# Towards an Inclusive and Accessible Metaverse

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## ABSTRACT

The push towards a Metaverse is growing, with companies such as Meta developing their own interpretation of what it should look like. The Metaverse at its conceptual core promises to remove boundaries and borders, becoming a decentralised entity for everyone to use - forming a digital virtual layer over our own "real" world. However, creation of a Metaverse or "new world" presents the opportunity to create one which is inclusive and accessible to all. This challenge is explored and discussed in this workshop, with an aim of understanding how to create a Metaverse which is open and inclusive to people with physical and intellectual disabilities, and how interactions can be designed in a way to minimise disadvantage. The key outcomes of this workshop outline new opportunities for improving accessibility in the Metaverse, methodologies for designing and evaluating accessibility, and key considerations for designing accessible Metaverse environments and interactions.

## CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **Accessibility**; **Virtual reality**; **Mixed / augmented reality**.

## KEYWORDS

Human Computer Interaction; Metaverse, Accessiblity, VR, AR

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## 1 BACKGROUND

The metaverse can be described as a network of connected virtual worlds run by different entities, similar in a way to the internet but different in that users commonly would access the Metaverse with a virtual reality (VR) headset to experience the environments in full 3D [2, 11]. These virtual worlds are places where people can spatially socialise, work and play with each other. To support this, each virtual world might have its own digital ecosystem, currency, and rules. Large companies are beginning to see the potential of a Metaverse and are competing to become leaders in this space. For instance, Meta is building their own platform Horizon Worlds[1], Roblox Corporation[2] has a sandbox platform popular with children, and Epic Games is leveraging on their successful IPs such as Fortnite[3]. Alongside the corporate interest and different platforms which are beginning to emerge, there is the potential for approaches and best practices for designing the Metaverse becoming fragmented due to "*walled gardens*" or centralised by one company [3] - which runs against the Metaverse ethos of a decentralised, open platform [7, 10].

While there is a growing push for the Metaverse to be something that will become as essential to our lives as the internet, there is still little documented when it comes to accessibility of Metaverse applications, specifically for how people with physical and intellectual disabilities would be able to engage and access them. This is particularly important if the Metaverse is to be an open platform and therefore should be inclusive. Furthermore, as the foundations are being set for this technology, there is an opportunity to integrate lessons learned from research on accessibility in VR as it relates to the hardware (VR headset and controllers), interaction, interfaces, and the environment. For instance, research has highlighted the need for customisable VR hardware [8], particularly for people with limited mobility. This suggests that VR headsets and controllers need to be adaptive, in a similar vein to the Microsoft Xbox Adaptive Controller[4] for their Xbox gaming console, enabling

[1]Meta Horizon - https://www.oculus.com/horizon-worlds/
[2]Roblox - https://www.roblox.com/
[3]Fortnite - https://www.epicgames.com/fortnite/en-US/home
[4]Xbox Adaptive Controller - https://www.xbox.com/en-AU/accessories/controllers/xbox-adaptive-controller

assistive devices to be connected and mapped to their standard control scheme.

Research on creating accessible VR experiences explored alternative input mechanisms, such as mapping a cane for people with vision impairments to a VR environment [19]. Work by Wedoff et al. [15] demonstrated the potential of using sound in a VR game for people with vision impairments. Other work has presented a toolkit for developers to enhance VR environments for people with low vision [20]. Virtual environments could also leverage physiological signals such as breathing [12] and heart-rate [17, 18] to enable natural interactions and reactions. Along with this, depth sensing cameras have enabled VR experiences to be adapted to people, such as people who use wheelchairs [4].

Accessibility features are also gradually being introduced to VR platforms. For instance, research by Teófilo et al. [14] highlighted that the Samsung Gear VR had the following accessibility features: Zoom, Inverted Colours, Screen Reader, and Captions. Work by Herskovitz et al. [6] has also explored accessibility of augmented reality (AR) apps and derived insights into improving their accessibility for people with vision impairments.

Despite the growing research in this space, according to work by Heilemann et al. [5], there has been a lack of standard accessibility guidelines for VR developers to follow, along with a limited number of tools to help avoid common accessibility problems. This situation is improving however with Meta publishing their own guidelines on Designing Accessible VR[5] for their Meta Quest VR platform. This covers aspects such as UX/UI, interactions, movement, display, app design, audio, and captions.

Utilising this growing knowledge of accessible immersive technology there is a need for researchers to come together and discuss how this knowledge can be utilised for a Metaverse and what further knowledge is needed to achieve one which is inclusive for users with accessibility needs. Alongside considerations for accessibility and possible standards for design, there is also a need to understand how the accessibility of an immersive Metaverse environment can be evaluated.

## 2 WORKSHOP THEMES AND TOPICS

Building on previous CHI workshops on understanding the future of the Metaverse [16] and immersive inclusivity [9], this workshop aims to build a community of researchers, designers and practitioners with interest in understanding the challenges and opportunities for the Metaverse from the lens of inclusivity and accessibility of people with physical and intellectual disabilities. Therefore the workshop will become a discussion platform broadly around new ideas for improving the Metaverse to address the identified challenges and opportunities. Attendees will share knowledge and insights into methods and tools by discussing topics of interest. These topics can fall under the following three broad themes related to building an accessible Metaverse.

### 2.1 Theme 1: Hardware and interaction

Understanding the limitations of current hardware in terms of meeting accessibility needs for accessing the Metaverse. Along with this, exploring new types of hardware and interactions that can better support individuals. This can include the following topics:

- Re-imagination of immersive hardware, like VR headsets and controllers.
- New sensors or hacks to support accessibility needs.
- Adaptive or assistive interaction techniques.

### 2.2 Theme 2: Evaluating accessibility and prototyping

Identifying strategies and best practices to evaluate the accessibility of existing and future Metaverse experiences. We are interested in compiling effective research methodologies and approaches which can be leveraged by not only researchers, but also designers and developers in the industry. Alongside this, specific understanding of methods for prototyping an accessible Metaverse, such as virtual environments, interfaces, and interactions. Topics can include:

- Evaluation of accessibility issues with Metaverse environments.
- New methodologies and approaches to running studies.
- Prototyping techniques.

### 2.3 Theme 3: Human Factors and design considerations for Metaverse applications

This theme relates to gaining knowledge how to increase the usability and inclusivity of Metaverse experiences for people with disabilities. This can include topics such as:

- Current and future accessibility challenges facing the metaverse. What does an accessible metaverse and the environments/worlds within it look like?
- Potential design considerations for metaverse environments and interactions.
- Discussion of ability-based design as it relates to VR and the Metaverse.
- Work towards the establishment of design guidelines and speculation on how they can be enforced within a decentralised Metaverse platform. Whose responsibility is it?

## 3 PRE-WORKSHOP PLANS

### 3.1 Target Audience

The overarching goal of this workshop is to bring together researchers and practitioners from various disciplines and backgrounds, to jointly develop a research agenda, to understand the challenges and opportunities for the Metaverse from the lens of inclusivity and accessibility of people with physical and intellectual disabilities. Therefore, we aim to broadly advertise the workshop to different communities of researchers and practitioners. We will select participants based on the potential contribution they can offer to the workshop agenda.

### 3.2 Recruitment

We will distribute the call for participation through posting announcements to distribution lists such as CHI-ANNOUNCEMENTS and social media platforms, namely Twitter and Facebook. We

[5]Designing Accessible VR - https://developer.oculus.com/resources/design-accessible-vr/

will send targeted email invitations to researchers in our own networks and to leading researchers across different academic institutions inviting them to participate and distribute the announcement within their organisations. Our website hosts the call for participation, information about the workshop's organisers, news and announcements, and paper submission instructions.

### 3.3 Paper Submission and Review Procedure

Submissions to this workshop will take the form of position papers (maximum 4 pages in ACM CHI Publication Format) addressing one of the themes of the workshop (cf. Section 2 Workshop Themes and Topics). Participants can also choose to submit a motivation statement (maximum 4 pages in ACM CHI Publication Format), describing their reasons for joining the workshop and/or what they would contribute towards the workshop agenda. They should also include a statement on the potential goals of their research and the problems it aims to address. Ultimately, the length is based on the weight of the contribution. Shorter, more focused papers are highly encouraged.

Submissions will be made through EasyChair. Following submission, the position papers will be divided for review among the workshop organisers and invited reviewers. Reviews will be based on quality and relevance to the themes of the workshop. After discussion of all submissions, successful submissions will be invited to the workshop. At this point participants will be asked to express any accessibility concerns which might affect their participation so that we can accommodate them accordingly.

Beyond the quality and relevance of submissions, we will aim to ensure an interdisciplinary and balanced group of researchers in this field. We will solicit widely and internationally for contributions to the workshop. This will both support the interactivity of the networking activities and also reflect the growing relevance and potential of interdisciplinary research across a range of HCI subdisciplines.

### 3.4 Workshop Format

This workshop will be held in-person between April 23 and April 28, between the online and the on-site phase of CHI23. To support participants that are unable to access in-person or synchronous virtual space, particularly for reasons relating to the pandemic or technical limitations, we will be offering asynchronous materials that will be offered to participants to engage with. To help participants familiarise themselves with each other's work and interests ahead of the workshop, participants will prepare a short introduction to upload to our workshop website two weeks before the workshop. Links to these will be shared among all participants, alongside the submitted position papers. We will use the Miro platform to engage in interaction between both in-person participants and online remote during the workshop activities. A Slack group for the workshop will be open at the same time, to allow participants to discuss each others' papers asynchronously and interests, ask questions and self-select discussion groups for activities at the workshop. We will provide a system for this group-selection (to be determined). As such, our one-day workshop will focus on meetings and interactions between the participants, including the panel, while also allowing researchers a brief time to present their own work.

## 4 WORKSHOP STRUCTURE - ON THE DAY

The workshop will run as a half-day hybrid workshop, enabling us to bring people together face-to-face while also welcoming international participants synchronously via Zoom, using an organiser's institutional account, and will make use of captioning for hard-of-hearing users. During the workshop, participants with position papers will be asked to briefly present their work for 5 minutes followed by 2 minutes Q&A. Along with this, we will contribute to a larger discussion and workshop activities. This will be based around an expanded set of key themes identified in our participants' responses to the online registration questionnaire and from their position paper submissions. A key component of the workshop will be a speculative design [1, 13] challenge to engage workshop participants in envisioning scenarios set in the future, that allow participants to speculate on possible designs, experiences or interactions with Metaverse experiences which allow for greater accessibility. The workshop will foster new ideas and a build a sense of empathy among its participants.

Table 1 below outlines a preliminary schedule - to be taken as an example, and subject to change.

**Table 1: Workshop schedules**

| Workshop Activity | Time (CET) |
|---|---|
| Welcome | 9:00am |
| Keynote speaker | 9:10am |
| Spotlight talks of position papers | 9:45am |
| Break | 10:30am |
| Group activities | 10:40am |
| Group presentations | 12:00pm |
| Workshop wrap-up | 12:30pm |

## 5 POST WORKSHOP PLANS

The results of the workshop will be summarised and published on the workshop's website. The posters and possible design framework developed by participants during the workshop, and summary of discussions will be linked on the project website and via social media to provoke further discussion in the community. Participants will also be invited to revise, develop, and submit extended versions of their position papers, based on their discussions at the workshop. We are currently in the process of identifying potential HCI journals (*e.g.*, TOCHI, IJHCS, and Journal of HCI) who would be interested in a special issue based on the topic of our workshop. In addition, the discussions and findings from the workshop will be refined into a "manifesto" on the challenges and opportunities for increasing the accessibility of the Metaverse. This manifesto will provide the basis for a special issue of a journal, where participants with an excellent contribution to the workshop will be invited to submit an extended version of their position paper.

With the organisers' strong links in the relevant research communities it can be expected that beyond concrete plans the workshop contributes to further follow-up activities such as iterations of this workshop in future conferences. To facilitate such activities the workshop's website will continue to be regularly updated. Furthermore, we plan to foster a community of researchers focused on

improving the accessibility of immersive technologies and the Metaverse through a Slack channel created for this workshop. This group will be maintained after the event to allow future collaborations and sharing of datasets, code, and best practices.

## 6 CALL FOR PARTICIPATION

The Metaverse has the potential to bring the world much closer together through its network of connected virtual worlds and decentralised nature. Considering its potential to reach global appeal it is important to ensure that the Metaverse is accessible for people with physical and intellectual disabilities. Therefore, this workshop intends to work towards a broad understanding of how the Metaverse can be designed in order to achieve this, with a focus on three core themes: (1) hardware and interaction; (2) evaluating accessibility and prototyping; and (3) human factors and design considerations.

Potential participants should submit maximum 4 page long position papers (in ACM CHI Publication Format), which address at least one of the key theme(s) of the workshop and must present original material. The paper should also include a statement on the potential goals of their research and the problem(s) it aims to address. Submissions will be made via EasyChair. For more information visit our website (https://sites.google.com/view/accessiblemetaverse) or contact accessiblemetaverse@gmail.com.

Papers will be selected based on relevance, quality, and diversity. At least one author of each accepted position paper must attend the workshop, and all participants must register for both the workshop and for at least one day of the conference.

## 7 ORGANISERS

The workshop has a broad international group of organisers, including established researchers, and younger perspectives; with interests in HCI, accessibility, metaverse.

**Callum Parker** is a Lecturer in Interaction Design at the Urban Interfaces Lab in the University of Sydney's School of Architecture, Design and Planning. Callum's research seeks to gain new understanding of interactive digital city interfaces and their place within urban environments, contributing towards the broader smart city. He is specifically focused on leveraging cutting edge technologies such as pervasive displays, augmented, virtual, and mixed realities, and media architecture.

**Soojeong Yoo** is a Research Fellow in UCL Interaction Centre (UCLIC) and Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS) at the University College London. Her research interests include human factors with novel technologies such as virtual reality (VR) and augmented reality (AR) within the context of surgery, physical activity, on-body interaction, personalised dashboards and human adapted HCI.

**Youngho Lee** is a Professor in the department of computer engineering at Mokpo National University, South Korea. His research interests include virtual and augmented reality, culture technology, and human-computer interfaces. Currently, he is focused on designing, implementing, and evaluating training systems for nurses with virtual and augmented reality technology.

**Joel Fredericks** is a Lecturer in Design at The University of Sydney's School of Architecture, Design and Planning. Joel is an urban planner, community engagement practitioner and interaction designer. His research is transdisciplinary and sits across the domains of community engagement, smart cities, participatory design, social inclusion, digital participation and immersive technologies.

**Arindam Dey** is a computer scientist on a mission to make Metaverse (AR/VR) better for users in various ways. Currently, he is working as a Research Scientist at Meta (previously known as Facebook) with a focus on health and safety in the metaverse. He is also held Honorary Research Fellow at the University of Queensland, Australia, primarily focusing on Mixed Reality, Empathic Computing, and Human-Computer Interaction.

**Youngjun Cho** is Associate Professor in the UCL Computer Science department and Global Disability Innovation Hub - WHO Collaborating Centre for Assistive Technology. He is also a program director of UCL MSc Disability, Design and Innovation. He has over 15-year track record of multidisciplinary research, innovation and user engagement. He explores, builds and evaluates novel techniques and technologies for the next generation of artificial intelligence-powered physiological computing that boosts disability technology innovation. He has pioneered mobile imaging-based physiological sensing and automated detection of psychological states for disability innovation. Also, he led a variety of industrial research projects over a decade, successfully turning research into real-world accessible products.

**Mark Billinghurst** is Director of the Empathic Computing Laboratory, and Professor at the University of South Australia in Adelaide, Australia, and also at the University of Auckland in Auckland, New Zealand. He conducts research on how virtual and real worlds can be merged, publishing over 550 papers on Augmented Reality, Virtual Reality, remote collaboration, Empathic Computing, and related topics. In 2013, he was elected as a Fellow of the Royal Society of New Zealand, and in 2019 was given the ISMAR Career Impact Award in recognition for lifetime contribution to AR research and commercialisation.

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