Haptics Beyond Vibration: Generative AI to Advance Multisensory Interfaces

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Abstract

Immersive experiences are increasingly moving beyond conventional vibrotactile and force-based feedback toward multisensory forms of interaction. This workshop examines the intersection of generative AI and such nontraditional haptics, asking how AI might support the authoring, prototyping, personalization, and evaluation of multisensory feedback that is often difficult to describe, simulate, or standardize. The workshop will combine live demonstrations of recent multisensory interfaces, short talks on how these systems were developed, and group discussions on where generative AI may—or may not—change the process of creating haptic experiences. Our goal is to identify emerging research gaps, design vocabularies, and potential evaluation methods for future AI-mediated multisensory interfaces.

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1 Introduction

Future immersive digital experiences will increasingly move beyond conventional haptic feedback toward multisensory forms of interaction. Researchers in the UIST community have long explored how less common sensory modalities (Figure 1), including temperature [4, 5, 8, 13, 23], taste [1, 17], smell [2], and other forms of bodily feedback, can enrich virtual experiences [18, 19], embodied interaction [3, 22], accessibility [15, 16], and human perception [12, 25]. However, designing, authoring, and evaluating these experiences remains challenging, as existing haptic tools and frameworks are largely built around conventional feedback.

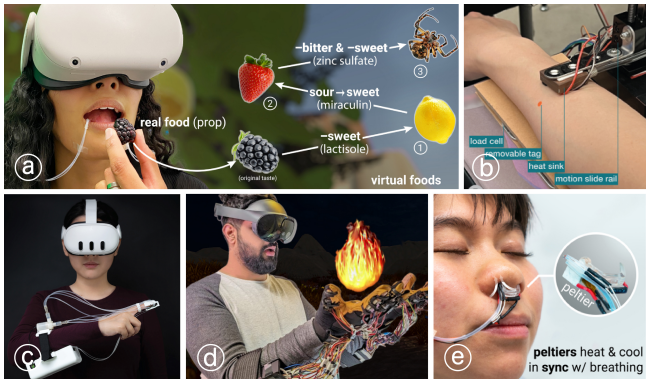

Figure 1: Examples of multisensory interfaces beyond conventional vibrotactile and force-based feedback: (a) chemical modulation of perceived taste with *Taste Retargeting* [1]; (b) pain-like sensations produced through the thermal grill illusion with *ThermOuch* [5]; (c) accelerated perceived thermal transitions through spatiotemporal thermal feedback with *TherMosaic* [25]; (d) hand-centered thermal feedback with *Fiery Hands* [22]; and (e) respiration-synchronized thermal stimulation with *Augmented Breathing* [3].

In recent years, generative AI has rapidly changed how people design and engineer interactive digital systems. Designers can now use AI to generate interface layouts, visual assets, audio, code, and interactive prototypes. More recently, researchers have begun exploring generative AI for rendering haptic sensations, such as vibrotactile feedback [9, 10, 20] and passive haptic proxies [6], suggesting its potential to reshape haptic design workflows. Yet its role in multisensory and nontraditional haptic interfaces remains much less explored. Unlike visual or auditory media, sensations such as warmth, smell, taste, or pain-adjacent feedback are difficult to describe, reproduce, and standardize [14, 20]. They are also highly dependent on individual perception, physical context, hardware constraints, and safety considerations [11, 21, 24]. Moreover, there are few datasets that provide sufficiently rich data to model or generate these sensory experiences [7]. As a result, it remains

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unclear how generative AI should be used in this space, what it can meaningfully automate, and where human designers, engineers, and participants must remain central.

This workshop examines the intersection of generative AI and nontraditional haptics. We ask how AI might support the authoring, prototyping, simulation, and evaluation of multisensory feedback, while also recognizing the limitations and risks of AI-mediated sensory design. Through live demonstrations, keynote talks, structured brainstorming, and group discussions, the workshop will bring together researchers working on haptics, multisensory interaction, AI-assisted design, physiology, and immersive experiences. Our goal is to identify what is currently missing in this emerging area, including design vocabularies, authoring tools, evaluation methods, datasets, safety guidelines, and future research questions for AI-mediated multisensory interfaces.

2 Agenda

Our workshop is a half-day morning event (9:00–12:15). It will consist of a short keynote, hands-on demos, a brainstorming session, and group synthesis, organized into the following activities.

Activity 0 — Online meetup before the workshop. To better facilitate the in-person workshop, we will collect participants' information before the event and create an informal Slack channel where participants can share their research interests, relevant experience, and questions they would like to explore regarding generative AI for multisensory experiences. The organizers will also create a dedicated workshop webpage where each participant can contribute a short paragraph about their background and interests. We will encourage participants to bring hands-on demos that can be used during the workshop.

Activity 1 — Opening and short keynote (9:00–9:40). Participants will be prearranged into three round tables. At the beginning of the workshop, participants will briefly introduce themselves at their tables. We will then kick off the workshop with a 20-minute keynote. The keynote speaker will be an expert in multisensory haptics, AI for haptics, or adjacent fields such as physiology. The keynote will be followed by a 10-minute Q&A session in which the speaker will answer questions from the audience. This opening session will set the tone for the rest of the workshop.

Activity 2 — Hands-on interactive demos (9:40–10:30, continuing through the coffee break). The three tables will rotate through a set of hands-on haptic demos centered on thermal, taste, smell, airflow, and other nontraditional sensory modalities, spending approximately 15 minutes at each station. The demos will be prepared by both the workshop organizers and participants. To facilitate the following discussion activities, we will provide participants with guiding questions about how generative AI could be involved in designing, authoring, personalizing, or evaluating these experiences. The demo stations will remain open during the coffee break (10:30–11:00) so that participants can revisit demos informally.

Activity 3 — Brainstorming session (11:00–11:30). Building on the insights from the hands-on demos, participants will discuss what the community needs to better leverage generative AI in multisensory interaction research. Discussion topics will include what generative AI can support, what it cannot yet do, what risks it may introduce, and what tools, datasets, design vocabularies, or evaluation methods are currently missing.

Activity 4 — Discussion and synthesis (11:30–12:00). Each table will present the results of its brainstorming session. The organizers will facilitate a synthesis discussion to identify recurring themes, open research questions, and possible community-level resources.

Activity 5 — Closing and next steps (12:00–12:15). During the final 15 minutes, participants will use sticky notes and shared documents to propose concrete next steps for the community. These may include research questions, workshop outputs, collaboration opportunities, shared datasets, demo repositories, or guidelines for evaluating AI-mediated multisensory interfaces.

3 Post-Workshop Plans

Following the event, we will: (1) publish a summary of workshop insights, photos, and key discussion points on the workshop website; (2) invite all attendees to join an ongoing mailing list to continue exchanging resources, updates, and collaboration opportunities; and (3) prepare a workshop report or position piece summarizing outcomes and future directions, to be submitted to venues such as ACM Interactions.

4 Organizers

The organizing team reflects the workshop's multidisciplinary nature.

Zining Zhang is a Ph.D. student at the University of Maryland. Her research focuses on developing and enhancing haptic devices to provide realistic experiences in virtual and augmented reality.

Daniel Honrales is a Ph.D. student at the University of Texas at Dallas. His research focuses on emerging haptic interfaces and multisensory interaction.

Jas Brooks is an Assistant Professor and KDD Career Development Professor in Communications and Technology at MIT EECS. Their research envisions a future where people can adjust their senses as easily as they adjust their phone settings, empowering them to modify smell, taste, temperature, or touch for health, comfort, and safety.

Jin Ryong Kim is an Associate Professor in the Department of Computer Science and Director of the Multimodal Interaction Lab at the University of Texas at Dallas. His research develops haptic and multisensory interaction techniques for virtual, augmented, and wearable computing, with recent work on thermal, tactile, olfactory, and mid-air feedback.

Kening Zhu is an Associate Professor at the School of Creative Media at City University of Hong Kong. His research interests span human-computer interaction, interaction design, tangible user interfaces, rapid prototyping, and multisensory haptics, including pain-related rendering through thermal feedback and leveraging multimodal reasoning agents for haptic proxy assignment.

Huaishu Peng is an Associate Professor in the Department of Computer Science at the University of Maryland. His research advances interactive technologies through the design, prototyping, and evaluation of novel embodied artifacts that are personal, intelligent, and often small in physical form, including multisensory interfaces.

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