

2024 XR Access Symposium

Insights from XR Assistive Technology

June 6-7, 2024 | New York City, NY



XR Access

Virtual, Augmented, & Mixed Reality for People with Disabilities

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Report authored by Dylan Fox and Sharon Lin.



Introduction to the 2024 Symposium Report

Insights from XR Assistive Technology

Welcome to the 2024 XR Access Symposium Report. This year's symposium, held on June 6-7 in the vibrant city of New York, marked a significant milestone in our journey towards creating a more inclusive digital world. With the theme "Insights from XR Assistive Technology," we delved into the transformative potential of XR technologies and their impact on accessibility.

The event brought together a diverse group of thought leaders, innovators, and advocates from industry, academia, and advocacy. Together, we explored the latest advancements and tackled the most pressing challenges in extended reality (XR) accessibility. Our discussions were enriched by presentations from renowned organizations such as Meta and Google, and groundbreaking research from institutions like Yale, Gallaudet, and the University of London.

This report encapsulates the collective wisdom and insights shared during the symposium. It serves as a beacon for future endeavors in XR accessibility, highlighting the power of assistive technologies to not only aid those with disabilities but to enhance the XR experience for all. As we reflect on the symposium's proceedings, we are reminded of our shared responsibility to foster an inclusive environment where technology serves everyone, regardless of their abilities.

Join us as we recount the inspiring stories, innovative solutions, and collaborative efforts that are shaping the future of accessible XR. Together, we are paving the way for a more inclusive tomorrow.

Event Impact

The 2024 Symposium was bigger and better than ever before, serving to both educate and inspire passion for accessibility in our attendees.

By the Numbers

140

Participants On-Site
in New York

413

Registrations Online

4.75 / 5

Average Satisfaction

30

Speakers

Direct From Our Attendees

"I loved all the presentations I attended. I appreciated both the technical design aspects discussed as well as the insights brought in from personal perspectives and user studies."

"The breakout sessions were a valuable way to engage with peers through dialogue. I felt the hosts did an excellent job leading the sessions, and I took away valuable learning and insights through the comments that others made."

“”

"My strongest takeaway from the Symposium is that XR accessibility concerns each and everyone one of us, irrespective of disability... Breakthrough innovation emerges through the manifestation of people's unique lived experience; therefore, embracing and paving the way for accessible design is to the end benefit of all members of society-at-large."

"[I learned] just how many wonderful passionate people work in this space and that there is a community of thought to be part of. I felt like I got a handle across a good range of research and understood something important about the landscape."

"Although my work is primarily within the visually impaired accessibility domain, I learned a lot of things about experiences of other disabilities and about just general feelings of disabled users towards XR and accessibility considerations that I hadn't personally thought of before or had very limited understanding of before."

Sponsors

We'd like to thank our Platinum sponsors Yahoo and the National Science Foundation, as well as our Gold sponsor Meta, for making the 2024 Symposium possible.



Supporting XR Access

XR Access is a research initiative at Cornell University; our mission is to connect and engage stakeholders across the field of XR through events, resource sharing, and other programs. However, we can't do it alone: support from our partners is critical to help us create accessible programming, remain sustainable, and achieve our vision of inclusion.

Industry and academic/non-profit partners who share our mission and goals can help keep XR Access by becoming a [research](#) partner or [sponsoring](#) next year's Symposium. To learn about becoming a research partner, email info@xraccess.org.

Individuals and organizations can make a one-time or recurring monetary donation of any size to support XR Access's work. Your donation supports XR Access's programs, research, and overall sustainability. One-time or recurring [donations](#) can be made via the XR Access Website, and are processed by XR Access's parent organization, Cornell University. We also welcome sustaining donations from industry partners.

Acknowledgments

Organizations

We'd like to acknowledge the following for their parts in making the Symposium a success:

- [Oxygen Eventworks](#) for providing audio/video support, photography, and video editing.
- [Interpretopia](#) and [3Play Media](#) for providing disability accommodations.
- [Constellation](#) for catering the event.

Conference Chairs

- Dylan Fox, General Chair
- Shiri Azenkot, General Chair
- Lucy Jiang, Demo & Poster Chair
- Jazmin Collins, Demo & Poster Chair
- Ria Gualano, Breakouts Chair
- Jonathan Segal, IT Chair
- Crescentia Jung, Volunteer Chair
- Woojin Ko, Volunteer Chair

Volunteers

Ahad Butt, Aisha Munir, Andre Cleaver, Chelsey Li, Danielle Oltman, Dharini Chandrashekar, Frank Omullo, Isabella Frank, Jayasri Sai Nikitha Guthula, K. Camille Sato, Kevin T. Martinez, Lauren Chun, Lena Plabst, Leona Edegbe, Logan Stevens, Mark Sturman, Melissa Tan, Nadeem S, Navinkumar Sadasivam, Pranav Adiga, Renan Chen, Sadia Suhail, Sharon Lin, Steven Rakhmanchik, Tasnim Islam, Veronica Pimenova, Vikranth, Xinqing Lin, Yeganeh Chatri, Yiran Li, Yumeng Ma, Zuri Chavers

A woman with short blonde hair, wearing glasses and a black top with a colorful floral pattern, is speaking into a black microphone. She is looking upwards and to the right. The background is a blurred conference setting with a large screen.

Panels & Presentations

Public Access

All of the Symposium main stage talks are available on the XR Access YouTube channel, making these powerful presentations available and free for all to watch.

[Watch the Symposium on XR Access' YouTube](#)

XR Access Stories: Why Access Matters

The panel “XR Access Stories: Why Access Matters,” moderated by Dylan Fox, featured Meryl Evans, Sunny Ammerman, Jesse Anderson, and Anne Burke, discussing the critical importance of storytelling when it comes to convincing stakeholders about the need for accessibility.

Dylan Fox introduced the XR Access Stories project, emphasizing that accessibility should be thought of in terms of its impact on real people, not treated as a mere checklist. The project collects personal stories to highlight the significant impact of accessibility in XR, such as the story of Jayde Malam, an accessibility consultant from Western Canada. Jayde shared her struggles with severe arthritis and chronic pain, and how a guided meditation app in XR provided significant relief during the COVID-19 pandemic. However, she also highlighted gaps in accessibility, such as the inability to use many apps from a seated or lying down position.

Meryl Evans, a deaf accessibility advocate, highlighted the importance of inclusive design. She shared her experiences with XR, noting the absence of essential accessibility features like closed captioning in many applications. Meryl stressed that these features benefit not only the deaf community but also non-native English speakers and others.

Sunny Ammerman, a VR user with optic nerve hypoplasia, discussed starting SpoonieVR, a support group for VR enthusiasts with chronic illnesses or disabilities. Sunny noted the importance of accessibility in virtual environments, emphasizing that inclusive VR can be a tremendous help for people who have difficulty leaving their homes.

Jesse Anderson, a blind professional accessibility advocate and content creator, told his story of having to ask a neighbor to help him activate his Meta Quest headset because of a lack of low-vision options. He spoke of his hope for the future and of the power of AI wearables to improve the quality of life of disabled people.

Anne Burke, a professor at Michigan State University and interviewer for the Stories project, discussed how talking to disabled people and sharing their stories is a powerful way to increase awareness of the need for accessibility. Stories can ultimately shape product development and policy. She emphasized the importance of thinking both emotionally and scientifically when it comes to publishing work on accessibility.

Overall, the panel underscored that accessibility in XR is about creating meaningful, inclusive experiences that consider the diverse needs of all users. The stories shared through the XR Access Stories project serve as powerful reminders of the real-world impact of accessibility and the ongoing need for advocacy and innovation in this field.

[XR Access Stories Project](#)
[Watch “Why Access Matters” on YouTube](#)



Dylan Fox
XR Access



Meryl Evans
Independent



Jesse Anderson
MN State Services



Sunny Ammerman
SpoonieVR



Ann Burke
Michigan State Univ.

Unseen Sound

“Unseen Sound” is a spatial audio-based extended reality (XR) experience developed by blind artist Andy Slater, in collaboration with Sammie Veeler, Virtual Access Lab, and the New Art City virtual art space. The project was created during the Leonardo “Crip Tech” fellowship and aims to challenge conventional accessibility in technology by integrating sonic way-finding, poetic captions, and custom controllers designed for universal use.

The exhibit allows a user to navigate a virtual space using an arcade joystick, triggering unique sounds. Each sound is accompanied by a sonic description displayed on a nearby screen, creating a sensory disjunction between sound and vision. This is designed to mirror the confusion experienced when trying to operate a headset or controller without being able to read the labels.

The creation of “Unseen Sound” was a collaborative effort. Andy provided Sammie with basic arrangement drawings, akin to Dungeons & Dragons maps, and trusted her to understand his vision and implement it. The goal was to create something that a blind person could use autonomously, without needing any training or instruction.

They rejected an offer from Thoughtworks to monetize “Unseen Sound” and chose to partner with New Art City, an artist-led infrastructure that prioritizes stewardship over corporate marketing schemes. Their work is a reaction against the exploitation they perceive in ableist, corporate platforms using disabled people as a marketing ploy to create content and PR for inaccessible platforms. Their approach challenges the notion of technological solutions to societal problems and encourages disabled people to create according to their own artistic and emotional needs.

[Watch “Unseen Sound” on YouTube](#)



Andy Slater
Virtual Access Lab



Sammie Wheeler
Virtual Access Lab



Designing Interactive AI Visual Guides for Blind and Low Vision People

In their talk, “Designing Interactive AI Visual Guides for Blind and Low Vision People,” Ricardo Gonzalez and Jazmin Collins explored the potential of AI in assisting blind and low vision (BLV) individuals. They highlighted how AI’s ability to describe photos can be beneficial, but the value of such descriptions often depends on the user’s specific needs and context. For instance, a user giving a presentation might be interested in knowing how many people are looking at them, while someone trying to exit a room would need to know its layout.

The speakers compared human-powered systems with AI-powered ones, noting differences in trust, privacy, and independence. They posed two research questions: What are the use cases for AI-powered scene description applications among BLV individuals? And how well are these needs being met?

To answer these questions, they conducted a study with 16 BLV participants. The study included downloading an application, maintaining a diary for two weeks, and participating in semi-structured interviews. A pilot study using SeeingAI was initially conducted, but it was found to be too complex for participants to submit entries, leading to missing and inconsistent data.

In response, they developed a custom scene description application for the main study. This application provided visual descriptions and a diary entry questionnaire, which participants could use to log entries immediately after use. The study resulted in 316 diary entries and 16 interviews.

The findings revealed an average trust score of 3.9 and satisfaction score of 3.6 out of 7, with an accuracy of 1.96 out of 3. Interestingly, trust and satisfaction could be high even when accuracy was low. For example, when the app described a pew with a pamphlet on it as “a wood cabinet with a white device and a white device on it,” the user was able to infer that it probably meant a white piece of paper. They suggested keeping focus on user-in-the-loop designs to empower users to utilize their own knowledge as well as the AI’s.

Future work includes AI scene description powered by users’ knowledge and experience in the real world, such as AI-powered guides in VR. They are now working on an AI-powered guide using GPT-4, which can answer questions, guide users around a scene, or provide an audio beacon as an accessibility modification. The goal is to understand what kinds of descriptive behaviors BLV users want from vision language models.

The contributions of this work include investigating the uses of AI-powered description in the daily lives of BLV people and uncovering novel use cases and challenges with AI-powered applications.

[Watch “Designing Interactive AI Visual Guides for Blind and Low Vision People”](#)



Ricardo Gonzalez
Cornell University



Jazmin Collins
Cornell University

Using Surface Electromyography (sEMG) to Create a New XR Human-Computer UI

Kati London, a product leader at Meta Reality Labs, presented on the development of a noninvasive neuromotor interface that uses surface electromyography (sEMG) for computer input. This technology, which has been in development for a decade, aims to provide an alternative to touch-screens, hand-held controllers, and keyboards, addressing the challenge of providing effortless, intuitive, and efficient input for XR experiences.



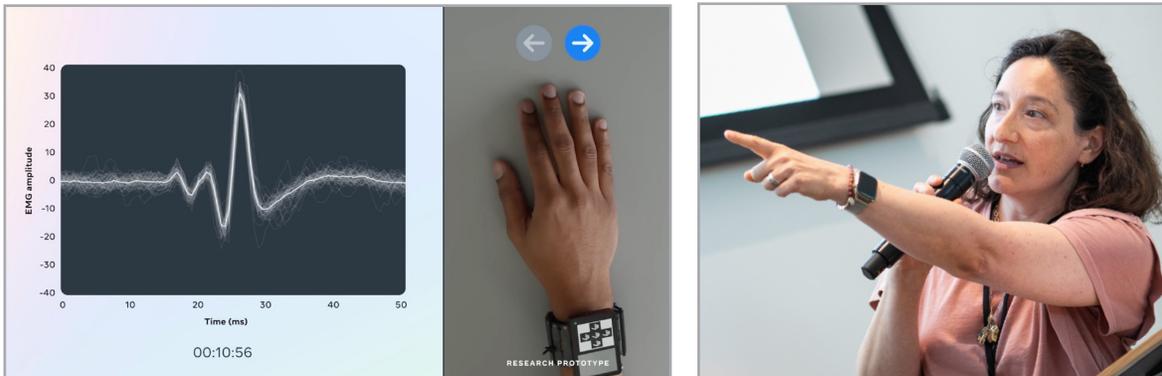
Kati London
Meta Reality Labs

Electromyography, a technique that detects electrical signals produced when users initiate motion in the body, forms the basis of this technology. The interface uses wrist-based sensors to detect signals generated by the neuromuscular system, which are then translated into device control commands. Unlike clinical EMGs, which require custom hardware and placement, complicated setup, and lack scalable data, London's team leveraged data from over 10,000 participants to build a scalable, generalized model that can work for a wide variety of people with a minimum of calibration.

London's team has recently published their first public paper on using a generic neuromotor interface for human-computer interaction. The signals from the wrist band can be used to swipe through applications, write characters, or type on any surface. Following the "Consider Everyone" responsible innovation principles of Meta Reality Labs, they ran a Responsible sEMG Innovation program, funding several academic initiatives on diverse sEMG use. They took into account a wide variety of motor abilities, including no movement (paralysis or amputation), limited range of motion (stroke/muscular dystrophy), and excessive movement (tremor).

London shared a video of her colleague Anton, who lost his hand at age 7, and was able to use the sEMG device to emulate an index-thumb pinch to play a game. This shows how these devices could be helpful to enable interaction where other technologies like machine vision are not. In the future, they hope to move from low-bandwidth naturalistic control to high-bandwidth always available control, exploring the limit of machine control if unfettered from the constraints of hands.

Watch [Using sEMG to Create a New XR Human-Computer UI](#)



ASL Champ! Learning ASL in VR with AI-powered Feedback

Lorna Quandt and Shahinur Alam of Gallaudet University shared a groundbreaking new tool for learning American Sign Language (ASL): ASL Champ! This platform provides immersive interaction and real-time feedback, aiming to harness VR and deep learning to offer new ways to learn ASL. The platform is particularly beneficial for the over 90% of deaf children born to hearing parents, as exposure to ASL can lay a foundation for later literacy, academic success, and health.



Lorna Quandt
Gallaudet University

The ASL Champ platform features an interactive game with a signing teacher avatar, created via motion capture from over 15 fluent signers. Placed in a virtual coffee shop, users learn words like “coffee,” “tea,” and “muffin” by mimicking the avatar’s signs, and the system provides deep-learning-based feedback on the accuracy of the user’s signs via the teacher avatar.



Shahinur Alam
Gallaudet University

The development of ASL Champ involved a 3D designer, animator, motion capture engineer, and deep learning expert. The 3D avatar was created in Autodesk Maya, and the motion capture engineer recorded the 3D movement of signers, which was then ported into Unreal Engine and applied to the avatar. The deep learning model for sign evaluation was trained on a dataset created in-house from Gallaudet signers.

The platform has demonstrated high accuracy rates in training, validation, and testing. A study was conducted with 12 hearing non-signers, who were asked to narrate their authentic responses. A sentiment analysis was conducted to understand which factors of the game were most impactful. The results showed that when users felt like sign recognition was working well, it led to better experiences.

Looking ahead, the team plans to expand the ASL vocabulary, improve accuracy, enhance the game experience, and seek industry partnerships. Their work represents a significant step forward in leveraging technology to facilitate ASL learning.

[Watch ASL Champ!](#)



XR for Individuals with Different Hearing Abilities

Stefania Serafin, a professor at Aalborg University in Copenhagen and leader of the Multisensory Experience Lab, is working on technologies to support individuals with different hearing abilities. Her focus is on developing applications ranging from virtual reality (VR) training for spatial awareness in children with hearing impairment to augmented reality-based solutions for regaining musical skills.



Stefania Serafin
Aalborg University

In Denmark, where sign language is less prevalent, children often receive auditory verbal therapy from a young age. Serafin's lab collaborates with a local hospital's "Center for Healing and Balance," which provides cochlear implants to children; their goal is to train new generations of children with hearing loss to gain abilities they lack, particularly teenagers who face challenges in social situations.

Denmark is home to three of the world's largest hearing aid companies. A significant challenge is ensuring "ecological validity," as traditional research often involves listening to a sound in isolation, whereas the real world presents many visual and auditory cues. Extended reality (XR) can help increase this validity.

In collaboration with speech and language pathologists, Serafin's team found that sound localization remains a challenge, especially in chaotic environments. To address this, they developed a VR game to improve teens' spatial skills. The game involves visiting a VR version of a local music museum and their school playground, where they earn trophies and try to understand the timber of different musical instruments.

A study conducted over two years (2021-2023) involved 22 children aged 8-12; 16 with bilateral cochlear implants, five with bilateral hearing aids, and one with a bimodal hearing solution. The results showed improvement in spatial awareness as the children played the game more.

Another application studied the tolerance level for audio-visual discrepancy in humans. Serafin's lab created "Holoband," an augmented reality band viewed through the Microsoft HoloLens, aimed at elderly musicians who missed attending concerts due to difficulty differentiating performers using their cochlear implant. Calibration was a challenge, but the therapist could move the different instruments so the patient could learn to localize them in space.

Overall, Stefania's collaborations with hospitals, families, and children have been beneficial in gaining an understanding of the potential of VR to support those with various levels of hearing. They continue to aim for XR solutions that can be brought out of the lab and into homes and schools.

[Watch XR for Individuals with Different Hearing Abilities](#)

Wheelchair Based Navigation in VR

Justin Berry, a Creative Producer and Project Director at the Yale Center for Immersive Technologies in Pediatrics, presented a talk on wheelchair-based navigation in virtual reality (VR). He aimed to challenge the conventional wisdom surrounding VR locomotion by comparing 1:1 walking to 1:1 wheeling.

The Blended Reality Lab conducted studies comparing walking and wheelchair use in VR, aiming to understand whether wheelchair interfaces for VR could lead to a meaningful and functional experience. The behavioral measure used was a spatial updating task, where participants were placed in one of a set of randomized mazes, given a glimpse of a destination, and then had to complete the maze. Afterward, they had to estimate where their original position was and their confidence in this estimation, and report on several qualitative measures. This was done once using a wheelchair and once walking; all participants were ambulatory.

The results showed that participants' ability to determine their starting position was roughly the same in both conditions. Self-report measures also showed minimal differences - people who didn't habitually use wheelchairs found using them in VR did not impact their comfort, confusion, presence, or understanding. Biometric measures of cognitive load found no significant differences between walking and wheeling.

These findings suggest that wheelchair-based interfaces can be created that rival or exceed the current standard of 1:1 walking for VR locomotion. This is significant because millions of dollars have been spent on creating walking interfaces, all based on the assumption that 1:1 walking is the best way to use VR. However, 1:1 walking has many challenges, including safety, affordability, practicality, and accessibility; we should consider investing in 1:1 wheelchair-based interfaces that could yield large returns with far fewer technological challenges.

[Watch Wheelchair Based Navigation in VR](#)



Justin Berry
Yale Center
for Immersive
Technologies in
Pediatrics



StoryTrails: The People's Metaverse

StoryTrails, a project led by Prof. Angela Chan, aimed to bring stories from underrepresented groups to audiences through local libraries in 15 cities and towns across the UK. The stories were told through 15 guided augmented reality trails, 8 virtual reality experiences, and immersive cinema experiences using archival content, LiDAR scanning, and 3D animations.

The StoryFutures team adopted an inclusive design approach, considering accessibility from recruitment through to production and delivery, and focusing on the stories of marginalized peoples. The project aimed to create a playbook for accessibility, as there is no single standard for live XR experiences, and showcase the challenges of taking XR out of the lab and into the hands of over 80,000 people.

The project brought together thousands of local stories, 50 diverse creatives, and 15 UK locations on one platform. To reach diverse audiences, they focused on public libraries, which had higher attendance by ethnically diverse groups and disabled adults. The stories were told by diverse talents, including 19.5% disabled creators, a significant increase compared to the 3% in creative industries in the UK generally.

The project offered three types of experiences: immersive cinema, a seated VR experience, and an AR experience. The experiences featured emotional maps, focused on psychological experiences of each city; these maps were not one-to-one representations of the physical world, but a creative re-imagining of places as told through local stories. The seated VR experience offered multiple VR stories, with trained VR ambassadors to explain the activities and provide accommodations. The AR experience used archival content placed into the real world to help users step back in time.

The project faced challenges in scaling from user testing and lab planning to an audience of 80,000 people. To address these challenges, they increased the size of the info labels for better legibility, removed underlying UI elements when modal overlays were on screen, and created alternate interfaces for more complex elements. They also found that "4 minutes" of walking varied widely across different people, especially in the wake of COVID.

The project won awards for Best Use of Digital at the Museum + Heritage Awards, a Best Use of Footage on Innovative Platforms Focal Award, and was an honoree at the Webby Awards. For StoryTrails 2, they hope to use AI to help people tell their own stories.

[Watch StoryTrails: The People's Metaverse](#)



Angela Chan
*CoSTAR National Lab
/ Royal Holloway,
University of London*

Do You See What I'm Saying? – The Design of Owlchemy Labs' Subtitle System

Peter Galbraith is Senior Accessibility Engineer at Owlchemy Labs, a VR game studio known for games like Job Simulator, Vacation Simulator, and Cosmonius High. He has been working on the design of a subtitle system specifically for VR. The need for this arises from the fact that traditional subtitle systems, while effective for standard screen-based games, encounter several challenges in the immersive environment of VR.



Peter Galbraith
Owlchemy Labs

In VR, the user lacks control over where the camera is pointing and there is no dedicated screen space for subtitles. Despite these challenges, it's crucial to maintain good practices from traditional subtitles such as controlling the amount and length of lines, ensuring the text is shown for an adequate length of time, using large and readable fonts, maintaining high contrast between text and backgrounds, and identifying speakers.

In designing for VR, subtitles need to be placed within the virtual world rather than simply overlaid on the screen. Ideally, they should be placed at the depth of the speaker, making it easier for the user to switch focus between the text and the speaker, thereby reducing eye fatigue and facilitating the tracking of body language. While subtitles are usually best placed above the speaker to avoid obscuring important information, developers can use an offset to place them elsewhere if needed.

The size of the subtitles should be adjusted based on distance to maintain a constant size from the player's perspective, allowing for multiple size options. Subtitles should loosely follow the player's vision, appearing even when the user isn't looking directly at the speaker. To reduce motion sickness, the motion of the subtitles should lag slightly behind the player's vision, and they should always remain upright.

Speaker identification can be achieved using an icon or name and an arrow, and the subtitle can be slightly offset towards the speaker, snapping to the speaker when the user is looking near them. Opacity and brightness can be used to convey depth, with subtitles appearing more opaque and darker when in front of geometry, and more transparent and brighter when behind it. This gives the impression that subtitles behind other objects are shining through them, and ensures that subtitles neither obscure nor are obscured.

Other considerations include providing more traditional subtitles for spectators and offering a range of options for VR subtitles, such as follow speed/strength, snapping range, vertical offset, and opacity when occluded. It's important to use sensible defaults to make the experience comfortable and accessible for as many users as possible; as VR is still in its early days, every game or app has the potential to be someone's first experience, and a negative experience could deter them from VR for good.

[Watch Do You See What I'm Saying?](#)

Virtual Steps: The Experience of Walking for a Lifelong Wheelchair User in Virtual Reality

Atieh Taheri, a PhD candidate at the University of California, Santa Barbara, conducted a participatory design study to explore the experience of virtual walking for individuals who have never walked due to congenital motor disabilities. Taheri, who has spinal muscular atrophy, aimed to understand how virtual walking experiences differ for those without experience in real-world walking. Her research method was focused on user-centered design, iterating nine times with Taheri herself as the participant.



Atieh Taheri
UC Santa Barbara

The initial VR system featured a basic walking simulation, including hills and obstacles to enhance engagement, and a voice-based interface. Parameters were adjusted for each iteration, including voice commands, head oscillation, sound effects, and animation. Iterative design led to improvements such as better voice recognition, introduction of a virtual avatar, auditory feedback for footsteps, adjustable walking speeds, and adjustable head oscillation. The final system allowed for a fully customizable walking experience.

Taheri used a diary method to capture her emotions and perceptions for each iteration. Data analysis included a trajectory analysis, thematic analysis, and sentiment analysis. The trajectory analysis focused on the time spent in each iteration. The thematic analysis studied the diary entries, coding the entries by emotional affect and theme. Sentiment analysis examined the quantitative shift in sentiment scores over the nine iterations.

The analysis revealed key themes, including the importance of aligning the VR experience with the user's mental model of walking, providing customization options, and managing emotional complexities. Taheri's experiences ranged from excitement and nervousness to a strong feeling of truly walking herself up a slope. She also noted the importance of control, expressing satisfaction with being able to control her walking pace.

However, her findings are based on a single participant, limiting generalization. To validate and extend the findings, a broader range of participants with different mobility impairments would be necessary. To further enrich the VR walking experience, additional sensory feedback mechanisms could be explored.

The study emphasizes the need for inclusive design practices and discusses how VR experiences can be designed to be emotionally engaging and accessible. It underscores the importance of personalizing VR experiences for those with congenital motor impairments and aligning VR parameters with users' mental models to enhance walking simulations. Taheri's work proves that VR holds huge promise for enhancing the life experiences of those with physical disabilities.

[Watch Virtual Steps](#)

Accessibility as a Guide for Equity and Sustainability in Virtual Conferences

Andrea Stevenson Won, professor and director of the Virtual Embodiment Lab at Cornell University, leads research on how mediated experiences change people's perceptions, especially in immersive media. In this plenary session, she discusses the benefits that conferences held in virtual reality might have over in-person conferences and remote video conferencing.



Andrea Stevenson Won
Cornell University

Virtual reality conferences have the opportunity to be more equitable, accessible, and sustainable than real-world conferences. Typically, in-person conference attendees might face inequities such as visa or citizenship restrictions, inaccessible physical spaces, travel demands, financial restraints, intense time requirements and social demands. On the other end of the spectrum, attendees of remote video conferencing may face issues with online self-representation, time zone differences, distractions and lack of immersion, technology constraints, and tiered attendance at hybrid conferences where remote attendees are often siloed. Virtual reality conferences have the opportunity to provide more synergistic interactions compared to video conferencing, but attendees need to have more agency in media choice to overcome restraints of the physical world.

Accessibility is a major strength of virtual conferences. People with caregiving responsibilities, people who have difficulty traveling to attend conferences, and people who find it otherwise challenging to leave their homes can attend online or remote conferences. To give virtual attendees the best conference experiences, organizers must ensure platform flexibility, temporal flexibility, and social flexibility. Platform flexibility is the idea that one may connect to the conference from multiple devices using multiple modalities, with the ability to select their level of immersion. For temporal flexibility, it is paramount that people can access and interact with content at their own pace, allowing them to conserve their energy. With social flexibility, attendees should be able to customize their avatars and render or represent social cues through different means. Through these three axes of flexibility, virtual conference attendees can be empowered to make connections they might not otherwise be able to.

[Watch Accessibility as a Guide for Equity & Sustainability in Virtual Conferences](#)



Learnings from Co-Designing Products with People with Disabilities

Co-design is an inclusive approach to product development which invites external stakeholders to participate as equal collaborators in design, moving them from “user as subject” to “user as partner”. By having external participants make design decisions alongside product teams, the co-design method can drive innovation, help uncover unknown biases, build relationships with community partners, add credibility to products, and minimize societal risks. In this talk, Nicol Perez, Meta Reality Lab’s Product Equity & Accessibility Programs Lead, and Erin Leary, Meta Reality Lab’s Product Accessibility Program Manager, discussed the do’s and don’ts of Meta’s co-design practices from idea generation to product launch.

Before the co-design even begins, product teams should identify core co-design questions based on an understanding of community needs and pain points. There should be a clearly defined scope for the co-design in order to keep designs actionable and focused. Co-designers should be sought who would use the product daily, not just community leaders. Product teams should share the topic in advance along with relevant research, reports, and news articles, and do as much research as possible into the needs of the users in order to both provide them with an accessible experience and to allow in-depth collaboration. Finally, product teams may want to consider a third party to run the co-design, as participants may be hesitant to share negative feedback directly with the product team.

During the co-design, product teams should be actively engaged in the design process, not on computers or taking notes. When setting an agenda, trust-building exercises should be prioritized as the first activity. Instead of assuming all participants have the same context, relevant context should be provided on product, constraints, and research. External co-designers should feel empowered to share what they know. Product teams should discuss impact and feasibility of ideas alongside co-designers, but should also leave ample time for prototyping and testing these ideas. Additionally, facilitators must ensure that everyone has the chance to speak and share their ideas, while also encouraging people to build on each other’s ideas. Regardless of perceived feasibility, participant ideas should not be shut down. Ideas should be properly documented with photos of prototypes and explanations of design decisions.

Finally, all findings should be synthesized prior to the product team debrief. At this point, there should be a structured conversation focused on impact and feasibility for the top findings. Product teams should not leave the co-design room until clear action for next steps has been identified and assigned to product teams and co-design leads.

[Watch Learnings from Co-Designing](#)



Nicol Perez
Meta Reality Labs



Erin Leary
Meta Reality Labs

A Machine-Learning-Powered Visual Tour Guide for Attentional Disorders

Hong Nguyen, a graduate student at The New School NYC, has been working on a 'bottom-up' approach to guide attention in Extended Reality (XR), specifically for individuals with attentional disorders. This approach is an alternative to the existing 'top-down' methods that rely on designers' theories about how attention should be directed. The new approach identifies a desired outcome, such as enjoying a virtual environment, and trains an algorithm on the attention patterns of users who achieve that outcome. This algorithm is then used to guide new users' attention in a similar manner to produce the desired result. In two validation studies, it was found that observers' enjoyment of a display significantly increased when they were guided towards regions that were attended by past participants who liked the display.



Hong Nguyen
The New School NYC

The research also discussed the potential of XR and Virtual Reality (VR) in the context of spatial memory, given that human memory systems evolved in a spatial context and humans learn information better spatially. However, they noted that this solution might not work for people with developmental navigation deficits, people with damage to medial and parietal brain areas, and the elderly.

Nguyen further explored the concept of 'attentional transplant', a procedure where inducing one person to attend similarly to another person can cause them to like images similarly. In a study, participants saw a moving window showing parts of an image beneath and had to rate how aesthetically pleasing they found the image overall to be, based on the moving window they were given. Using the most aesthetically pleasing attention patterns, participants in a follow-up study were able to have a more accurate prediction of what they would see next in the viewing. The researchers also mentioned the possibility of transplanting attention in 3D environments by attracting the gaze vector forward.

The researchers identified students, gamers, and individuals with attentional disorders as potential target populations for attentional transplants. This research provides a new perspective on guiding attention in XR and has potential implications for improving user experience and learning outcomes.

Video of this talk withdrawn at speaker's request.





Breakout Sessions

Our Breakout Sessions offered an opportunity for all of the experts and experienced members of our community to come together and brainstorm solutions to the greatest problems in XR accessibility. Each breakout session was a one-hour group discussion, moderated by experienced leaders, to talk about the challenges facing us with regards to XR accessibility and how we can best solve them. There was one set of breakout sessions on each day, running in parallel; attendees could choose two sessions total to attend.

[Full breakout session information](#)

A1 Cognitive Overload

Moderator: Yuning Gao, New York University

Cognitive overload results when the brain receives too much information or simultaneous tasks at once, leading to a difficulty in processing all that information. Simultaneous sensory, interactive, and textual images in VR can significantly increase cognitive load in users. So how can we manage multimedia elements to create a smooth VR experience?

Participants discussed simplifying and reducing visual information by utilizing noninvasive alerts and haptic feedback instead. Additionally, sensory cues can be helpful in defining spatial boundaries and enhancing depth perception. However, it is necessary to create multiple customization options to accommodate individual preferences, as people may have different requirements or accommodations. For example, offering various locomotion options and interaction capabilities can cater to diverse user needs. Current AI technologies could be used to help users automatically adjust their settings, so as to not ironically increase cognitive load while in the process of trying to reduce it.



A2 Sign Language & XR

Moderators: Lorna Quandt & Abraham Glasser, Gallaudet University

Millions of people around the world communicate using sign language. Yet, sign language technology still remains within its infancy stage due to lack of comprehensive, robust datasets. Many companies and groups interested in this technology aim to create a dataset with complete sign language recognition, but collecting this data can be difficult and very time consuming. To address the current paucity of data, it might be better to incrementally add to smaller, pre-existing datasets instead.

Current AI and computer vision technologies need improvement in recognizing hands. While there is very little signing in the current state of the metaverse, it is possible to sign in select social VR experiences — albeit with limited capturing of intricacies, quality of hand depictions, and facial expressions. While newer models of VR headsets can more effectively capture hand movements in higher resolution, they still require users to keep their hands within a bounded field of view. There are multiple ongoing challenges to building a genAI-powered signer, but the technology is presently being worked on.

A3 Immersive Healthcare

Moderators: Peirce Clark, XR Association; Jeanne Li, Unity Technologies

There are multiple use cases for VR in healthcare, including exposure therapy for mental health interventions; medical imaging, diagnostics, and tumor identification using AR projections for radiology; VR assistance in surgeries; and training for both practitioner and patient education.

However, new technologies can be intimidating for people, especially elderly patients who may be less technologically literate. VR treatments have yet to be personalized as well. When designing healthcare products, there are multiple parameters to consider, including age group, health conditions, and severity. Introducing VR to the healthcare system can also pose unique challenges, as wifi or technology issues may lead to disruptions in the processes for real-time situations such as surgeries. Despite these challenges, extended reality remains an important and unique avenue to explore in offering equitable access to healthcare.



A4 Productizing | Creating Scalable Solutions

Moderators: Tomer Joshua, Cornell Tech; David Begun, Beshi Tech

What strategies can we employ to prioritize accessibility in industry settings and bring novel accessibility products to market? Companies can employ customer discovery methods by asking customers about their wants and pain points in order to avoid biases. To better represent users with disabilities, companies should talk not only to users with disabilities, but also advocacy groups to uncover broader market statistics. Even if a product is not perfect, it might still be good enough as a solution to a user's problems.

While stakeholders may be convinced that there is lower return on investment for accessibility, there is also a "cost of inaccessibility" to consider. Accessibility raises the rate of employee retention, which is the most valuable resource a company can have. Time and time again, accessible products with universal design have also proven to be useful not just for people with disabilities, but also for people without disabilities. As such, accessibility isn't just the right thing to do, but can ultimately prove profitable for companies.

B1 Harnessing Community

Moderators: Dylan Fox, XR Access; Thomas Logan, Equal Entry

When we have people who care about accessibility—but do this important work as a project of passion after work hours—how can we enable them to help move the cause forward and effect change? Rather than requesting community members to labor and create content for us, we can tap into their networks instead. Who in their communities could benefit from our help? What information or research have they heard about that we might be interested in?

In addition to trying to create passion for accessibility in people that we know, we can reach out to people with pre-existing passions and harness their energy. Additionally, more user research could be done within communities to understand changing and developing needs. Coworking sessions can be powerful tools to check in with community members and review content as a group. We might also explore conducting meetings in VR. And if things in VR aren't accessible from the outset, we can hack it until it is and report our solutions to our larger community.



B2 Blind AR

Moderator: Sean Dougherty, LightHouse for the Blind

VR is very visual in nature, which can pose accessibility challenges for blind and low vision users. There is a lack of audio cues and descriptions, applications typically rely on complex interfaces, and UI remains inconsistent and unstandardized. Many design considerations also have to be taken into account to optimize for screenreader technologies, magnification tools, and other accessibility features.

Despite such challenges, there are many benefits of XR technologies for blind and low vision users, including (but not limited to): navigation assistance, indoor wayfinding, optical character recognition, facial recognition, visual descriptions, and conveying contextual information.

B3 Universal User Data

Moderator: Gregory Welch, University of Central Florida

It's important for datasets to include data from diverse groups of participants. However, how can we make sure that researchers accessing these inclusive datasets do not discard participant data that appear to be outliers?

Proposed solutions include transforming participant data from people with disabilities to statistically appear more like surrounding participant data for less consequential data points. However, creators of inclusive datasets cannot account for the specific interests that outside researchers might have when accessing those datasets, so there is only so much that normalizing certain data points might be able to achieve. Researchers therefore need to consider how to examine this feedback loop and bridge the gap between how research data is collected and how research data is used.



B4 Co-Design

Moderators: Nicol Perez & Erin Leary, Meta Reality Labs

Co-design is an inclusive approach to product design which invites external stakeholders with diverse experiences and expertises as equal collaborators. In the context of co-designing with people with disabilities, how can we ensure equitable practices that lead to tangible solutions?

Historically, people with disabilities have been expected to freely provide labor and expertise. In a co-design session, product teams must be properly trained in trust-building to shift the balance of power in the room in favor of the co-design participants, so that people with disabilities have equal decision-making power in decision decisions. Fair compensation should be provided on three axes: monetary payments, transparency, and results.

For the XR space, the co-design procedure should be optimized for the product team to make real-time changes. Co-design participants may have expertise in their field, but not in the co-design process, making it paramount for them to receive and comment on immediate feedback.

Compared to one-on-one research methods, co-design allows participants to bounce ideas off one another. In a group setting, participants may also feel less pressure about monolithically representing their disability. However, product teams must also be conscientious that some participants may feel less comfortable speaking in group settings and that groups may influence each other. Procedures must be put in place to moderate discussions, and product teams must also be co-creating with the participants, rather than simply "observing" the conversation.

Demos & Posters



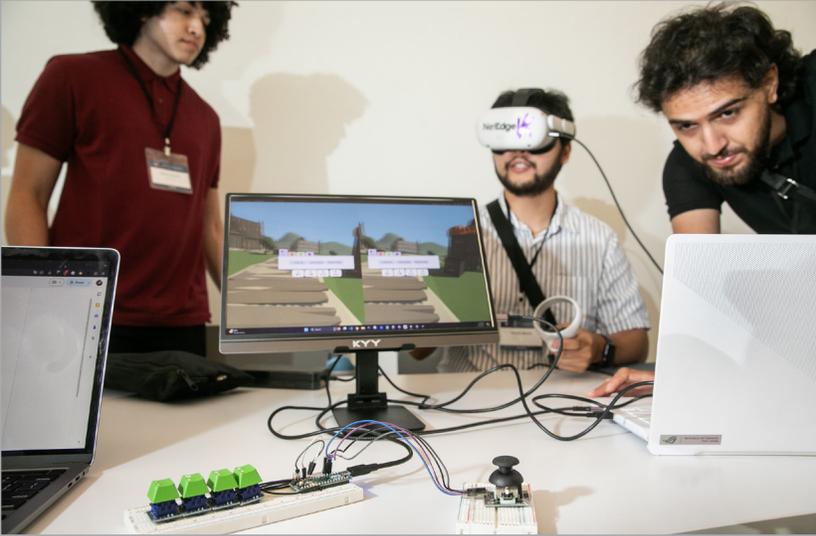
Full Exhibit List

Our app demonstrations and poster sessions gave the Symposium audience a look at the latest and greatest in XR accessibility research and projects. [Select posters can be found here.](#)

1. "Making XR More Accessible." Mike Chaves
2. "Virtual Reality, Cyberspace, and Embodiment: A Historical Debate with Contemporary Resonance." Emmie Hine
3. "Recovery Reimagined: Making VR Accessible to People in Recovery from Addiction and Mental Illness." Kaitlin Yeomans
4. "InclusiveVR@Work - Inclusive Collaborative Environments for Workers with and without Visual Impairments Using Virtual Reality." Julia Anken
5. "Making Avatar Gaze Accessible for Blind and Low Vision People in Virtual Reality: Preliminary Insights." Jazmin Collins
6. "Preliminary Insights for Supporting People with ADHD or Autism Who Experience Frequent Social Challenges in Social VR." Jazmin Collins
7. "Ergonomic Hand Motion Assistance and AR Rehabilitation Bridging the Gap in Tremor Disorder Therapies through DEI-focused Mixed Reality." Jeanne Li
8. "AR application design for HCWs." Jonathan Segal
9. "Live Captions in Virtual Reality (VR)." Abraham Glasser
10. "Towards the Guidelines for More Accessible and Inclusive Virtual Reality, Augmented Reality and the Metaverse." Vanja Garaj
11. "Identity, advocacy, or accommodation?: Self-representation of chronic pain conditions through social VR avatars." Ria Gualano - **Best Poster**
12. "Opportunities for Accessible Virtual Reality Design for Immersive Musical Performances for Blind and Low-Vision People." Khang Dang
13. "Using AR to augment labeling and validation of street-level accessibility information." Harish Lingam
14. "Dobble Debate XR." Lynne Heller
15. "Using VR in a Japanese Convenience Store with Object Descriptions." Thomas Logan
16. "ASL Champ!: Learning ASL in VR with AI-powered feedback." Lorna Quandt, Shahinur Alam - **Best Demo (tie)**
17. "Bring the hidden story to virtual space - the Virtual Reality Museum of Banjo." Yuning Gao
18. "Developing an AI-Powered Prototype for a Sighted Guide in VR." Jazmin Collins
19. "IT'S AN IDEA (Inclusion, Diversity, Equity and Accessibility)." Jim McEwen
20. "Enhancing Art Accessibility for Low Vision Audiences through Spatial Audio in Virtual Reality Environments." Wei Wu, Binyan Michelle Wu - **Best Demo (tie)**
21. "Meta Accessibility Showcase." Nicol Perez
22. "Unseen Sound." Andy Slater
23. "Multimodal AI Visual Guide prototype." Ricardo Gonzalez
24. "AR-based Tools that Support Visual Access." Sean Dougherty
25. "VERA Locomotion Accessibility Toolkit." Parsa Baghaie, Corey Clements, Josh Federman, Adam Lei, Cristian Merino, Oliver Wacker

Clockwise from top:

- “ASL Champ!: Learning ASL in VR with AI-powered feedback.” Lorna Quandt, Shahinur Alam
- “Dobble Debate XR.” Lynne Heller, Nina Czegledy, Ted Carrick, Jananda Lima
- Symposium attendees enjoy the demo floor.
- “VERA Locomotion Accessibility Toolkit.” Oliver Wacker et al



Clockwise from top:

- “Enhancing Accessibility Among the Visually Impaired Using Computer Vision and Soundscapes.” Sala et al
- “It’s an IDEA (Inclusion, Diversity, Equity, and Accessibility).” Jim McEwen
- “Ray-Ban Meta Smart Glasses.” Meta
- “Unseen Sound.” Andy Slater, Sammie Veeler



Towards a More Accessible Future



XR Access

Key Takeaways

The 2024 Symposium played host to a wide variety of lessons and learnings, rooted in both theory and real lived experience. There's no shortage of great content for those willing to dive into each talk and breakout, but here are some of the key takeaways from the Symposium as a whole.

Lived Experience is Vital

We must never forget the core rule of accessibility: nothing about us, without us. Presentations such as XR Access Stories: Why Access Matters, Unseen Sound, Learnings from Co-Designing, and Virtual Steps hammered home the importance of including the lived experience of people with disabilities in every project. From Slater's soundscapes to Taheri's voice-driven locomotion, disabled XR creators can innovate in ways never before seen; and the insights from disabled users can propel products to new heights of usability for disabled and nondisabled people alike.



Best Practices Keep Evolving

XR is still a new field, and every application gives us a chance to learn new things about how to best practice accessibility. From learning about Owlchemy's fine-tuned subtitles to understanding the challenges of rolling StoryTrails' XR experiences out to tens of thousands of people, we can advance as a community by learning from each other's experiences about bridging the gap between theory and practice.

New Solutions for New Problems

While XR has rapidly grown to utilize many types of inputs and tools, such as gaze, voice, and even brain-computer interfaces, we are still far from the end of invention. At this year's Symposium, we saw sEMG enable a handless man to control a game with an invisible pinch, and learned even more about how blind people can combine their experience with AI-powered machine vision to master their environment. We must constantly be on the lookout for how new technologies can be developed and repurposed for accessibility.



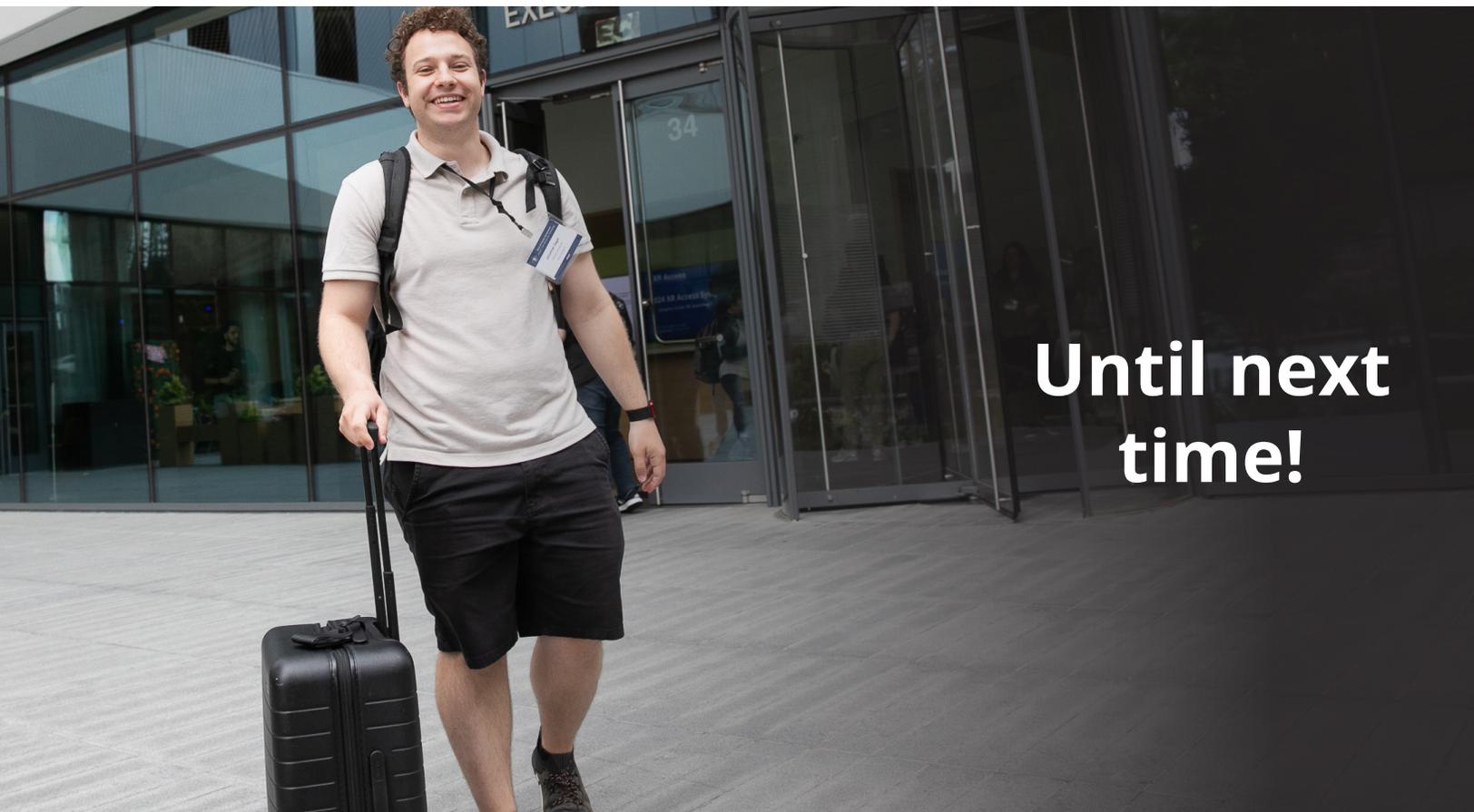
Looking Ahead

We're proud to have once again brought together experts from around the world for the 2024 Symposium. Science and advocacy both work best when people that care can come together to share their passion and experience, and the Symposium remains a vital mixing pot for a wide variety of researchers, creators, advocates, and more.

XR Access will keep pushing on all fronts to create inclusive and accessible XR technology. Our own research at Cornell on low vision and neurodiversity accessibility continues unabated, and this year we intend to shine new light on other cutting edge science via our [Research Network](#). We've also cofounded an Accessibility in the Metaverse group with the [Metaverse Standards Forum](#) to ensure that standards for XR exist and can be used to help organizations ensure accessibility within their applications, and hold those who disregard accessibility accountable. We continue to advise on projects like the Virtual Experience Research Accelerator, FCC Disability Advisory Committee on Blind Gaming, Meta accessibility co-designs, and anyone else who requests guidance on making their XR applications inclusive.

Of course, we can't do what we do without resources and funding. We have some excellent sponsorship opportunities for next year's symposium lined up for future-minded organizations, and if you would like to support or collaborate with XR Access, don't hesitate to reach out to us at info@xraccess.org.

A huge thank you to all of the chairs, volunteers, sponsors, and attendees who made the 2024 Symposium possible. If you want to join XR Access and help secure a more equitable and accessible future, make sure to visit our [website](#), sign up for our [newsletter](#), and join our community on [Slack](#). Here's to an even better Symposium in 2025!



**Until next
time!**