Conceptualizing Opportunities and Challenges Relevant to the Inclusion of Humanoid Service Robots in the Context of COVID-19

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Abstract. The COVID-19 pandemic has heightened the need for a better understanding of how service robots (SR) can aid practitioners as well as the society. Individuals must not only embrace the robotic environment, but also learn how to collaborate with humanoid service robots for collective value creation. Starting with the eminence of humanoid SR in the context of the COVID-19 pandemic, we majorly focus on anthropomorphism and social exclusion. These two key concepts present both opportunities and challenges, being the most eminent areas of research in the quest for understanding society-robot relationships.

Keywords: Robots · Humanoid Service Robots · Services · Service Robots · SR · COVID-19 · Anthropomorphism · Social exclusion

1 Introduction

The COVID-19 pandemic accelerated many businesses' digitalization, particularly for frontline services where employing humanoids reduces risks for human actors that cannot distance socially during the encounters. Humanoids, also known as anthropomorphic robots, prove advantageous in adapting to humans' physical spaces with their human-like forms, sizes, and motions. Service robots (SR) have long been deployed for socially-assisting the elderly, in dining and catering services, and even for sexual pleasure. As time with robots passed, several entrepreneurs took on the role of warning against uncontrolled artificial intelligence and the use of robots largely for defense purposes. Thus, individual and societal emotions towards robots turned from excitement and empathy towards anger and fear [1]. As humanoid SR's deployment in service provision unfolds, there is also a heated debate across business circles on whether COVID-19 speeds up robots' use to replace human workers {Mende, 2017 #222}. Some believe that robots help the world resume 'normal life' faster at the cost

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of their potential contribution to already high unemployment levels [2]. In short, the rise of SR can be conceptualized as a double-edged sword with buzz and engagement on the one hand versus eeriness [3].

Yet, the inclusion of humanoid SR in providing numerous services and its effects remain as emerging fields of research, mainly as it unfolded in the context of COVID-19. As a response to the COVID-19 challenges in unavoidable indoor proximity settings, many services replaced their touchpoint staff with robots, such as delivering medical and vital supplies and samples across hospitals, collecting patient information from those with possible exposure to the SARS-Cov-2 virus [4], contactless services at hotels such as check-in and various contactless payment mechanisms.

We aim to contribute to the ongoing research efforts on the inclusion of robots in services by focusing mainly on humanoid robots, which have globally received attention in the context of COVID-19. First, the eminence of SR as well as the context of the COVID-19 pandemic and relevant conditions are introduced briefly. Then, we discuss a number of challenges and opportunities related with SR in the context of the COVID-19 pandemic. Among those, first anthropomorphism is discussed conceptually, and a list of related empirical findings are presented. As anthropomorphic SR are being introduced as social entities in an accelerated pace, both the level of anthropomorphism and humanoid interaction's kind and type can influence overall attitudes towards robots [5]. Both opportunities and challenges related to the anthropomorphic SR are discussed.

This is followed by a discussion of the anthropomorphic-robots and human relationships from a social exclusion perspective. Compared to social distancing and the functionality of SR, individual social exclusion and its impact on both micro and macro levels on SR acceptance is relatively ignored. Even though we provide a glimpse of a theoretical as well as practical discussion, the short-and long-term effects of a worldwide social exclusion (such as the one experienced during the COVID-19 pandemic) are unknown.

2 Service Robots (SR) and the COVID-19 Pandemic

Service robots (SR) are defined as robots possessing a certain degree of autonomy as they perform personal or professional tasks for humans [6]. Their capabilities in registering habits and attitudes of the humans that they interact with are known to affect the perception of intimacy, privacy, bonding, and emotional support in those individuals [7-9]. In addition to looking and moving like humans, recent technological progress also equips SR with human-like learning and creating abilities [10-12].

The COVID-19 outbreak accelerated the adoption of SR. They offer contact-free reliable performance in various tasks such as contactless delivery of food and medications, disinfecting, patrolling non-pharmaceutical social interventions, and assisting in reception [13, 14]. SR proved particularly helpful in supporting the healthcare services that struggled to cope with increasing demand [15-17]. On the other hand, SR are also a source of concern during the pandemic with already rising unemployment figures. They can replace human workers by serving drinks and food to customers in hotels and airport lounges [18] or handling check-in and check-out

services at hotels [19]. Recent research already reported the preference for robot-staffed hotels when COVID-19 is salient [20].

As the marketplace and various servicescapes rely more and more on technological assistance such as SR and AI, related discussions of human-humanoid relationship should weigh both opportunities and challenges of the phenomena.

3. The Anthropomorphism – Opportunities and Challenges

Anthropomorphism is "the tendency to imbue the real or imagined behavior of nonhuman agents with humanlike characteristics, motivations, intentions, or emotions" [21]. It is an inductive inference mechanism whereby individuals assign distinct human characteristics to non-humans, particularly the capacity for rationality (agency) and conscious feeling [22]. In terms of form, robots are roughly classified in three forms: anthropomorphic (human-like), zoomorphic (animal-like), or machinelike [23]. Later on, robots were classified in more detail on a continuum of human-like / animate dimensions such as physical versus virtual, humanoid versus non-humanoid. Non-physical robot entities can be holographs, videos, voicebots, textbots or software bots. Anthropomorphizing robots is performed based on factors such as voice [24], facial features [25] and ability to take the listener's perspective [26].

With the increasing rates of social isolation and virtual immersions in non-animate worlds during the COVID-19 pandemic, the need for research to understand human perceptions of anthropomorphic robots is way imminent than ever.

Anthropomorphic SR are donated with more opportunities compared to machine-like robots in terms of functions but more importantly in terms of acceptance and attitudes of human beings. Degree of anthropomorphic representation is an essential determinant of both how a person acts towards them or how a person should respond in relation to or in the existence of them. For example, anthropomorphic virtual assistants are shown to enhance users learning in software programs by dealing with knowledge overload better [27]. Anthropomorphic faces and voices in the interface of a survival task made individuals feel better understood [28]. Waytz, Heafner and Epley [22] demonstrated that individuals perceived an autonomous vehicle more competently as it acquired more anthropomorphic features such as being named, gendered, and voiced. Moreover, participants trusted their anthropomorphized vehicle more, were more relaxed in an accident, and blamed their vehicle and related entities less for an accident caused by another driver. Anthropomorphism enhances the demand of buyers for goods with a superior beauty by the stereotype of "beautiful is good" [29].

On the other hand, there are numerous challenges that come with an anthropomorphized SR. Primarily, the theory of uncanny valley drives these challenges. An influential theory, the Uncanny Valley by Mori [30], states that as the presence and behavior of a robot are made more human, the emotional response of individuals will become more optimistic and empathic - until a point is reached at which a reaction of revulsion will arise. Accordingly, as robots become more similar to humans, humans increasingly tend to avoid them. Among many examples, individuals do not choose to cooperate and work with serious-looking anthropomorphic robots [31]. Moreover, robots with wheels, treads or squared edges

cannot be anthropomorphized as easily [32], and thus not lead to desired outcomes as in other anthropomorphic robots.

Anthropomorphic robots present enormous opportunities following the endured social exclusion periods of human beings during the COVID-19 pandemic, too. Literature shows that anthropomorphic entities, who can provide genuine human interactions, partially mitigate many negative and unwanted effects of social exclusion. Anthropomorphic entities (i.e., robots) can satisfy the social assurance needs of individuals, in the absence of other real human entities and reduce the need for socially close others in the near future [33]. Social needs and exclusion are discussed in more detail in the next section in the context of humanoid SR deployment during the pandemic.

4. The Social Exclusion – Opportunities and Challenges

The social distancing recommended during the COVID-19 pandemic resulted in a more severe exclusion of some members of the societies based on physical social contact. As some of these vulnerable groups involved older adults and persons with disabilities who were already falling into the digital divide's cracks even before the pandemic, they faced exclusion from digital services that aimed to compensate for the lack of physical contact [34]. All around the World, even in well-developed countries with progressive digital societies, such groups struggled with the double burden of social and digital exclusion.

As psychological distress, social exclusion emerged as an additional challenge to be tackled amid the pandemic [35]. As a humanoid robot introduced in 2016, Sophia the robot [36] assumed a new task towards this challenge by following its producer Hanson Robotics' decision to mass-produce thousands of robots by the end of 2021. The idea was built on taking Sophia as the foundation character and generating spin-offs to enhance human-to-machine empathy and compassion in the healthcare sector. The robot Sophia, "capable of measuring temperature with its thermal camera on her chest or leading morning exercise for the older adults, it aimed to help take care of sick and elderly. It was also useful in helping to communicate, giving therapy, and providing social stimulation even in difficult situations"[36]. As such humanoid SR emulated the human form, figure, and interaction, it was believed that they might also help with the loneliness felt due to the social exclusion. The aimed delivery of human warmth through telepresence or autonomous extension of human expertise offered both an opportunity and a challenge in touching the hearts of the people by positioning SR as our true friends.

5. Conclusion

Acceptance towards humanoid SR during the COVID-19 pandemic accelerated, yet the challenges persist despite the involved opportunities. The emerging social technological acceptance demands further research for improved policymaking that can facilitate better affordances and readiness.

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