Unintended Failures of Robot-Assisted Feeding in Social Contexts

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ABSTRACT

Over 1.8 million Americans require assistance eating. Robot-assisted feeding is a promising way to empower people with motor impairments to eat independently. Yet, most robot-assisted feeding research has focused on individual dining (e.g., eating at home with a caregiver), but not social dining (e.g., family meals, friends' brunch, romantic dates). What happens when a robot developed for individual contexts gets used in social contexts? In this humorous video, we present unintended consequences that can arise from robot-assisted feeding in social settings. This video aims to raise awareness about the importance of accounting for social context when designing assistive robots.

CCS CONCEPTS

• **Computer systems organization → Robotics**; • **Human-centered computing → Accessibility technologies**.

KEYWORDS

assistive technologies, social context, speculative video

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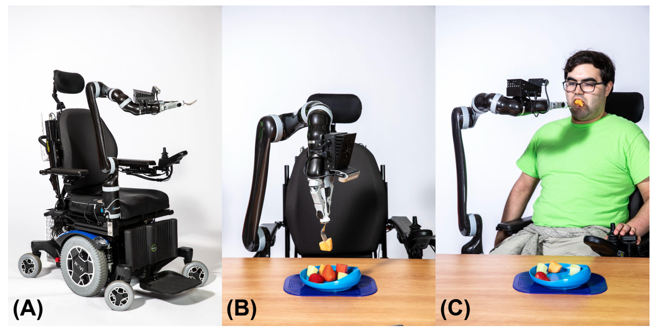

Figure 1: The robot-assisted feeding system used in this work (A) picking up food (B) and feeding it to the user (C).

1 INTRODUCTION

Social dining is an important way in which humans connect with one another, strengthening relationships and improving well-being [6, 7, 13]. Unfortunately, for the over 1.8 million Americans who require assistance with eating [12], social dining can bring up feelings of self-consciousness, discomfort, and being a burden [9].

Robot-assistive feeding (Fig 1) has emerged as a promising technology to alleviate some of the challenges people with motor impairments face during dining. However, much of the prior work on robot-assisted feeding has focused on individual dining, where only the user, and sometimes a caregiver, interacts with the robot. These projects have yielded valuable technical insights and improvements in the state-of-the-art for picking up food and moving it to the user's mouth [1, 4, 5, 10, 14].

Yet, users also want to use robot-assisted feeding systems in social contexts [9]. When technological systems designed with *individual* contexts in mind are used in *social* contexts, unexpected consequences can emerge—from limitations of the technology to violations of social norms. This humorous video exposes several unexpected consequences that can emerge when using a state-of-the-art robot-assisted feeding system in social contexts. This video is paired with the paper "Design Principles for Robot-Assisted Feeding in Social Contexts" [9]. Humor aside, *this video is intended as a call to action for robot designers and developers to anticipate and design for social contexts when creating assistive robots.*

2 VIDEO CREATION METHODOLOGY

2.1 Speculative Videos

We used a speculative design approach to create the scenarios present in this video, following the guidelines from Mitrović [8]. Specifically, we created scenes that showcased intended usage of the robot-assisted feeding system and unintended consequences that could arise from using it in social settings.

2.2 Storyboarding Videos

We began by creating storyboards of different robot behaviors that may or may not work well in social contexts. This gave rise to three key themes we focused on for the videos: (1) how should a user ask the robot for food? (2) should a robot share food with dining

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partners, and how? (3) where should the robot rest its arm while delivering food? For each theme, we identified multiple features the robot could exhibit, coupled with specific social contexts in which the feature may or may not work as intended.

2.3 Actors

We recruited actors from our university. One person acted as someone with motor impairments, seated in a wheelchair and using the robotic arm for assistance feeding themselves. Others acted as dining partners who did not have motor impairments. During each scene, we told actors what robot feature would be shown and instructed them on the social scenario and desired outcome.

2.4 Robot-Assisted Feeding System

We used a 6 degree-of-freedom Kinova JACO Gen2 robot arm attached to a power wheelchair base (Fig 1). The robot arm autonomously perceives and skewers bites of food using an on-board RGB-D camera, a custom 3D-printed fork, a force-torque sensor, and state-of-the-art food manipulation algorithms [2–4]. It then transfers the bite to the user's mouth using face detection and visual servoing. We used a "Wizard with Oz" methodology [11] when recording the videos, where the robot autonomously acquired bites and a Wizard decided when and how to transfer the bite to the user.

2.5 Video Post-Production

This recorded footage served two purposes. First, we edited it into a playlist of videos that showcased each robot feature, its intended uses, and its unintended consequences. This version of the videos was used in a study with people with motor impairments, to invite them to share viewpoints on the design of robot-assisted feeding systems. The findings from that research can be found in [9].

Second, we edited the footage into a humorous video, which is the focus of this paper. This video showcases a few robot features and the resulting unintended failure. Each failure is paired with a meme that highlights the humor in the scene. This version of the video is designed to spark discussions amongst the human-robot interaction (HRI) research community about: (a) challenges that can arise when social contexts are not accounted for during technology development; and (b) the inherent complexity present in the social contexts that the robots we develop may be used in.

3 FAILURES IN SOCIAL CONTEXTS

In our video, we primarily focus on two types of failures that can arise when a robot is used in novel social contexts. *Robot failures* are situations where the novel social context prevents the robot from behaving as intended. *Social failures* are situations where the robot behaves as intended, but the novel social context results in its actions being interpreted as a faux pas.

As an example, consider the scenario where the user verbally tells the robot when they are ready for a bite. The intended behavior is that the user says "Food, please" when ready, and the robot responds by moving the bite to their mouth. However, when the table is too loud, the robot cannot detect the user saying "Food, please," so does not give them food. This is a *robot failure*, since the technology does not behave as intended. This scenario requires the other diners to

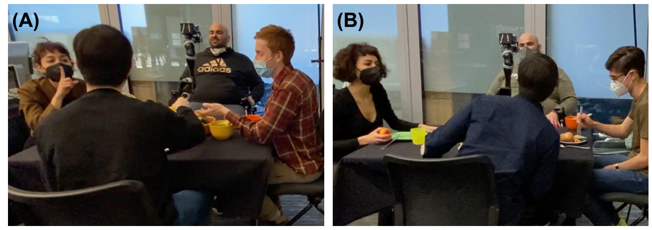

Figure 2: (A) A diner shushes the others, so the robot can hear the user say "Food, please." (B) The diner in front of the user leans in order to see the user behind the robot.

shush one another (Fig 2A), interrupting their conversations until the robot hears and responds to the user's command.

As another example, consider the scenario where the robot moves in front of the user's face after acquiring a bite, so it can easily detect and approach their mouth. In doing so, the robot blocks the user's view of the person sitting in front of them. This leads the person sitting in front to bob up and down, trying to see the user through the robot (Fig 2B). This is a *social failure*, since the technology behaves as intended, but when executed in a social context that behavior gives rise to a negative outcome.

These two types of failures can arise in a variety of social contexts and with a variety of assistive technologies. However, the realm of social dining provides a rich domain to explore them in, because social dining scenarios can vary in the nature of the meal (e.g., familial or romantic), the interaction dynamics (e.g., how many simultaneous conversations there are, the pace of the conversation), the number of people, and more.

4 CONTRIBUTIONS

In addition to providing comedic relief, this video is intended to highlight situations that are not often a primary consideration when designing and developing assistive robots. We hope to inspire critical conversations about how the HRI community can incorporate nuanced social contexts into the design of assistive robots.

5 DISCLAIMERS

Throughout this video, it is the *robot* that is failing and should be laughed at, *not* the user. People with motor impairments face a plethora of challenges during social dining that result in very real negative impacts [9]. *It is up to us*, as robot designers and developers, to create a system that assists users in all their desired contexts of use, including social contexts.

No person or robot was harmed during the filming of this video.

6 ACKNOWLEDGMENTS

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