# Examining the implications of automation on user autonomy in robot-mediated presence

Andriana Boudouraki
andriana.boudouraki@nottingham.ac.uk
University of Nottingham
UK

## ABSTRACT

Within the domain of robotic solutions for accessibility, automation has begun to play an increasingly bigger role. Automating an action that a person struggles to perform on their own can of course be beneficial. However, this position paper puts forward that the relationship between automation and user autonomy ought to be examined more critically. I ground this discussion on the example of Mobile Robotic Telepresence (MRP) technology. MRP technology allows us to remotely control a robotic body with a videoconferencing screen so as to be "present" in another location when unable to travel there in-person. This is often presented as an accessibility solution. Existing MPR systems are limited in what they can do and they can be difficult to operate. As such many proposed improvements to these systems involve automating their various functions. Whilst this would expand the ways in which users can remotely experience and interact with hybrid spaces, thus making them more accessible, it is important to consider how such implementations of automation affect the ways in which the users experience this robot-mediated access, as well as how automation affects the ways in which their robotic presence is incorporated in social interactions. As we proceed into a future of ever increasing automation, we must take steps to ensure that it supports rather than hinders users' autonomy and control over their self presentation.

## CCS CONCEPTS

• **Human-centered computing → Accessibility theory, concepts and paradigms**.

## KEYWORDS

autonomous systems, self presentation, hybrid participation, remote presence

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## 1 INTRODUCTION

Mobile Robotic TelePresence (MRP) technologies combine videoconferencing with remotely-controlled robotics to allow users to move independently in a mediated space. The most common MRP systems generally resemble a tablet screen mounted on a simple, thin, tall structure that has wheels at the bottom (e.g., Figure 1). Whilst having a video-call on the robot's screen, a remote user can also "drive" the robot through an online interface, so as to explore the location of the robot more freely. Such systems have been used in a variety of settings, including schools, offices, conferences, care homes and museums, to allow those who are unable to travel in-person more opportunities for education, work and social connection [Kristoffersson et al. 2013]. Within the scope of assistive technologies and accessibility, robotic telepresence is studied as an avenue for people gaining access to more spaces and participating in hybrid activities (see 2.1).

Reflecting the general interest in autonomous systems, work on improving MRP technology is also increasingly exploring the use of automation to alleviate the users from the burden of operating the technology. Among other functions, MRP systems augmented with automation might move autonomously in space, and adjust the user's gaze direction (see 2.2) so that the user can relinquish manually operating the robot and focus on the more social aspects of interaction through the medium.

In light of this growing trend, this position paper presents MRP as an example case to examine the implications that automation might have for users' autonomy. Assistive robotic technologies, such as MRP, do not simply allow users to perform actions, but to perform them "as a robot". The users experience and act in the world through the capabilities and affordances of the robot. They are also perceived and interacted with by others through the form of the robot and the behaviours that is enables. Therefore, the ways in which the robots act are a core part of the users' subjective experience of the robot-mediated world, and of how the users' robot-mediated presence is projected onto it [Boudouraki et al. 2023a]. When autonomous features are added, such as the robot moving without direct user input, this naturally affects how much control the users have over their own presence in the world that the robots allow them to access.

Discussing some of the ways in which automation is applied in robotic telepresence systems, and taking a closer look at the role of autonomy and accountability in social interaction, I draw out some implications that automation might pose for users' self presentation and capacity for inclusive participation. The aim of this position paper is not to make a definitive stance on the role of automation, nor to dismiss it altogether, but to highlight the importance of scrutinising its impact from this angle. Such implications might be

**Figure 1: The Double 2 telepresence robot by Double Robotics**

more evident in the case of robotic telepresence — a technology that quite literally represents the user's presence in robotic form and completely defines their action capabilities in a mediated space — but can apply to any robotic technology that mediates between a person and the way in which their intentions are manifested in the world, or the way in which they perceive and experience the world. Whether it is a shared-control wheelchair, a robotic prosthetic or a telepresence robot, automation will have an impact on the user's lived experience that is worth understanding better.

## 2 RELATED WORK

### 2.1 Robotic Telepresence for Accessibility

Whilst MRP technology is not specifically developed or marketed for accessibility, several studies have explored its use for supporting disabled, elderly or homebound individuals. A systematic review on studies of MRP for special needs was recently conducted by Zhang and Hansen (2022), but I will briefly share some examples to contextualise the subsequent discussion. For use in conferences, Cogburn (2018) reported that telepresence robots allowed disabled remote attendees to connect more freely and have a more immersive experience of the event. Such technology has also been tested in museums, to allow users with motor and cognitive impairments to move around exhibits and engage with artwork [e.g., Bagherzadhalimi and Di Maria 2014; Tsui et al. 2015]. A great amount of literature also reports on the use of MRP by hospitalised or homebound students to maintain their social life, and engagement in school [e.g., Newhart et al. 2016; Yeung and Fels 2005]. Another notable case is that of the Avatar Robot Cafe in Japan; a cafe run by robots that were teleoperated by disabled workers [Barbareschi et al. 2023; Takeuchi et al. 2020]. Overall MRP is seen as a valuable tool for allowing people to be present and actively participate in hybrid spaces. Greater advancements in robotics in the future might result in more such opportunities for people with disabilities to participate in public life, education and work through robot-mediated forms. It is possible to imagine that this also results in greater pressure on disabled people to find employment remotely —although this is another discussion in itself. It is thus important to consider the impact that automation in such robots might have on the users' control over their participation.

### 2.2 Automation in Robotic Telepresence

Automation in robotic telepresence can take many forms, and automate actions to varying degrees.

Given reports that driving telepresence robots can be burdensome a lot of research has explored semi-autonomous driving [e.g., Kiselev et al. 2015, 2014; Macharet and Florencio 2012]. The commercially available system Double 3 by Double robotics features autonomous way-point navigation. In addition to using the arrow keys of a computer to directly operate the movement of the robot, the user can also use the cursor to click a point on the floor visible on their the camera and the robot will autonomously move there, making sure to avoid obstacles and people in its path. On the more recently released robot by Temi it is also possible to map a space in advance and set up locations and preferred paths.

Beyond driving, other studies have explored the use of automation for other functions that assist in social interaction. These include adjusting the size of the robot to match an appropriate height [Jouppi and Thomas 2005], adjusting for appropriate interpersonal distance to people near the robot [Yokoyama et al. 2014], tracking the person the user is speaking to [Mishra et al. 2019; Riano et al. 2011], automatically moving to avoid occlusions to the user's vision of their speaker [Radmard and Croft 2013], following the speaker as they move in space [Cheng et al. 2019; Cosgun et al. 2013] and guiding the attention of the user to relevant areas captured by a 360 degree camera [Chandan et al. 2021]. More recently, a paper presented a telepresence robot indented for working remotely as guards in shopping malls in Japan, which automatically alters speech into more polite phrasings [Daneshmand et al. 2023]. Given the importance of politeness in that setting, that robot employed a system that automatically detected the intended meaning of the user's speech and matched it to a pre-scripted, more polite phrasing. Such augmentations can alleviate the mental workload of operating the robot and help steer the behaviours elicited by the robot in more socially desirable ways.

## 3 IMPLICATIONS OF AUTOMATING TELEPRESENCE

### 3.1 Loss of autonomy

Automation systems such us those presented above, whilst undoubtedly providing many benefits, can also result in a loss of autonomy for the user. For example, although an autonomously driving robot requires less effort from the user, it also means that the user has less input into where, how fast, and through what path the robot moves.

Beyond loss of autonomy being a negative outcome in and of itself, this also can have several other implications depending on the context and on how the autonomous system is implemented. One such implication is that there is less opportunity for spontaneity and exploration. Following an automated route across a museum

exhibition might be easier, but robs the user of the chance to decide for themselves which of the exhibits to approach and how long to spend at each one. Autonomously following another speaker may be more conducive for maintaining conversation, but forgoes the opportunity to notice other things and people in the environment —and in that way fully experience being that space. In earlier ages, lack of autonomy to explore may have even more dire implications in terms of young users learning to move and act in the physical world, developing their sense of self and learning through play. Marshall et al. (2023) moreover, put forth an argument on the value of being allowed to have physical collisions with one another, and with and through technology; something which autonomously moving robots are generally designed to avoid.

Another issue to note is that automated ways of moving and behaving might result in rather uniform, filtered ways of being. Automating behaviours such as gaze and interpersonal distance, for instance, erases idiosyncratic and cultural diversity. How do we decide which behaviours are appropriate, and what does this imply about identities that deviate from this (e.g., other cultures, neurodivergence, personality). Moreover, being able to automate behavior in this ways might give a concerning amount of control to the stakeholders in charge of developing and deploying the technology. Taking the example of the mall guard robot that converts user speech to more polite phrasings [Daneshmand et al. 2023]: although the study reports positive reactions by users, there is arguably something black-mirror-esque about technology that censors employees' words in real time based on a limited, pre-approved script.

When it comes to use for accessibility, this is even more concerning given that disabled users might have a greater reliance on such technology as it presents one of the limited ways in which they can participate in certain activities. In addition, the implications of reduced autonomy are concerning given the impact of assistive technology on disabled users' social identity and sense of self [Lupton and Seymour 2000; Ripat and Woodgate 2011]. Automating robot-mediated behaviours means automating users' presence in the world, and the implications of this should be more carefully examined.

## 3.2 Autonomy and Accountability in Self Presentation and Participation

Besides the fact that automating mediated actions reduces people's control over what they can do, another implication to explore is with regards to how automated systems impact the users' self presentation and participation in interactions with others.

One angle of seeing this is through Goffman's conception of the presentation of the self as a performance. This view posits that interactions with other people consist of things we do to influence the definition of the situation as one that paints us in a certain favourable light and is acceptable to others [Goffman et al. 1978]. For example, one might act confident and sociable during a networking event, and do things that are normal in that situation (e.g., smile to others), to elicit a sense of belonging there. Or one might act visibly "lost" by looking around with a confused expression to communicate that they are new in that space and solicit some help. While a robot's affordances, in conjunction perhaps with a user's disabilities, limit how effective of a 'performance' the user can put on (e.g., fewer embodied cues), a mediating technology still ought to allow the user to produce actions so that they can influence a situation according to their needs and wishes.

Approaching participation in social life through an Ethnomethodological and Conversation Analytic (EMCA) lens — paying close attention to the actions people employ in interaction so as to achieve a common ground understanding — moreover highlights the importance of accountable behaviours. EMCA studies demonstrate that verbal and embodied actions within an interaction serve not simply to exchange information but also to ground and frame our presence and participation in the interaction in relation the other people and their perspectives, as well as in relation to the environment and broader situation [e.g., Kendrick and Drew 2016; Licoppe et al. 2017]. For example, turning to gaze at a person who spoke serves not only to allow us to see that person but to also show them that we are ready to pay attention to them. Exclaiming "oh what's this", when approaching an obstacle does not literally ask of others to describe the obstacle, but foregrounds the object so that a possible interaction sequence about it might begin [Boudouraki et al. 2021]. Having the autonomy and flexibility to make intended actions then is a crucial part of participation in that sense.

Accountability, in this frame, describes actions that can be expected or explained within a given context (e.g., if you turn to look at me, I can expect that you might speak to me). Others can easily make sense of such behaviours and incorporate them into the interaction. When actions are not accountable communication is difficult (e.g., speaking abruptly without first indicating wanting to speak). Accountability is already an issue in robotic telepresence, as the perspectives and capabilities of remote users are not well understood by people interacting with the robot (e.g., it is not clear how much a robot user can see or hear or how fast they can move). This often results in people either neglecting or over-assisting telepresence users [Boudouraki et al. 2021; Cogburn 2018] and in users feeling awkward during interaction [Boudouraki et al. 2023b]. This is again might be further compounded when telepresence is used for accessibility, given that a disabled body in itself is responded to by others as something difficult to account for and smoothly incorporate into interactions [Robillard 1999].

Augmenting such technology with automation could help make certain behaviours more accountable by making them more socially predictable (e.g., automatically maintaining gaze on a person speaking during a conversation). On the other hand, if not implemented correctly, it could result in less predictable behaviours (e.g., the robot maintains gaze on the other person, even through the user is trying to draw attention to something else in the environment). Moreover, it might be even harder for people to interact with the remote user if they do not know which behaviours are a result of automation and which were made intentionally by the user. Therefore, when implementing automation for technologies used in situations involving social interaction, it is important to ensure that they still support accountable actions that align with users' intentions.

# 4 CONFIGURING AUTOMATION

## 4.1 Automation and autonomy: a trade-off or win-win

When considering automation for technology related to disability and accessibility, given that such technology mediates between the users and their actions in the world, it is all the more crucial to better understand its impact on user autonomy in their self presentation and capacity to participate in interactions.

From the issues presented above it may seem that there are certain trade-offs between automation and autonomy. As pointed out, automation can alleviate users from the manual work of operating a robot and allow them too focus on other more meaningful tasks. Freed form having to press buttons to make the robot move alongside a walking museum guide, or from having to turn the robot's gaze between the speaker and the exhibits, the user can just listen along and experience everything that is relevant in that environment. In addition, given various technical limitations of such technology, it can be difficult for users to know where the robot stands in the mediated space and in relation to other people there. Freed from worrying about accidentally making the robot do something inappropriate (such as invading someone's personal space), the user can approach and talk to people at a conference more easily. Automation of the robots' movements then can be beneficial as it addresses such difficulties. Some trade-offs to this, to recap points raised in section 3, are that the user has less control over their actions, that there is less opportunity or spontaneity and exploration, that there is less diversity of behaviours, that whoever designs the technology can limit and dictate the actions available to the users, and that such involuntary and unaccountable actions might make interactions with other people difficult. It appears that there are certain benefits to automation, which come with certain costs to user autonomy. Adopting this view, future solutions might weight the benefits vs the costs and attempt to arrive at appropriate middle ground compromises or at automation that could be customised or overridden by the user.

Without dismissing the idea that automation curtails autonomy, it is also possible to conceive of ways in which automation supports user autonomy; ways of implementing automation that result in win-win outcomes. In the case of autonomous driving for robotic telepresence, for example, being able to employ way-point navigation, such that the robot goes to a desired location without needing manual teleoperation, does not only make driving the robot easier but it also respects the user's intentions; the robot goes where it is told to go by the user. In some cases this may even be more accessible for people who find it difficult to use keyboards or who might get tired by multi-tasking. An intention recognition politeness system, such as the one presented by Daneshmand et al., might also empower autonomy for users who desire to communicate but find it difficult to do so — with the caveat that it should flexibly allow them to express everything they wish to say. In that case, such automation could give users more autonomy, as it would expand the ways in which they can interact with and access the world. That is to say, automation can support autonomy as long as it reflects the users' intentions. Still, impact of automation is certainly not clear-cut. Following such a view, the solution may more complex than simply weighing the benefits and costs to find the appropriate medium. It would involved more closely scrutinising the actions relevant in any target task or activity, understanding what user autonomy entails in that context and assessing how they can best be supported.

Whether looking at trade-off or win-win cases, it will be vital to consider is the users' specific needs, values and desires. Do users' want to explore a mediated space or would they prefer to be guided? And whilst automated driving is easier, do users have a good experience being 'driven' around or would they prefer the opportunity to gain mastery over the manual system? These are also questions that are currently overlooked.

## 4.2 Supporting user autonomy within autonomous systems

The aim of this paper has not been to provide an exhaustive overview of the implications of automation on user autonomy, nor to make a definitive statement on the type of relationship between the two concepts, but rather, to hopefully motivate more exploration into the subject. This paper has proposed some possible implications in order to engage discussion of the various ways in which automation might be cause for concern. Moreover, it raises attention to the — perhaps less obvious — impact of automated actions within the practical details of interpersonal interaction.

Taking this onboard, future work on autonomous systems intended for application in accessible robotic technologies should closely examine the possible implications of such automation in terms of their practical impact in users' autonomy to act. One avenue of research would be to work towards building a more comprehensive understanding of the ways in which automation is enacted in various settings and use cases. Automation can take many forms, and be implemented to various degrees. Developing a clearer framework of the dimensions of automation and how they interact with user autonomy in different settings could be a worthwhile pursuit of future research. An autonomously driving wheelchair, is still largely under the use's control, yet it also makes some decisions for them. A telepresence robot that takes the user on a fully pre-scripted museum tour might allow for less freedom. The impact is likely to change across use cases, as well as across different types of users or even dynamically within an interaction. Still in all cases we must ask questions such as what kinds of actions are automated, what actions are restricted, how are automation decisions made and who is in control. What are the preferences of the intended users and how can their needs and values be respected with automation? We must also look at how interactions between the user and other people are going to be achieved through or alongside the mediating technology. Such research, should consider not only the surface level benefits and limitations, but also consider the potential win-win scenarios, were automation is intentionally designed to increase user autonomy. Moving forward in this field inclusive, participatory, critical research can build a richer understanding of these issues and build more effective autonomous systems.

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