

Multidisciplinary Perspectives on Designing Accessible Systems for Users with Multiple Impairments: Grand Challenges and Opportunities for Future Research

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ABSTRACT

Historically, the accessibility community has focused on designing assistive technologies and systems related to single categories of impairments. While this approach is justifiable and contributes to the advancement of the field, many researchers argue that designing technologies for one impairment at a time contributes to an oversimplification of disability and does not reflect real-world experiences of a significant number of users who live with multiple impairments. How can the accessibility field leverage theories and concepts from other disciplines (e.g. disability studies, medical humanities, social work, engineering, education) to support more appropriate and inclusive technologies for users with complex needs? How can future assistive technologies take into consideration a diverse combination of sensory, cognitive, and physical characteristics? In this workshop, we invite researchers and practitioners from different disciplines to share their perspectives related to challenges and opportunities in designing accessible systems that consider the multidimensional and often complex needs of users living with multiple impairments.

CCS CONCEPTS

• **Human-centered computing** → Accessibility; Accessibility theory, concepts and paradigms; • **Social and professional topics** → User characteristics; People with disabilities.

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KEYWORDS

Assistive Technologies, Disability Studies, Accessibility, Multiple Impairments

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1 BACKGROUND

Historically, the accessibility research community has primarily focused on designing assistive technologies and systems related to single categories of impairments. In other words, accessibility researchers often focus on evaluating technologies and addressing the needs of technology users who experience a single type of sensory [25, 27], cognitive [16, 18], or physical impairment [4, 26] at a time. While this approach is justifiable and contributes to the advancement of the accessibility field, many researchers argue that designing accessible systems and assistive technologies for one impairment at a time contributes to an oversimplification of disability and does not reflect real-world experiences of a significant number of users of technology who live with multiple impairments [5, 14, 23].

A 2016 survey reported that almost 75% of people with disabilities in England live with more than one type of long-term impairment [29]. According to the report, the combination of sensory and mobility impairments is the most common combination of impairments among English survey respondents. However, a combination of cognitive and physical impairments is also prevalent among older adults [17, 31]. Furthermore, findings also show that more than 20% of respondents live with at least three types of impairments [9].

Not surprisingly, 51% of those living with three or more impairments do not think current assistive technologies address their needs or support their daily activities in an adequate way. Similar American reports [10, 20] showed that the US Department of Education has to provide special accommodations for at least 122,559 students with profound or multiple impairments each year. In order to be effective, educational programs need to incorporate a variety of components, including the use of personalized assistive technologies that meet the considerable needs of these individuals. These results indicate that people with disabilities do not always belong to fixed, clearly defined categories and assistive technologies should be able to accommodate these individualities.

Many scholars question the oversimplification of disability(ies) among accessibility researchers. Hofmann et al argue that the accessibility field frames disability as discrete and isolated blocks of impairments for practical reasons. According to the authors, these categorizations are often decontextualized [23]. Similar arguments related to the need for a multifaceted approach in the accessibility community are also made by Mankoff et al [14], Bennett et al [6, 7], Shinohara et al [19], and Frauenberger [5]. Yet, little research has explored the challenges and design considerations involved in addressing the multidimensional and often complex experiences of users of technology living with complex or multiple impairments.

If we look at the work presented at ASSETS over the years [1, 3, 8], the majority of technical contributions still rely on relatively rigid categories of impairments or user groups (e.g. “older adults” or “hearing impairments”) and empirical research rarely includes users with more than one impairment. According to related work examining the personal experiences of people with disabilities, many individuals living with multiple impairments do not feel like they belong to one category or the other. Often, these individuals are rejected by both communities for being “different” [22]. This issue is also reported among people with deafblindness who do not think assistive technologies designed specifically for people with “visual” or “hearing” impairments effectively address their needs [28]. Similar issues are faced by people in the neurodivergent community who may experience a combination of different sensorimotor and cognitive impairments [11].

We argue that the design of assistive technologies and accessible systems play an important role towards the participation of people with multidimensional accessibility needs in society. In accordance with Wobbrock et al [12], accessible systems should be able to accommodate the needs of different users, regardless of their abilities, extent, or complexity of their impairments. However, examples of successfully designed systems that accommodate the complex needs of users living with multiple impairments are limited in the accessibility community. Different interaction modalities, such as gaze [4], audio-visual [25, 27], haptics [13, 15, 24], or multisensory approaches [2, 30], are not always easily adaptable to the multi-layered needs of users who may experience challenges in compensating one ability with another. A multidisciplinary approach to this problem could help the accessibility research community address the challenges involved in designing accessible systems that take into consideration a diversity of users living with complex accessibility needs.

In this workshop, we invite researchers and practitioners from different disciplines to share their perspectives related to challenges

and opportunities in designing accessible systems that consider the multidimensional needs of users with multiple impairments. This workshop intends to challenge current paradigms in the accessibility field and draft a joint research agenda that actively involves users with multiple impairments in our practice.

2 WORKSHOP PLANS

The motivation for this workshop builds on our previous experience working with communities of people living with multisensory impairments (e.g. deafblindness) and other complex disabilities. As accessibility researchers, we realized that most currently available technologies do not address their user needs and that well-established research methods do not necessarily facilitate conducting work *with* and *for* these communities. Therefore, we invite academics and practitioners from different disciplines to discuss issues related to designing accessible systems and assistive technologies *with* and *for* users with multiple impairments.

Our goal in this workshop is to explore questions in three sub-domains (*theory*, *technology*, and *users*) using a multidisciplinary approach: sharing perspectives and experiences from individuals with lived experience of disability, scholars in the humanities, disability studies, engineering, human-computer interaction and so on. To add focus and rigour to our discussions, 500-word abstracts will help us split workshop participants into different groups working on sub-domains (*Theory*, *Technology*, *Users*) depending on their interests and expertise.

Furthermore, we plan to invite our extensive collaboration networks of organizations, international agencies, special needs colleges, and industry partners to be part of the discussions. The workshop intends to challenge current paradigms in the accessibility field, devise new approaches for designing multifaceted accessible systems, and draft a joint research agenda that promotes the involvement of users with multiple impairments in our field.

Planned sub-domains for discussion with workshop participants:

Theory:

1. How can the accessibility field leverage theories and concepts from other disciplines (e.g. disability studies, medical humanities, social work, engineering, education) to support more appropriate and inclusive technologies for users with complex needs or multiple impairments?

2. Are commonly used design frameworks (e.g. Universal Design [21], Ability-based Design [12]) appropriate in the context of multidimensional user needs? What new theoretical frameworks are needed in order to support the design of accessible systems for users with multiple impairments?

Technology:

3. How can we mitigate potential harms and make current assistive technologies more accessible for users with multiple impairments?

4. How can future assistive technologies take into consideration a diverse combination of sensory, cognitive, and physical characteristics? For instance, should a multisensory approach be used? How can we adapt interfaces based on multi-layered user needs?

Users:

5. Are commonly used participatory design and evaluation methods appropriate and inclusive? What methods and tools should be

Table 1: - Draft structure for the day (all times in CEST)

Proposed time	Activity
12:00 – 12:30	Workshop presentation, individual introductions, description of activities for the day.
12:30 – 13:30	Panel discussion with invited speakers from different disciplines (TBD): Current practices and sharing knowledge related to accessibility and users with multiple impairments
13:30 – 13:40	Short break
13:40 – 14:40	Group activity 1 (in breakout rooms): Each multidisciplinary group of participants will start focused discussions around challenges related to one of the sub-domains of the workshop (<i>Theory, Technology, Users</i>) and their impact on designing accessible systems for users with multiple impairments
14:40 – 14:50	Short break
14:50 – 15:10	Communicating results of activity 1 to other groups
15:10 – 16:10	Group activity 2 (in breakout rooms): Each multidisciplinary group of participants will continue their focused discussions around one of the sub-domains of the workshop (<i>Theory, Technology, Users</i>) and will draft a list of priorities to push for advancement in the field, including opportunities for future research related to designing accessible systems for users with multiple impairments
16:10 – 16:30	Communicating results of activity 2 to other groups
16:30 – 17:00	Wrap up – Define future plans and consolidate multidisciplinary collaborations. What next?

used to effectively involve users with multiple impairments and complex disabilities in our research and practice?

6. How should we actively involve and foster collaboration with different communities of people with multiple impairments in accessibility research?

The workshop will be held virtually (Sunday October 23) and will involve focused group discussions during the event. Table 1 shows a draft structure for the day, however, this schedule can be adapted based on the needs and interests of workshop participants. We anticipate using the Central European Summer Time (CEST) to accommodate participants who will be attending the ASSETS 2022 conference in person, but this can be changed to better accommodate the final list of participants. Following the event, we plan to create a community of researchers and practitioners interested in working with communities of people living with multiple impairments or complex disabilities. We will also invite participants to submit an expanded version of accepted 500-word abstracts to a special journal issue. For that, we will discuss the best strategy for moving forward with workshop participants during the day.

3 DIVERSITY AND INCLUSION CONSIDERATIONS

Our goal is to bring participants of different disciplines and lived experiences of disability to discuss challenges and opportunities related to designing accessible systems *for, with, and by* users with multiple impairments or complex accessibility needs. Participants will be asked to follow the guidelines for accessible submissions as part of the selection process. Furthermore, all workshop participants will be expected to follow the ACM Code of Ethics and Professional Conduct during the course of the event.

In order to increase accessibility and equitable participation during unprecedented times, the workshop will be fully virtual and will include all the necessary reasonable accommodations requested by participants. Furthermore, all workshop materials and accepted

abstracts will be shared with participants via the workshop website and email ahead of the workshop day. The workshop timings will be decided based on the most appropriate times for participants in different geographic regions, including those who will be attending the in-person ASSETS conference in Athens, Greece.

To encourage participation from researchers, practitioners, and individuals with lived experience of disability from underrepresented communities, we will actively share in the possibility to cover workshop registration fees through the SIGACCESS Diversity and Inclusion Scholarship.

4 ORGANIZERS

Each of the organizers has experience conducting multidisciplinary research related to critical disability studies, inclusive design and engineering, accessible computing, and human-computer interaction. We bring diverse methods, theoretical frameworks, and extensive experience working closely with disabled users of technology. Furthermore, our team is made of scholars at different points in their careers, including early career researchers and established faculty. More information about the workshop organizers can be found in the list below:

Arthur Theil is a Lecturer in Human-Computer Interaction within the School of Computing and Digital Technology at Birmingham City University, England. His research focuses on the study of novel interaction techniques to support users with diverse sensory abilities. His current focus is on designing accessible interfaces for individuals with multisensory impairments (e.g. deafblindness). Arthur has also conducted accessibility research with older adults who experience age-related changes in sensory, cognitive, and motor abilities. In addition to conducting academic work, Arthur currently also serves on the ACM SIGCHI Accessibility Committee and is part of the Program Committee for the ACM SIGACCESS ASSETS Conference.

Chris Creed is an Associate Professor in Human-Computer Interaction at Birmingham City University (UK) where he leads the HCI Research Group. His core research interest is around the design and development of assistive technology for disabled people (across a range of impairments). He is currently leading multiple funded research projects focused around accessibility such as investigating new interface techniques for facilitating creative work via gaze/speech interaction (supported through an Adobe Fund for Design grant), exploring the development of inclusive AR/VR experiences (funded by a Meta/Facebook research award), making coding more accessible for people with physical impairments (which has received support from a Google Inclusion Research Award and a Microsoft “AI for Accessibility” grant), and investigating the potential of wearable technology to support young people with special needs (e.g. ADHD) within residential care (funded through Innovate UK). Dr Creed’s research is multidisciplinary in nature and has been conducted in close partnership with national charities, disability and accessibility organisations, special needs colleges, large arts/cultural partners, and disabled people.

Mohammed Shaqura is a Research Fellow in Haptic Communication and Navigation at the Institute of Design, Robotics, and Optimisation, University of Leeds. He received a BSc degree in Control Systems from King Fahd University of Petroleum and Minerals, and a PhD in Controls and Dynamics from King Abdullah University of Science and Technology. He held various engineering positions in robotics in the Middle East. He has been involved in multiple research projects focussing on the engineering and non-engineering aspects of assistive technologies, including. His current research focuses on developing haptic interface systems and the design of wearable haptics for navigation and localisation. His research interests are optimal control, indoor localisation and mapping, embedded robotic systems, and learning algorithms.

Nasrine Olson is a Senior Lecturer in the field of Library and Information Science at SSLIS, University of Borås, Sweden. Core research interests have involved issues of power and the relationship between day-to-day action, and broader societal structures. In the more recent years the focus has been on the societal implication of ICTs and information practices that enable or hinder the potential for equal opportunity for all. Towards this, Nasrine has adopted participatory practices in her research and has developed methodologies and technical innovations for haptic communication. She has also been instrumental in creating research environments that promote and lead to improved inclusive technologies and environments by coordinating projects such as SUITCEYES (H2020 – 2018-2021) and a new Horizon Europe project called MuseIT (to start in October 2022) which intends to (among others) create multisensory representation of cultural assets for broader accessibility. Nasrine is also the director of an interdisciplinary research centre called INCLUDE – Centre for Inclusive Studies, where through critical examination the ideology of normal, the unequal treatments of societal members will be explored.

Raymond Holt is a Lecturer in Product Design in the School of Mechanical Engineering at the University of Leeds (UK), where he is a member of the Institute of Design, Robotics and Optimisation, the Immersive Cognition Lab and the Centre for Disability Studies. His core research interests are the study of haptic perception and

prehension and the cocreation of assistive and rehabilitation technologies with users. He has led co-creation activities on two rehabilitation robotics projects funded by the National Institute for Health Research, and led the Leverhulme Trust-funded project Facilitating Meaningful Play for Disabled Children through Participatory Design. He has recently been part of the European Commission funded project SUITCEYES (<http://suitceyes.eu>), where he led activities on the sensing and navigation elements, and is currently extending this work as part of the Wellcome Trust-funded Imagining Technologies for Disability Futures project (<http://itdfproject.org>).

Sayan Sarcar is a Lecturer in Human-Computer Interaction within the School of Computing and Digital Technology at Birmingham City University, England. His research sits at the intersection of Human-Computer Interaction (HCI) and Accessibility. His research emphasises improving human individual abilities through developing intelligent systems using design and modelling practices, specifically focused on individual differences in users’ sensorimotor abilities.

Stuart Murray is Professor of Contemporary Literatures and Film in the School of English, and Director of the Centre for Medical Humanities, at the University of Leeds. His research focuses on representation of disability and technologized embodiment and the critical/theoretical contexts for research into disability and health. His last book is *Disability and the Posthuman: Body, Technologies, and Cultural Futures* (Liverpool UP, 2020) and his new study *Medical Humanities and Disability Studies: In/Disciplines* will be published by Bloomsbury next year. He is the PI and works alongside Raymond Holt on the 5-year research project ‘Imagining Technologies for Disability Futures’ and Joint-PI on the 3-year ‘LivingBodiesObjects: Technology and the Spaces of Health’, both funded by the Wellcome Trust.

5 WEBSITE

<https://www.mpdas-assets22.org/>

6 PRE-WORKSHOP PLANS

We plan to invite different research communities to our workshop. This includes sharing the Call for Participation with members of the SIGCHI, SIGACCESS, and GATE communities. Similarly, we plan to invite practitioners working with the European Disability Forum, Deafblind International, Anne Sullivan Foundation, SENSE, SCOPE, AbilityNet, African Community on Assistive Technologies, and members of the South Asian and Latin American HCI communities. All workshop materials and accepted abstracts will be shared with participants via website and email ahead of the workshop day. Based on accepted abstracts, we will split participants into different multidisciplinary sub-domains related to their interests or expertise (*Theory, Technology, Users*).

7 CALL FOR PARTICIPATION

Historically, the accessibility community has focused on designing assistive technologies and systems related to single categories of impairments. While this approach is justifiable and contributes to the advancement of the field, many researchers argue that designing technologies for one impairment at a time contributes to an oversimplification of disability and does not reflect real-world

experiences of a significant number of disabled users of technology. This workshop intends to challenge current paradigms in the accessibility field and draft a joint research agenda that actively involves users with multiple impairments in our practice.

We invite researchers and practitioners of different disciplines interested in designing assistive technologies with and for people with multiple impairments or complex disabilities to submit 500-word abstracts (excluding references) stating their existing work, new ideas, or their critical position related to challenges in designing technologies for users with multidimensional accessibility needs.

Abstracts should discuss the relevant academic literature, include short position statements or issues related to the workshop's theme. We also welcome submissions in the form of videos or posters. Authors must ensure the accessibility of their submission by following the SIGACCESS template and accessibility guidelines. Submissions can be made by September 9, 2022 by emailing the abstract to arthur.theil@bcu.ac.uk. Authors will be notified by September 26. If accepted, at least one author must attend the workshop at ASSETS 2022 on Sunday 23 October (via Zoom). Authors will be invited to expand their abstracts and contribute to a Special Issue Journal submission after the workshop.

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