

# Topics on Augmented Reality/ Extended Reality for Metaverse

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# Introduction to XRAccess



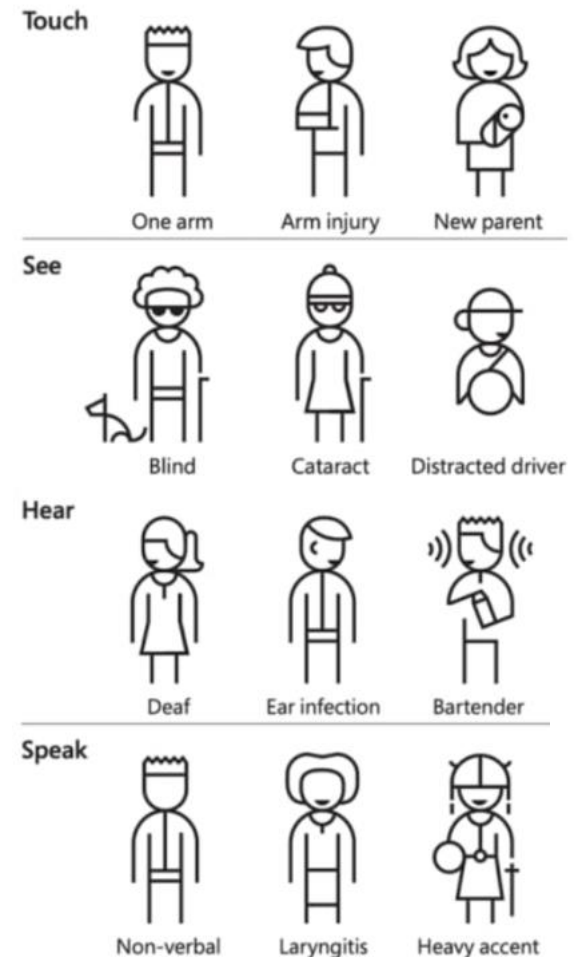
# Importance of Inclusivity and Accessibility

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- ✓ Inclusive designs often produce more adaptable and flexible technologies
  - Design for an “average” user can lead to designs that are inflexible and constraining for all
- ✓ Ensure equal opportunity employment and advancement
- ✓ Follow all disability and accessibility laws and regulations

# Ensure All Users Benefit from XR

- ✓ Create inclusive and ergonomic designs
  - Consider the differences many users may have in their abilities to experience XR system
- ✓ Permanent disabilities
  - Vision and hearing loss, mental, cognitive, and intellectual disabilities, or physical disabilities
- ✓ Temporary or situational limitations
  - Broken or sprained limb, muscle soreness, ...



# Inclusive Design

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- ✓ The most effective way to ensure that all users can easily navigate XR environments
  - Including users with disabilities
- ✓ Go beyond simply making technology accessible to people with disabilities
- ✓ Aim to create a universal XR experience that integrates tools that all users can enjoy

# Immersive Environment Challenges

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- ✓ Include the use of highly complex input devices and control schemes that require
  - A high degree of precision, timing, and simultaneous action
  - Ability to distinguish subtle differences in busy visual and audio information
- ✓ Must juggle multiple complex goals and objectives
- ✓ Need a high level of usability for someone with a disability using assistive technology

# Accessibility

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- ✓ Accessibility can be thought of as supporting multi-modal requirements and the **transformation** of content or aspects of a user interface from one mode to another that will support various user needs

# Best Practices for Inclusive Design

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- ✓ Provide comparable experience for all users
- ✓ Give users control of their experience
  - Provide with various options for how to complete tasks and/or how to alter their XR environment to fit their needs or desires
- ✓ Solicit and incorporate the input of people with disabilities
  - The development and the testing phases of the platform and/or application designs



# General Accessibility



- ✓ Accessibility in XR requires the creation of a flexible environment
  - Users can control the way they experience a platform or application
- ✓ Removing or reducing background details and audio
  - May have difficulty discerning the most important experience options or tasks amidst rich background visuals
  - Background audio could be confusing or disorienting
- ✓ Undo/redo functions
  - All people make mistakes when using XR platforms and apps
  - Especially helpful to improve the experience for users with disabilities

# General Accessibility

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## ✓Reducing speed and setting up action sequences

- Users may have difficulty quickly and accurately reacting while experiencing XR
- Helpful to allow users to reduce the speed of the app or to increase the time allotted for making decisions or completing challenges

## ✓Save progress

- Unexpected real-world interruptions, difficulty completing tasks in the app
- Users may not want to repeat experiences challenging for them to complete in the first instance

# General Accessibility

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## ✓Bypass functions

- XR experiences, including physical or reflex challenges, complex puzzles, or other decision-making tasks, put pressure on users
- A bypass function would permit users to skip challenging or timed experiences while still allowing them to progress in the app
- Reduce the difficulty of challenging tasks

## ✓Customize their experience and choose the information that best suits their needs

# Visual Accessibility

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- ✓ 1.2 billion people globally may have vision impairment or blindness (World Health Organization)
- ✓ Types of vision loss or low vision affecting the user's XR experience
  - Blurred vision
  - Loss of peripheral vision
  - Light sensitivity
  - Monocular vision (loss of vision in one eye)
  - Blind spots
  - Color blindness
  - ...

# Visual Accessibility: Possible Problems

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- ✓Text overlaid onto an image, object, or other element in an XR app may be difficult to read
- ✓Rich visual backgrounds may make it difficult for users to discern the most important information being communicated in the app
- ✓For those with reduced peripheral vision, objects, text, or other essential elements that are outside the user's central field of vision may go unnoticed

# Visual Accessibility

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- ✓ Altering the size of objects, elements, and text
  - Allow users to control the visual elements in an app, aiding low-vision users in completing tasks and/or enhancing their experience
  - Magnify or reduce objects and text to make them larger or smaller
  - Change fonts for more easily readable text
  - Add contrasts or edge enhancements to highlight objects and text
  - Change foreground or background colors of text
  - Change the brightness levels in the app
  - Employ peripheral maps to show objects outside of the field of vision

# Visual Accessibility

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## ✓ Audio augmentation and text-to-speech

- Audio augmentation is an essential feature for users with vision loss
  - Add labels to objects and elements to assist in identifying them
- Text-to-speech (TTS) may work especially well to ensure that users who otherwise cannot read text instructions, labels, or other written elements
- Use optical character recognition to extract texts in images to aid low-vision users

# Visual Accessibility

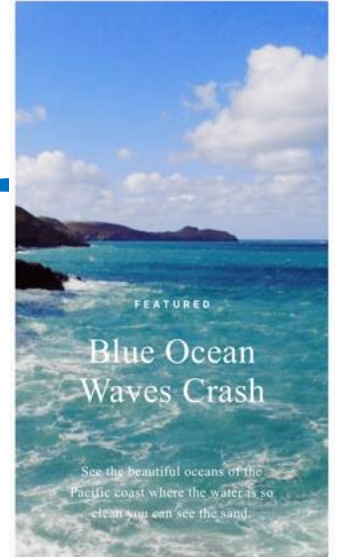
## ✓ Color filters and symbols

- Allow users to recolor the interface and objects, provide shapes or symbols alongside meaningful colors, or provide textures on objects or elements to help distinguish information
- Help users comprehend information in the experience communicated by color

## ✓ Scrim or scrim-like overlays

- A scrim is a translucent gradient layer that aids in making text more readable against background pictures, colors, objects, and other elements
- Not introduce color gradients that may make the text unreadable by users with vision loss

✗ Don't



✓ Do





# Deaf and Hard of Hearing

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- ✓ Auditory disabilities occur in 5% of people worldwide (WHO)
- ✓ Should provide multiple ways for users to understand and control audio features of XR platforms and apps

# Deaf and Hard of Hearing

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## ✓ Captioning audio features

- The most common ways to make XR accessible to users with deaf or hard of hearing
- Ensure the captions are readable given the dynamism of XR technology
- Allow users to move them to ensure other visual aspects of the app are observable
- Allow users to change the font as well as the colors of captions and their background to make them easier to read
- For more than one speaker, the captions should clearly indicate or label which speaker is talking
- Developing 3D captioning for XR poses an added challenge, given the difficulty in predicting where a user may look or turn at any given moment

# Deaf and Hard of Hearing

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## ✓Using icons to identify audio features

- Use icons or other indicators to identify for users how they should move their heads or reorient their focus
- Use icons or captions to indicate background sounds or other non-speech indicators
- Should ensure specifying the source or direction from which the sound is coming

## ✓Sign language

- Allow users to control the placement of the sign language interpretation in the app

# Deaf and Hard of Hearing

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## ✓ Mono audio

- Users with hearing loss in only one ear may not be able to hear everything in a stereo recording, particularly when using headphones
- Allow users to switch from stereo to mono audio so both stereo channels can be heard in either ear
- Mono audio will no longer contain information on the directionality of an audio source, so the directionality will need to be communicated using other methods (e.g., icons)

# Mobility Disabilities

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- ✓ Affect a person's ability to walk, stand, move comfortably, use their hands and arms to grip, hold, lift, and interact with objects (2017)
- ✓ One of the most difficult barriers to using virtual reality programs

# Mobility Disabilities

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## ✓ Settings and menu options

- Allow users to access the experience from a seated, reclining, or stationary position
- Allow users to slow down various aspects of an app (e.g., cursors, camera movements)
- Allow users to automate some actions to reduce the number of physical actions they must make within an app
- Allow users to map several actions to a single controller button
- Allow remapping of controls onto alternate controllers, sensors, or keyboards

# Mobility Disabilities

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## ✓Dynamic foveated rendering and eye tracking

- Incorporating eye tracking and dynamic foveated rendering features to improve the performance of the hardware as well as the user's experience
- Foveated rendering reduces the image quality in a user's peripheral vision while providing clear and detailed images at the eye's focal point
- Dynamic foveated rendering uses eye tracking to move the user's field of vision as the user's eye move
- Eye tracking and foveated rendering features help users with significant mobility disabilities (E.g., paralysis, severe tremors)

# Mobility Disabilities

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## ✓Dynamic foveated rendering and eye tracking

- Interface navigation
- Input selection
- Automatic scrolling
- Aim assistance
- Object selection



# Cognitive Disabilities

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- ✓ Cognitive and intellectual disabilities encompass a broad spectrum of conditions

# Cognitive Disabilities

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## ✓ Save settings and preferences for future use

- Provide information to users about where they are in the virtual space, what they can or should do next, what their current progress in the app is
- Allow the users to receive assistance in orienting themselves in the experience or to receive more context about their progression
- Provide training opportunities to experiment with the interface and control configurations
- Allow to review the objectives of challenges or tasks that must be completed
- Allow to hide distracting or non-critical interface components to ensure focusing on the most essential information
- Allow to reduce the number of controls to limit the number of things they must do to complete any objectives accurately

# Cognitive Disabilities

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## ✓Explore world options

- Make feel more comfortable taking an active part in the experience and help to understand and experiment with the interface and the environment before using it
- Allow familiarizing with the app and its various interfaces and input needs

ACCESSIBILITY TECHNIQUES	Sight Disabilities	Auditory Disabilities	Non-Speaking/ Speech Impairments	Mobility Disabilities	Cognitive Disabilities
Removing or Reducing Background Details and Audio	•	•			•
Undo/Redo Functions	•	•		•	•
Reducing Speed and Setting Up Action Sequences	•			•	•
Bypass Functions	•	•		•	•
Save Progress	•	•		•	•
Altering the Size of Objects, Elements and Text	•			•	•
Audio Augmentation and Text-to-Speech	•		•		•
Color Filters and Symbols	•				•
Scrim or Scrim-Like Overlays	•	•			•
Captioning Audio Features		•			•
Using Icons to Identify Audio Features		•			•
Sign Language		•	•		
Mono Audio		•			
Settings and Menu Options	•	•		•	•
Dynamic Foveated Rendering and Eye Tracking				•	
Controller-Free Hand-Tracking		•	•	•	
Explore World Options	•			•	•



<https://youtu.be/izmKY17CDhg?si=-trt7OIVrmAdRqzf> (0:31)

# Q/A

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