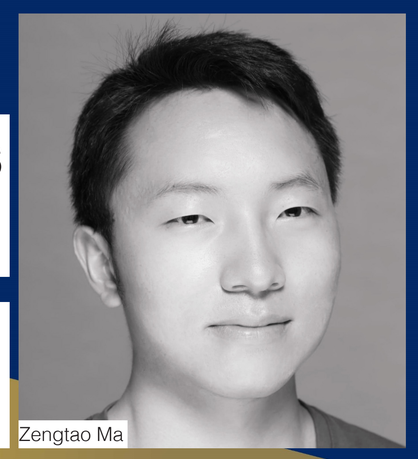
# Human-Centred AI Design Methods to Understand Intelligent Systems Design Empowered by Multisensory Experience with Textiles

Zengtao Ma[1,3], Lissy Hatfield[1,3], Elif Ozden Yenigun[1,3], Stephen Jia Wang[2,3], Ya Qi Zhang[2,] Cong Fang[2,] Boyuan Tuo[1,3], Chipp Jansen[1,3], Sharon Baurley[1,3] and Kun-Pyo Lee[2,3]

1Royal College of Art, United Kingdom

2School of Design, The Hong Kong Polytechnic University, Hung Hom, Hong Kong Special Administrative Region

3Laboratory for Artificial Intelligence in Design, Hong Kong Science Park, New Territories, Hong Kong Special Administrative Region



Zengtao Ma

## Background

This poster presents ideation results from a workshop on new forms of human-robotic collaboration primed with human experience of multisensory experiences with textiles run as a collaborative effort between the Human-Centred AI Design (RP2-4) and the Intelligent Design Systems for Innovation (RP2-5) projects from the Laboratory for Artificial Intelligence in Design (AiDLab)

The objective of this research is to understand human sensory experiences of textile materials and the relationships between physical properties and characteristics and the subjective assessment of materials. The aim of the workshop was to introduce textile assessment to the participants, Prof Stephen Wangs MDes Intelligent System Design (ISD) students from Hong Kong Polytechnic University, through textile assessment and ideation to develop ideas in groups around human-robot collaboration that incorporated the use of textiles in different applications.

Due to their minimal experience and knowledge of textile materials, we examined the participants' approach to assessing the materials and how they included textiles in the brainstorming section. We were interested in their outcomes due to the interdisciplinary nature of their backgrounds but also their experience in working with AI and robotic systems and equipment on the ISD course, see Figure 1.

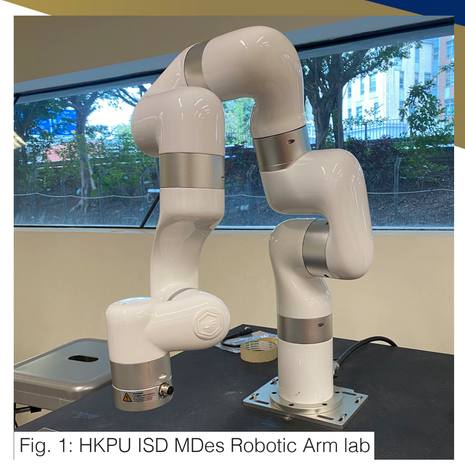


Fig. 1: HKPU ISD MDes Robotic Arm lab

## Methods

The practical implications of this workshop were to demonstrate how a human-centred design process focused on multisensory experiences presented in theory and then through tactile practice can contribute towards ideation within intelligent systems design. This was done in 3 parts:

### Part 1 - Presentation

The participants were presented with traditional and contemporary design methods regarding the human experience of textiles. This includes our sensory perceptions and tactile receptors, an overview of the preexisting textile industry and traditional assessment techniques, and the latest research in AI and robotic evaluation of multisensory textile properties.


Fig. 2: Presenting to ISD students

### Part 2 - Tactile Experience through Subjective Fabric Analysis

Putting theory into practice, participants experienced individual tactile subjective assessments of the 10 selected materials. After a warm-up session where they compared visual and tactile properties of a single material, participants used six paper-based bipolar scales to assess the textile materials. To wrap up, participants reflected in a group on the bipolar scales.

Fig. 3: Physical assessment exercise

### Part 3 - Brainstorming and Ideation

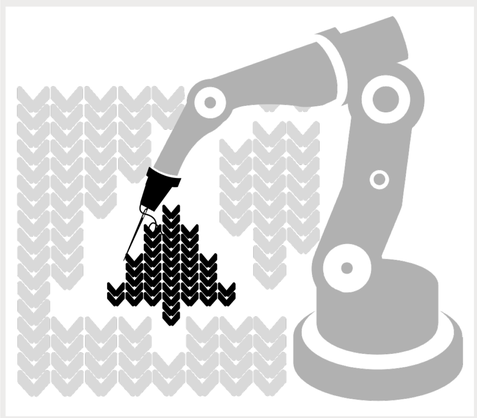
This led into the brainstorming portion of the workshop with the prompt: How can AI collaboration in material assessments advance the applications intertwining with material tangibility? In order to have a range of ideations, participants were organised into separate application domain groups. The groups were organised by having participants vote on eight application domains and self-organise into five groups with specific application focuses. Participants were given 20 minutes to brainstorm with post-it notes and whiteboards and presented their ideas at the end of the session.


Fig. 4: Brainstorming in groups

## Results

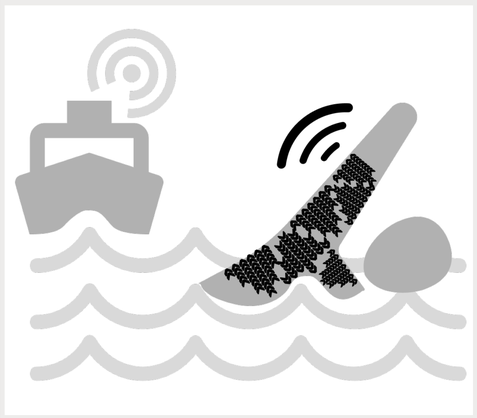
We present the ideation results in the form of summaries and a conceptual illustration to capture the themes produced by the groups.

### Craft



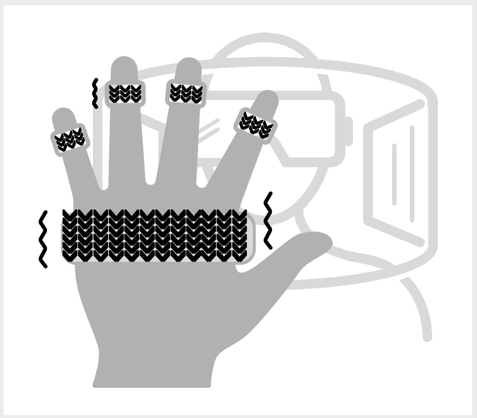
The craft application domain was clearly the most textile related. The group proposed using robotics to preserve craft through heritage restoration and integrating traditional Chinese textile techniques. The group presented concepts here that involve both textiles as a craft and material with robotic technologies, and asked how robotics can benefit honouring traditional crafting techniques and intangible cultural heritage.

### Mobility Design



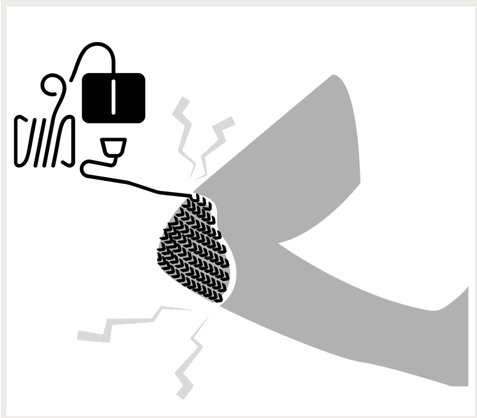
This group conceived an idea around a soft robotic rescue device in the maritime environment. They speculated on a rescue robot saving survivors from the sinking Titanic, which integrated sensors using smart yarns to monitor environment conditions, such as water temperature. Their concepts were a novel mixture of textiles and robotics, as opposed to more traditional textile interiors for automotive applications.

### Gaming and Metaverse



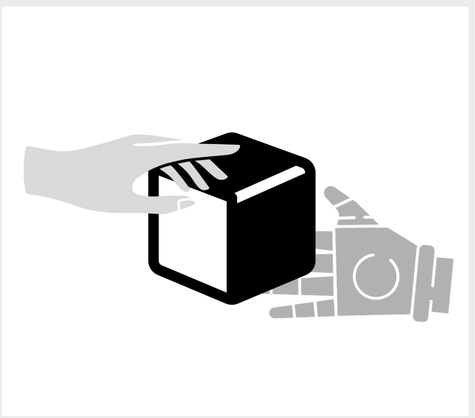
This group's concepts explored VR equipment providing high fidelity feedback to a gamer. Textiles were involved in constructing a body-suit that had "woven conductive smart yarns into the fabric to give force feedback to the user". They envisioned immersive environments with AI-driven characters, as well as environments with tangible feedback provided by robotic characters, citing TV-series WestWorld as inspiration.

### Wellbeing and Care



This group's brainstorm connected textiles with the concepts of having robotics providing skin tissue healing made from a 3-D printed soft material to restore or mend damaged skin. Although the topic of textiles is not explicit, the group's concepts involve novel soft materials. They also conceived a surgical robot with forced-feedback which relates to a wearable sensor device that records and reports patient data.

### Product Design



This group's brainstorming within product design did not consider materiality or textiles as part of their concepts. This group focused on the concepts of human-robotic collaboration in general. They emphasised a human taking a supervisory role and the robot being an extension of the human's capabilities. In addition to defining that relationship – they brought up topics such as data, AI, 3-D structure and parametrised design.

## Discussion

We find that the group's brainstorming that involved textiles and materiality featured prominently in craft, mobility design and in gaming applications. Where craft has a more direct application, the application area of mobility design is more abstract like product design, yet the concept of maritime smart textiles for rescue was a unique outcome from this group. While presenting a subjective assessment experience of textiles yielded brainstorming with textile materiality content, we believe various factors could improve the outcome of the workshop as a research activity.

**1. Balance Multi-sensory Experience and Ideation Parts.**

The brainstorm was at the end of the 3 hour workshop. While there were two 15 minute breaks, participants were tired and distracted and their senses exhausted, through both listening and touching. Each group had 20 minutes to brainstorm and come up with ideas to present. With more balance of activities in the schedule, there might have been a richer set of ideas.

**2. Clearer prompt.**

Including theoretical terms like "material tangibility" as part of the prompt was confusing to the participants and veered away from the assessment task. Streamlining the prompt in tandem with the assessment task might bring more clarity to exactly what the groups would have to be brainstorming about.

**3. Higher-fidelity of data gathering.**

Because there is a conversation that occurs during the brainstorms that is not fleshed out via the post-it notes and white-board drawings, having a recording of the process would provide more data to understand the ideations process. In addition, having a follow-up survey to assess whether the multi-sensory assessment experience contributed to the brainstorming would make for a more rigorous study.

## Conclusions

This workshop proposes to integrate a multi-sensory experience with a material (textiles) prior to conducting an ideation session. We present brainstorming ideas around human-robot interaction with regards to textile materials involving specific application domains from participants who are non-textile experts. The outcome of this research are recommendations surrounding conducting future multi-sensory workshops in conjunction with design ideation.

## Contact:

Email: sensory.materials@rca.ac.uk
Instagram: @sensory.materials
Website: www.aidlab.hk / QR code

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AiDLab Laboratory for Artificial Intelligence in Design 人工智能設計研究所

The Hong Kong Polytechnic University 香港理工大學

Royal College of Art Postgraduate Art and Design