

The Third Workshop on Building an Inclusive and Accessible Metaverse for All

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Abstract

The Metaverse is envisioned as a shared, persistent experience that encompasses both augmented and virtual reality, representing the convergence of a virtually enhanced physical reality and interconnected persistent virtual spaces. It has the potential to break down physical boundaries, connecting people from all walks of life together through digital technology. As the Metaverse is still evolving, there is a unique opportunity to shape its development into an inclusive, all-encompassing space that is accessible for all. However a key challenge lies in designing the Metaverse from the ground up to ensure inclusivity and accessibility. This workshop aims to explore how to build an open, inclusive Metaverse and develop methods for evaluating its success. Key outcomes will include identifying new opportunities to enhance inclusivity, establishing evaluation methodologies, and outlining considerations for designing accessible environments and interactions within the Metaverse.

CCS Concepts

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

Keywords

Human-Computer Interaction, Metaverse, Inclusivity, Accessibility, Virtual Reality, Augmented Reality, eXtended Reality

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1 Motivation

In recent years, Augmented (AR) and Virtual Reality (VR) have evolved into widely adopted technologies, finding extensive use in various educational, research, and commercial applications, including video games, simulations [4], design [28], training, and social interactions [33]. These developments point towards the emergence of the Metaverse, a concept describing a network of interconnected virtual worlds, each governed by distinct entities, and the convergence of a virtually enhanced physical reality, and a physically persistent virtual space [24]. The Metaverse offers immersive experiences in 3D environments [5, 25], and augmented experiences in the real world. Envisioned as a persistent parallel world [1], the Metaverse will integrate technologies like Blockchain to create a digital economy and enable asset ownership [3, 16], and Artificial Intelligence (AI) to automate the creation of digital assets and drive realistic non-human virtual actors [17]. Companies such as Meta and Apple are developing platforms for their respective VR devices, but differences in functionality could fragment design approaches due to “walled gardens” or centralisation by one company [8], a

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challenge that contradicts the Metaverse’s core philosophy of decentralisation and openness [19, 23].

The rise of the Metaverse presents an opportunity to remove physical and social barriers, enabling people from all walks of life to connect, engage, and participate in virtual environments. However, as the Metaverse takes shape, there is a significant risk that many communities, especially those on the “*digital fringe*,” (Table 1) may be left behind. This includes individuals with disabilities, geographically isolated populations, culturally diverse groups, economically disadvantaged individuals, senior citizens, disadvantaged youth, women, LGBTQIA+ individuals, refugees, migrants, First Nations people—communities, and others traditionally excluded from technological advances. Without intentional, inclusive design, the Metaverse could unintentionally perpetuate or even exacerbate existing inequalities. Population diversity is critical to ensuring that the Metaverse becomes a truly open and empowering platform for all, similar to the aspirations of the internet. To achieve this, we must leverage over 60 years of Human-Computer Interaction (HCI) research to enhance the core principles of the Metaverse, particularly around inclusivity and accessibility, ensuring that it helps connect marginalised groups to their communities and provides equal opportunities for participation and engagement.

Table 1: Examples of the fringe communities.

Fringe community	Examples
Geographical	Communities in small cities, suburbia, regional, rural or remote areas.
Socio-economic	People in lower-income neighbourhoods, teenagers in custody or in care, homeless people, drug addicts, sex workers, people in prison, and former detainees (immigration and prison).
Age-driven	Elderly people, children.
Gender-driven	Women, women in STEM (Science, Technology, Engineering and Mathematics) professions, women in politics, gender-x, LGBTQIA+.
Disability-driven	People with physical and cognitive disabilities, congenital disorders, mental illnesses.
Cultural and ethnic	Indigenous people, migrant communities, refugees, minority ethnic groups, immigrants.

Research investigating accessible AR and VR experiences explored alternative input mechanisms, such as mapping a cane for people with vision impairments to a VR environment [34]. Work by Wedoff et al. [31] 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 [35]. Virtual environments could also leverage physiological signals such as breathing [26] and heart rate [32] 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 [12]. Accessibility features are also gradually being introduced to VR platforms. For instance, research

by Teófilo et al. [29] highlighted that the Samsung Gear VR had the following accessibility features: Zoom, Inverted Colours, Screen Reader, and Captions. Work by Herskovitz et al. [15] has also explored the 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. [14], there has been a lack of standard accessibility guidelines for AR and VR developers to follow, along with a limited number of tools to help avoid common accessibility problems. However, this situation is improving, with Meta publishing their own guidelines on Designing Accessible VR¹ for their Meta Quest VR platform. Apple has also released some initial design guidelines for their VisionPro Headset². This covers aspects such as UX/UI, interactions, movement, display, audio, ergonomics, and accessibility.

Despite the growing adoption of AR and VR headsets among home users, these devices are far from being widely accessible to all, particularly in economically disadvantaged regions such as developing or third-world countries. As a result, collaborative group settings often involve members using AR/VR headsets (HMD users) working alongside those without headsets (non-HMD users) within the same Metaverse. In these asymmetric configurations, it becomes challenging for non-HMD users to sustain their engagement and collaborate effectively with HMD users due to the lack of adequate information regarding the HMD users’ activities in the virtual environment. To bridge this gap, several approaches [20, 30] have been explored to enable non-HMD users using desktop computers or mobile devices to remotely view HMD users’ activities and interact with them in the VR environment. Drey et al. [7] adapted these asymmetric hardware configurations for co-located learning pairs. To enhance non-HMD users’ immersion and engagement when observing VR content controlled by co-located HMD users, Gugenheimer et al. [13] projected the VR environment onto the floor, spatially aligned with the physical positions of the HMD users. These 2D projections provided non-HMD users with a visual representation of the virtual content and its spatial relationship to the HMD users. Further research by Fages et al. [9] and Do et al. [6] explored the use of third-person perspectives (or scene views) of AR environments to facilitate non-HMD users’ understanding of the spatial relationships between HMD users and virtual objects, in both remote and co-located settings.

Alongside hardware and interaction design, it is important to comprehend the social dimensions of the Metaverse to empower individual users of diverse identities. For instance, community groups are currently using virtual environments, as exemplified by the potential of the LGBTQIA+ community using virtual spaces, to provide support for one another [11] and seek embodied visibility online [10, 18]. Future virtual spaces should be conceived to empower communities, fostering safe environments where people can convene and freely express themselves.

Using this growing body of knowledge of accessible immersive technology, there is a need for researchers to come together and discuss how this knowledge can be used for a Metaverse and

¹Designing Accessible VR - <https://developer.oculus.com/resources/design-accessible-vr/>

²Designing for visionOS - <https://developer.apple.com/design/human-interface-guidelines/designing-for-visionos/>

what further knowledge is needed to achieve a Metaverse which is inclusive for users with various accessibility needs. Alongside considerations for accessibility and possible standards for design, there is also a need to understand how the inclusivity and accessibility of an experience within the Metaverse can be evaluated. This workshop builds on our previous CHI workshops in 2023 [22] and 2024 [21]. As with the previous workshops, we aim to advance the HCI community's knowledge on how Metaverse platforms and the augmented and virtual environments within them can be designed to foster inclusivity and accessibility. Additionally, this workshop aims to develop a more holistic understanding of the challenges faced by fringe communities and how they are currently engaging with the Metaverse. Furthermore, we will explore how the design process can be improved to ensure future Metaverse platforms get it right from the start. Attendees can share aspects such as:

Theme 1: Conceptualisation and Prototyping

Understanding of methods for prototyping an inclusive and accessible Metaverse, such as virtual environments, interfaces, and interactions. Topics can include:

- Prototyping techniques (low-fi through to hi-fi).
- Tools and platforms to support prototyping.
- Potential design considerations for metaverse environments and interactions.

Theme 2: Methods and Metrics for Evaluation

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 that can be used by researchers and designers and developers in the industry. Topics can include:

- Understanding how to improve the inclusiveness of virtual environments.
- Potential new methods and metrics for evaluating accessibility issues with virtual environments.
- New methodologies and approaches to running studies.

Theme 3: Supporting Inclusive Access

AR and VR headsets have been pivotal devices for experiencing the Metaverse. However, fostering an inclusive Metaverse requires supporting users from diverse backgrounds and technological conditions to ensure equitable access to and experience within this virtual environment. Thus, it is essential to explore novel technologies and designs that promote equity in Metaverse experiences for a wide range of users. This theme may include the following topics:

- Novel technologies and designs to support users without using HMDs to adequately experience the Metaverse in AR or VR.
- Investigations into enabling seamless collaboration of asymmetric groups, comprising both HMD and non-HMD users, within the Metaverse.
- Discussions of novel approaches to improve the accessibility of users with special needs or impairment to the Metaverse.

Theme 4: Future considerations for the Metaverse

This theme relates to broader discussions around the current state of the Metaverse, what the Metaverse should be in the future, and

what challenges need to be overcome to achieve the desired state. 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?
- Discussion of ability-based design as it relates to AR, VR and the Metaverse.
- Work towards establishing design guidelines and speculation on how they can be enforced within a decentralised Metaverse platform. Whose responsibility is it?

2 Organisers

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

Callum Parker is a Lecturer in Interaction Design at the Urban Interfaces Lab within the University of Sydney. Callum's research seeks to gain a new understanding of how interactive digital city interfaces can work for everyone, of all shapes and sizes, and abilities. His work is also dedicated to exploring the evolving concept of "public space" in the Metaverse and understanding how diverse people can engage with it. Callum utilises cutting-edge technologies, including pervasive displays and augmented, virtual, and mixed realities.

Soojeong Yoo is a Lecturer in Design at The University of Sydney's School of Architecture, Design and Planning. Her research focuses on human factors in healthcare, aiming to design effective immersive interactive health technologies (VR/AR/MR) for work and hospital settings, and to promote wellbeing through technology integrated into everyday life.

Joel Fredericks is a Lecturer in Design at The University of Sydney's School of Architecture, Design and Planning. His research is at the intersection of interaction design, community engagement, urbanism, and smart cities. Joel has worked on various transdisciplinary research projects that incorporate participatory methods to design, develop and deploy interactive systems that enhance community engagement and contribute to collaborative city-making. Joel has authored and co-authored in numerous publications and books. Most notably he was the lead author of *Media Architecture Compendium Vol.2 – Concepts, Methods, Practice*, which draws on academic research and global studies to present an evolutionary account of concepts, methods, and practice for bringing media architecture thinking into projects.

Tram Thi Minh Tran is a postdoctoral researcher at the University of Sydney's School of Architecture, Design and Planning. Her research explores the applications and implications of emerging technologies, with a particular focus on AR/VR and autonomous mobility.

Mark Colley is a Lecturer at the UCL Interaction Centre. His research crosses the boundaries between accessibility, mobility, and computational methods to create scalable solutions for all.

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.

Khanh-Duy Le is a Lecturer at the Faculty of Information Technology within the University of Science, Vietnam National University Ho Chi Minh City. He is also the founder and currently the Head of the Human-Computer Interaction Research Group at this university. His research focuses on exploring augmented reality, virtual reality, possibly in combination with AI, to enhance group collaboration, knowledge transfer, and skill acquisition.

Simon Stannus is an Applied AR Researcher at Square Enix with a background in 3D interaction. His work involves evaluating new AR hardware, researching new graphics and interaction techniques and creating prototypes of new AR games and experiences.

Woontack Woo is the Director of the Post-Metaverse Research Center and a Professor at the Graduate School of Metaverse at KAIST in Daejeon, Korea. In 2001, he coined the term "ubiquitous virtual reality" and has since published over 600 papers/patents on topics such as Augmented Reality, Augmented Humans, and related subjects. His current research interest lies in exploring how to Augment Society with the Metaverse.

Mark Billinghurst is Director of the Australian Research Centre in Interactive and Virtual Environments and Professor at the University of South Australia in Adelaide, Australia. He conducts research on how virtual and real worlds can be merged, publishing over 800 papers on Augmented Reality, Virtual Reality, remote collaboration, Empathic Computing, and related topics. In 2019 he was given the ISMAR Career Impact Award in recognition for lifetime contribution to AR research and commercialisation, and in 2023 elected as an IEEE Fellow.

3 Plans to Publish Workshop Proceedings

The workshop proceedings will be published in CEUR-WS³. 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 journal special issue, where participants with an excellent contribution to the workshop will be invited to submit an extended version of their position paper. We will also issue a call for contributions outside of our workshop attendees, from the wider HCI community.

4 Workshop Format, Accessibility Considerations and Asynchronous Engagement

Like our previous workshops, Metaverse4All 2025 will be running as a full-day hybrid event. This will enable us to bring people together face-to-face while also welcoming participants who cannot physically attend to join synchronously via Zoom. We will make use of captioning for hard-of-hearing users, and also zoom translation to enable full participation from people not fluent in English. To support participants who are unable to access in-person or synchronous virtual space, particularly for reasons relating to health, travel, accessibility, or technical limitations, we will be offering

asynchronous materials that will be provided to participants to engage with. To help participants familiarise themselves with each other's work and interests before the workshop, participants will prepare a short introduction to upload to our website two weeks before the workshop. Links to these will be shared among all participants alongside the accepted position papers. We will use the Miro platform to engage in interaction between both in-person participants and online remote during the workshop activities. We will create a Slack group for the workshop, allowing participants to discuss each others' papers asynchronously, ask questions, and self-select discussion groups for activities at the workshop. As such, our one-day workshop will focus on meetings and interactions, creating an opportunity for people to connect and begin a longer term collaboration. The Slack group will continue to be used following the workshop to keep the conversation going after the event.

5 Pre-Workshop Plans

5.1 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, and to understand the challenges and opportunities in creating a truly inclusive and accessible Metaverse. This will be considered through the lenses of inclusivity and accessibility for all possible stakeholders, including culturally and linguistically diverse communities, people living with disabilities, senior citizens, and children. To support this, 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. Based on our previous workshop attendee numbers, we expect this workshop to have between 25-35 in-person and 5-10 remote participants.

5.2 Recruitment

We will distribute the call for participation by posting announcements to lists such as CHI-ANNOUNCEMENTS and social media platforms, such as LinkedIn, Facebook, and WeChat. We will send targeted email invitations to researchers in our own networks and to leading researchers across different academic institutions around the world, inviting them to participate and distribute the announcement within their organisations. Our website will host the call for participation, information about the workshop's organisers, news and announcements, and paper submission instructions.

5.3 Paper Submission and Review Procedure

Submissions to this workshop will take the form of position papers (maximum 6 pages in single-column [CEUR-WS Format](#), excluding references) addressing one of the themes of the workshop (see Section Workshop Themes and Topics). Participants can also choose to submit a motivation statement (in the same 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 their research goals and the problems they seek to address. Ultimately, the paper length is based on the weight of the contribution, and shorter, more focused papers will be highly encouraged.

³<https://ceur-ws.org>

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 workshop's themes. 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 that 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 contributions to the workshop widely and internationally. This will both support the interactivity of the networking activities and reflect the growing relevance and potential of interdisciplinary research across various HCI sub-disciplines.

6 Workshop Activities

During the workshop, participants with position papers (remote and in-person) will be asked to briefly present their work for 5 minutes, followed by 2 minutes of Q&A. These presentations will align with the themes of the workshop and will contribute to a larger discussion and workshop activities. These key themes will be identified in our participants' responses to the online registration questionnaire and from their position paper submissions. A key component of the workshop will be group activities, beginning with a discussion on how needs, access, and usage of XR and the Metaverse might vary across different geographical contexts. This will be followed by a speculative design [2, 27] challenge group activity, where workshop participants will collaboratively explore possible future designs, experiences or interactions with Metaverse experiences which allow for greater inclusivity and accessibility. Following this group activity there will be presentations back to workshop as a whole about the designs generated. In this way, the workshop will foster new ideas and a build a sense of empathy among its participants.

Table 2 outlines a preliminary schedule - to be taken as an example and subject to change.

Table 2: Workshop schedule

Workshop Activity	Time (JST)
Welcome	9:00am
Keynote speaker	9:10am
Morning tea	9:50am
Presentation of position papers	10:00am
Lunch	12:00pm
Group activities	1:00pm
Afternoon tea	2:30pm
Group presentations	2:40pm
Workshop wrap-up	3:30pm

7 Post-Workshop Plans

With the organisers' strong links to the relevant research communities it can be expected that the workshop will initiate further follow-up activities, such as iterations of this workshop in future conferences, collaboration between attendees, development of tools and design frameworks, and further publications. To facilitate such

activities, the workshop's website will be updated regularly. 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.

8 Call for Participation

The Metaverse, envisioned as a shared, persistent, and interconnected technology encompassing augmented and virtual reality, has the potential to transcend physical and social boundaries, connecting individuals from all walks of life. However, designing it to be inclusive and accessible for everyone is a significant challenge. Building on the success of our 2023 [22] and 2024 [21] CHI workshops, this hybrid workshop will explore how the Metaverse can be designed to serve diverse communities on the "digital fringe", including people with disabilities, those in geographically isolated areas, culturally diverse groups, and marginalised socio-economic communities. The discussions will focus on four key themes: (1) Conceptualisation and Prototyping, (2) Methods and Metrics for Evaluation, (3) Supporting Inclusive Access, and (4) Future Considerations.

We invite submissions for position papers (up to 6 pages, excluding references, in single-column [CEUR-WS Format](#)) that address at least one of the workshop's key themes and present original work. Papers should also include a statement on the research goals and the problems being addressed. Alternatively, participants may submit a motivation statement outlining their reasons for attending, contributions to the workshop, and the research goals and issues they aim to explore. Submissions will be made via [EasyChair](#). For more information, visit our website (<https://sites.google.com/view/accessiblemetaverse>) or contact callum.parker@sydney.edu.au.

Papers will be peer-reviewed and published on CEUR-WS, with selection based on relevance to the workshop themes and the quality of the work. At least one author of each accepted paper must attend, and all participants must register for the workshop.

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