# Extended Realities

## Topics in VR & AR

**MA Creative Technologies**
**16.10.2024**

*Image: Colour Fiction*

# VR: The Basics

- (a definition:) *a means of navigating and experiencing virtual environments that maps the body's movements onto corresponding movements in the virtual world.*
- VR is therefore less a medium and more like a "diving suit" that allows the audience to dive into a new environment.
- Why is it helpful to think like this? This is what makes designing experiences for VR fundamentally different from making other 3D experiences.

# Framing the problem...

- From the point of view of traditional image-based media, VR distinguishes itself by the **lack of a frame** (or at least a frame as we know it from cinema, photography, film, theatre, video games etc.)
- This has a number of implications for designing experiences… without the ability to explicitly direct the audience's attention by framing the subject, VR experiences typically have to do away with linear narratives or else rely on tricks in order to direct attention to and/or away from the subjects of the story.

# VR Design Challenges

## *1. Narrative*

How does narrative work without a frame to direct audience attention towards particular subjects?

How to create complex and compelling narratives when scenes must (more or less) be told from the first person?

How can linear narratives be told in non-linear spaces? (n.b. this question is one that has been approached in other media, e.g. theatre, video games, board games, escape rooms etc.)

*Source: Richmond News*

# VR Design Challenges

## 2. *Embodiment*

How can the presence of a physical body be implicated in VR?

How should the audience's body be accounted for in the virtual world?

How can embodiment be used as a design "lever" to create compelling experiences?

*Source: VRwandlung, Mika Johnson*

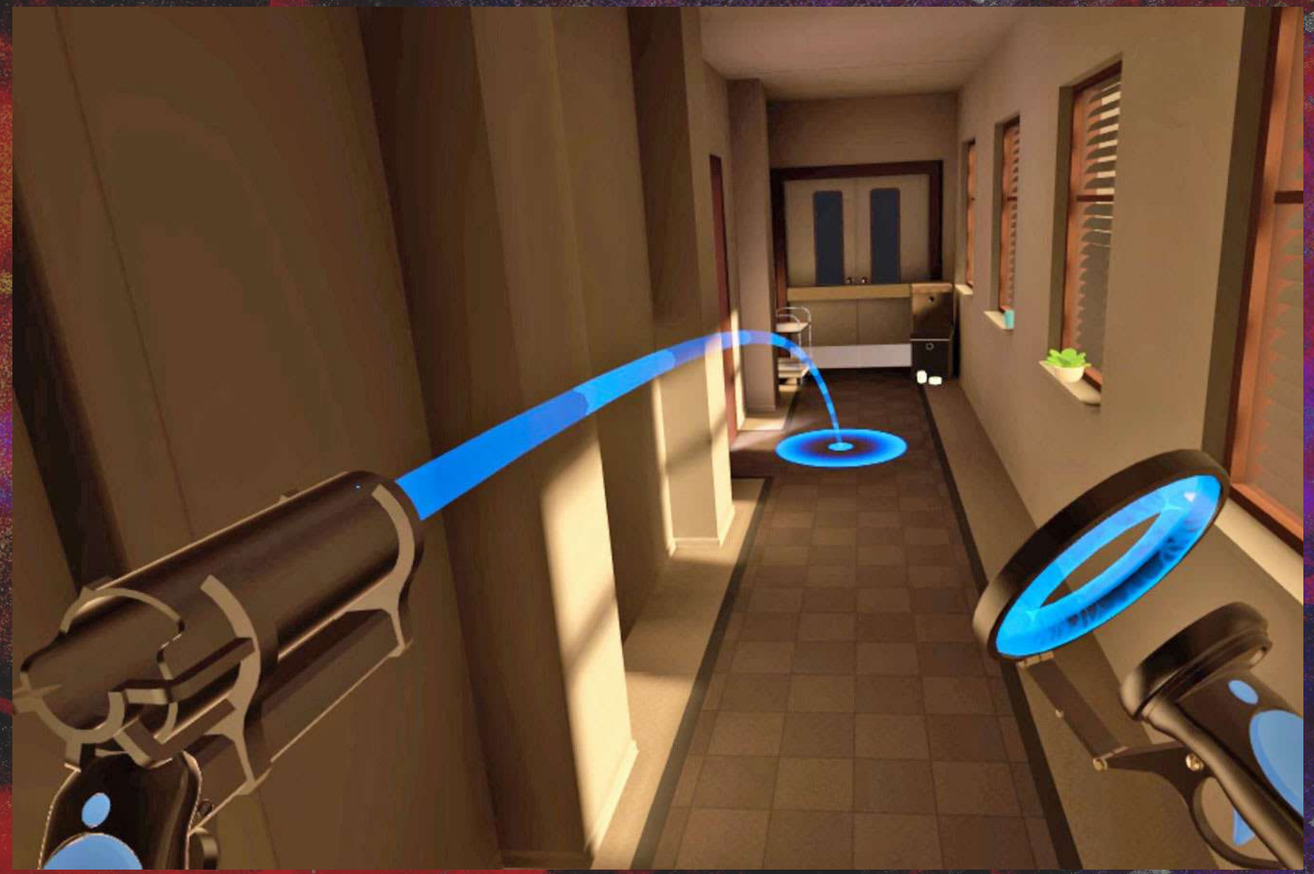
# VR Design Challenges

## 3. *Locomotion*

How should the audience be able to move around an environment in VR safely and intuitively?

How can locomotion be used and integrated into a narrative experience?

How can locomotion be used to give freedom to the audience, while at the same time support and extend the world-building project? (OR: locomotion is not just an afterthought…)



Source: engadget.com

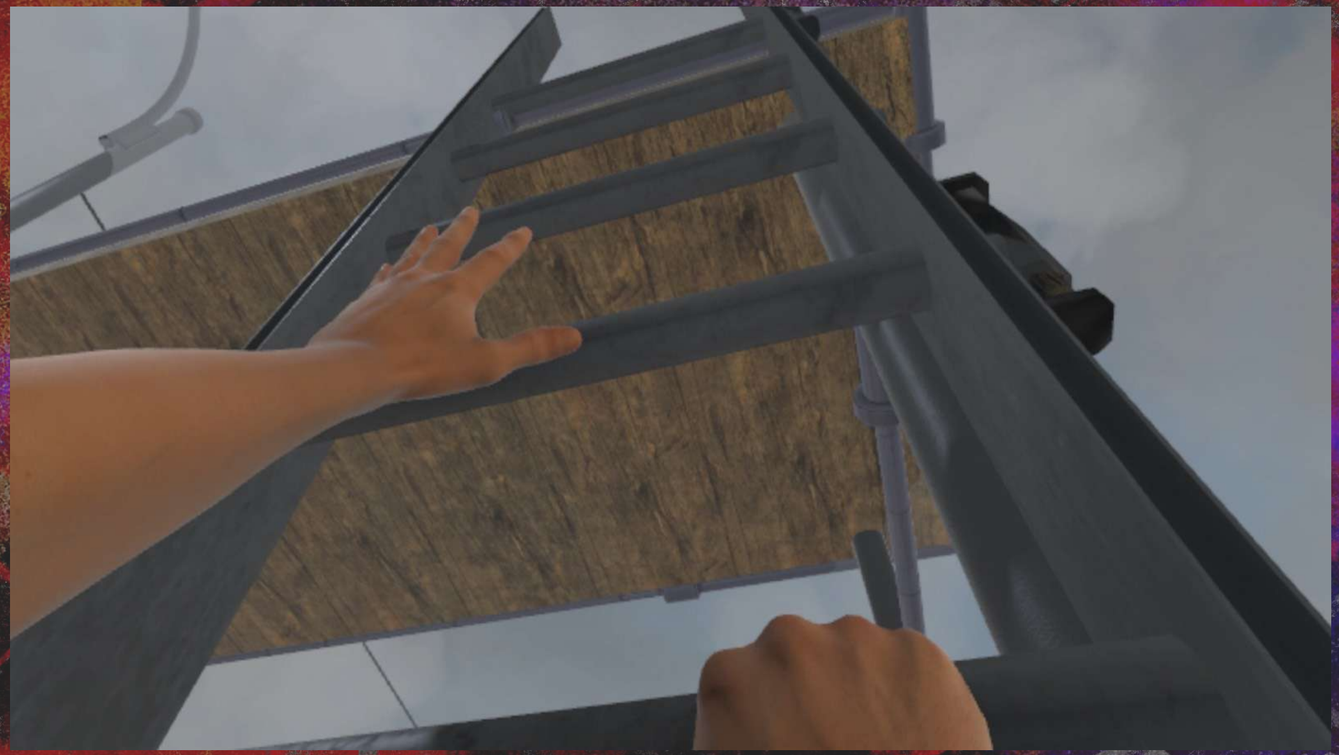
# VR Design Challenges

## *4. Physics*

How should the audience be able to interact with the virtual world?

What rules should the virtual world have? To what extent do these reflect or reject real world conditions to which the human body is accustomed?

How can the gap between the audience's physical and virtual bodies be overcome (or exploited)? e.g. picking up a heavy object that has no weight in the virtual world



*Source: Boneworks*

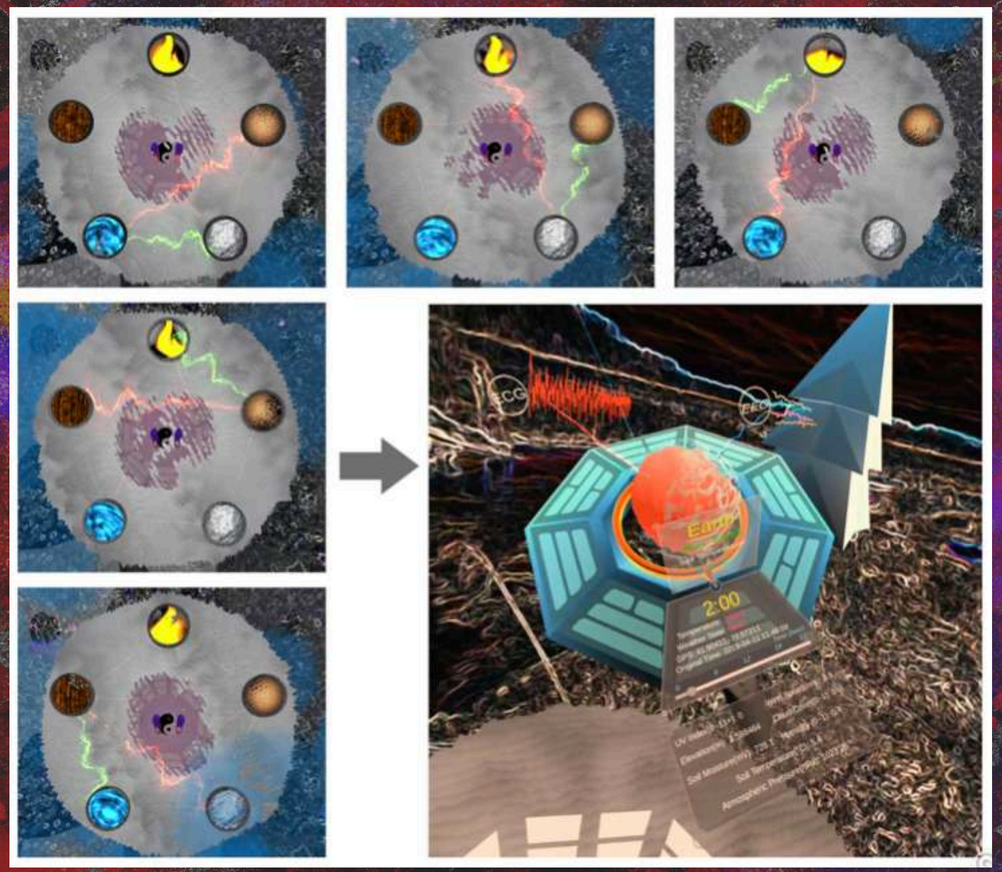
# VR Design Challenges

## 5. *Interfaces*

How should the audience be able to navigate between different parts of an experience? e.g. different chapters/different scenes

How can 2D interfaces be integrated into 3D environments in a convincing way?

How can information be presented to the audience without the use of flat screens placed in the 3D world?



*Source: Baguamarsh, MIT Media Lab*

# VR Design Challenges

## 6. *Accessibility*

How can the transition between real world / virtual world be made smooth and not jarring (especially for first-time users)?

How can the isolating experience of being in VR be alleviated? Or indeed made part of the experience?

How can instructions be integrated into the experience and/or narrative?

*Source: EPFL Lausanne*

# VR Design Challenges

## *7. Hardware*

How can the diverse hardware requirements be accounted for within a VR experience?

How can experiences be adapted for different hardware with different capabilities and different integrations (e.g. Steam vs Oculus)?

How can experiences be optimised for mobile devices with a more limited performance (e.g. Oculus Quest/Quest 2)?

Source: Apple

# VR Design Challenges

*... further considerations*

How will the experience be installed in the physical space?

What about the headset itself?

How can VR be linked with and/or integrated with other hardware and software media?

Distribution?

*Above: Tirana Time Capsules, Daejeon Biennale of Arts and Sciences 2022*

# Unity vs. Unreal

- C#
- Modular script components
- Less powerful graphics engine
- Slightly bigger community
- Best for: Lightweight, mobile, 2D

- C++ (but native node-based visual coding)
- Powerful graphics engine
- Slightly smaller community
- Loads of free, high-quality assets
- Best for: High production value, photo-realistic graphics, people who think with nodes…

**Both well-suited to building VR experiences - choice is largely a personal one. Learn both!**

# Oculus vs. the Rest

- Still the leader in mobile VR (Quest 2, Quest 3)?
- Large ecosystem with games/experiences/ documentaries/productivity apps etc.
- Owned by Meta, potential data privacy concerns
- SideQuest for 3rd-party non-Oculus approved content
- Meta trying to establish itself as the platform for social VR, entry-level VR, gaming etc.

- HTC Vive, Valve Index, HP all make solid PC-linked VR headsets; Playstation VR is a console-based device; all are more or less gaming-oriented VR headsets
- The above run via Steam VR, meaning easy integration with Unity and Unreal
- Apple Vision Pro is the newest offering, also the first from Apple and by far the most expensive (around €3500) - aimed at professional/business/premium entertainment customers
- HTC Vive Flow is a VR headset aimed primarily at wellness/productivity market
- Loads of content via Steam store / itch.io etc.

**This choice is perhaps the more important one, as it has important implications for what kind of experience you are designing and how it can be accessed by the audience.**

**Overall trend towards a coming together of VR and AR technology?**

# Case Study: The Apartment of Sergei Eisenstein (2022)

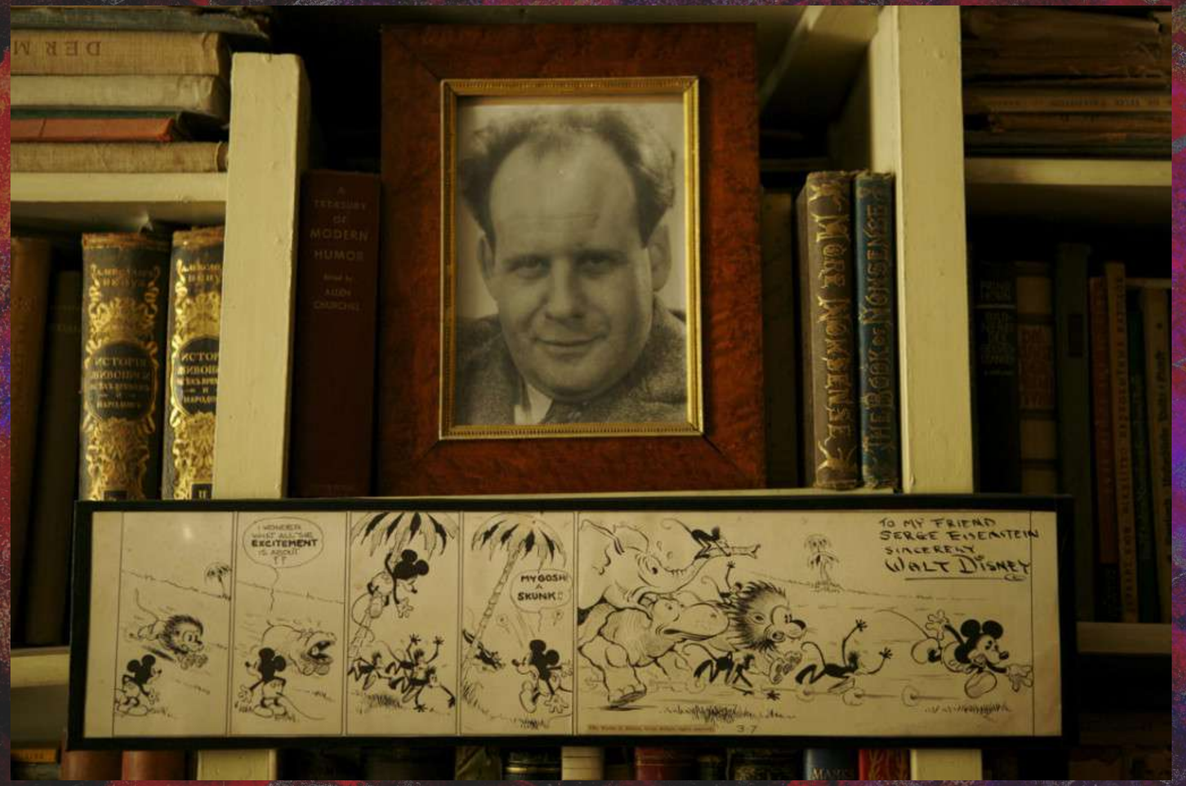

*Above: Opening Menu, The Apartment of Sergei Eisenstein (2022)*

# Case Study: The Apartment of Sergei Eisenstein (2022)

PROCESS

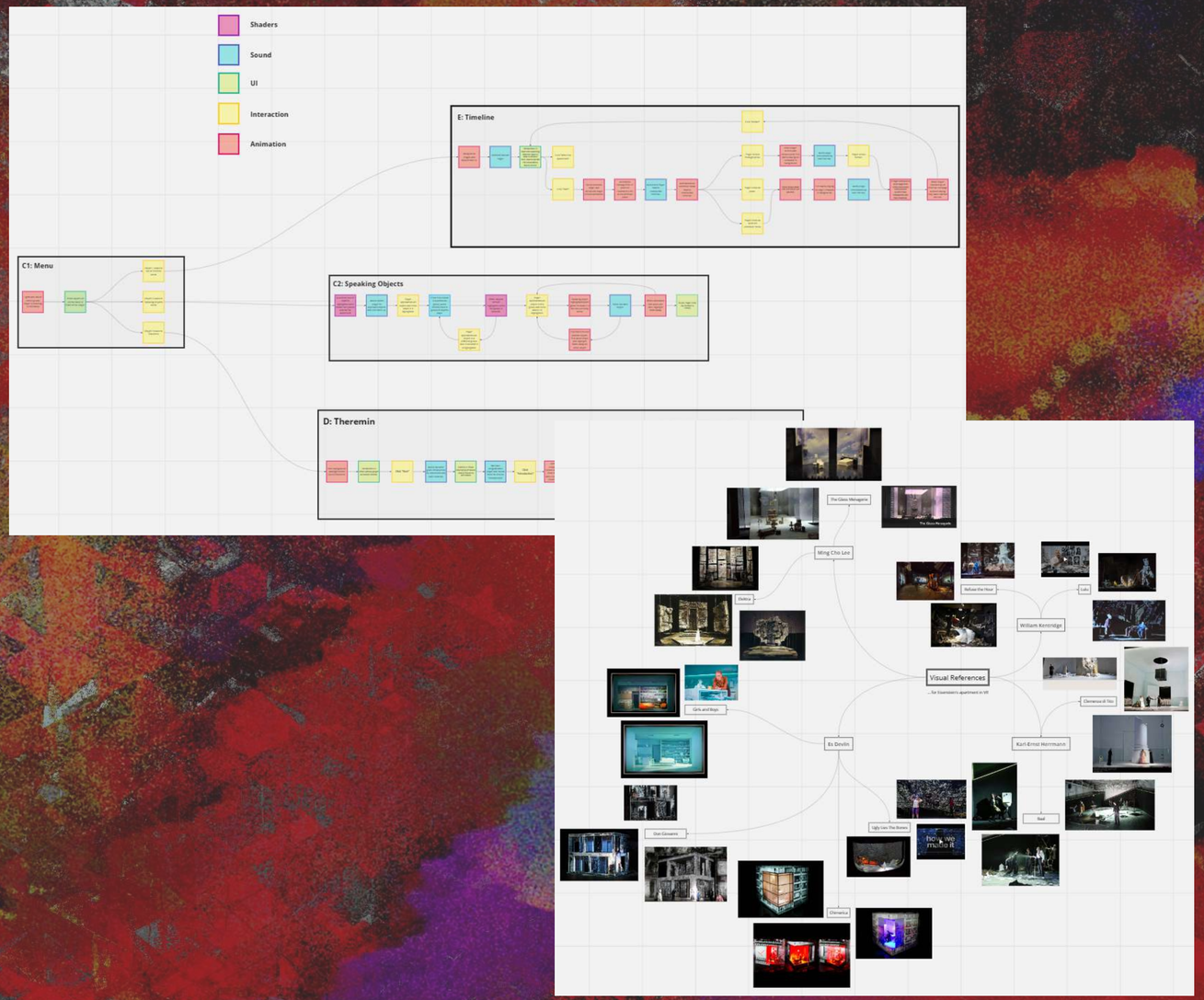
Concept: The apartment of Sergei Eisenstein in Moscow had been an important symbolic centre in the cosmology of film studies and film history scholars. The apartment itself was destroyed after Eisenstein's death and the objects moved to the Russian Cinema Museum, which was subsequently closed by Putin's administration in the mid 2010's...

- How to make this apartment "accessible" again? How to re-display and re-contextualise the objects that were previously in the Cinema Museum in Moscow?
- Is it possible to translate some of Eisenstein's thinking about film into the current media landscape?
- How to broaden knowledge of Eisenstein's work and expand his legacy to a wider audience?




*Above: Still from "Cinema: A Public Affair" (2015), dir. Tatiana Brandrup*

# Case Study: The Apartment of Sergei Eisenstein (2022)







PROCESS

Early design decisions:

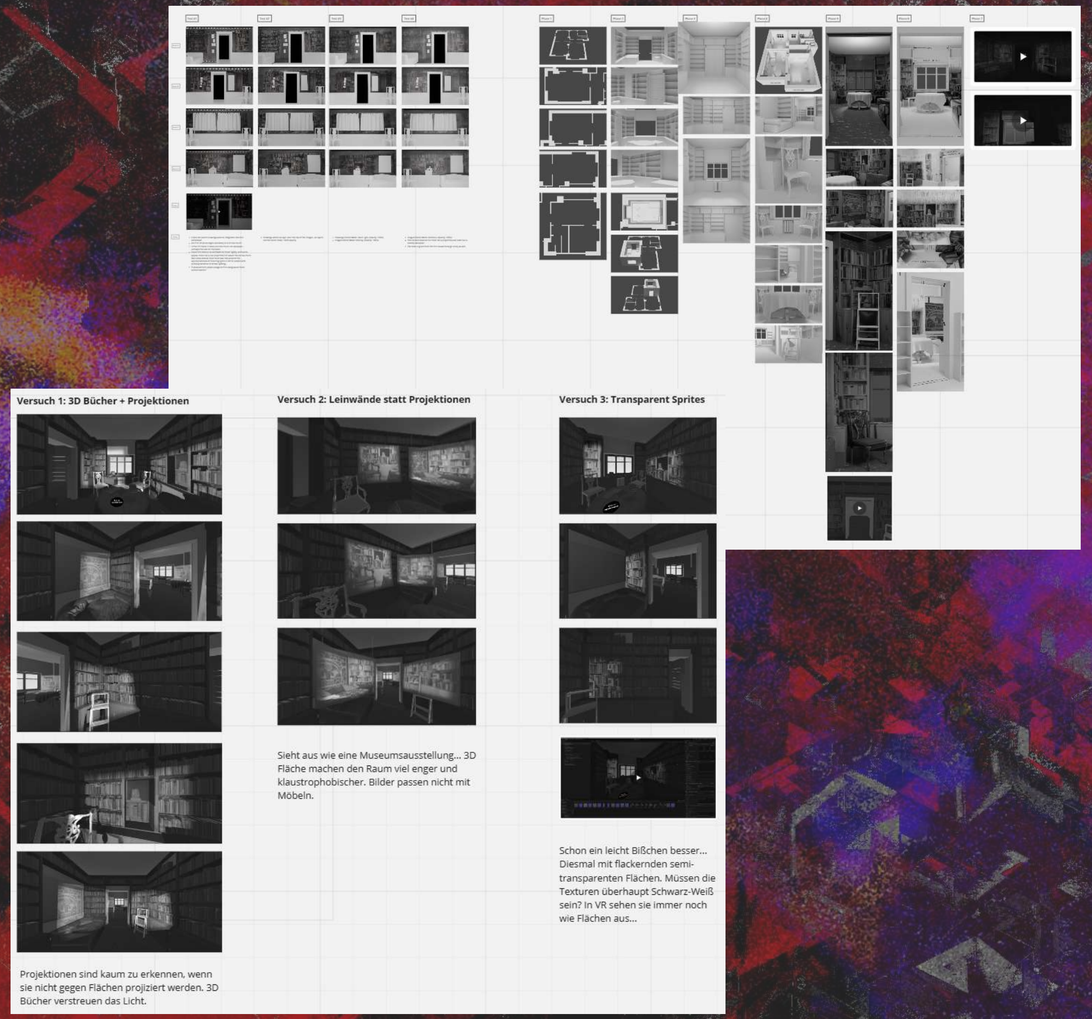
- Hardware? *Oculus Quest 2* - decision was made for mobile VR, as we wanted to prioritise reaching a wider audience. Mobile VR has a lower cost barrier to entry, and is also easier to set up and use for people with no previous experience of VR.
- Software? *Unity* - Given the choice of the Quest 2 as hardware, it seemed wise to use Unity as the game engine, as it was considered to be more suitable for mobile devices.
- Storyboard/Player Journey? The first step in the actual design process was to construct a rough sketch of how the experience would progress, including as much detail as we could give about the interactions, visuals, soundscape, VFX etc
- Visual/Sound development? Also at this stage we gathered visual material to act as references for the visual and sound environment.

# Case Study: The Apartment of Sergei Eisenstein (2022)

PROCESS

Early Production:

- Prototype stage - The first step in production was to build a prototype of the experience based on the storyboard. The experience was implemented in code in its most basic form possible, using placeholders for almost all content. The visuals and sound were also prototyped using pre-build shaders and free assets from asset store etc.
- Iterations - Meanwhile, we iterated over the visual style in Unity, trying to achieve the desired effect and deviating from our original plans when necessary.
- Revisiting original design - Once we began on production, it became clear that we need to revisit the original design repeatedly in order to adapt the experience to what Unity would allow and indeed what we had time for...



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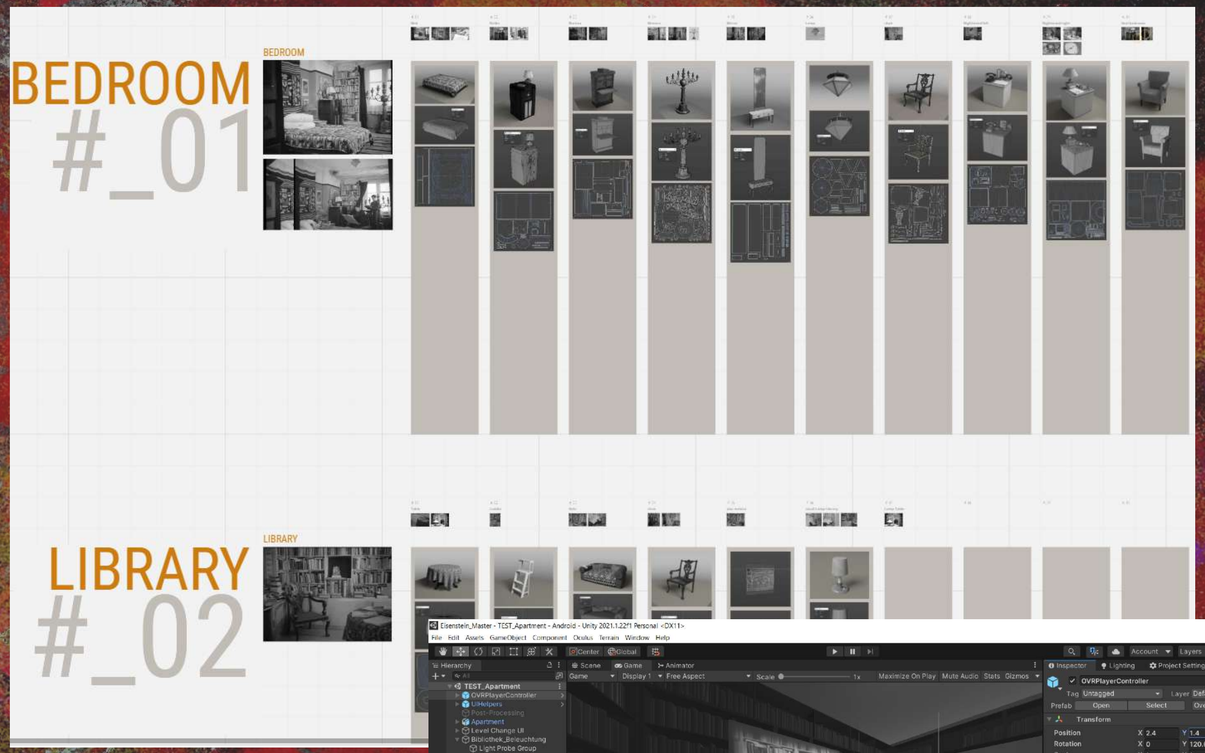
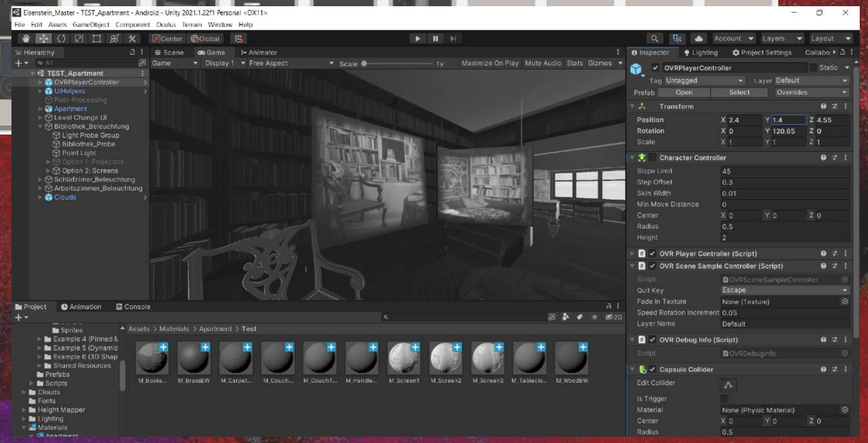



*Above: Courtesy of Jan Schneider*



## PROCESS

Continued Production:

- Sound - We began working with a sound designer quite late (due to hiring difficulties), which ultimately led to having to rethink a lot of the earlier design decisions. The addition of sound brought a whole new dimension to the project that we had somewhat overlooked as we were so deep in the visuals and narrative...
- 3D Modelling - We also began to replace many of the lower-resolution models with higher-resolution ones, with detailed texture maps
- Interactions - These became more and more complex as the development process went on and through repeated testing. Particularly for the Timeline and Theremin scenes, the interactions had to be made quite robust and precise, as they were more "innovative" than the apartment scene.

# Case Study: The Apartment of Sergei Eisenstein (2022)

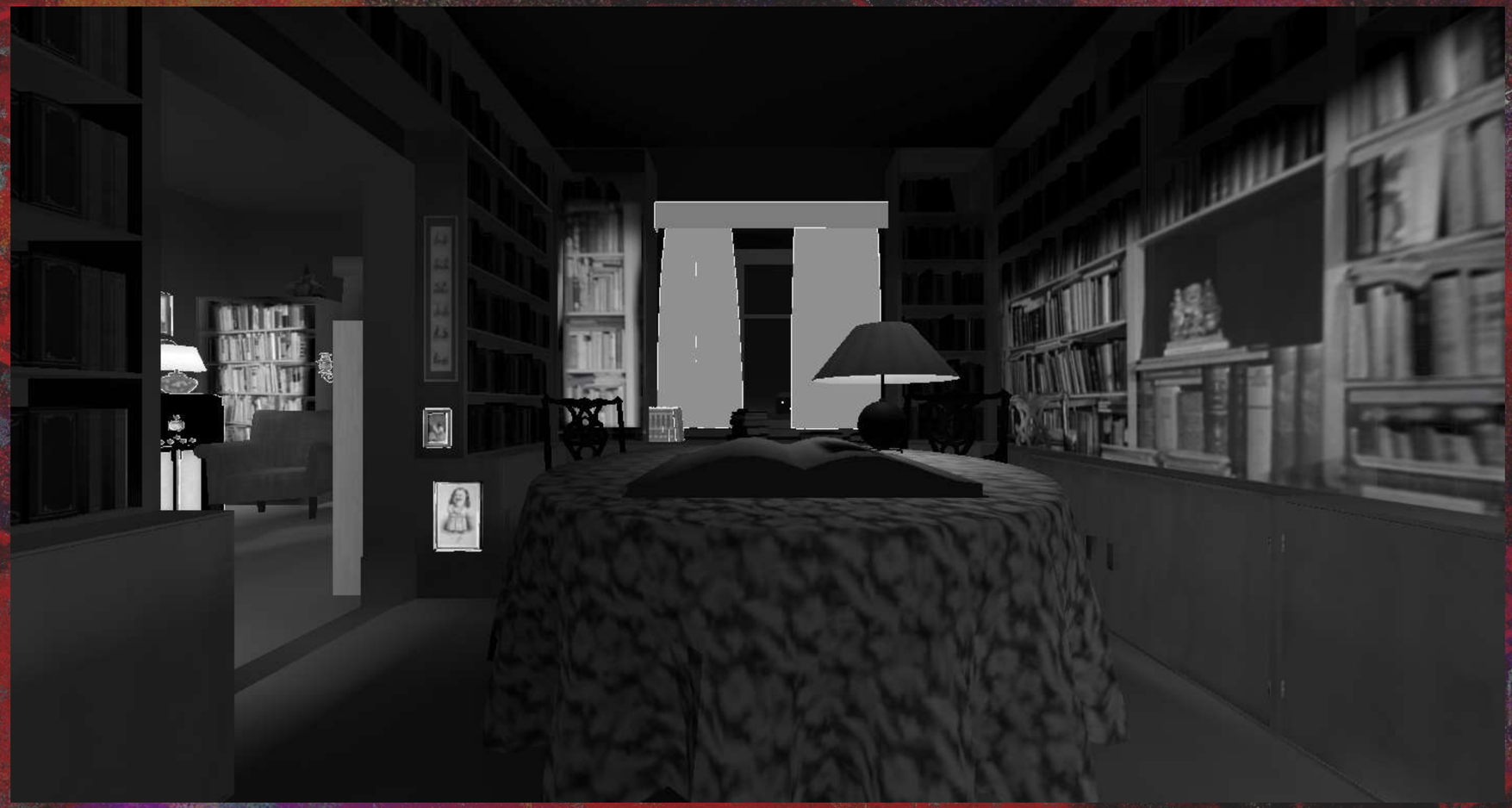
PROCESS

Final Production:

- Polishing of visuals, sound, interactions - At this point the main task was to iterate over the content of the experience and make sure everything was up to a high standard. Even at this stage though we added in new features, such as the method of selecting chapters in the experience by turning the pages of a book.
- Editing - We ended up with far too much content... this was problematic not only for run-time but for optimisation of the experience, which we wanted to keep below 1Gb total. We ended up leaving out one chapter completely from the final experience (*Eisenstein and Music*), and cutting down the amount of content in the other chapters.


https://eisensteinshouse.projekte-filmuni.de/

# Case Study: The Apartment of Sergei Eisenstein (2022)



https://vimeo.com/763707229/4223f69cc4?share=copy

# Case Study: The Apartment of Sergei Eisenstein (2022)

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# AR: The Basics

- (a definition:) *a medium in which real-time audio/visual content is overlayed over (a camera image/3D model of) the physical world.*
- Designing for AR is therefore quite a different task than designing for VR - you are not designing so much a 3D environment from scratch than mapping content onto the existing environment.
- AR therefore has very different use cases and possibilities than VR. To lump these two together into the category XR is somewhat confusing...

# AR Design Challenges

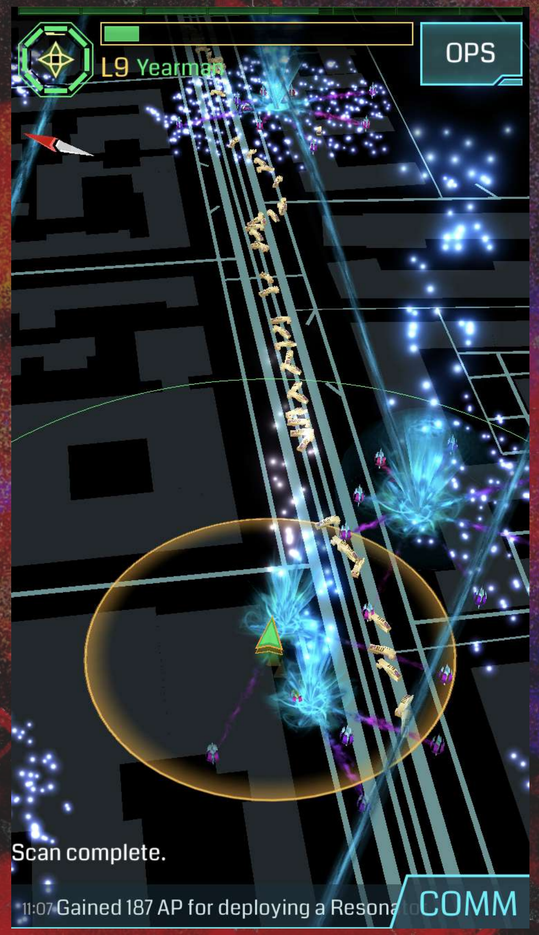
## 1. World Space

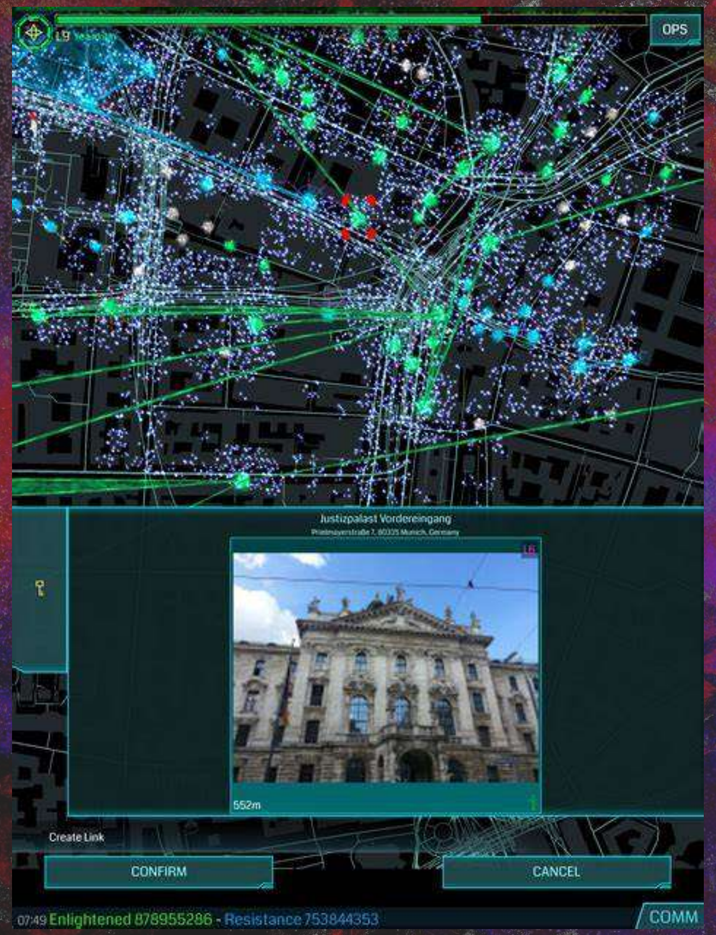
How do objects in the virtual world become mapped onto spaces in the real world?

What criteria should be considered when deciding how to locate AR objects in real 3D space?

How should size and scale of AR objects be accounted for?

Do elements need to be placed in real world or otherwise installed? How can AR play with this idea of installation?




Source: Ingress

# AR Design Challenges

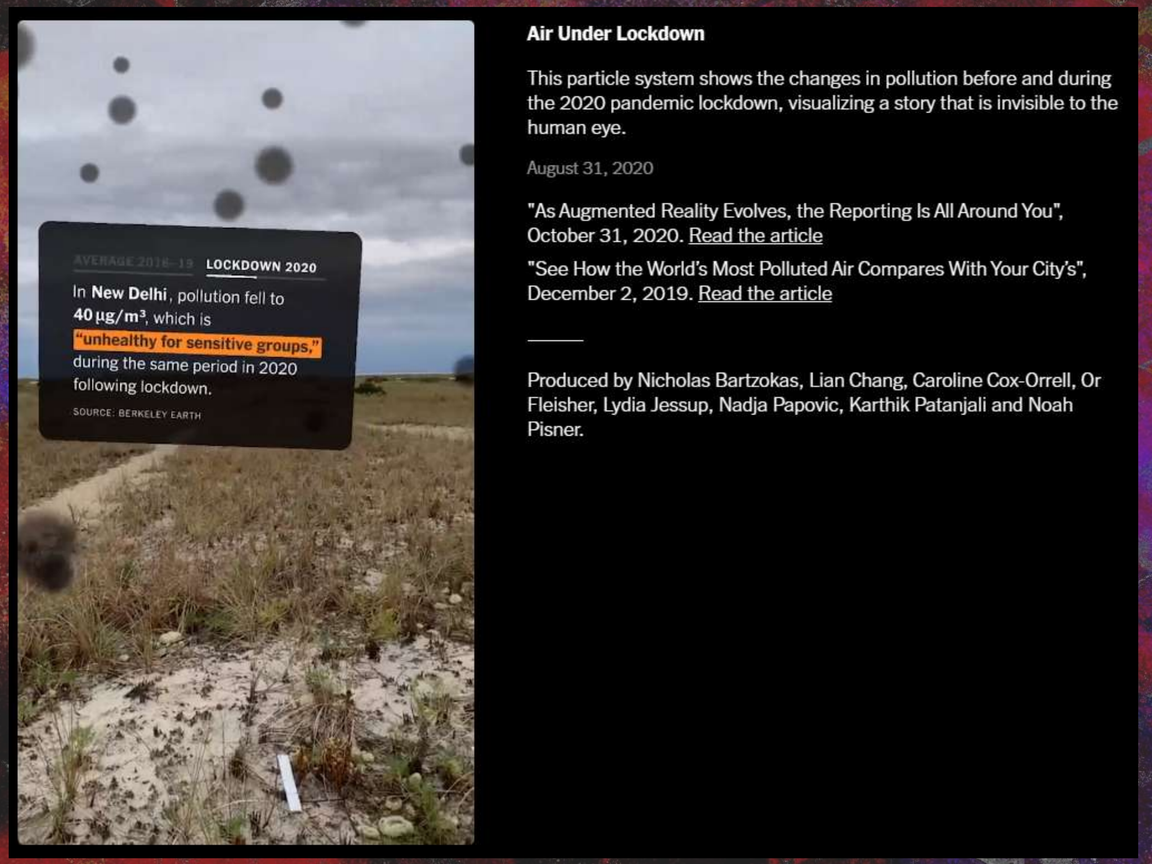
## 2. Screenspace

In AR, the frame is the screen is the interface - how can the phone/tablet screen fulfill all these roles simultaneously?

How can you maintain immersion in the 3D scene while still allowing attention to be diverted (or not) by the 2D interface?

How to create the effect of depth on a 2D surface (more a problem for mobile AR rather than binocular AR)?

How to direct the eye in space?



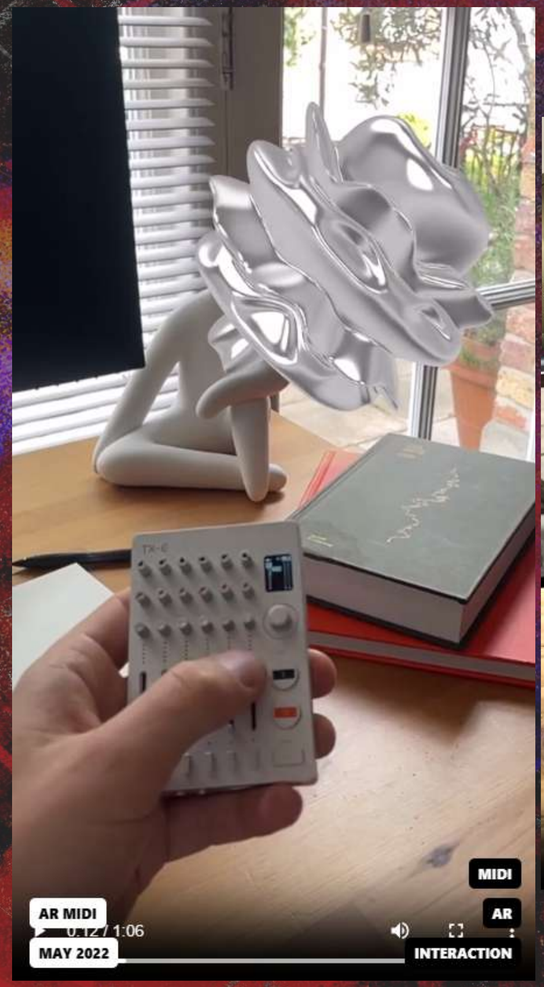

Source: NYTimes

# AR Design Challenges

## 3. Interactions

How to work within the framework of traditional mobile phone screen interactions while also encouraging new kinds of interactions (e.g. walking around the room rather than zooming in and out on the screen)?

What about using other devices as input devices? What are the possibilities/challenges here?





Source: Harley Turan

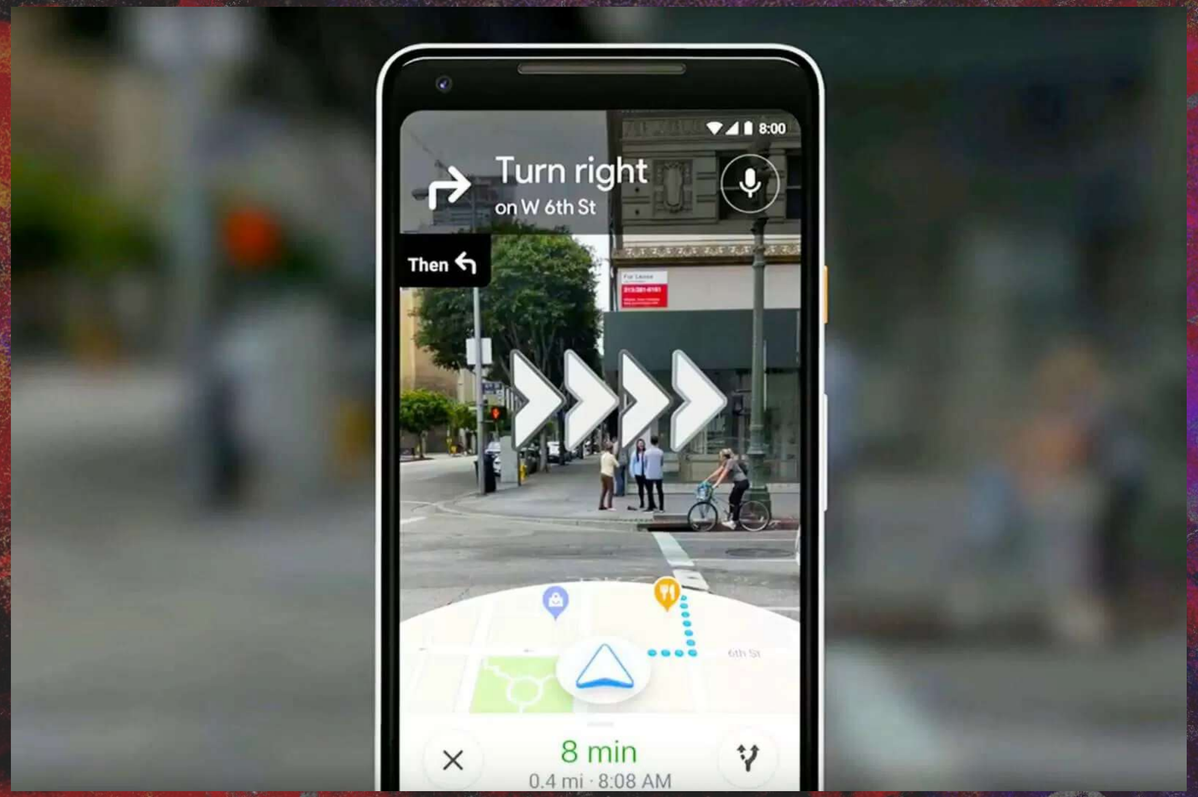
https://hturan.com/

# AR Design Challenges

## 4. Accessibility

How will the experience be made available for people to download and install? Or will it be integrated into another app (e.g. Instagram or Snapchat)?

Does the experience require the user to move around/stand/perform any kind of physical interaction outside of the screenspace?




Source: Google

# AR Design Challenges

## 5. Hardware

How to optimise the experience to run on limited hardware capacity?

How can experiences be adapted for different hardware with different capabilities?

How to make experiences that run on both mobile AR and glasses-based AR (e.g. Hololens, Apple Vision Pro)?

What technical frameworks does the AR experience need to run (e.g. LiDAR, image tracking etc.)? These vary between devices.

Source: Apple

# AR Design Challenges

## … further considerations

How can the device be made part of the experience itself?

Are there parts of the experience that are non-AR and therefore use the traditional 2D interface? How do these different parts of the experience connect?

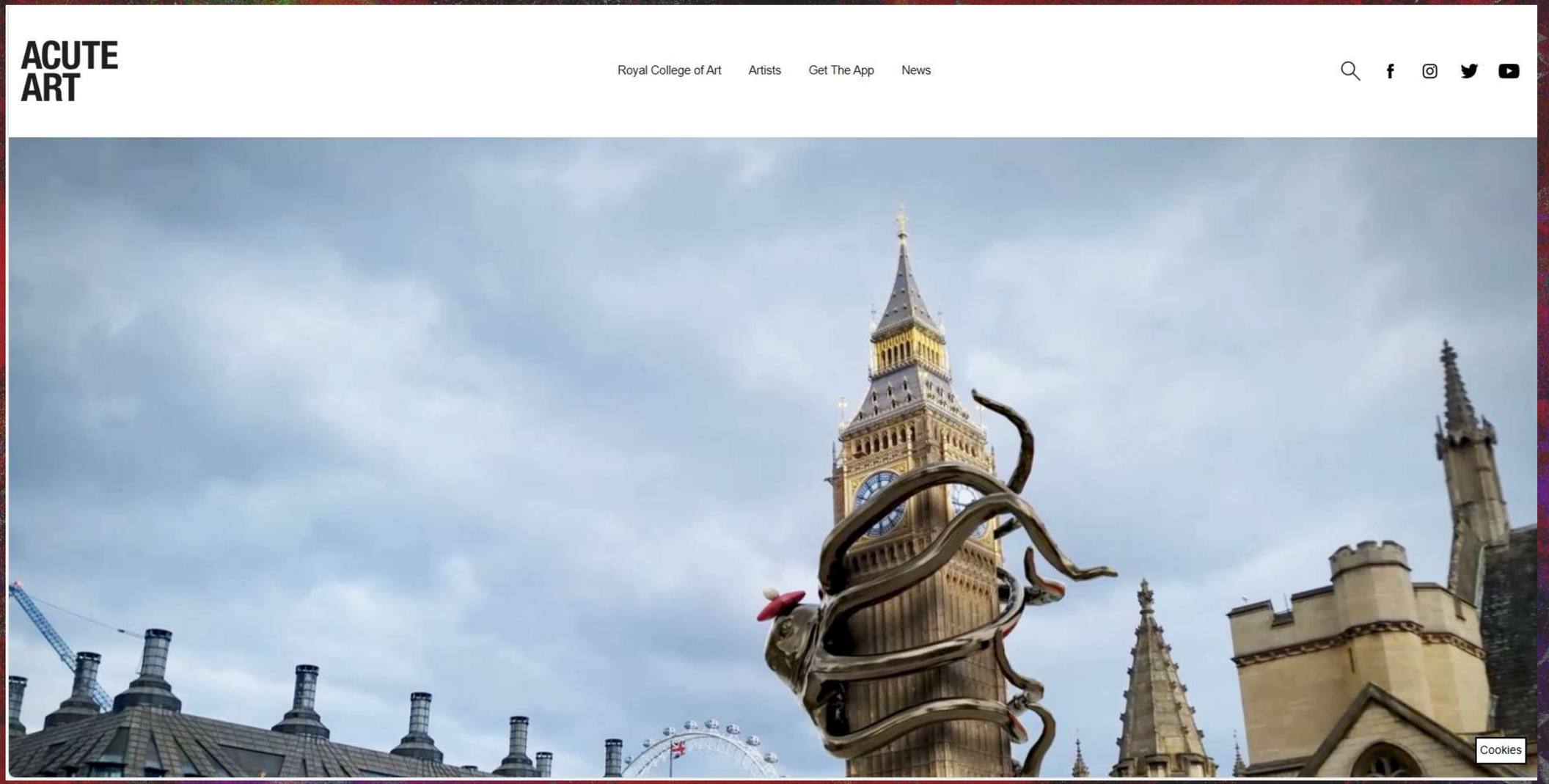
How can Computer Vision be integrated into AR?

Above: *Pure Land AR*, EPFL Laboratory for Experimental Museologies

# Mobile AR vs. AR Glasses

- All(?) modern Android and iOS smartphones can support AR (Camera + Gyroscope + GPS + AR software are minimum requirements)
- iPhone 12 / 4th Gen iPad Pros / Google Pixel 4 / Samsung Galaxy S21 Ultra onwards also have LiDAR, which is a huge help in tracking 3D space
- High degree of accessibility, relatively low barrier to entry
- AR apps for mobile AR generally target a wider audience in areas such as (location-based) gaming, productivity, tourism, advertisement etc.
- Less performant, as these are not dedicated AR devices... problem of depth perception on single 2D screen

- Hololens 2, Glass Entreprise 2, Apple Vision Pro, Meta Quest Pro, Lenovo ThinkReality, Vuzix Blade, Magic Leap; the list continues to grow...
- Relatively high barrier to entry, as all these products are quite expensive (€1500 upwards)
- Targeted more towards industry/business customers, and in some cases private users (Apple). Particularly in industries like construction/engineering etc. AR glasses are used more and more
- Generally much more performant; also issue of perceiving 2D objects in 3D space is solved with binocular vision
- Binaural audio also often included in these devices




https://acuteart.com/

BESUCHEN AUSSTELLUNGEN NRW KUNST PALAST FORUM VERANSTALTUNGEN ÜBER TICKETS DE EN

# AR BIENNALE


https://www.nrw-forum.de/ausstellungen/ar-biennale


https://rd.nytimes.com/research/spatial-journalism

EPFL About Education Research Innovation Schools Campus EN

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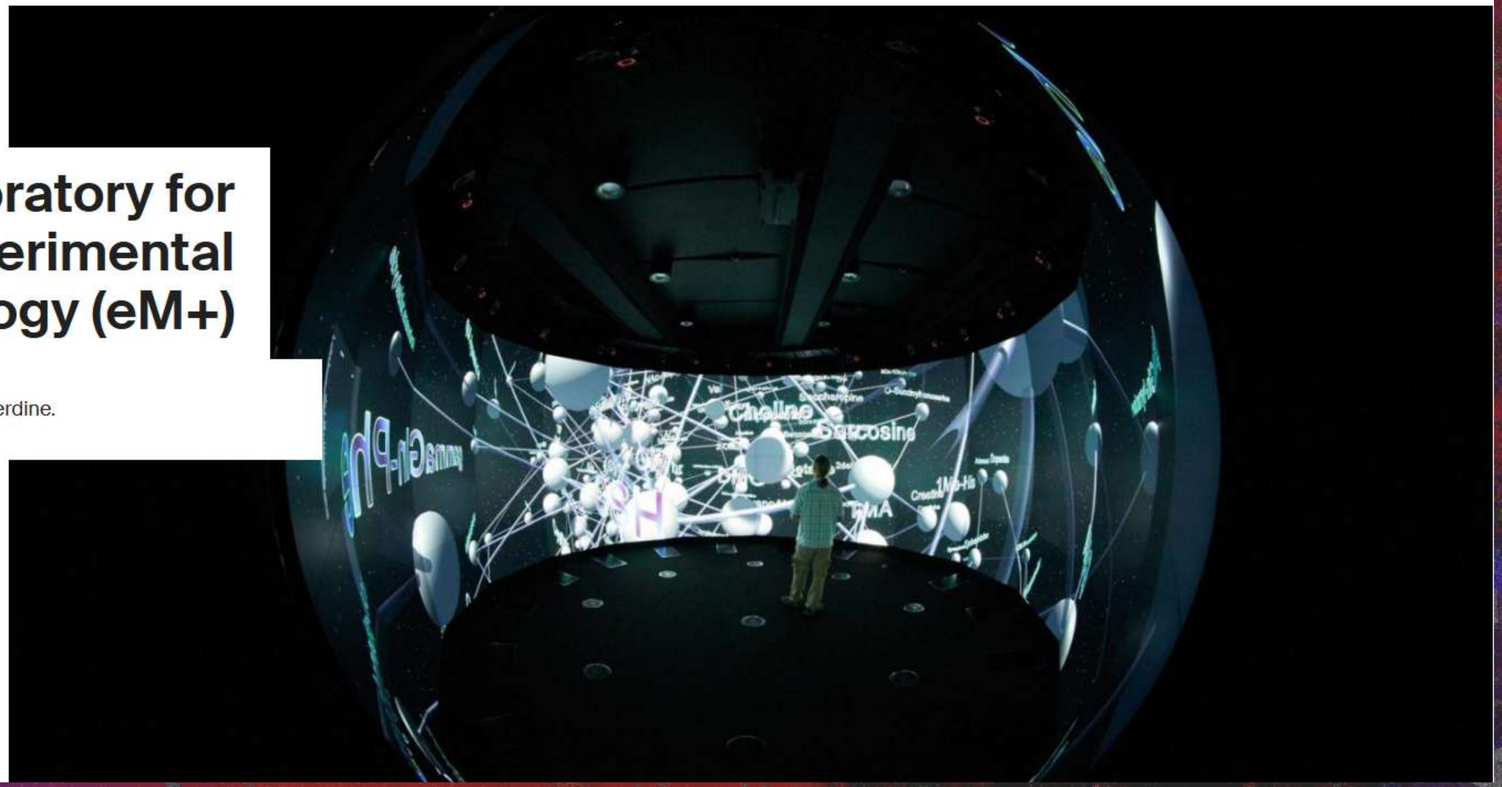
# Laboratory for Experimental Museology (eM+)

led by Prof. Sarah Kenderdine.



https://www.epfl.ch/labs/emplus/

# Personal Projects

# Personal Projects

**What is the aim?**

- Prototype a short VR/AR experience using existing Unity knowledge + available assets
- Should not be any longer than a few minutes (length of experience of course dependent on interactions, environment size etc.)
- Development time: the rest of today + whatever you want at home + the next two workshop mornings (Total = 10-12 hours?)
- Use whatever plug-ins / media available to you - whether you prefer working with images, 3D models, sound, VFX etc.

**Theme:**

Free to choose!

# Difficulty Levels

**EASY**
- (If VR) 360° environment
- 3D models / images / sounds as raw material
- 1 way of interacting with the world in VR/AR

**MEDIUM**
- All of the above
- Spatial sound / particle system / animations
- 2 ways of interacting with the world in VR/AR

**HARD**
- All of the above
- Different shaders / interactive sound / etc.
- (If VR) VR Locomotion; (If AR) External interaction input

# Resources & Documentation

- Unity Assets Store (many assets available for free - n.b. make sure to check the compatibility of the assets with mobile systems, as not all will work with the Quest)
- Github (many shaders and scripts published here that are not published in the assets store)
- Documentation:
  - Unity Manual (https://docs.unity3d.com/Manual/XR.html)
  - Unity API (https://docs.unity3d.com/ScriptReference/index.html)
  - Oculus (https://developer.oculus.com/documentation/unity/)

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- Documentation
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  - Unity API (https://docs.unity3d.com/ScriptReference/index.html)
  - Oculus (https://developer.oculus.com/documentation/unity/)
- Podcasts/Reviews/Essays/Platforms
  - Voices of VR (https://voicesofvr.com)
  - Road To VR (https://www.roadtovr.com)
  - MIT Docubase (https://docubase.mit.edu)
  - Radiance VR (https://www.radiancevr.co)