

Designing Functional Clothing for Human-robot Interaction

Natalie Friedman
Cornell Tech
Nvf4@cornell.edu

Kari Love
New York University
kari@karimakes.com

Alexandra Bremers
Cornell Tech
awb227@cornell.edu

AJ Parry
Bay Area Artist collective, Mixed
Baggage
a.joan.parry@gmail.com

Ray LC
City University of Hong Kong
luor840@newschool.edu

Bolor Amgalan
Parsons School of Design
amgab699@newschool.edu

Jen Liu
Cornell University
jl3835@cornell.edu

Wendy Ju
Cornell Tech
wendyju@cornell.edu

ABSTRACT

We believe that we can design robot clothes to help robots become better robots—help them to be useful in a wider array of contexts, or to better adapt or function in the contexts they are already in. We propose that robot clothing should avoid mere mimicry of human apparel, and instead be motivated by what robots need. While we have seen robots dressed in clothes in the last few decades, we believe that robot clothes can be designed with thoughtful intention and should be studied as its own field. In this workshop, we explore this new area within human robot interaction by bringing together HRI researchers, designers, fashion and costume designers, and artists. We will focus on potential functions of robot clothes, discuss potential trends, and design clothes for robots together in an interactive prototyping session. Through this workshop, we hope to build a community of people who will push forward the field of robot clothing design.

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1 BACKGROUND

HRI researchers have often considered the importance of the material coverings and surfaces of robots, but robot clothing gives robots the potential to extend or change their physical surface qualities to adapt to various contexts or tasks. Moreover, robot clothing can help to make robots more suitable for various social contexts, signalling for attention, identity or group affiliation. To help HRI designers think about how to outfit their robots with intention, it

can be useful to draw upon the knowledge of people with expertise in materials, design and fashion.

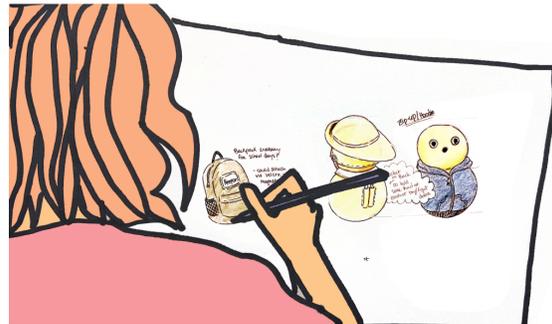


Figure 1: Designing fashion for robots

2 WORKSHOP GOALS

Our goals for this workshop are:

- Providing an interdisciplinary space for designers, practitioners, and researchers in HRI, HCI, and fashion to discuss characteristics of robot clothing design
- Discussing potential functions for robot clothes including signalling, protection, attention, adaptability,
- Discussing emerging trends in robot clothes for existing robots, such as the use of human-inspired clothes (e.g. Sofia's dress [2]) and protective armor (e.g. Baymax' battle outfit [1]).
- Designing potential clothes for robots and discuss the rationale behind this and the resulting affordances

3 ORGANIZERS

This workshop will be organized by a team of researchers and practitioners with interdisciplinary backgrounds in HCI, art, fashion design, psychology, and human-robot interaction. Many of us have attended or organized ACM workshops in the past.

Natalie Friedman is currently a 2nd year PhD student at Cornell Tech in the Information Science Department with a background

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in Cognitive Science and HCI. Currently, her work focuses on developing a framework for fashion design for robots. Within the field of human-robot interaction, she has experience in prototyping robot motion, social appropriateness and accessibility.

Kari Love teaches soft robotics at NYU Interactive Telecommunications Program in Brooklyn, NY. She is a consultant for soft goods innovation design, a Broadway and puppet costumer, a former NASA spacesuit contractor, and co-author of the book *Make: Soft Robotics*.

Alexandra Bremers is working towards her PhD in Information Science at Cornell Tech, with experience in Industrial Design, Artificial Intelligence and Automotive Interaction Research. She is interested in designing interactive, adaptive systems for non-expert users, specifically in the automotive and consumer electronics domains.

AJ Parry is an artist and educator with a degree in Art Practice from UC Berkeley where they specifically focused on sculpture, illustration, textiles, and installation. Their personal practice focuses on concept design for environments and characters, examining gender and performativity, and reimagining material use through experimentation with various media (metal, wood, clay, textiles, etc).

Ray LC is an assistant professor at City University of Hong Kong School of Creative Media. His fashion technology research involves using conductive weave for stress and anxiety sensors, wearable motion sensing for creative expression, and dressing for older adults. He is incorporating these technologies into HRI work on spatial interactions.

Bolor Amgalan is an interaction designer using craft materiality to design culturally sensitive transition design interventions. Her research spans programmable matter, virtual materiality, creativity support tools and craft preservation in VR. Formerly trained as a fashion designer, she is currently teaching at Parsons School of Design.

Jen Liu researches how computing technologies are sourced, developed, and designed to address social and ecological challenges that arise from climate change. She is currently a PhD student in Information Science at Cornell University. Her background spans art, design, and technology, and she has previously worked in smart textiles and environmental sensing.

Wendy Ju is an Associate Professor of Information Science at Cornell Tech in New York City. Her research focuses on interaction with automation, particularly human-robot interactions and automated vehicle interfaces, and novel research methods to understand interaction with autonomy.

4 WEBSITE

On our website, we include the workshop proposal, a call for participation, the workshop program, accepted work and the biographies of the organizers.

This is the site: <https://sites.google.com/cornell.edu/hri-clothes-for-robots/home>

5 PRE-WORKSHOP PLANS

We invite academics and practitioners with a background in human-robot interaction design, fashion design, art, and psychology. In

order to recruit participants, we will email through HRI related mailing lists, email lists at universities with a fashion department, as well as journals focusing on technology and fashion. Lastly, we will reach out to the official SIGCHI HCI mailing list.

In order to attend, we ask participants to submit a position 2-3 page paper in the form of CHI abstract about how the participant's experience informs the fashion for robotics topic. We will also ask for a complimentary visual in the form of a poster. Prior to the workshop, the workshop-related materials and the accepted posters will be uploaded on our website.

If the workshop takes place in person, we will bring materials like fabric remnants, adhesive Velcro, hot glue guns, yarn, and zip ties to support prototyping activity during the workshop. If the workshop needs to take place virtually, we will put together a list of materials for participants to assemble locally. With advance notice to accommodate shipping speeds, we can mail materials to participants who have difficulty finding bits, free of charge.

5.1 Material List

Please assemble the following list of materials (at least one from each category). It is not required, but will likely enhance the workshop experience. Many materials can be found at home, and we encourage creativity and flexibility in selecting the materials from the home (i.e. soap dispenser as robot form, old pillow cases, etc.). If you do not have access to any of the following, please let us know by February 28th.

- Robot
 - robot or robot stand in
- Main Material
 - yarn, ribbon, and/or trim
 - fabric remnants, plastics, or other scrap materials (contents of your recycling bin)
 - tissue paper
- Cutting
 - scissors or pinking sheers
 - exacto knife
- Attachment methods or adhesives
 - adhesive velcro or zip ties
 - ball point pins
 - needle and thread
 - Hot glue gun (optional)
 - tape and/or staples
- Marking/ coloring
 - sharpies or other colored markers

6 WORKSHOP STRUCTURE

This is a half-day workshop (4 hours) that includes presentations of the posters, discussions about characteristics of robot clothes, activities where participants are guided in prototyping robot fashion designs and a follow-up discussion. We expect approximately 17 participants excluding the organizers. Table 1 shows an overview of the workshop schedule.

Time	Phases
09:00 - 09:15 MT	Welcome and introduction
9:15 - 10:15 MT	Poster Fair
10:15 - 10:25 MT	Tea / Coffee
10:25 - 12:00 MT:	Interactive Prototyping in Breakout Rooms
12:00 - 12:30 MT	Presentation and Discussion in Breakout Rooms
12:30 - 13:00 MT	Closing remarks

Table 1: Workshop schedule

7 WELCOME, INTRODUCTORY POSTER SESSION

Here we describe the topics of the workshop, introduce the organizers, and ask participants to present their posters to the group. Based on attendance numbers, this will be in either a lightning round or in small group discussions. The organizers will introduce characteristics of robot clothing. We will invite participants to discuss these topics in terms of their current field.

8 INTERACTIVE PROTOTYPING SESSION

This session will have similar activities whether it is in person or virtual. The in person activity, however, will allow for exchanging materials and tools in a more collaborative setting.

8.0.1 In Person. If we have an in-person workshop, we will need table space and meeting tables to support small group activities: design and discussion activities. Participants will work in groups to design robot clothing in which we will provision tools and materials to enable physical draping and pinning. We will provide several robots to support this activity, but participants are also welcome to bring their own. We will ask the participants to sketch their designs, with liberty to make additions that might have been difficult to physically prototype.

8.0.2 Virtual. In the virtual version of the session, we will provide advance guidance on forms and materials to assemble to support this activity. We will ask that participants find a robot in their home (could be commercial, self-made creation, or a mundane object, like a mouse, or electric thermometer), three soft materials, and three hard materials to cover their robot with. Next, we will ask participants to get into break out rooms and cover their robot in these materials. Then, we will have a drawing session. We will prompt participants to find a partner, and to draw their own materials onto an outline of their partner’s robot. We will ask them to post these photos on the Miro board.

At the end of the prototyping session, participants will be asked to describe why they chose their robot and its clothing. Additionally, we will have a few prompts. Prompts might include:

- Is your robot naked without coverings?
- Why might a robot need these coverings?

- How are these coverings functional in signaling or protection?
- In what context could these coverings be more useful?
- Why would a robot, rather than a human, wear this?

9 PRESENTATIONS

Participants will present their designs and share their learnings including possible new areas for future inquiry or exploration. After all the presentations, we will invite questions and discussion about the themes that came up in the workshop.

10 POST-WORKSHOP PLANS

After the workshop, with permission of the recipients, we will publish a document with themes that arose on the workshop website. We will encourage and consider active collaborations on topics that emerged from this workshop. With permission, we will also create a mailing list with the attendees emails, in addition to a slide with contact information of attendees. Depending on how the workshop evolves, the organizers of the workshop will discuss future collaborations to further develop the emerging themes.

11 CALL FOR PARTICIPATION

“Designing functional clothes for human-robot interaction” – Half-day Workshop at HRI2021 in Boulder, Colorado, USA

This workshop aims to gather designers, researchers, academics and practitioners with a background in human-robot interaction design, fashion design, psychology, design, and design research to discuss a future of clothes for robots. Half the workshop will consist of hands on design (materials list provided on website), while the other half will consist of discussion.

To participate, submit a 2-3 page CHI abstract in the form of PDF to the email hriclothingworkshop@gmail.com. If the paper is accepted participants will be asked to prepare a poster, which should include perspectives on robot clothing and any prior work relevant to this topic. Here are some topics which applicants might focus on:

- The role of aesthetics in HRI
- Relevant theory or research methods in design
- Relevant best practices in robot/fashion design
- Psychology of fashion
- Art practice of fashion design
- Textile affordances for user experience

Papers will be reviewed by the workshop organizers and evaluated based on their novelty, quality, and relevance to the workshop themes. Posters and papers can be created by one or more participants; however, at least one author of the accepted poster is required to register for the workshop.

11.1 Important dates:

Position paper deadline: February 10th, 2021

Acceptance notification: February 20th, 2021

Workshop at HRI2021: March 12th, 2021

More Information: <https://sites.google.com/cornell.edu/hri-clothes-for-robots/home>

REFERENCES

- [1] 2014. Big Hero 6.
- [2] Sophia 2020. Robots: Your guide to the world of robotics: Sophia. <https://robots.ieee.org/robots/sophia/>. Accessed: 2020-09-10.