Immersive Design

Uncontrollable Background

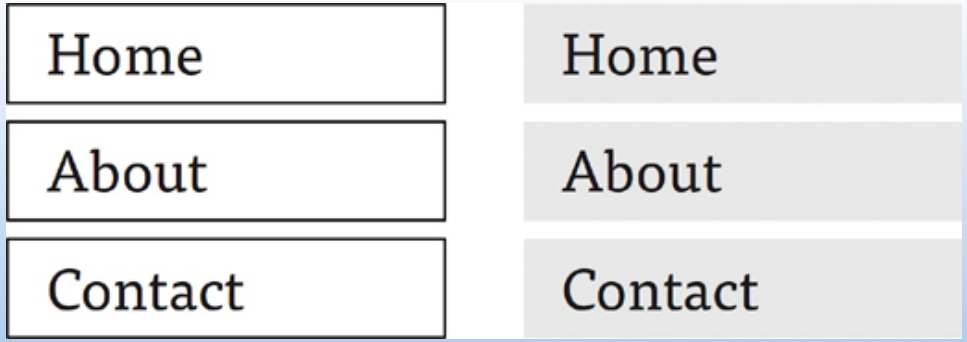
- XR environments
  - Many things beyond the designer's control
    - Especially true for AR
    - Indoor vs outdoor
    - Lighting and background conditions may vary significantly from moment to moment
  - Can predict certain components
    - Guidelines to help adapt to unpredict things
    - Define the relationship between figure and ground to help perceive each element
    - Location and placement of objects
      - Best view allows for the most impact

Uncontrollable Background

- Blending
  - ➢ Blending mode
    - The method of combining layers in an image-editing application
    - Determines how a specific object or layer will react to any objects or layers underneath it
    - Depending on the mode
      - Relationship between the foreground and background layers will change
    - Allowing users to view layers behind, less obstruction
      - Especially with limited FoV

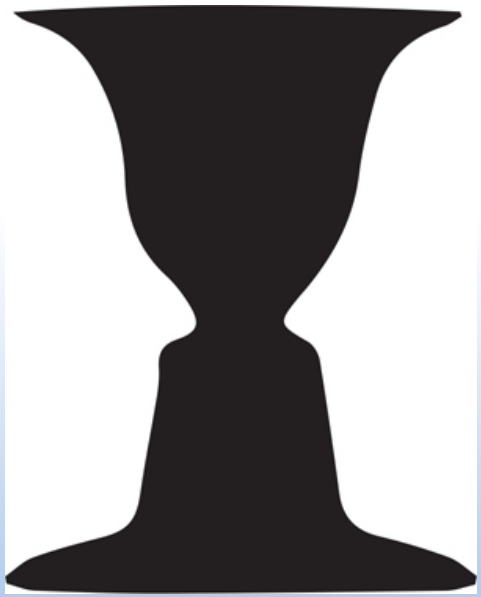
Uncontrollable Background

- Figure-ground
  - ➢ Visual relationship in which elements are perceived as either foreground or background
    - One element will fade to the back, another will stand out in front
  - ➢ Can be stable or unstable
    - For example
      - Left, unstable: outlines and text at the same visual level makes distinction between figure and ground ambiguous
      - Right, stable: clear that grey rectangles are the background



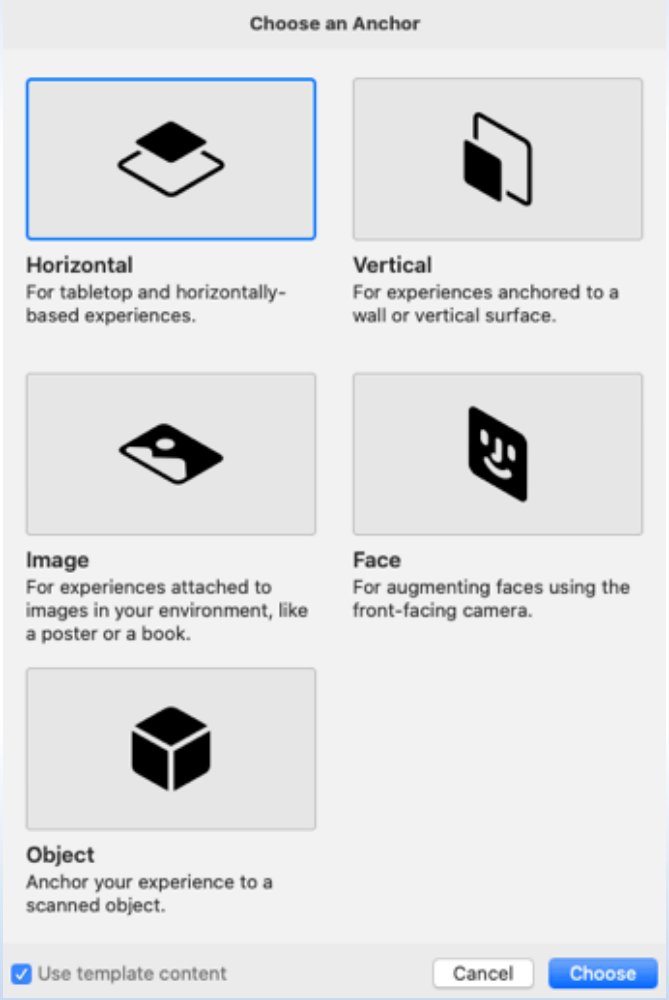
Uncontrollable Background

- Stable
  - No confusion between the main focus in foreground and what falls back to background
  - Consistent, roles do not switch
  - When a user can differentiate the main element, e.g., UI element
    - Minimises confusion and can focus more clearly
- Unstable
  - Relationship between figure and ground ambiguous
  - Roles can reverse
  - Useful for communicating more than one message
    - E.g., in logo and branding design



Uncontrollable Background

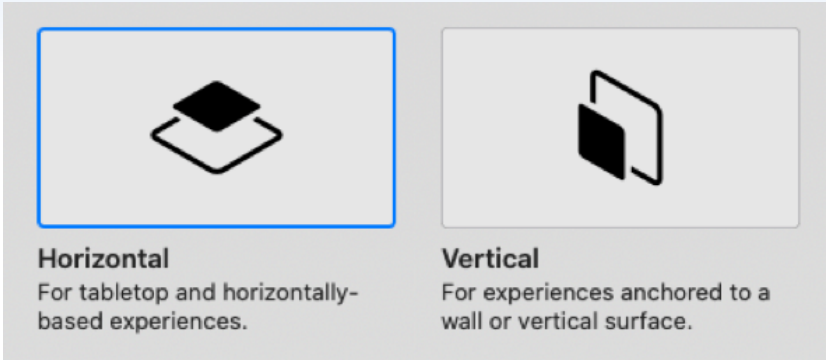
- Anchors
  - A good way to connect 3D objects (figure) to the environment (ground)
  - Particularly relevant to AR
    - Recognise something in the real world and build experience around it
    - Need to know where to place content
    - Anchors trigger the experience
    - Related to real world detection and tracking

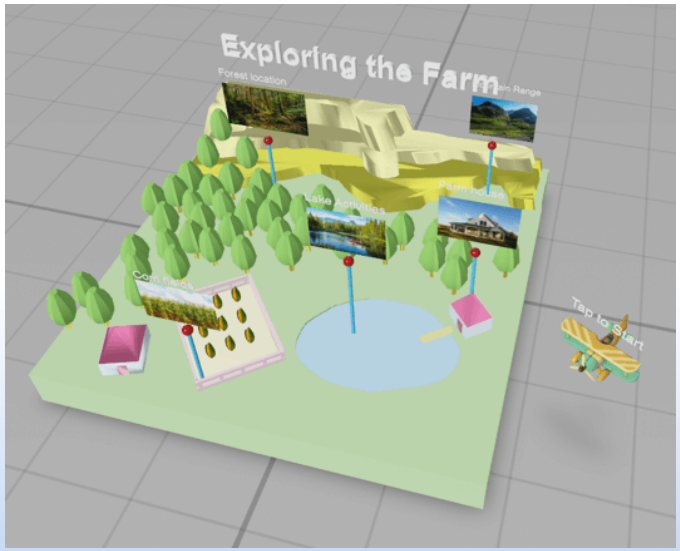


https://www.learningguild.com/articles/understanding-anchors-in-augmented-reality-experiences/

Uncontrollable Background

- Anchor types
  - Plane anchors
    - Flat surface, either vertical or horizontal
      - » E.g., floor, table, walls
  - Face anchors
    - Use camera to scan facial features
    - Build experience around the face

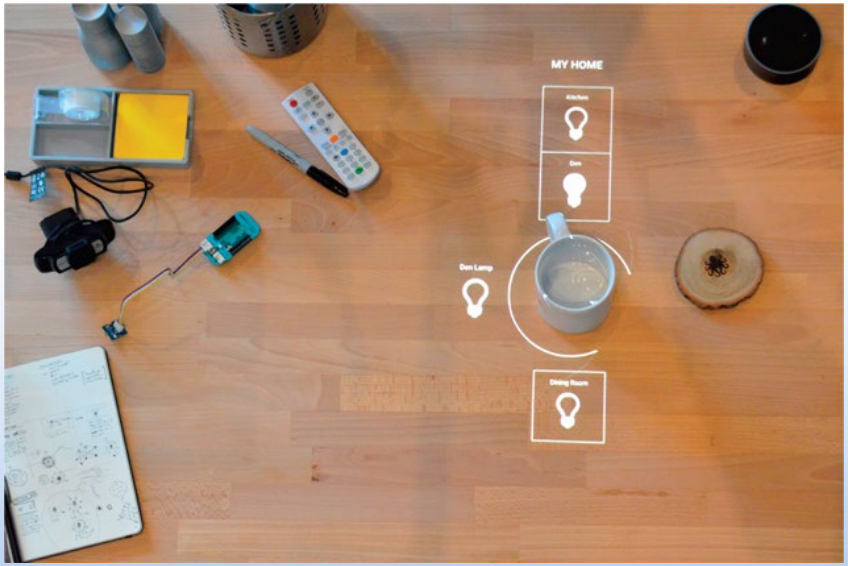




https://www.learningguild.com/articles/understanding-anchors-in-augmented-reality-experiences/
https://developers.google.com/ar/develop/augmented-faces

Uncontrollable Background

- Image anchors
  - Capture a static image
  - AR marker
- 3D anchors
  - Use a 3D object as an anchor
  - May need to scan a physical object



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XR Typography

- Typography
  - The art and technique of arranging text to be legible, readable and appealing when displayed
    - Typeface, point size, line-spacing (leading), letter-spacing (tracking), space between pairs of letters (kerning)
  - Legibility
    - The ease with which a reader can decode symbols
  - Readable
    - The ease with which a reader can understand a written text

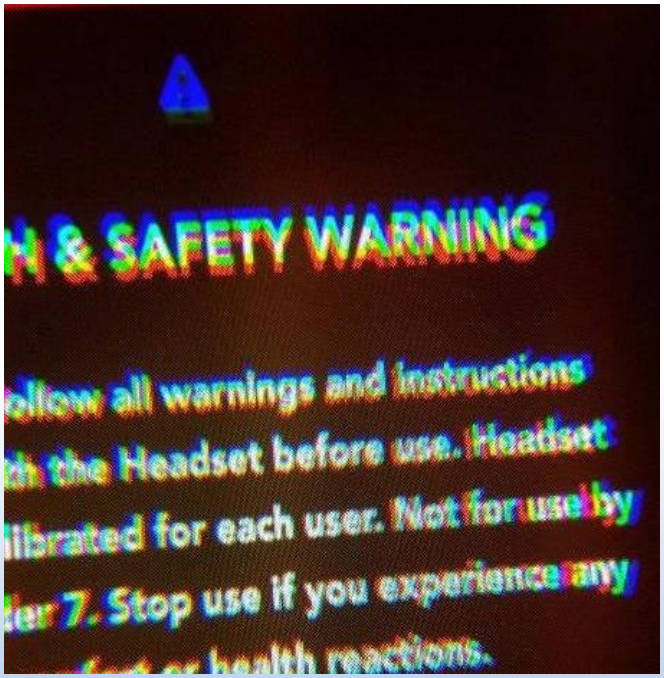
GearedBull at English Wikipedia, Public domain, via Wikimedia Commons

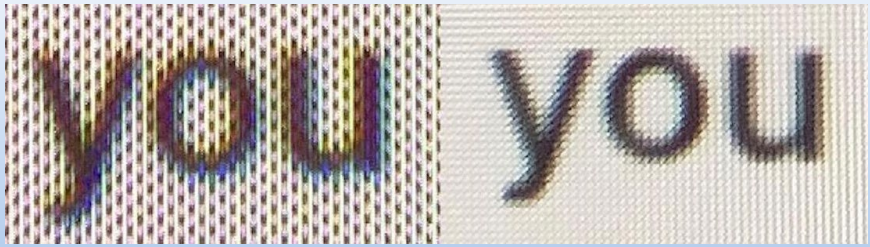
XR Typography

- Legibility and readability
  - Many different types of displays
  - Challenging to present text on a variety of screens
  - Typefaces have been designed to improve user experience
  - Displays evolve, so does type design

XR Typography

- Example aberrations
  - ➢ Halation
    - Spreading of light beyond proper boundaries
  - ➢ Chromatic aberrations
    - Inability of a lens to focus all colours at the same place
  - ➢ Screen doors effect
    - Visible fine lines between pixels, like looking out of a screen door





https://xr-typography.niteeshyadav.com/reading-experience/technical-aspects/aberrations

XR Typography

- Type anatomy
  - ➢ Terminology
    - Understanding anatomical features will help in making informed decisions for a better reading experience in XR

https://xr-typography.niteeshyadav.com/basic-concepts/type-anatomy

XR Typography

- Legibility and readability
  - ➢ Legibility
    - A measure of how easy it is to distinguish one letter from another in a particular typeface
    - Primarily the concern of the typeface designer
      - Ensure that each individual character or glyph is unambiguous and distinguishable from all others in the font
    - Also about choosing the right typeface at the right size

https://xr-typography.niteeshyadav.com/basic-concepts/readability-vs-legibility

XR Typography

- Legibility and readability
  - ➢ Readability
    - The spacing and arrangement of characters and words to make the content flow together to aid in reading it
    - How easy it is to read words, phrases, or blocks
    - Depends on style, spacing, font weight, length of text, etc.
    - Legibility also plays a crucial role in making text readable

There now is your insular city of the Manhattoes, belted round by wharves as Indian isles by coral reefs—commerce surrounds it with her surf. Right and left, the streets take you waterward. Its extreme downtown is the battery, where that noble mole is washed by waves, and cooled by breezes, which a few hours previous were out of sight of land. Look at the crowds of water-gazers there.

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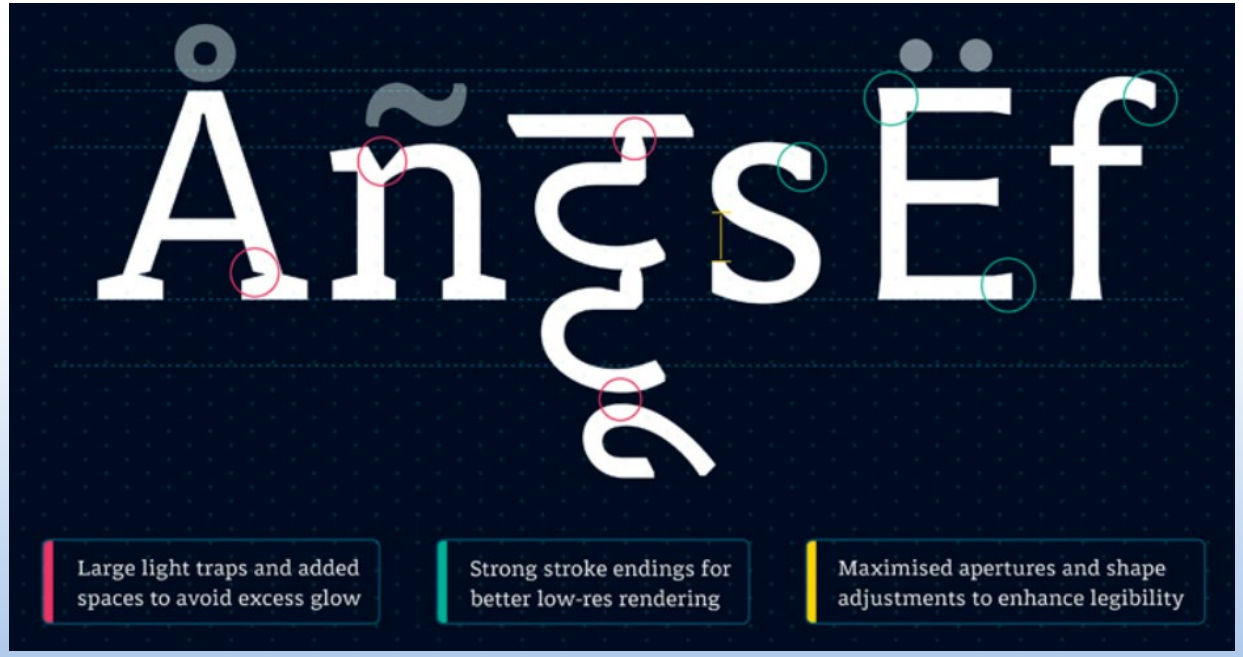
https://xr-typography.niteeshyadav.com/basic-concepts/readability-vs-legibility

XR Typography

- Types made for XR
  - ARone
    - AR typeface designed to provide a quality reading experience across a variety of AR devices
    - Includes multiple weights that work from lo-res to hi-res headsets



XR Typography

- Types made for XR
  - ➢ Many dominant XR companies launch their own typefaces
  - ➢ LominoUI by Magic Leap
    - Generous spacing to allow for increased legibility at small sizes
    - Soft curves and smooth connection are inviting

https://ml1-developer.magicleap.com/en-us/learn/guides/design-typography

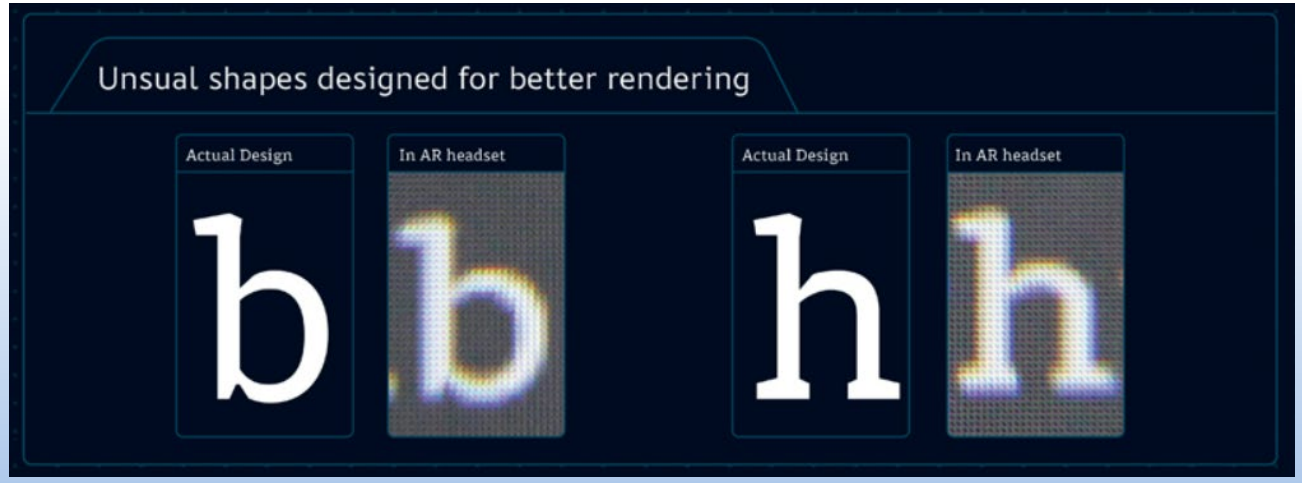
XR Typography

- Segoe UI by Microsoft for digital platforms
  - Designed to maintain optimal legibility across sizes and pixel densities. Offers clean, light and open aesthetic

https://learn.microsoft.com/en-us/windows/apps/design/style/typography

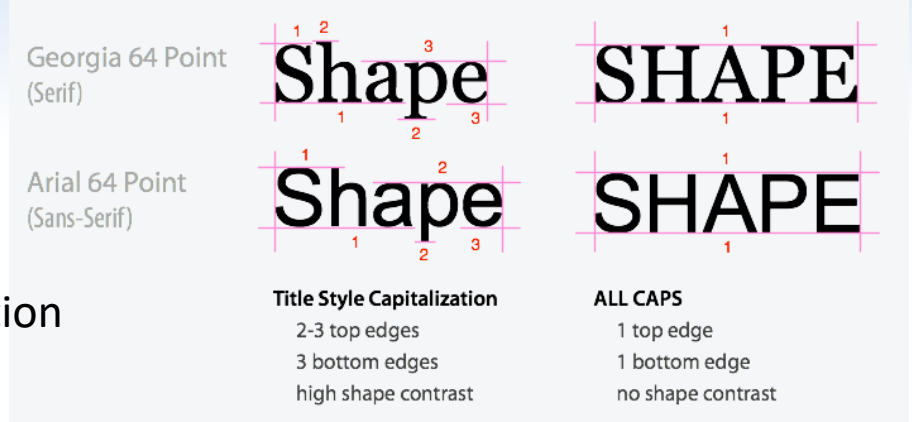
XR Typography

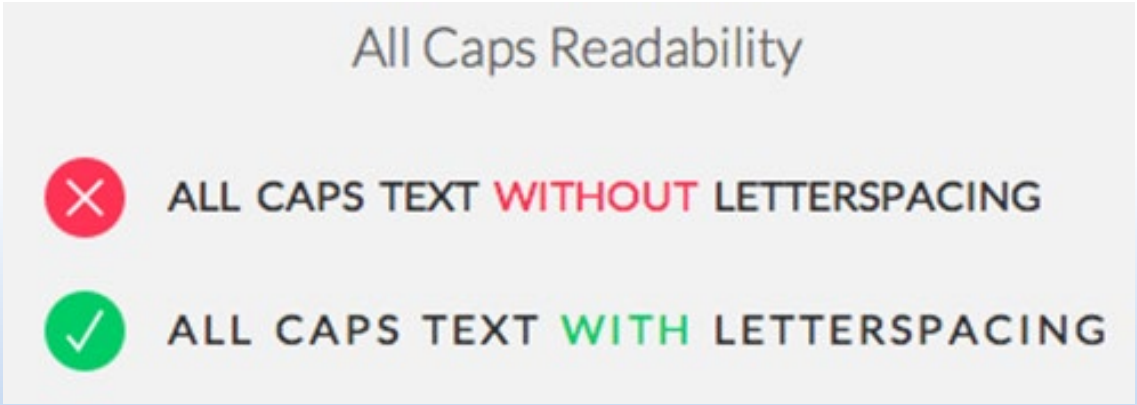
- Readability
  - Legibility connected to typeface design
  - Readability is the ease of reading the words
  - Guidelines
    - Give it space
      - Increasing overall tracking (character spacing) helps with readability
      - Avoid overlaying the halos and letters



XR Typography

- Guidelines
  - Say more with less
    - Reduce the amount of text
    - Other forms of communication
      - » Image, tooltips, audio
  - Casing
    - Uppercase is hard to read in large amounts, loses readability

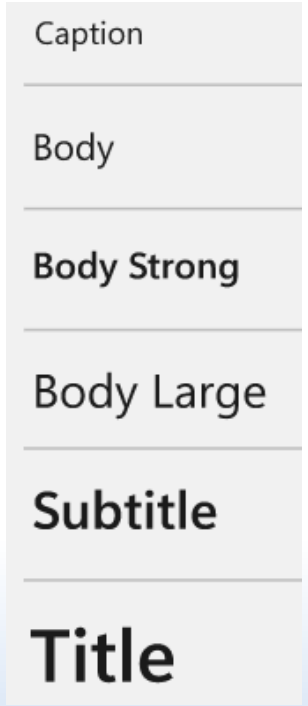




https://uxmovement.com/content/all-caps-hard-for-users-to-read/
https://uxmovement.com/content/how-letterspacing-can-make-all-caps-easier-to-read/

XR Typography

- Guidelines
  - Limit line length
    - To reduce eye strain, keep to 50 – 60 characters per line
  - Weights
    - Varying weights adds hierarchy and guides the user's eye
    - Light and extra bold weights less legible than regular, medium or bold weights
  - 2D type easier to read than 3D type
    - Extruded and volumetric types become harder to read
    - Logotypes are an exception



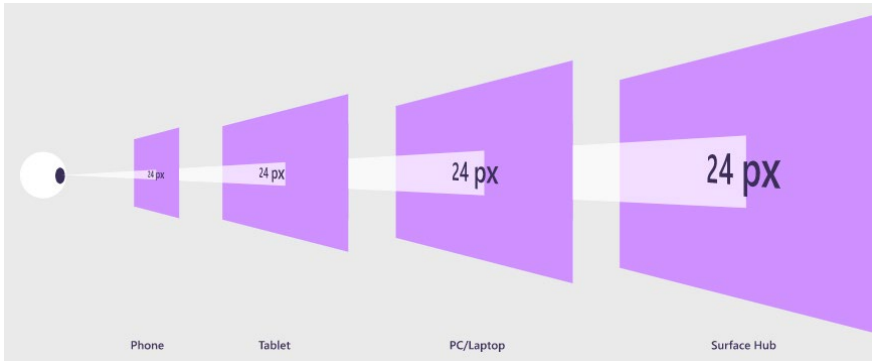
https://learn.microsoft.com/en-us/windows/apps/design/style/typography
https://wearetribu.com/2d-to-3d-graphic-design-and-3d-animation/

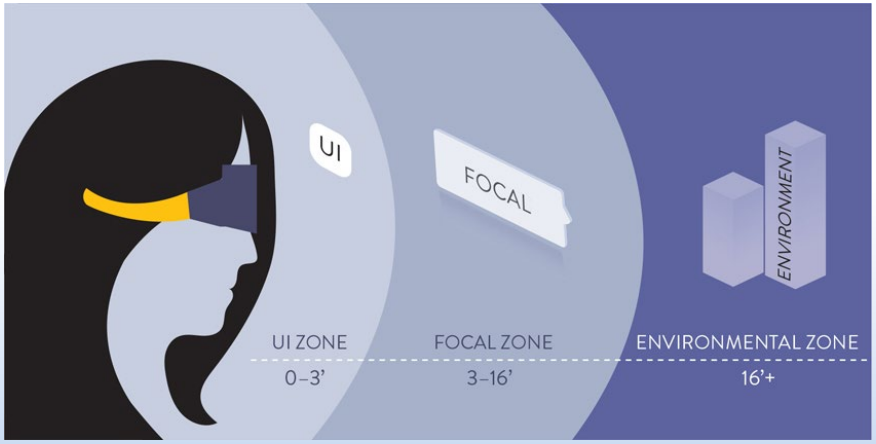
XR Typography

- Consider
  - Is the type there for a functional or stylistic purpose?
  - A type can add to the mood or tone
    - Readability may not be an essential part of the experience
  - For example
    - In a VR racing game, text on a sign may not be relevant, more important to feel like being on a real street
    - In a navigational AR experience, the readability of street names is vital

XR Typography

- Creating visual contrast
  - ➢ Viewing distance
    - Consider how close a reader can get to the type
    - Spatial zones
      - UI zone
        - » Remains in one place on the screen
      - Focal zone
        - » Ideal reading distance for essential type
      - Environmental zone
        - » Cues for the user

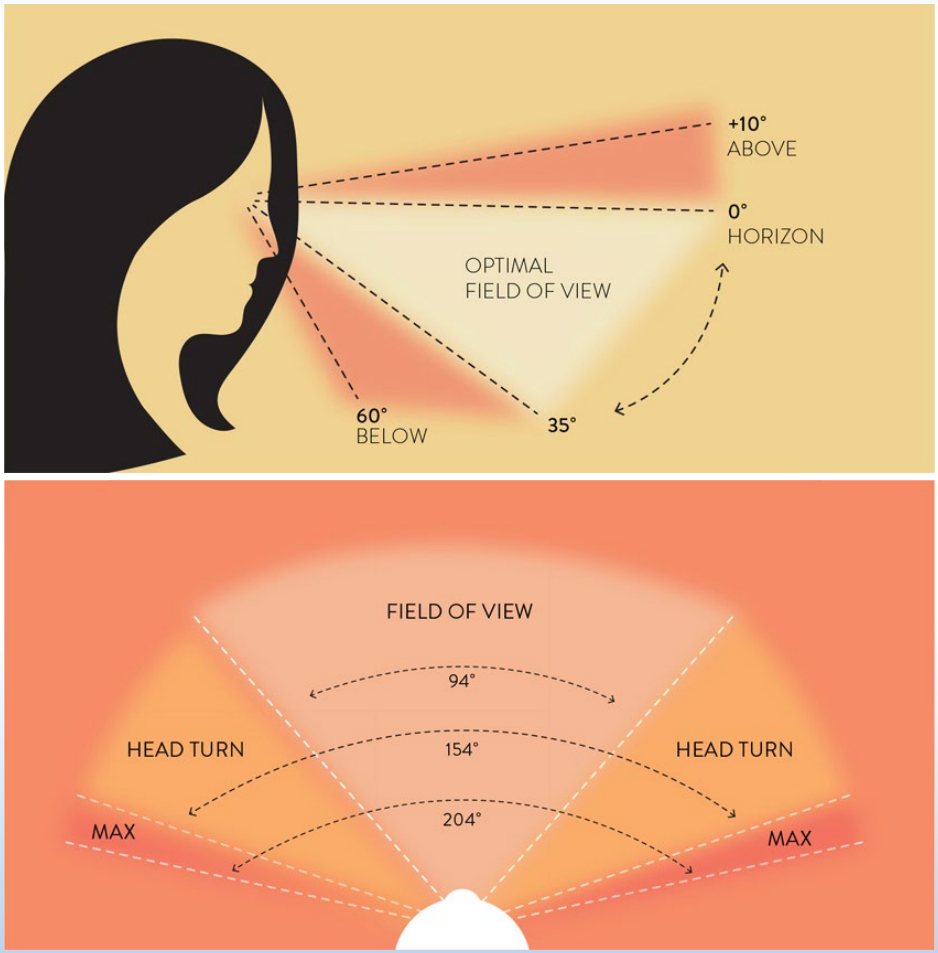




https://learn.microsoft.com/en-us/windows/apps/design/style/typography

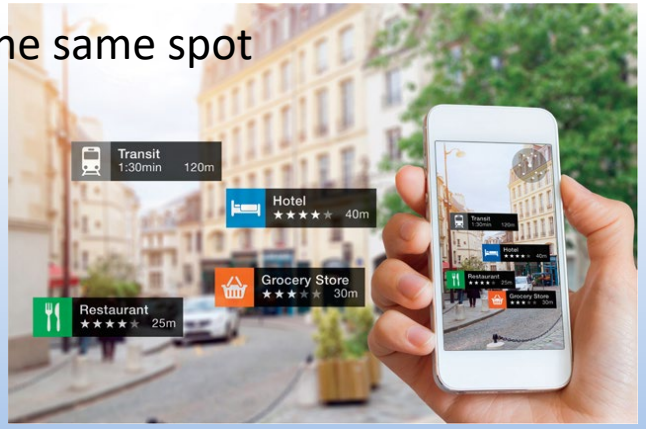
XR Typography

- Gaze
  - Up and down
    - Optimal FoV between 0° and 35°
    - Can cause neck and eye strain
  - Left and right
    - Keep type in the centre zone to avoid head turn or blurring for peripheral sight



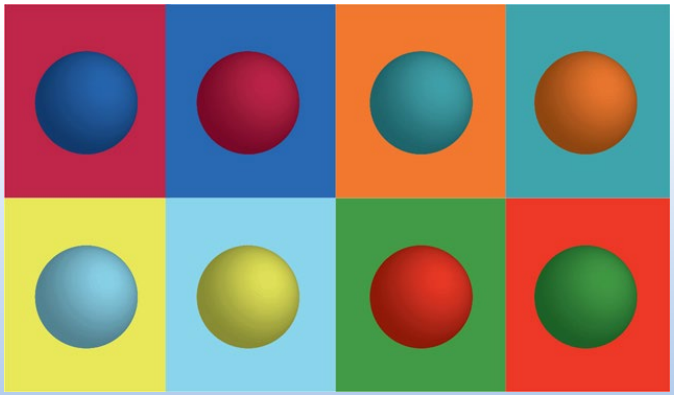
XR Typography

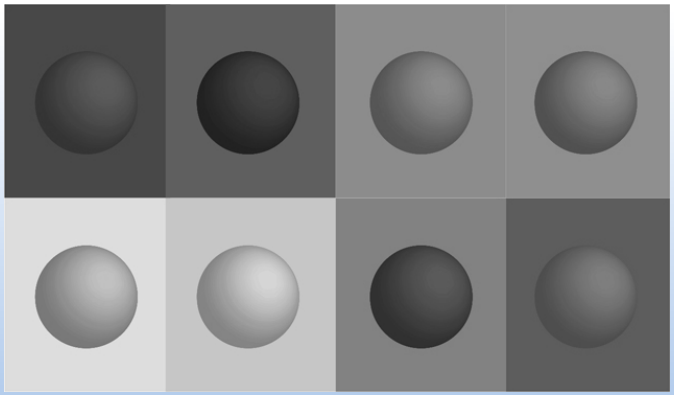
- Consider 3D experience for each type relative to spatial zones
  - UI type
    - Static in the experience, on top or bottom of the screen
    - Text critical for providing important information
  - Immersive type
    - Acts like a 3D object, but flat 2D element for readability
    - Should match the perspective of the planes where it is placed
  - Anchored type
    - When user moves, type will remain at the same spot
    - Connected to specific plane or object



Colour for XR

- Usability
  - ➢ Legibility and readability
    - Not only colour of the text but also of elements surrounding text
      - Helps separate letters from the environmental background
    - White is the most common colour for text and icons in XR
  - ➢ Contrast
    - Colours close in shade or saturation vibrate off one another
    - Select colours with visual contrast



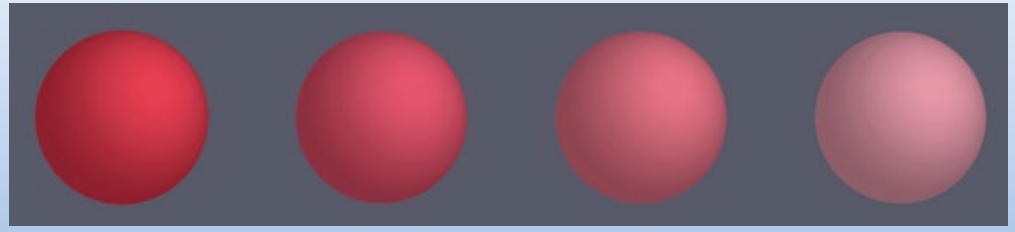


Colour for XR

- Contrast essential for keeping experience accessible
- Do not rely on colour alone as a visual indicator
  - Limiting to those who are colour blind

➢ Vibrancy

- Energy of a colour caused by increasing or decreasing the saturation of the least saturated tones
- Colour in its purest form is called chroma
  - Bright and vibrant
  - Fully saturated without addition of grey
    - » As more grey added, colours become desaturated
- Bright oranges and reds grab attention over desaturated greens or greys



Colour for XR

- Comfort
  - Colours that are too intense or create too much strain causes discomfort
  - Larger areas of colour in XR hard on the eyes
    - Especially vibrant and fully saturated colours
    - Use to attract attention, but not in large quantities
- Transparency
  - Colour will be displayed differently based on the kind of display
  - OST displays will show all elements as more transparent
  - VST displays use the camera, graphics on top of the camera view can be fully opaque

The UX of XR

- User Experience (UX) for XR
  - ➢ Approachable design
    - An XR experience is personal
      - HMD attached physically, covering eyes
      - Controls what a user sees and experiences
    - The greeting
      - First introduction
        - » Need user to feel comfortable
      - Needs to be personal and establish trust
      - No universal standards for XR yet
      - For some people, immersive VR/AR is new to them
        - » The user may not have a human guide present
        - » Orientation into a new form of reality, essential for trust

The UX of XR

- Onboard tutorial
  - » Step-by-step instructions and explanations
  - » Experience equivalent to an in-person guide
  - » Explain and show the main functions of the experience
    - Only essentials, do not overwhelm the user

The UX of XR

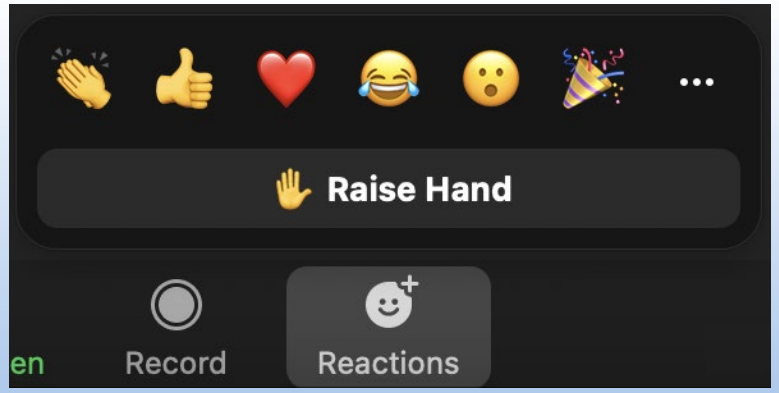
- Design positive UX experiences
  - Many components that work together in XR
  - Designer creates environment that the user can understand
    - Both diegetic and non-diegetic elements
    - *Diegetic*: the placement of an element to appear inside the virtual environment
    - *Non-diegetic*: overlaying an element on top of a virtual environment, making it clear it is not part of the environment itself
  - Design the
    - *Interaction*: the impression created by interacting with an object
    - *Context*: the situation where interaction occurs
    - *Fusion*: UX is multifaceted, combination of experiences together

The UX of XR

- Elements to consider
  - Respect the user's personal space
    - Entry point
      - » Reduce cognitive load by limiting the number of elements
      - » Avoid extremes
      - » Do not place content too close to the user
      - » Avoid fast-moving (potentially alarming) elements
  - Agency
    - The ability for a user to control or change something in an experience
    - Designing how must power and control the user has
      - » Too much and the user may be overwhelmed, distracted from the goal
      - » Too limited, the user may feel constricted

The UX of XR

  - For an educational or training experience
    - » Makes sense to limit the agency
    - » More directed experiences, same for all users
  - Games
    - » Benefit from more agency, freedom and a sense of control
- Social signifiers
  - A visual cue that carries meaning based on a social or cultural agreement
  - For example, raising a hand in a physical setting → a hand icon in a video conferencing platform



The UX of XR

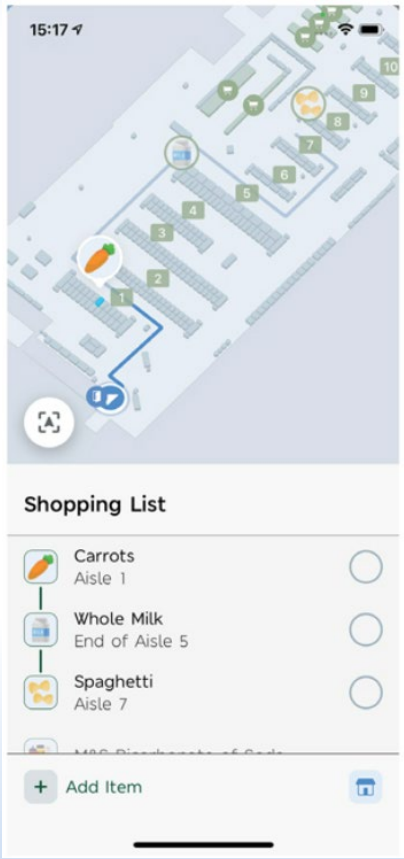
- Feedback
  - Every time the user communicates something, important to receive some type of response
  - Keep feedback natural and timely
  - User gains confidence
- Affordances
  - A property of an object that informs a user how they can interact with it to carry out an action
  - Within the first minute of an experience the user should have an understanding of
    - » Where they are and how they fit into that space
    - » Why they are there (what is their goal)
    - » How they can interact with the elements within the experience to achieve the goal (most important)

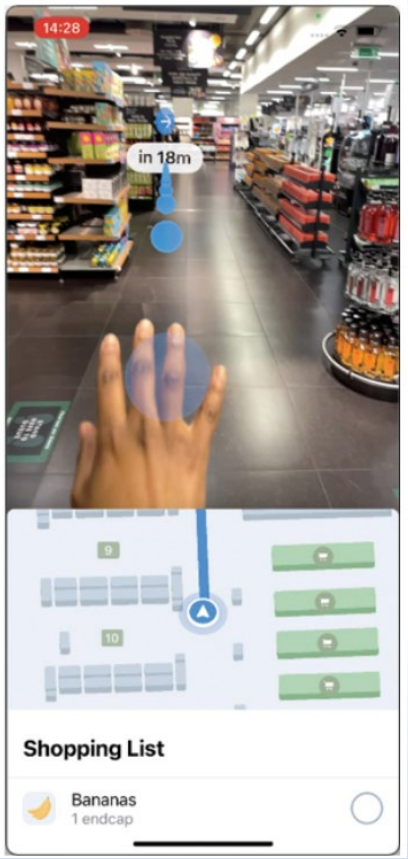
The UX of XR

- Interactions
  - Types
    - » *Direct interactions*: virtually touching an object, or physically touching an object on screen
    - » *Indirect interactions*: joystick or scrolling a mouse
    - » *Semi-direct actions*: mix of direct and indirect, e.g., world-in-miniature
  - Minimise the number of different types of interactions
    - » Easier to remember
  - More natural gestures, easier learning curve
- Safety
  - Examples
    - » Guardian boundary: establishes interaction space
    - » Avoid situations like having to walk backwards

The UX of XR

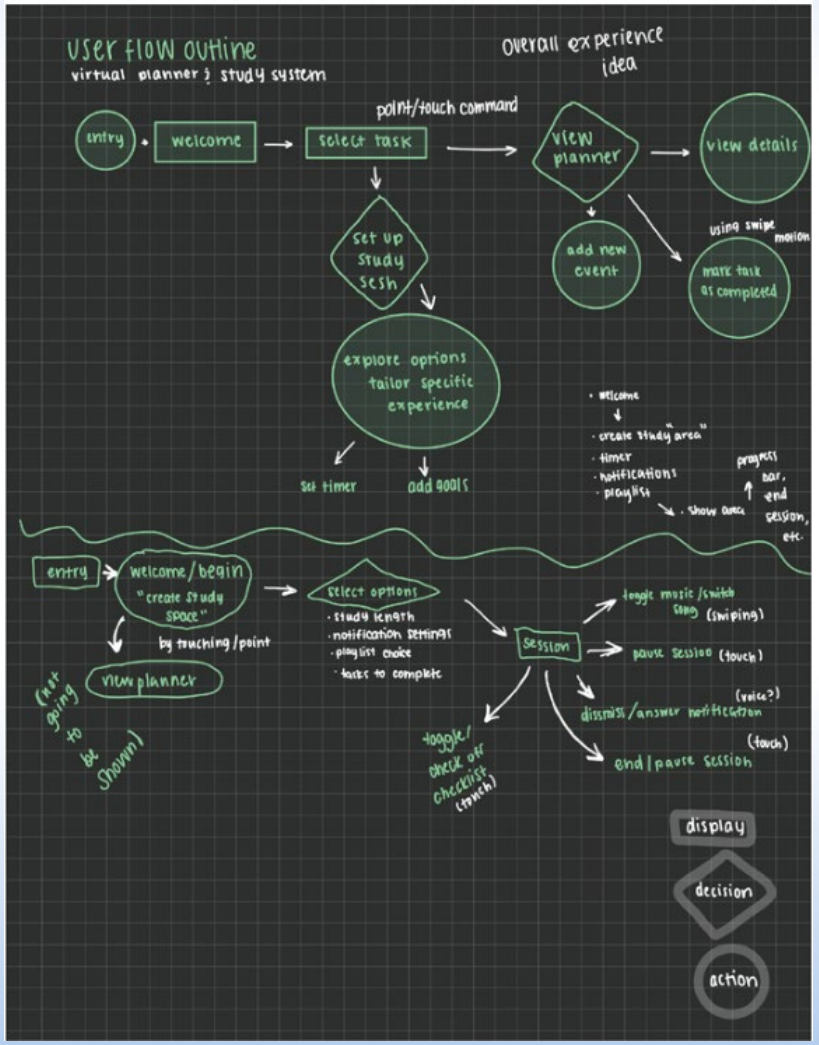
- Guides
  - Visual cues to help direct the user
    - » Visual tools that capture attention, e.g., arrows, lights, lines
  - Keeps the user orientated
- Cohesion
  - Consistent style
    - » E.g., colours, text, sound, objects





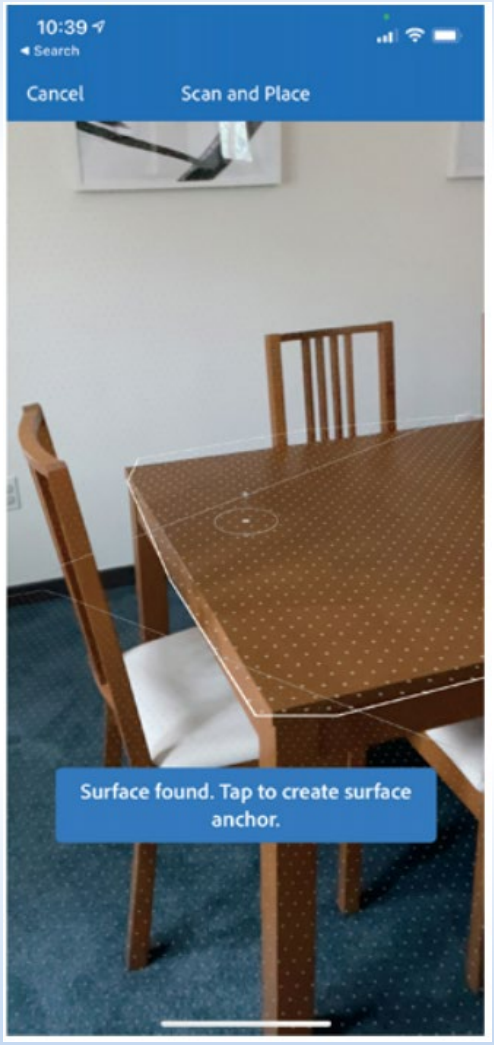
The UX of XR

- Seamless user flow
  - ➢ XR experience is a story
    - Easier and logical to break down each step into a sequence
  - ➢ User flow
    - A diagram of the step-by-step journey a user takes through an experience
    - Evaluating and highlighting the possible display, decisions, and actions along the way



The UX of XR

- A user needs to develop a mental model of the experience
  - To understand the space
  - How they relate to it
- Provide a tool tip or instruction
  - Before the user has to perform an action
  - May provide more detailed information the user can choose to view
- More complex in VR
  - Can leave one environment and enter a completely different one
  - Start the scene with a wide angle on the space



The UX of XR

- Things to consider
  - Introduce user agency
    - What can the user control or customise?
    - Balance between power and retaining control over baseline experience
      - » Designed to maintain user comfort
  - Guide the user to start interacting
    - The first step is sometimes the hardest one
  - Identify any needed transitions between spaces
    - How does the user get from one to the next?
  - Allow for mistakes
    - Mistakes without consequences
      - » E.g., undo, try again

The UX of XR

- Allow for a refresh
  - New technology may glitch or freeze
  - An option to refresh or reload may provide the user with the ability to resolve individual issues
- Provide an exit
  - Easy to find and perform
  - Helps user feel comfortable and instil trust
    - » They know they can always leave
- Provide a clear way to save the experience
  - Save/pause and resume later
  - Users will be more willing to try a different experience and return later

The UX of XR

- Questions to answer when planning user flow
  - What is the goal the user is trying to accomplish?
    - How do they learn about this goal?
  - What information is needed for the user to accomplish this goal?
    - Where is the information presented to them?
  - What pain points, or challenges, can prevent the user from achieving this goal?
    - What can help them overcome these challenges?
- Usability testing critical to get feedback and observe user behaviour
  - Needs to be part of the design process
  - Design improvements

The UX of XR

- Know the target audience
  - ➢ Develop user personas
    - User persona
      - A representation of a real user intended to represent key audience to provide a reference within the specific context of an experience
    - Audience should be part of the design process
    - To start, identify three to five diverse personas
      - Can use real data about actual people, realistic reference of a user
      - Know their needs and expectations
    - Used to plan and test user flow
      - Helps identify any needed features and functionalities
      - Walk through the experience with the personas

The UX of XR

USER PROFILE:

JASMINE

HR Practitioner | Age: 28
Location: Portland, OR

DEVICES

BIO

Most of her work has been in recruitment and selection and she now works in that field as a consultant.

She is in a partnership and has no children.

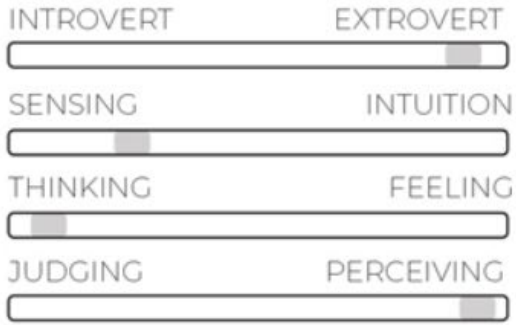
MOTIVATIONS

USER NEEDS

Quick links/access to evidence-based examples of practices that have led to more diverse appointments.

Private forum to discuss practice with fellow practitioners.

PERSONALITY



INTERNET USE

The UI of XR

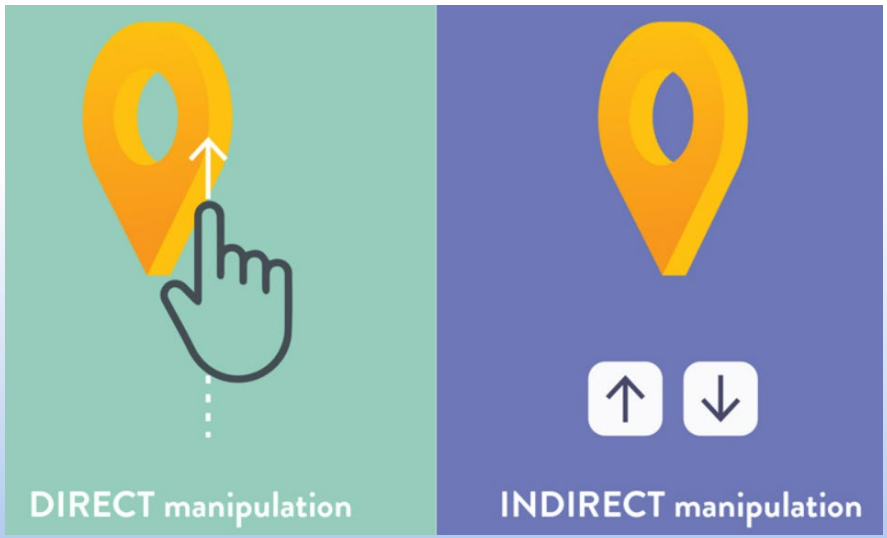
- User interface (UI) for XR
  - Many foundational elements of usability remain
    - New challenges/considerations for immersive interactions
    - Unlike traditional UI, addition of depth
  - Visual elements that make interaction a positive experience
    - Do not want to overpower the core experience
    - XR often have limited FoV
      - Avoid cluttering the view
      - Optimise available space by keeping interface elements minimal
  - UI and UX often referred to in partnership
    - UI design should reflect data and information discovered by UX research

The UI of XR

- Screen space vs world space
  - *Screen space*: defined by viewable area, reliant on screen size, position and resolution of the device
  - *World space*: 3D coordinates, defined by the environment
  - Often need both types of interface elements
    - Based on the context
      - E.g., direct or indirect interaction
- UI for XR
  - Points to keep in mind
    - Stationary screen space UI for main navigation items
      - Will not change location regardless of what else is happening
      - Avoid user feeling lost

The UI of XR

- For UI elements in world space, place them in centre third of viewing area
- Allow direction manipulation for objects wherever possible
- Design how each element will appear and disappear from view
- Place any spatial UI elements at a viewing distance far enough to avoid eye strain from vergence-accommodation conflict
  - Ideally, 1.3 to 3 meters away from user



The UI of XR

- Use solid areas of bright colour and pure white sparingly
  - Brightness can increase eye fatigue
- Avoid transitions between dark and bright scenes
- Let the user have the control to hide/show certain UI elements
- Use minimal text, only what is needed
- Use real/perceived affordances to allow users to anticipate action of an icon
  - E.g., gear icon for settings menu
- Avoid flashing and blinking elements
- Minimal use of small detailed textures and patterns
  - Unnecessary clutter

The UI of XR

- 3D interface metaphors
  - ➢ Versatile and powerful visual communication tools
  - ➢ Interface metaphor
    - Commonly understood method/language based on cultural connection that informs a user how to interact with the UI
    - Refer to an idea, object, or concept using a parallel symbol
    - Knowledge user already has
    - Same concept may be used in 3D
      - XR currently lacks accepted UI metaphors

The UI of XR

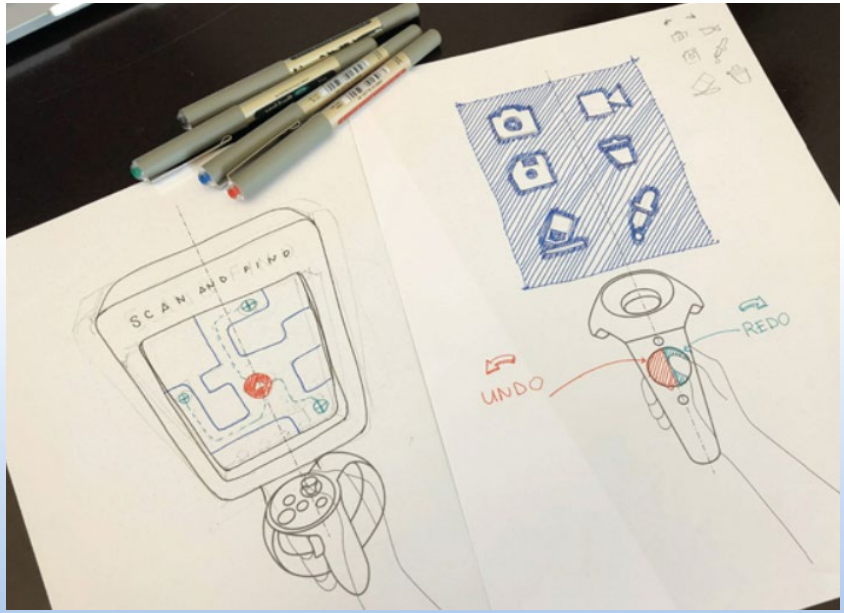
- How real should it be?
  - Balance between real versus playful
    - Metaphors are not exact replications
  - May have adverse reaction when an object does not work the way the user expects
  - Consider
    - User should be able to use their dominant hand
    - Interacting in the virtual world may not be very precise
      - » Need some form of feedback
    - Make the visual imagery less realistic
      - » User will adjust expectation
    - User research to test whether metaphors understood by users

The UI of XR

- Portal metaphor
  - Visual way to transition between spaces
    - Door, window, display screen
  - Users already understand doors serve as transition points
    - More natural transition
- In AR
  - Trigger space
    - Small screen on a mobile device
      - Challenging to be precise, especially distant objects
      - Apple suggests make space around the object its trigger space

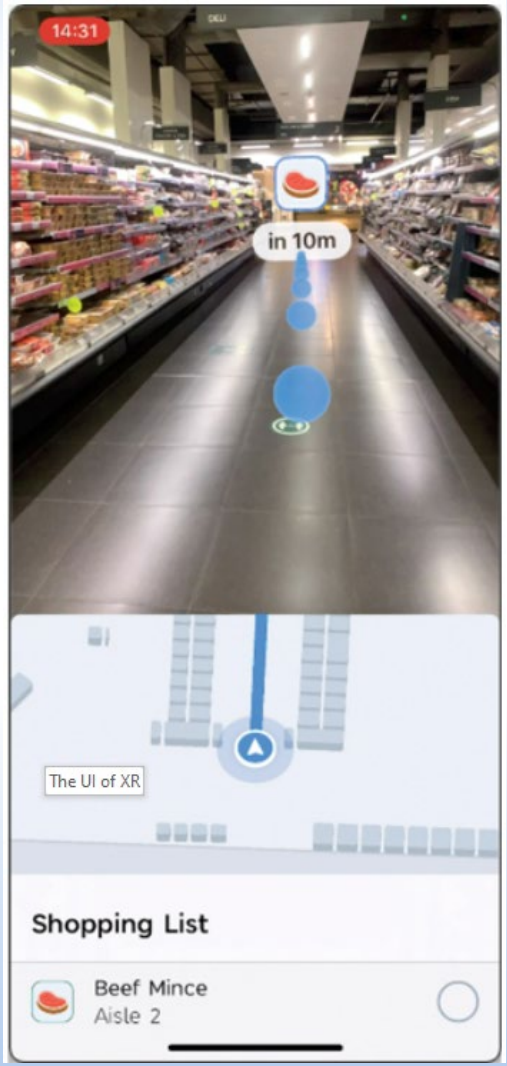
The UI of XR

- In AR, users can see their hands
- Interaction screen
  - Gestures need allowance for imprecision
  - Interaction other than gestures, e.g., tilting the device
- Hand controllers
  - More precise
  - Need to plan button mappings
- Navigation
  - Map, compass, signs, paths



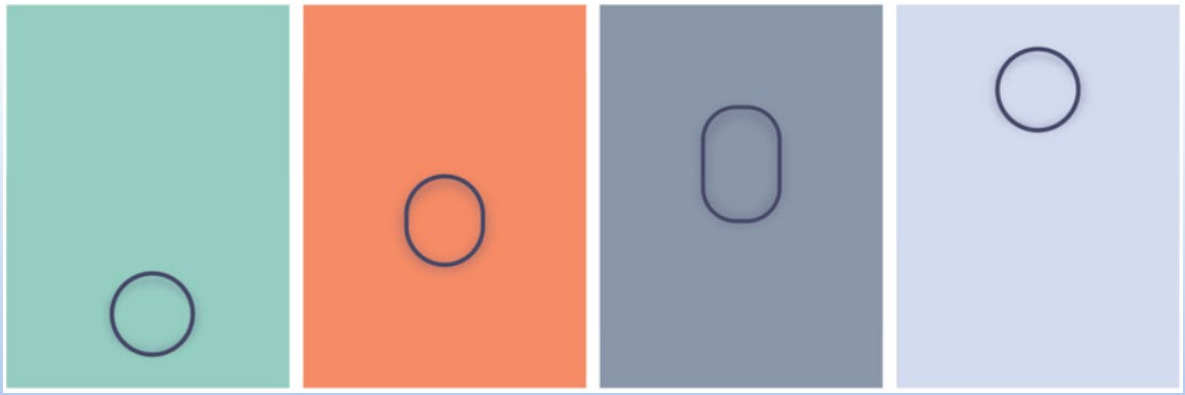
The UI of XR

- Time and space in relation to UI for XR
  - ➢ User needs will change
    - When more familiar with the application
    - Some controls only needed at the start of the experience
    - When users explore around, may need different controls
    - Only have needed UI elements for the given moment
  - ➢ *Meta UI*: Temporary or situational 2D window on top of a virtual environment
  - ➢ *Spatial UI*: Temporary or situational 3D element on top of a virtual environment



The UI of XR

- Microinteractions
  - ➢ Small and subtle details of an interaction with a product or experience
  - ➢ Show something, rather than tell
    - Powerful to see something in context to understand how it works
      - Faster and can communicate universally
      - Animation
    - Supplement with tool tips provide additional instruction



The UI of XR

- Four parts of microinteractions
  - Trigger
    - Start of the interaction
      - » Can be started by the user or automatically initiated if a condition is met
  - Rules
    - Guidelines on what can or should happen in a specific order
  - Feedback
    - Communication to the user about what is happening
    - Should be multimodal – visual, sound, touch
  - Loops and modes
    - How long interaction will last
    - Final part of microinteraction
    - Whether action repeatable

The UI of XR

- 3D objects deserve 3D microinteractions
  - Consider animations or hints to facilitate interaction
  - A 2D tool tip with written directions
    - Misses context and efficiency
  - For example, arrows around a 3D object
    - Fully visual
    - Faster, more intuitive
    - A step further, add slight rotation animation

Sound Design

- Sound localisation
  - The ability of a listener to identify the origin of a sound based on distance and direction
- Sound
  - Created through vibration of an object
  - Travels a distance
    - Through a medium, e.g., air, water
  - Sound wave reaches the eardrum
    - Will vibrate at the same rate
  - The cochlea, inside the ear, processes the sound into a format read by the brain

Sound Design

- Loudness
  - The intensity of a sound, measured in relation to the space that the sound travels
  - Unit of decibels (dB)
  - Human lowest hearing threshold 0 dB, pain threshold 120 dB
- Pitch
  - Perceived highness or lowness of sound based on the frequency of vibration
  - Changes depending on how fast an object is vibrating
  - Measured in hertz (Hz)
  - Human hearing ranges from 20 to 20,000 Hz
    - Most sensitive between 2000 and 5000 Hz

Sound Design

- Sound in XR
  - Three main ways to use sound
    - Ambient sound
      - Background noises, creates a sense of space and mood
      - Not too noticeable, but adds a sense of realism
    - Feedback sound
      - Sound when interacting with an interactive element reinforces successful activation
      - Should be consistent, so users will start to associate the sound with their actions
      - Sound cues can guide interactions
        - For example
          - Direct the user's gaze
          - Alert a user they are close to the boundary

Sound Design

- Spatial sound
  - Sound to reflect depth
  - Provides information on distance to an object

➢ Audio recordings

- *Mono*: recorded from a single microphone
- *Stereo*: recorded from two microphones spaced apart
  - Creates a sense of depth, i.e. 3D audio
  - Binaural
    - » Recording two-channel sound, mimics the human ears by placing two microphones position in opposite locations
  - Ambisonic
    - » Recording four-channel sound that captures a sphere of sound, reproduces 360^{o} sound

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