Empowering Robot Designers: A Digital Tool for Early-Stage Social Robot Prototyping and Communication

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Introduction

Design teams for social robots are typically multidisciplinary, including psychologists, computer scientists, engineers, and product designers. This mix highlights the challenges of sharing complex or specialized knowledge and meeting end user perceptions and needs effectively. There is an evident gap in practical tools for idea generation and communication, as well as for creating social robots that resonate with user needs and preferences. This study introduces a prototype design tool intended to help designers with diverse levels of expertise to conceptualize and mockup early-stage social robot designs. The tool focuses on creating conceptual summaries and low-fidelity models that incorporate the robot's social functions and physical appearance, considering user needs, perceptions, and attitudes. The paper details the prototype's key features, user flow, an initial expert assessment, and usability.

Design Objectives

1. Developing a comprehensive, early-stage design tool for social robot designers that accounts for both physical and social-cognitive design aspects.
2. Crafting an easy-to-use and low barrier-to-entry interface that allows designers from various disciplines to participate in the design conversation, even without extensive experience in Human-Robot Interaction (HRI).
3. Offering a structured design process that allows for the exploration of innovative paths and applications.
4. Facilitating the integration of end user needs into the robot design workflow.

User Flow

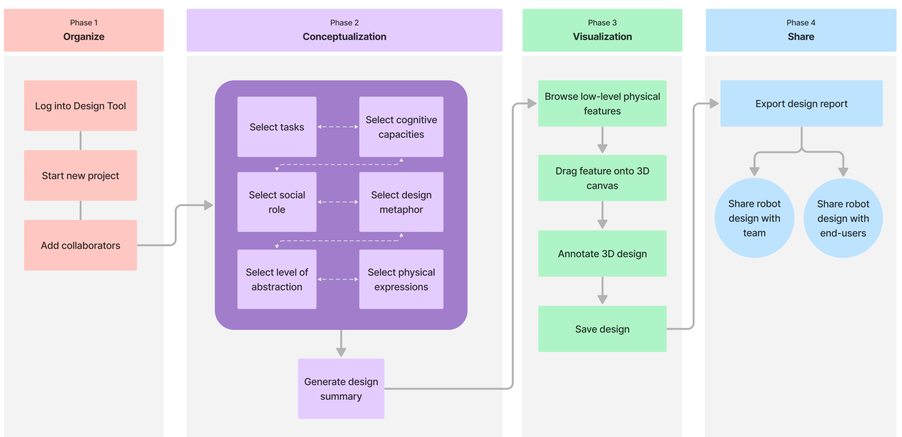
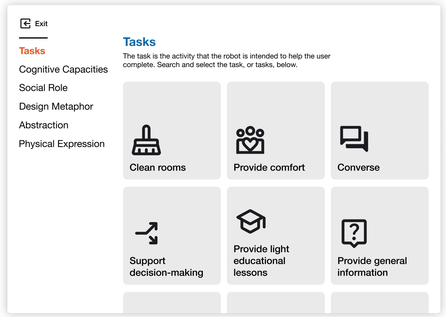
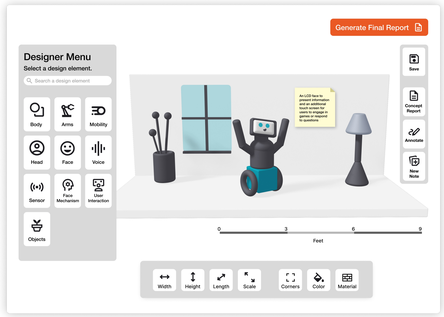
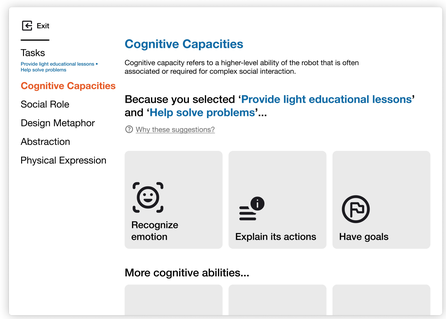


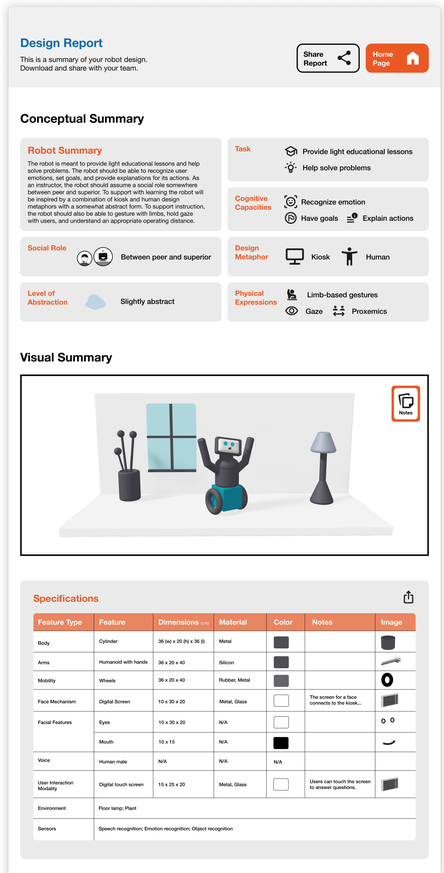
Figure 1. The proposed user flow demonstrating the four major phases: Organize, Conceptualize, Visualize, and Share. The foundation for this user flow is inspired by the work of Deng et al. (2019).

Prototype Screens









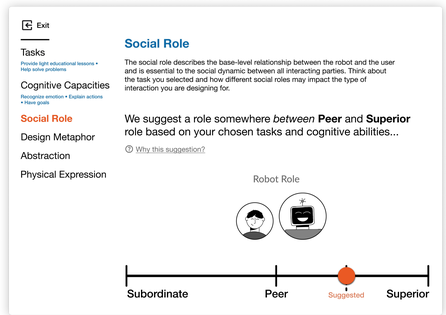


Figure 2. Screenshots of all pages of the prototype are displayed. The left column of screenshots represents steps from the Conceptualize phase, including Task Selection (top left), Cognitive Capacity Selection (middle left), and Social Role Selection (bottom left). The right column of screenshots demonstrates the Visualize phase with a 3D Visual Builder (top right) and the Final Design Summary (bottom right).

Method

To test the prototype's design and usability, we recruited two experts with research and practice experience in human-computer interaction and social robot design from both academia and industry. They each joined a two-hour interview on Zoom, where we discussed their opinions on the tool's layout, content, and utility of the features. Additionally, we explored their suggestions for enhancing the tool to better support teamwork, collaboration, and the participatory design process.

Preliminary Findings

Support for interdisciplinary and participatory design. Participants believed that the tool could facilitate design conversations among stakeholders and support someone who does not have the design skills to envision their ideas. They also believed this tool could facilitate direct design with end users.

Education. Participants expressed how the tool could support transparency to end users regarding design decisions and how the tool could introduce social robotics to people without domain knowledge more generally.

Rapid concept generation. Experts also believe that the tool enables idea generation without substantial investment in learning software. One expert noted that the platform could facilitate theoretical discussions beyond simply sketching design.

Suggestions for improvements. The experts recommended changes to the organization of content, like grouping tasks options into related categories. They also noted that terms like 'subordinate' and 'superior', were less relatable. One expert recommended that a storyboard feature was introduced to better visualize selections and scenarios during the Conceptualization phase.

Implications and Conclusions

Our research indicates a demand for the development of this tool in the field. It should promote collaboration across disciplines, assist non-designers in visualizing ideas, and educate users about social robotics. Additionally, the tool should facilitate quick idea generation and incorporate storyboarding features for improved concept visualization. Moving forward we aim to continue our expert interview study and then engage end users of social robots in a similar cognitive walkthrough study.

References

1. Eric Deng, Bilge Mutlu, Maja J Mataric, et al. 2019. Embodiment in socially interactive robots. *Foundations and Trends in Robotics* 7, 4 (2019), 251-356.