistently suggested that robots can be perceived by humans as social agents and evoke mental models, it is clear that people do not interact with humans and robots alike. Instances of bullying towards robots have been observed multiple times and remain a topic of investigation but still little is known about the transferability of this behavior to the world of teleoperated embodied machines. Still, while waiting for future research to shed light into this question, we can assume with a fair degree of confidence that the distinction between an autonomous acting robot and one that is being controlled by a human might elicit different responses from people and thus, constitutes a central aspect of this discussion.

³By the use of the expression “acting on its’ own” here, we mean both to engage in an action without the user’s expressed command (e.g., steering away from an obstacle) and to disregard a user’s expressed command through inaction (e.g., disregard commands to hurt someone).
3) **Accountability:** The subject of accountability is one particularly hard to address when considering the use of certain types of technology. Its’ definition has been traditionally associated with the level of autonomy of the robots performing as social actors. In this context, accountability seems to be strongly interwoven with both previous topics. On one hand, it is a necessary legal consideration in cases of misuse or foul play and on the other, is facilitated by (and facilitates) the transparent communication of the teleoperated nature of a robotic agent.

While this discussion might exist for all robotic agents in general, it seems to derive from logic that teleoperated robots differ significantly from other types of robots in what regards their level of agency [20]. Thus, despite some ethical guidelines suggesting that the accountability for robot failure belongs to the developers and people involved in its’ creation, in the specific case of teleoperated robots, the robot is merely an interface. **This is, therefore, an issue of autonomy (or semi-autonomy) design and it pertains to how operator commands can be reconciled with the autonomous behaviors of the robot [4], thus creating a system of dual agency (in which agency is divided between the user and the robot.**

It seems to follow that accountability for a robots’ intentional controlled actions falls with the user under the guise of misuse, whereas technical failure responsibility is in the hands of the developer. Although this distinction is greatly simplified here, it is congruent with the currently agreed upon notion of accountability in the fields of autonomous robotics. It is, however, necessary to engage in a more in-depth discussion on accountability, both within the community of researchers in HRI, as well as within the larger society. **It is also necessary to extend the efforts to create safety mechanisms to protect the user (as well as other people) of malicious attacks, thus reducing the risk of malicious use** (see, for example, [29]).

4) **Privacy, Law and Societal Concerns:** The threat of invasion of privacy is one that lurks in all technology related areas. This concern stems from the increased omnipresence of technological devices in almost all parts of everyday life and it is also present in the realm of teleoperated social robots. Although the establishment of measures to ensure full privacy is often out of the full control of researchers, it is important to analyze how the feeling of privacy (or lack of it) affects the use and experiences of people while teleoperating this type of robots. It is also important to create instinctive and transparent ways to communicate the user the exact extent of his/her privacy and to what ends his/her information can be used and spread among different governmental and private companies.

In addition, it is fundamental to raise societal awareness and discussion of the social roles and spaces that can (should) be occupied by these agents. Involving the public in the definition of, as discussed at the beginning of this paper, what teleoperated technology is, what is it for and why is it useful, might be an important factor in increasing its’ acceptance. This is, perhaps, particularly important for the elder and less tech-savvy segments of the population, as well as, for those with more negative perceptions of technology and robots.

Moreover, we should also reinforce the creation of **accessible technology** that can accommodate the needs of all people. If the day comes in which teleoperated social robots become a widespread form of communication, we must ensure that it is accessible and that is intuitive enough so that it can be easily adopted by everyone, from children to elders. In addition, its’ creation and development must follow the previously agreed upon set of ethical guidelines for dealing with special populations (e.g. for the elder population [30]. From this societal discussion, should emerge a set of guiding principles and laws to regulate the implementation of teleoperated robots that address not only the ethical and practical concerns of researchers but that also takes into consideration the voice of the people.

B. Conclusion

Technology continues to provide new ways to improve social interactions and reduce the barriers of distance. Despite its’ many advantages, it also presents risks that must be seriously considered in advance, by those researching and developing it. In this context, we believe that developing principles for ethical research, use, and development of new technologies can contribute greatly towards the possible avoidance of negative outcomes. For this reason, we would like to call for more work examining the social, interpersonal and relational consequences of the use of teleoperated robotic platforms as interfaces for social interaction.

We believe that this is a relevant topic because it will allow researchers to gain a better understanding of how this type of technology influences human relationships and thus, will be a useful source of information to feed the development of better social robots and technological platforms.

Although the technological automation of ethics and the modeling of human understanding of what is wrong or right has been successfully achieved in the past (for example, with autonomous agents [31]), it is important to consider the specificities of each type of HRI.

In this paper, we sought to provide a brief reflection on ethical principles and practical considerations to guide the development of teleoperated robots to serve as interfaces for the social world. Although these guidelines do not differ significantly, in quantitative terms, from the general ethical guidelines for the field of (social) robotics, there are qualitative differences that are worth taking into consideration.

These differences stem from the peculiar nature of this type of HRI. In particular, they emerge from the duality between robotic autonomy and agency. While some areas of social robotics are interested in developing autonomous mechanisms **that people can interact with**, the goal of the development of teleoperated platforms is to create robotic embodied platforms **through which people can interact with other people or social spaces.**
REFERENCES


