Bridging Ethnography and Design in HRI: Making Space for Diverging Perspectives

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ABSTRACT

Ethnography and design goes hand in hand in human-centered research. However, while design is receiving increasing interest within the Human-Robot Interaction (HRI) communities, ethnographic research adds additional complexity that has yet to be mapped. While there is a need for bridging ethnographic and design methodologies for HRI, this also brings inherent tensions. In this position paper, we present insights from an empirical study in which ethnographic and design methods were utilised for co-design of a collaborative robotic system. Through ethnographic methods, we established a collaborative relation with technicians in a manufacturing facility. We then conducted three in-situ design workshops in which the same technicians engaged in development of a collaborative robotic system. Through this process, we encountered a tension inherent to challenging assumptions and knowledge about what a robot can or could do. In this paper, we present activities we included to tackle this tension and future research directions for bridging ethnography and design in HRI.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in interaction design**; **Interaction design process and methods**.

KEYWORDS

Human-Robot Collaboration, Designerly HRI, Participatory HRI, Design tensions

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1 TENSIONS IN DESIGN OF HRI

Design plays an increasing role in the research areas of Human-Robot Interaction (HRI). Prior research has recognised that designing and developing interactive robotic systems involves bringing together diverse, and sometimes diverging, perspectives. From an engineering perspective, Prati et al. [4] recently presented a toolbox of interaction design methodologies for the purpose of gathering requirements, mapping user journeys, creating wireframe prototypes, and VR evaluation. From a design perspective, Lupetti et al. [3] call for designerly approaches to HRI that move beyond the typical narrow-scope evaluations of specific functionalities that only offer limited findings that are difficult to extend in further research.

Participatory Design (PD) is one way that HRI and robotics researchers engage people in co-designing robotic systems, especially for design of social robots. The goal of participatory design is to facilitate a democratic process in which stakeholders have equal say in the development of a design. This process relies on enabling participants to engage with the materials and technical domain of the problem. Robotics is one area for which participatory design is an increasingly relevant approach as robots become more diverse, and people and robots can more commonly collaborate in close physical proximity. However, robotics research relies on highly complex technical systems and steep learning curves, and this poses a challenge for the typical iterative steps of participatory design processes that take place in the early stages of a project.

As shown by Tian et al. [5], simulation software offers one way to quickly iterate through different robotic application scenarios and explore the impact of a robot's behaviour, but simulations also limit participants' experience of the design and, thereby, their ability to imagine further improvements. When the goal is to ultimately design something for someone, and the research is situated in a real setting, tensions arise that sometimes contradict common practices for engaging participants. For example, Holone and Herstad [2] described that engaging children with disabilities required more time than usual which meant they had to set aside ideals of rapid prototyping. Where rapid prototyping is a typical approach for bringing in participants early to leverage their expertise, establishing a common vocabulary and getting the participating children accustomed to being part of a design project ultimately set the speed limit for the project.

We suggest that participatory design can play a role in bridging ethnography and design in HRI, conducting research in-situ and incorporating reflections anchored in practice early in the design process. However, while participatory design and co-design methods typically rely on low-fidelity, open exploration during early design phases, the design of a robotic system typically also includes engineering perspectives in order for the resulting system to be a feasible solution. At this workshop, we wish to discuss 1) how this challenge can potentially be tackled, and 2) how this changes assumptions designers may have about how to conduct a participatory design process.

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2 CASE STUDY: CO-DESIGNING A COLLABORATIVE ROBOT FOR MANUFACTURING

We conducted a 8-month study with a global company that manufactures medical devices, specifically a local facility that manufactures aortic stent grafts. Aortic stent grafting is a surgical method in which a catheter carrying a stent graft is inserted into an artery. This helps, e.g., to prevent blood clots. We collaborated with a team of four technicians and one direct supervisor responsible for part of the manufacturing as well as a senior manufacturing engineer, innovation manager, and project site manager. The technicians in the participating team conduct different types of soldering and cleaning tasks. Through ethnographic methods and a subsequent iterative design process, the goal of the project was to identify how a robotic system could assist in a soldering task and collaboratively make a feasible design, taking into account the perspectives of all participating stakeholders.

We conducted a contextual inquiry that entailed observations of technicians' current work as well as in-situ interviews. Building on the relations that were established between the research team and the participants, we conducted three co-design workshops, each intended to give insights into existing work practices and participants' reflections on a prototype design. One challenge inherent to the process was to identify ways that we could support mutual reflections on the concept design between the research team and the participating workers. This challenge became a centre for each workshop. Below, we outline examples on the ways we chose to tackle the challenge. In the following section, we present questions that we identified through this process and one ongoing activity we have engaged for addressing them.

2.1 Workshop 1: Initiating the Design Process

The main goal of the first design iteration was to explore how a robot could even be equipped to support the current manufacturing. We initiated Workshop 1 by introducing the robot arm which would be utilised for prototyping. This was done to clarify constraints and opportunities for how the robot could eventually perform a task in the manufacturing facility. We found that, even with video demonstrations of the robot arm, there were certain assumptions about the robot's physical capabilities. As an example, this includes the precision with which it works. One technician raised a concern that they would only be operating the robot with a button while the robot would perform their work.

2.2 Workshop 2: Fitting a Robot into Practice

The main goal of the second design iteration was to identify ways that a workstation at the manufacturing facility could be designed to support human-robot collaboration. In Workshop 2, a discussion was facilitated around robot communication for that reason. We utilised sketches of the robot arm in the workspace to address how communication could fit into work practices. The aim of using sketches at this stage was to situate communication designs at the same level of fidelity as the robot. We found that instead of engaging participants in further brainstorming of communication designs, the discussion returned continuously to current practice.

2.3 Workshop 3: Feasibility of Robot Solution

The main goal of the third design iteration was to demonstrate that a robot arm could perform the chosen manufacturing task and mutually reflect on project learnings. In this workshop, we presented learnings from the initial contextual inquiry. Those learnings highlighted aspects of work enjoyment and practices that were emphasised by technicians before starting the design process. We found that the functional prototype demonstration offered reflections around efficiency and safety. As such, presenting early insights provided a contextual framing to those reflections.

3 FUTURE RESEARCH

Following our research study, we identify the following questions for future research. While participatory design offers techniques for bridging ethnography and design in HRI, there are inherent challenges that can be distinguished as two key questions:

(1) How do we balance alternative views in design processes for human-robot collaboration?
(2) How do we make sure that the presence of a robot does not derail a participatory design process?

In a contribution to the Participatory Design Conference 2018, Bratteteig and Verne [1] discussed ways that users can participate when the design process revolves around AI technology. They suggest that design fiction or acting out scenarios can be utilised to aid in deciding which ideas to develop further. Scenarios can help designers and users recognise values to emphasise and explore the long-term impacts of a design. Extending this, we propose that for designing collaborative robotic systems, there is a need for mediation activities in which we make space for diverging perspectives.

3.1 Prototyping Tools for Enabling Participation

In our current research, we investigate how prototyping tools could play a role in enabling participation in future design of HRI. This involves exploring ways that a prototyping tool can mimick certain robot characteristics as well as how they fit into a particular application. We envision that a prototyping toolkit would provide concrete benefits for end user engagement by meeting certain requirements. First of all, it should facilitate communication by emphasising different aspects of a proposed design without having to relay very technical details about a system. Second, it should provide a creative space for generating and evolving alternative ideas in order to maintain the explorative nature of early design phases.

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REFERENCES

[1] Tone Bratteteig and Guri Verne. 2018. Does AI make PD obsolete? exploring challenges from artificial intelligence to participatory design. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–5. https://doi.org/10.1145/3210604.3210646

[2] Harald Holone and Jo Herstad. 2013. Three Tensions in Participatory Design for Inclusion. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 2903–2906. https://doi.org/10.1145/2470654.2481401

[3] Maria Luce Lupetti, Cristina Zaga, and Nazli Cila. 2021. Designerly Ways of Knowing in HRI: Broadening the Scope of Design-Oriented HRI Through the Concept of Intermediate-Level Knowledge. In *Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction* (Boulder, CO, USA) *(HRI '21)*. Association for Computing Machinery, New York, NY, USA, 389–398. https://doi.org/10.1145/3434073.3444668

[4] Elisa Prati, Valeria Villani, Fabio Grandi, Margherita Peruzzini, and Lorenzo Sabattini. 2021. Use of Interaction Design Methodologies for Human–Robot Collaboration in Industrial Scenarios. *IEEE Transactions on Automation Science and Engineering* 19, 4 (2021), 3126–3138.

[5] Leimin Tian, Pamela Carreno-Medrano, Aimee Allen, Shanti Sumartojo, Michael Mintrom, Enrique Coronado Zuniga, Gentiane Venture, Elizabeth Croft, and Dana Kulic. 2021. Redesigning Human-Robot Interaction in Response to Robot Failures: A Participatory Design Methodology. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI EA '21)*. Association for Computing Machinery, New York, NY, USA, Article 57, 8 pages. https://doi.org/10.1145/3411763.3443440