

Rethinking the Senses: A Workshop on Multisensory Embodied Experiences and Disability Interactions

Maryam Bandukda

Aneesha Singh

Catherine Holloway

Nadia Bianchi-Berthouze

University College London Interaction Centre (UCLIC),
Global Disability Innovation Hub (GDI Hub), London, UK

Emeline Brule

University of Sussex, Falmer, UK

Ana Tajadura-Jiménez

Universidad Carlos III de Madrid, Madrid, Spain

Oussama Metatla

Ana Javornik

University of Bristol, Bristol, UK

Anja Thieme

Microsoft Research, Cambridge, UK

The emerging possibilities of multisensory interactions provide an exciting space for disability and open up opportunities to explore new experiences for perceiving one's own body, its interactions with the environment and also to explore the environment itself. In addition, dynamic aspects of living with disability, life transitions, including ageing, psychological distress, long-term conditions such as chronic pain and new conditions such as long-COVID further affect people's abilities. Interactions with this diversity of embodiments can be enriched, empowered and augmented through using multisensory and cross-sensory modalities to create more inclusive technologies and experiences. To explore this, in this workshop we will explore three related sub-domains: immersive multi-sensory experiences, embodied experiences, and disability interactions and design. The aim is to better understand how we can re-think the senses in technology design for disability interactions and the dynamic self, constructed through continuously changing sensing capabilities either because of changing ability or because of the empowering technology. This workshop will: (i) bring together HCI researchers from different areas, (ii) discuss tools, frameworks and methods, and (iii) form a multidisciplinary community to build synergies for further collaboration.

CCS CONCEPTS

•Human-centered computing ~ Interaction design •Human-centered computing ~ Accessibility

Additional Keywords and Phrases: disability interactions, disability design, embodied experience, multisensory interactions

ACM Reference Format:

First Author's Name, Initials, and Last Name, Second Author's Name, Initials, and Last Name, and Third Author's Name, Initials, and Last Name. 2018. The Title of the Paper: ACM Conference Proceedings Manuscript Submission Template: This is the subtitle of the paper, this document both explains and embodies the submission format for authors using Word. In Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY. ACM, New

York, NY, USA, 10 pages. NOTE: This block will be automatically generated when manuscripts are processed after acceptance.

Background

Increasingly technologies are being designed to support people with disabilities, ageing, psychological distress, and chronic conditions in different ways including performing activities of daily living, leisure, and social interactions. Novel technological developments have enabled the use of multiple sensory channels, including the visual, auditory, olfactory and tactile, allowing for the creation of rich and natural experiences across a range of abilities. Correspondingly increased availability of affordable devices has allowed a fast adoption of such multisensory technology in many areas (e.g., entertainment, games and exergames, and assistive technologies).

Our senses contribute to form our sense of self and identity which drive the embodied experience [1]. Therefore, sensory impairments and long-term conditions not only alter people's sensory interactions but also their perception of self and how they interact with their environment. The mind compensates the loss of a sense by extending and refining the other senses, for example blind people using a long cane often perceive the long cane as an extension of their hand and are able to perceive the changes in the environment through sound reverberations of the cane hitting the ground as well as the change in texture of the ground itself. Echolocation is another example of how some blind people use a 'clicking' sound to inform the proprioceptive sense and orientate themselves by listening to the reverberations from objects in the environment. People with certain forms of chronic pain have an altered perception of their own body [9] and their own capabilities and pain level may modulate these altered perceptions. Artificial alteration of senses, using sensory substitution techniques, extend the sensory functions to compensate the loss of another. For example, a smart cane uses audio and tactile feedback to indicate the presence of an obstacle (visual) to the blind user. Beyond sensory substitutions in everyday tasks, we ask how can technology enable adaptation to the changing sense of self and body perception due to different life experiences?

Multisensory technologies are being used to design novel multisensory experiences to enhance people's perceptions of their body and its abilities, its appearance and ways of interacting with the environment as well as socially with others [10]. Different modalities, such as sound feedback (e.g. [11]) and haptic and visual bodily feedback (e.g. [7]), smell stimuli [4], taste and texture stimuli [8] have been used to enhance experiences of the body and how we interact with the environment. Multisensory feedback has a role in exploring body perception and presentation [6], facilitate everyday function, foster coping capabilities, restore distorted body perceptions (e.g. body shape or size) and body capabilities (e.g. movement fluidity, strength, extent of stretch), compensate and substitute for missing sensory inputs, or even trick the brain to create the sensation of having a different and "better" body, and get feedback about the environment.

Research on these technologies has focused on augmenting people's senses and their sense of self. Much of accessibility and assistive technologies focus on sensory substitution with the view of people's abilities as being constant. However, people's lives and therefore their needs are dynamic and changing – sometimes the transitions are small and vary on a daily basis, such as in the case of chronic pain where people have good days, where they have less pain and can get more done, and bad days where the pain can be debilitating [9]; at other times, the transitions can be life changing leading to a change in identity and sense of self and leading to new challenges [2], for example, a visually impaired new parent who now needs to manage a pram along with a cane. Therefore, designing for disabilities (or different abilities) needs to adapt to these dynamic and changing needs of people. Ability-based design [12] has helped to shift the design mindset from one of deficit which aligned with the medical model of disability, to one of abundance as we focus on and design for people's abilities rather than disabilities. Disability Interactions (DIX) [5] moves the design paradigm from designing for individuals to solving the more embedded societal problems faced by people living with disability and chronic illness. Initial work has shown the importance of community in enabling use of devices such as mobile phones and demonstrated the ability for co-design of multisensory experiences of future technologies [3]. The ultimate aim of the disability interaction manifesto is to help broaden our expectations of technologies for people with disabilities. To design these

within the community they will be used and helping to understand the evolving needs of people and design experiences to support their dynamic abilities.

In this workshop we focus on three related themes (i) designing rich sensory, multisensory or cross-sensory interactions for augmenting the self (including perceptions of one's self, one's body or one's abilities in a dynamic and adaptive way); (ii) re-thinking how to adapt embodied experiences where one's senses contribute to form our sense-of-self and the changes in sensing capabilities evolves one's sense of self, and (iii) re-visiting disability interactions and design to go beyond accessibility and assistance to a rich experience designed to support this dynamic self or even enable fruitful exploration of self.

Workshop Aims and Topics of Interest

This workshop aims to build a community of researchers, designers and practitioners with interest in three main aspects: (i) expertise of designing for different senses or multisensory and cross-sensory technologies (ii) to support people with disability, but also for life transitions (e.g., ageing, new parents, becoming disabled) and long-term conditions (e.g., chronic pain and MS), and (iii) embodied interactions. This session will enable networking, new collaborations and potentially novel ways of exploiting such research from varied perspectives. Attendees will share knowledge and insights into methods and tools by discussing questions of interest, such as:

- *How can the artificial alteration of senses enable adaptation to different life experiences and even exploration of different selves/ identities due to dynamic life situations? What is the effect of such an alteration on mental health and self-efficacy? How can technologies adapt to people's evolving sensory needs? What about sensory overload – when sensory stimulation through technology that seeks to augment becomes too much?*
- *How can sensing technology for disability (or for different/ changing abilities) be designed to support this dynamic self or even enable fruitful exploration of self? What happens when such exploration leads to dysmorphic experiences , psychological distress or negative results on the self?*
- *How can multisensory technologies enable and enhance novel interactions for leisure, entertainment, and social interactions, that support diverse ways of interacting, respectful of the diversity of abilities and sensory experiences?*
- *Can a rethinking of sensing technology facilitate the critical change necessary to move beyond accessibility research and consider disability experiences in all their complexity?*
- *What are the potential ethical issues that arise when doing such research? What kind and level of support needs to be in place?*
- *Who are the stakeholders that need to be involved in this space?*

Pre-workshop Plans

The workshop will be publicized to HCI researchers through SIGCHI email distribution lists and social media groups (Sensedbody, GDIHub) and promoted through the GDI Hub website (<https://www.disabilityinnovation.com/projects/rethinking-the-senses>), MagicOutfit website (www.magicoutfit.com) and a community website for interest in multisensory technologies from our previously organized SIG (<https://sensedbody.org>), Inclusive Education Technologies website (<http://www.inclusiveeducation.tech>) and EnTimeMent website (<https://entiment.dibris.unige.it/>) exploring the multi-temporal scales of movement experience. We will also communicate workshop structure and aims, a call for participation, prior readings, and a workshop schedule on the GDI Hub website and subsequently also the accepted position papers or alternative submissions in the form of conceptual design sketches, presentation slides, and posters. We will actively seek submissions from our network and contacts. We will accept 10-12 submissions which will be reviewed by the workshop organizing committee. We expect up to 20 participants at the workshop based on the position papers submitted.

To better facilitate remote participation, we will offer pre- and post-workshop activities: we will aim to use materials collected in advance to provoke discussion at the workshop. We will use a cards prioritization method (using WellSorted) to generate main points of interest as the pre-workshop activity. A planned pre-workshop activity will include a remote meeting where all participants will be introduced and become familiar with the overall scope and idea of the workshop. Based on their submissions and research interests, several sub-groups will be established to work on different themes identified in the cards prioritization activity to determine topics of the workshop, which will be presented during the two-day workshop. We will create Slack/Discord channels for participants to introduce themselves and communicate prior to the workshop with the aim to keep these channels open for further collaboration after the workshop.

The workshop will be fully virtual and we will use Zoom for live workshop discussions and Slack/Discord for offline communication and resource sharing. Additionally, all workshop materials will be shared with participants through email and on shared drive folders prior to the workshop. We will use the Breakout Room feature in Zoom to facilitate the design activity among workshop participants and use Miro for participants to create a collaborative virtual workspace. The workshop timings will be decided based on the most appropriate times for participants using a survey prior to the workshop.

Diversity and Accessibility

The organizers are committed to inclusion of participants across abilities, gender, ethnicity, location, institution, seniority, and research background. The participants will be asked to make workshop submissions accessible and include alt-text image descriptions. We will also have a sign language interpreter and live closed captions of the presentations for any participants that may need it. We realize that the accessibility of Zoom and Miro may be limited for people with visual impairments, therefore, we will have volunteers at the workshop to facilitate group work and Zoom/Miro interactions if needed by participants.

Workshop Structure

The two-day workshop will consist of three main activities (see Workshop Schedule) which will be moderated by workshop organizers, interwoven by keynote talks by experts on the workshop themes of multisensory interactions, embodied experiences, and disability interactions to inspire discussion.

The first breakout activity will focus on brainstorming and ideation on the topics prioritized from the pre-workshop activity. The participants will be organized into sub-groups of 4 people to discuss the themes prioritized in the pre-workshop activity. We will use a virtual World Café¹ method to enable each sub-group to discuss each topic in short sessions of 15 minutes before moving on to the next topic (4-5 topics). We will use Miro to set up workspace areas as a virtual replacement of small tables for sub-groups to work with individual topics. The participants will be encouraged to add post-it notes of emerging ideas from discussion on to the Miro board. Between the breakout activities, the workshop coordinators will de-duplicate and group similar ideas into an affinity diagram to help converge the ideation process for the next activity.

In the second breakout activity, the workshop participants will build on the ideas developed in the first activity to formulate the guiding principles for future work at the intersection of multisensory interactions and embodied disability experiences, driven by the diversity of participants' needs and inclusion in research. The third activity will focus on the research methods and approaches for co-designing with people with disabilities and long-term health conditions as their needs evolve over the life course. The participants will be encouraged to critically reflect on the existing design approaches and speculate novel methods with the help of scenarios provided by the workshop organizers.

¹ <http://www.theworldcafe.com/>

Following the afternoon coffee break, the organizers will moderate a panel discussion with invited experts on the outcomes of the activities and future research directions. Our panelists will include Marianna Obrist, Michael Proulx, Sri Subramanian, Cecily Morrison, and Antonio Camurri among others to confirm pending acceptance of the workshop. We will also conduct a post-workshop activity for participants to reflect on their workshop experience and set up communication channels to continue the conversations from the workshop and create opportunities for collaboration.

Workshop Schedule

We include the suggested workshop schedule below. The organizers are flexible to adjust the schedule to most appropriate timings for virtual participation.

DAY 1	
15 min	Welcome and Introductions
15 min	Keynote 1- TBD
15 min	Keynote 2- TBD
60 min	Activity 1: Situating multisensory interactions and embodied experiences in the context of disability
10 min	Short break
60 min	Activity 2: Formulating guiding principles for future work at the intersection of multisensory interactions and embodied disability experiences
10 min	Wrap-up of Day 1
DAY 2	
15 min	Keynote 3 - TBD
60 min	Activity 3: Developing novel methods and approaches for co-designing for evolving user needs
10 min	Short break
60 min	Panel Discussion
15 min	Consolidate Future Plans and Closing

Post-workshop plans

The post-workshop activities will focus on developing a community to support each other and continue the work either as a whole group or as sub-groups established during the workshop. We will establish a means of communication through which participants can support one another and identify collaborations/ funding streams (e.g., slack channel or a series of seminars or speaker series to be organized collaboratively throughout the year. The summarized workshop findings will be disseminated through our website. The organizers also aim to publish an article in the ACM Interactions magazine summarizing the main contributions of the workshop and a reflective account of the workshop lessons and findings. The workshop participants will be invited to contribute as co-authors.

Workshop Organizers

The organizers are experts in HCI research relevant to multi-sensory technologies, affective computing and embodied experiences, accessibility and assistive technologies, and disability design and interactions.

Maryam Bandukda (main contact)

Maryam Bandukda is a 4th year PhD student at UCL Interaction Centre and Global Disability Innovation Hub. Maryam's research focuses on enabling and enhancing experiences of blind and partially sighted people in open spaces. Her PhD work is being supervised by Prof. Catherine Holloway, Prof. Nadia Berthouze, and Dr. Aneesha Singh. Maryam's PhD research has been funded by the Engineering and Physical Sciences Research Council (EPSRC) Doctoral Training Program.

Aneesha Singh

Aneesha Singh is a lecturer (Assistant Professor) of Human Computer Interaction at the UCL Interaction Centre. She is interested in the design, adoption and use of personal health and well-being technologies in everyday contexts. Her research focuses on digital health, ubiquitous computing, multisensory feedback and wearable technology, especially in sensitive and stigmatized populations.

Catherine Holloway

Catherine Holloway is a Professor of Interaction Design and Innovation at UCL's Interaction Centre and the Academic Director and co-founder of the Global Disability Innovation Hub (GDI Hub). GDI Hub exists to accelerate disability innovation for a fairer world and Cathy's research revolves around supporting this aim. GDI Hub supports the core values of the Paralympic movement - courage, determination, inspiration and equality - and seeks to design our activities in support of the UN Sustainable Development Goals (SDGs).

Nadia Bianchi-Berthouze

Nadia Bianchi-Berthouze is a Full Professor in Affective Computing and Interaction at the UCL Interaction Centre. Her research focuses on designing technology that can sense the affective state of its users and use that information to tailor the interaction process. She has pioneered the field of Affective Computing and for more than a decade she has investigated body movement and more recently touch behavior as means to recognize and measure the quality of the user experience in full-body computer games, physical rehabilitation and textile design. She also studies how full-body technology and body sensory feedback can be used to modulate people's perception of themselves and of their capabilities to improve self-efficacy and copying capabilities.

Emeline Brule

Emeline Brulé is a lecturer (Assistant Professor) of Product Design at University of Sussex. She is interested in disability design, technologies in education and the design process, and works at the intersection of sociology and Human-Computer Interaction.

Ana Tajadura-Jiménez

Ana Tajadura-Jiménez is a lecturer (Associate Professor) at the DEI Interactive Systems Group, Universidad Carlos III de Madrid. Her research focuses on multisensory body perception, wearable and self-care technologies at the intersection between the fields of human-computer interaction and neuroscience. She is currently Principal Investigator of the MagicOutFit project, which investigates the design of technology integrating sensory feedback to alter the way people

perceive their body in order to drive positive changes in emotional and physical health in populations with body concerns.

Oussama Metatla

Oussama Metatla is a Senior Lecturer and EPSRC Research Fellow in the Department of Computer Science at the University of Bristol. His research interests include exploring how insights and principles from multisensory interaction, crossmodal perception and embodied cognition could be used to design more inclusive interactions between people with and without disabilities.

Ana Javornik

Ana Javornik is a Lecturer (Assistant Professor) in Digital Marketing at the School of Management, University of Bristol. Her research broadly focuses on consumer behaviour and digital marketing, with a particular interest in the use of augmented reality in commercial contexts and in relation to mental well-being. Her work has been published in internationally recognized journals and presented at leading conferences in marketing and human-computer interaction.

Anja Thieme

Anja Thieme is a Senior Researcher in the Health Intelligence group at Microsoft Research Cambridge, UK. Her work includes the design of interactive digital artefacts to aid the coping and self-management abilities of people with severe mental health problems, as well as audio-tactile technology to augment the learning processes and sense-making capabilities of people with vision impairments.

Call for participation

We invite researchers, practitioners, and designers with an interest in creating inclusive multisensory interactions for people of all abilities to submit position papers of up to 4 pages in single-column SIGCHI submission template (including references) stating their existing work, a conceptual design, or their position with respect to the workshop topic. Submissions should also include up to two discussion points and issues that participants would like to discuss in the workshop. We also welcome alternate submissions in the form of presentation slides, design sketches, and posters. Authors must ensure the accessibility of their submission by following the SIGCHI Accessibility Guidelines (<https://chi2021.acm.org/for-authors/presenting/papers/guide-to-an-accessible-submission>).

Submissions can be made, by February 21, 2021 by email to m.bandukda@ucl.ac.uk. The submissions can be individual or group. If accepted, at least one author must attend the workshop at CHI2021 (via Zoom). All accepted submissions will be published on the website prior to the workshop.

References

1. Elena Azanón, Luigi Tamè, Angelo Maravita, et al. 2016. Multimodal Contributions to Body Representation. *Multisensory Research* 29, 6: 635–661.
2. Maryam Bandukda, Catherine Holloway, Aneesha Singh, Giulia Barbareschi, and Nadia Berthouze. [In Submission].
3. Giulia Barbareschi, Catherine Holloway, Katherine Arnold, et al. 2020. The Social Network: How People with Visual Impairment use Mobile Phones in Kibera, Kenya. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, Association for Computing Machinery, 1–15.
4. Giada Brianza, Ana Tajadura-Jiménez, Emanuela Maggioni, Dario Pittera, Nadia Bianchi-Berthouze, and Marianna Obrist. 2019. As Light as Your Scent: Effects of Smell and Sound on Body Image Perception. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in*

- Bioinformatics*), Springer Verlag, 179–202.
5. Catherine Holloway. 2019. Disability interaction (DIX). *Interactions* 26, 2: 44–49.
 6. Ana Javornik, Yvonne Rogers, Delia Gander, and Ana Moutinho. 2017. MagicFace: Stepping into Character through an Augmented Reality Mirror. .
 7. Ana Javornik, Yvonne Rogers, Ana Maria Moutinho, and Russell Freeman. 2016. Revealing the Shopper Experience of Using a “Magic Mirror” Augmented Reality Make-Up Application. .
 8. Marianna Obrist, Rob Comber, Sriram Subramanian, Betina Piqueras-Fiszman, Carlos Velasco, and Charles Spence. 2014. Temporal, Affective, and Embodied Characteristics of Taste Experiences: A Framework for Design. .
 9. Aneesha Singh, Stefano Piana, Davide Pollarolo, et al. 2016. *Go-with-the-Flow*: Tracking, Analysis and Sonification of Movement and Breathing to Build Confidence in Activity Despite Chronic Pain. *Human-Computer Interaction* 31, 3–4: 335–383.
 10. Aneesha Singh, Ana Tajadura-Jiménez, Nadia Bianchi-Berthouze, et al. Mind the Gap: A SIG on bridging the gap in research on body sensing, body perception and multisensory feedback. .
 11. Ana Tajadura-Jiménez, Maria Basia, Ophelia Deroy, Merle Fairhurst, Nicolai Marquardt, and Nadia Bianchi-Berthouze. As Light as your Footsteps: Altering Walking Sounds to Change Perceived Body Weight, Emotional State and Gait. .
 12. Jacob O. Wobbrock, Shaun K. Kane, Krzysztof Z. Gajos, Susumu Harada, and Jon Froehlich. 2011. Ability-based design: Concept, principles and examples. *ACM Transactions on Accessible Computing* 3, 3.