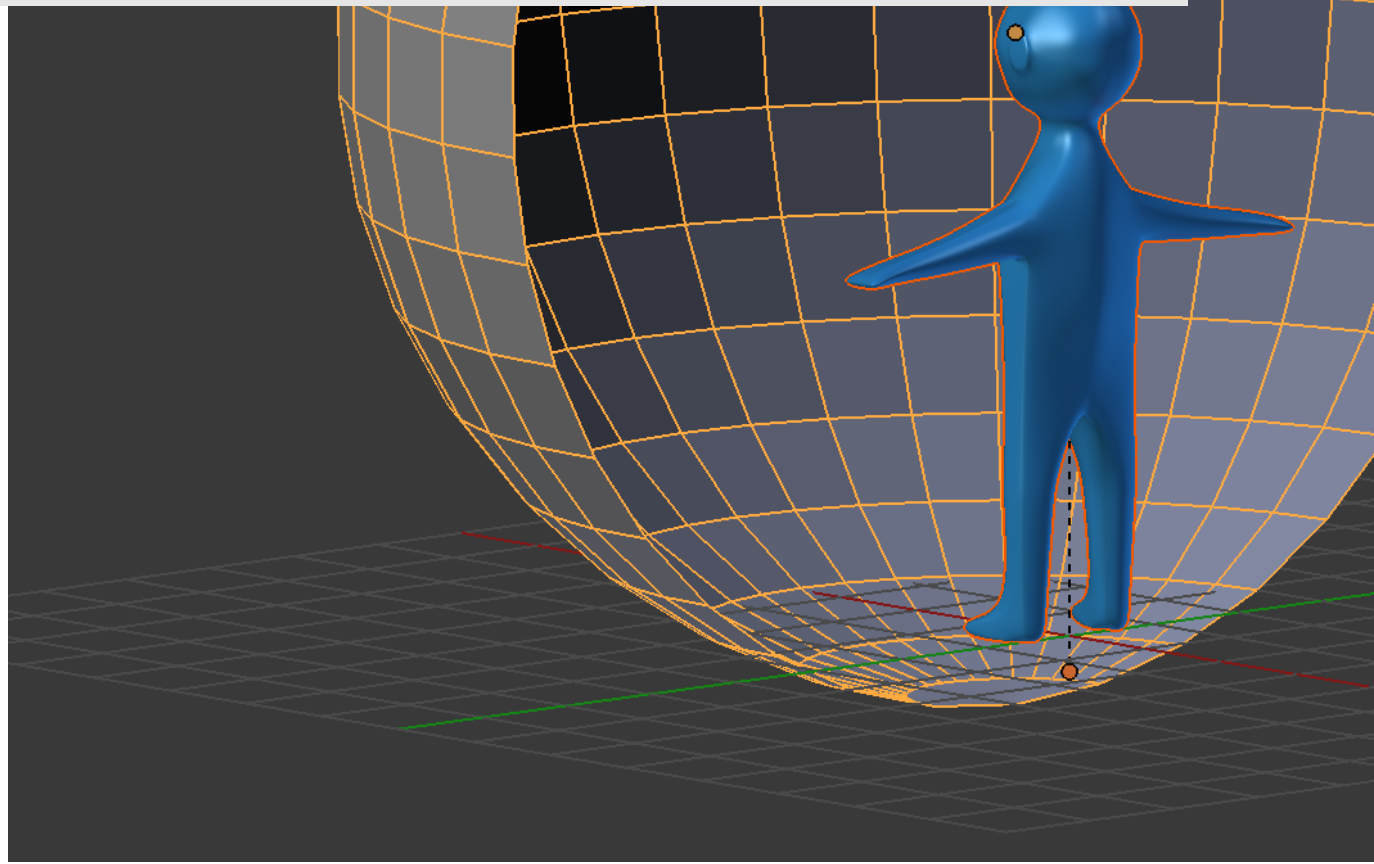


Eye Tracking

In 360 Video

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In this lecture

1. Recap from Winter School
2. Eye Tracking in 360 video
 - Analysing user behaviour
 - Attentive user interfaces
3. Live Demo and walkthrough

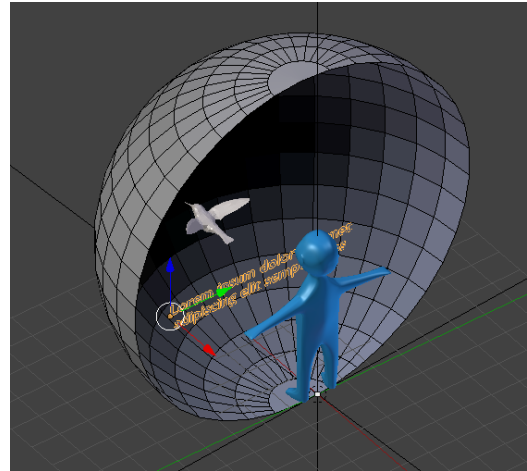
Background and Motivation



Accessible Immersive Video

360° Video

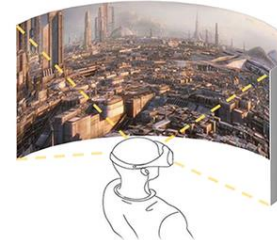
Time... and space!



100°



210°



My interest - Subtitling

Main challenges

- Comfort & Readability
 - Especially for VR glasses
 - Where can subtitles be rendered on the screen (safe area)?
 - What fonts and text sizes are reasonable?
- Speaker identification
 - How does the viewer know who is speaking?
 - How can the user keep orientation in the scene?
- Narrative
 - Does the user follow the narrative?

Comfort & Readability



← Image quality falls off towards the edges

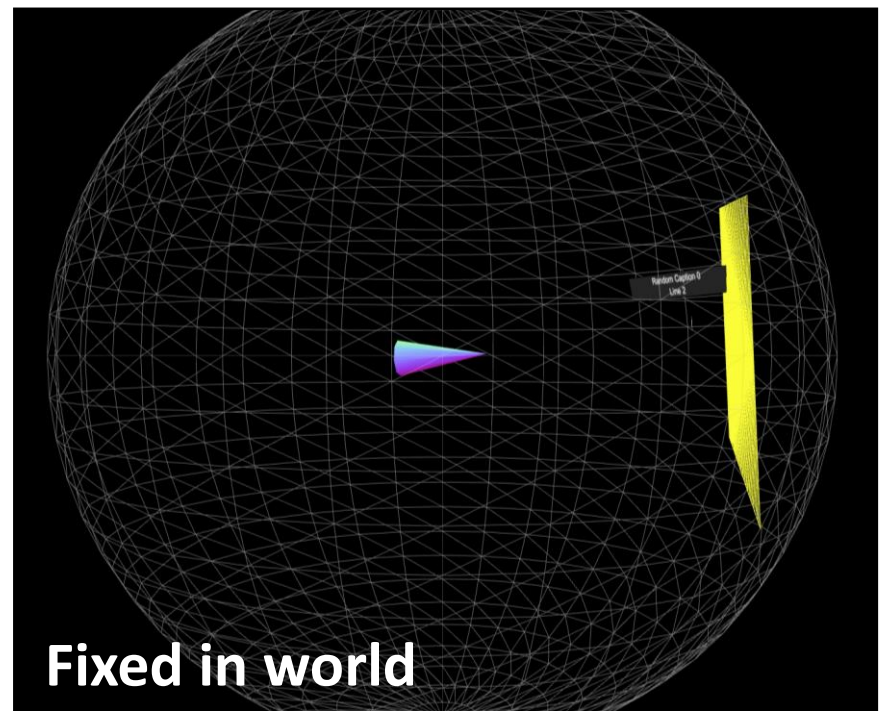
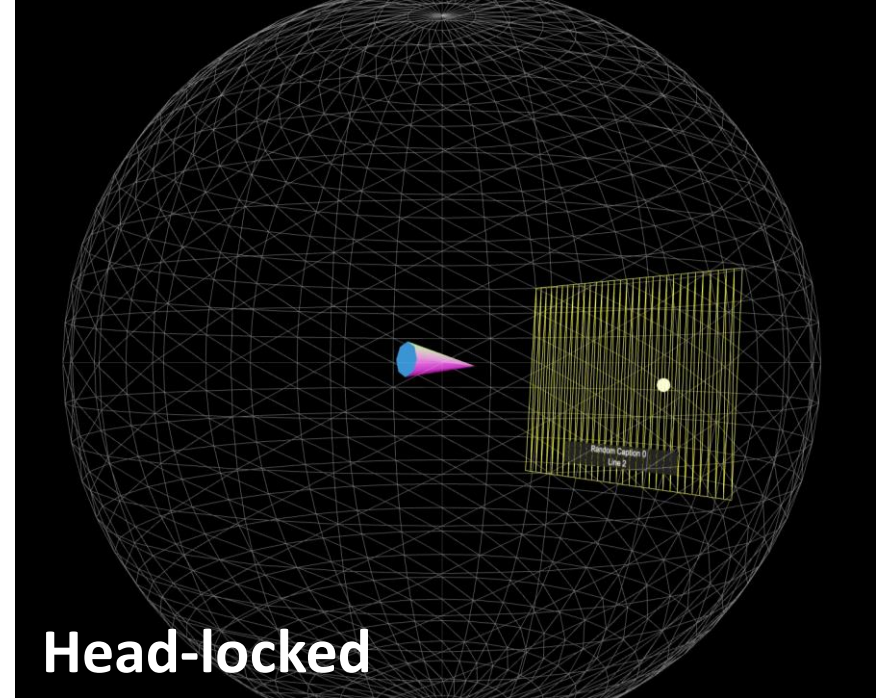
(Only exemplary, does not represent real image quality)

Photo through lens of the Oculus Go

Speaker Identification

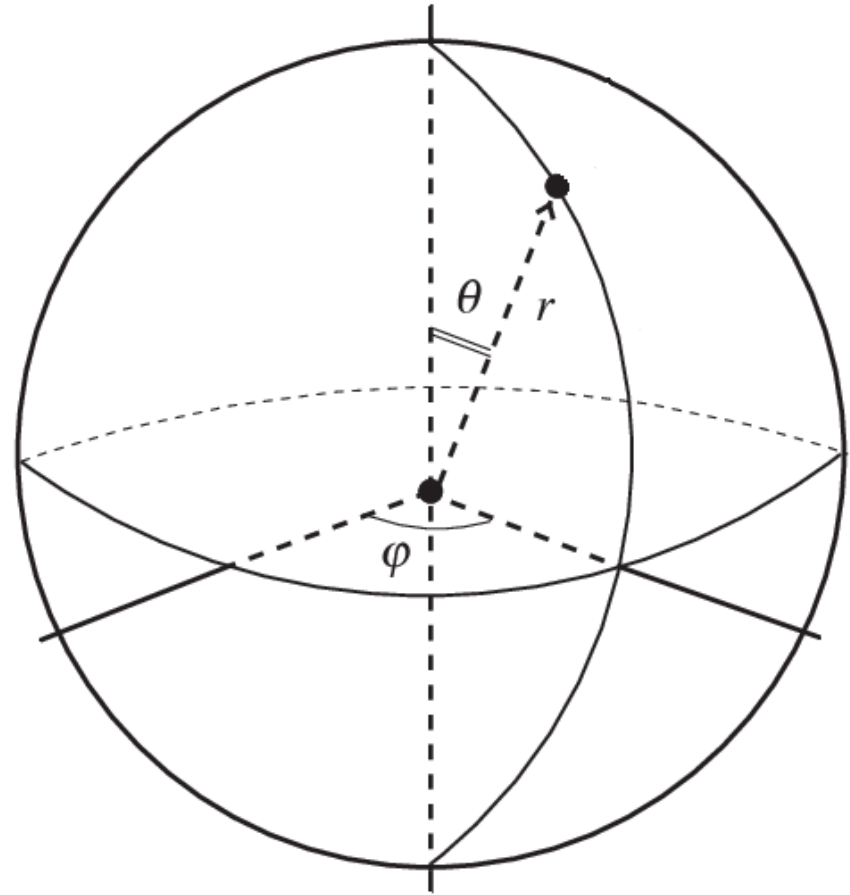


- **Fixed in Scene, Locked Vertical** - The caption is positioned at the target, but the azimuthal position (ϕ) is restricted to 0 so that it remains locked to the horizon.
- **Fixed in scene, repeated evenly spaced** - The caption is positioned at the target location then duplicated at $2\pi/3$ rad (120°) intervals around the horizon.
- **Appear in front, then fixed in scene** - The caption is rendered in the centre of the user's current view and remains there until the caption is updated.
- **Fixed, position in scene** - The caption is rendered at the target location.
- **Head-locked** - The caption is rendered in the user's view point and is moved in sync with the user to ensure the caption remains statically attached to the view point.
- **Head-locked on horizontal axis only** - The caption is rendered as *head-locked*, however the azimuthal angle (ϕ) is restricted to 0, ensuring that the caption is always rendered on the horizon.
- **Head-locked on vertical axis only** - The caption is rendered as head-locked, however the polar position (θ) is locked to the target.
- **Head-locked with lag, animate into view** - The caption is rendered in the *head-locked* position, however as the users' viewpoint changes the caption is pulled back towards the *head-locked* position. An animation loop moves the caption incrementally causing it to smoothly animate into view.
- **Head-locked with lag, jump into view** - This is the same as above, except the animation time is reduced to 0, forcing the caption to jump into the users view.



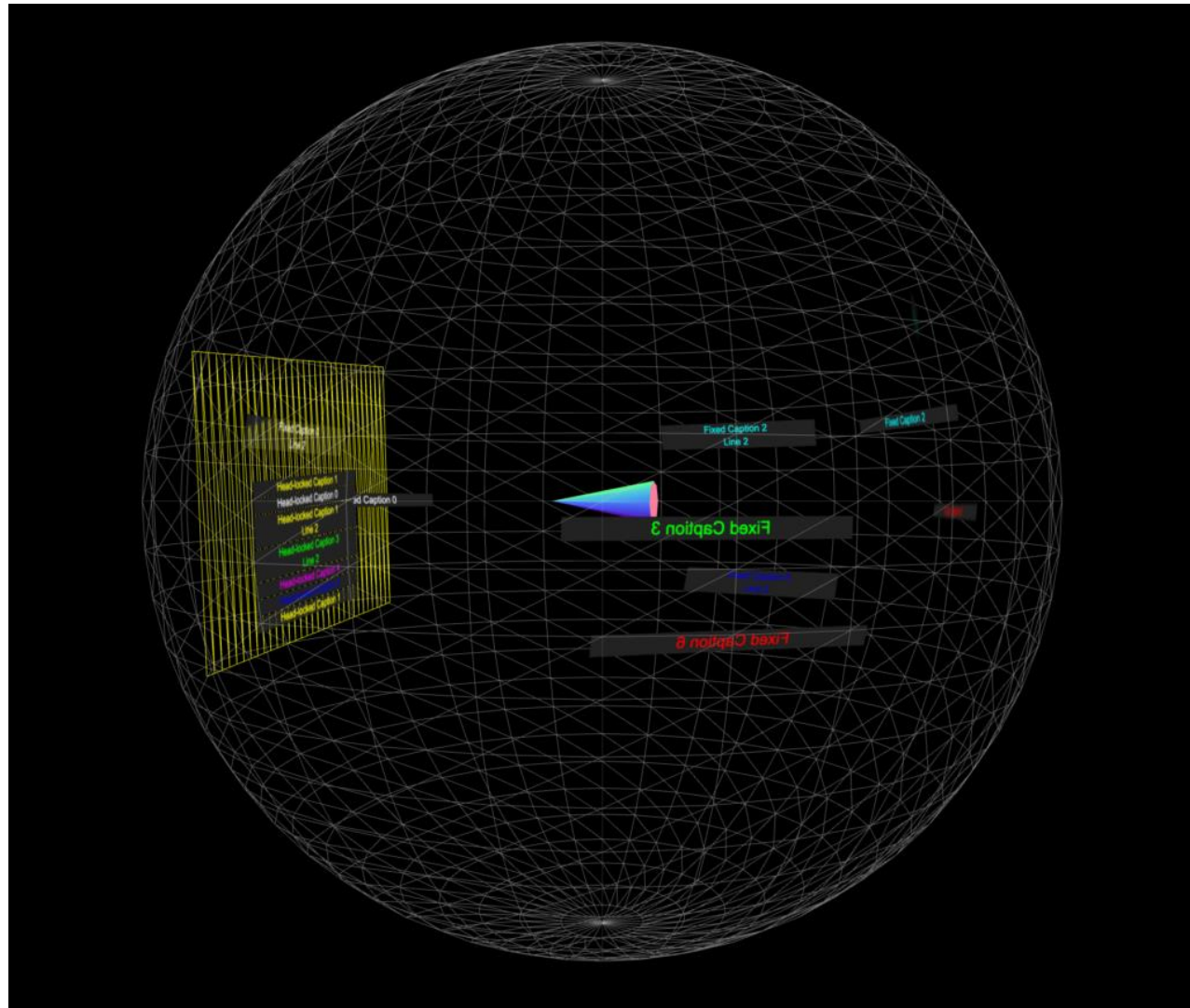
Polar Coordinates

- Position the caption anywhere in the scene using a spherical coordinate system
- radial distance (r)
- polar angle (θ - theta) and azimuthal angle (ϕ - phi)
- values are stored in the caption file



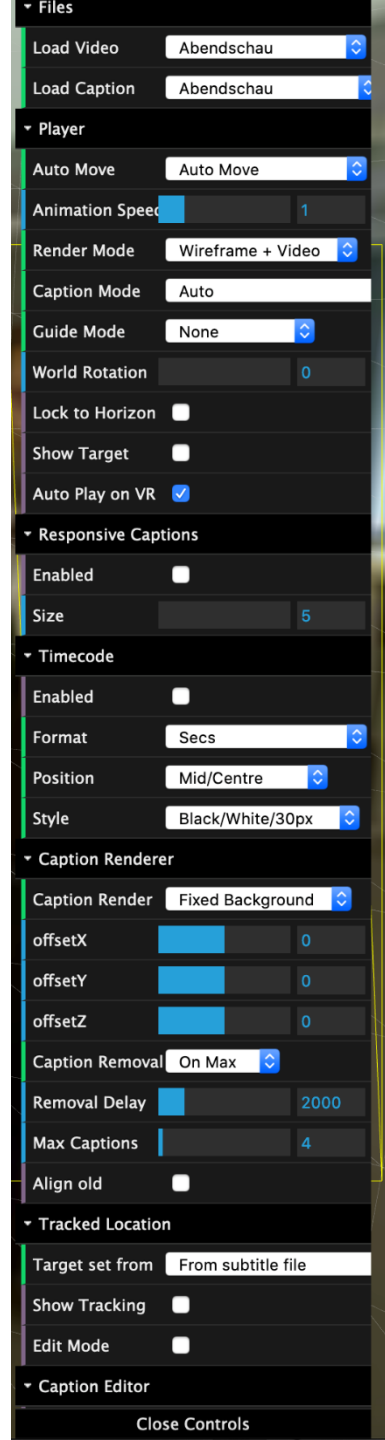
Captions Object based

- Caption Emitter
- Caption Manager

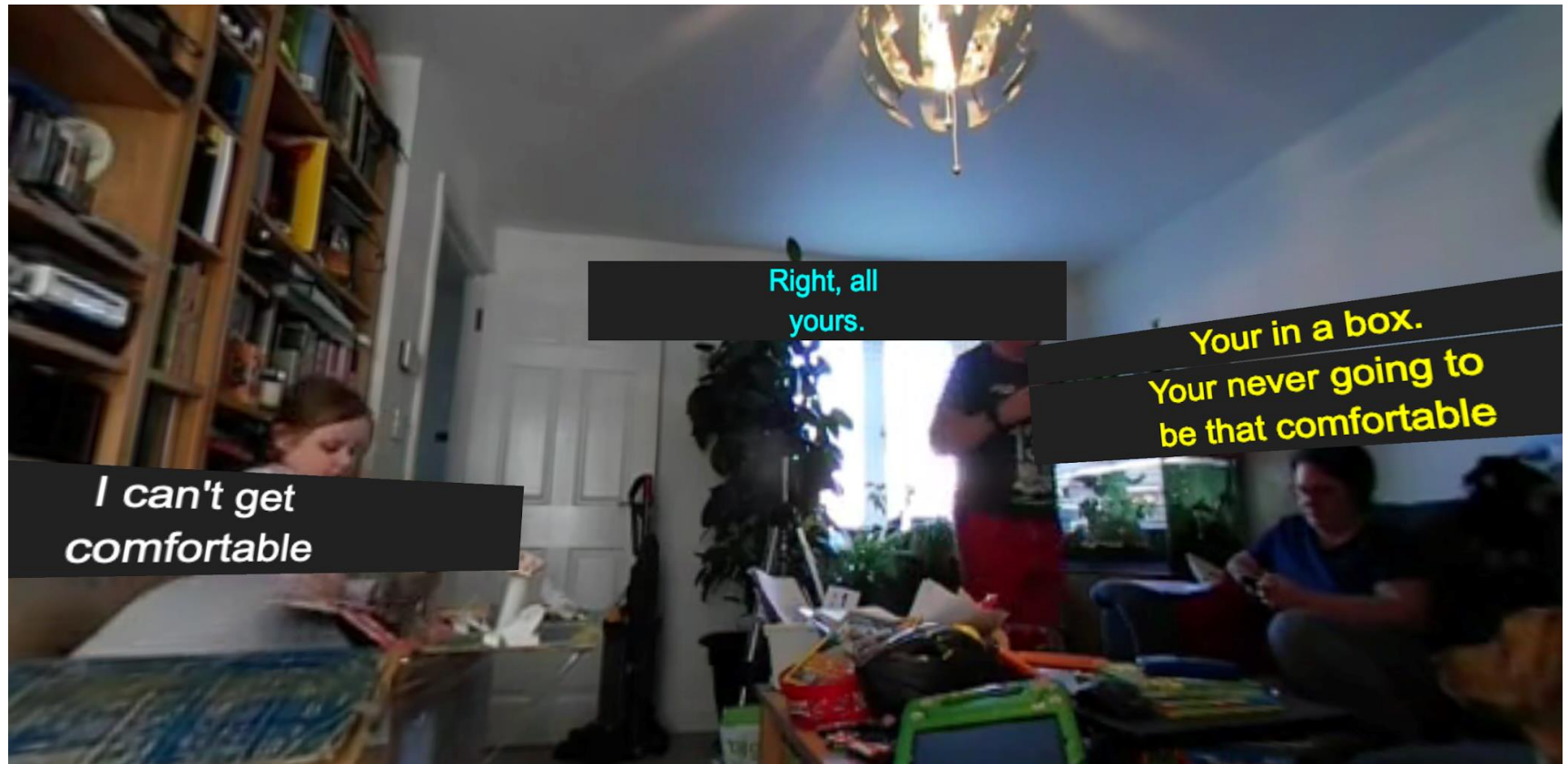


Experimental Framework

- DASH, HLS, Local Files
- Auto move
- Caption Modes
- Guide Modes
- Responsive Captions
- Timecode
- Custom Renderer
 - Offsets
 - Handle removal
- Location Tracking
- Caption Editor



Captions fixed to speaker

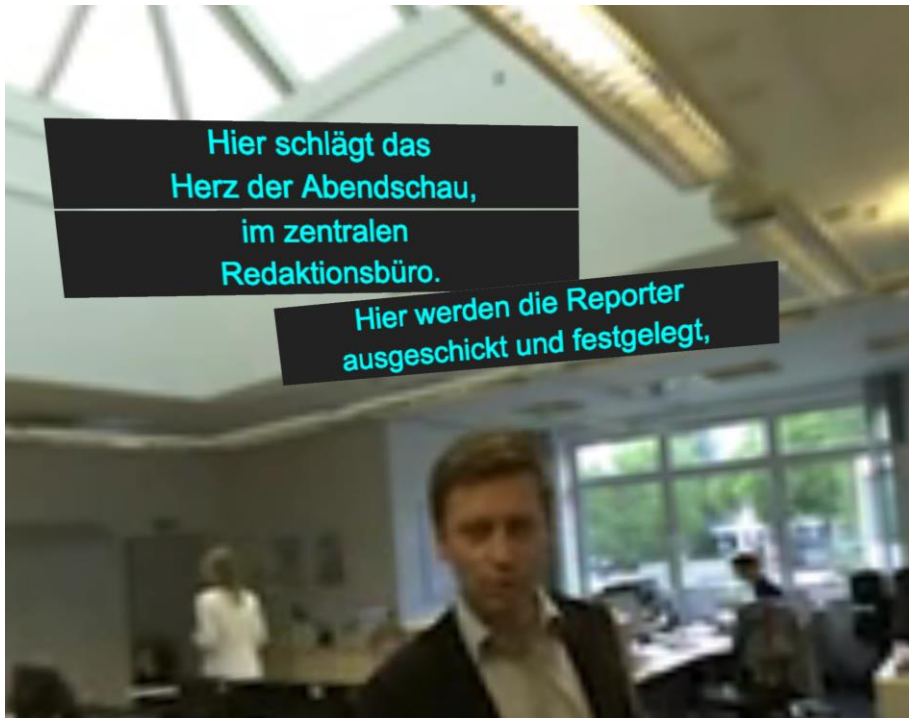


I can't get comfortable

Right, all yours.

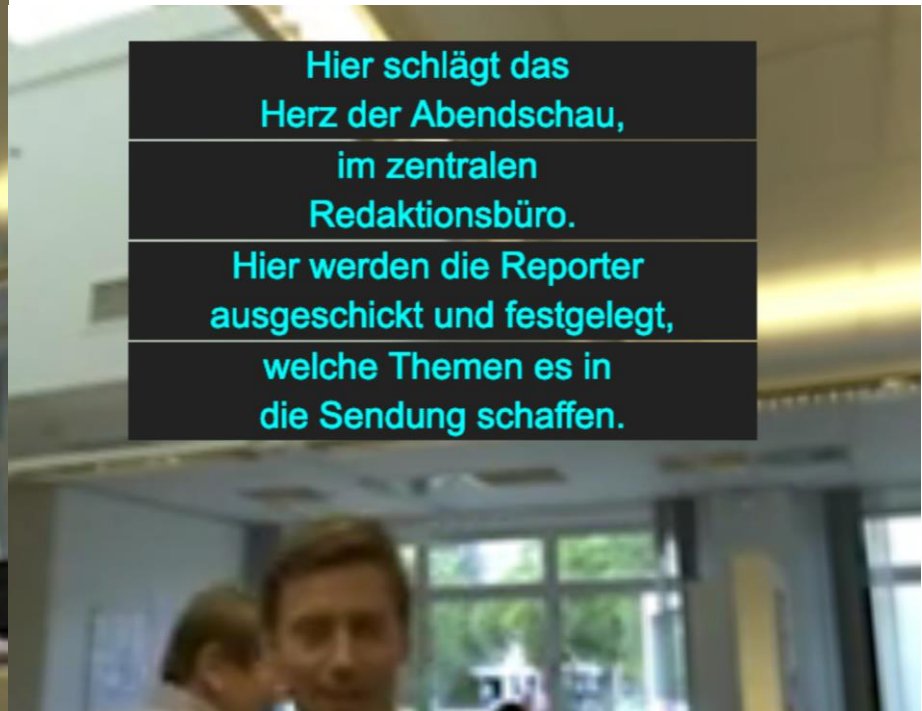
Your in a box.
Your never going to be that comfortable

Stacking (Collisions)



Hier schlägt das Herz der Abendschau, im zentralen Redaktionsbüro.

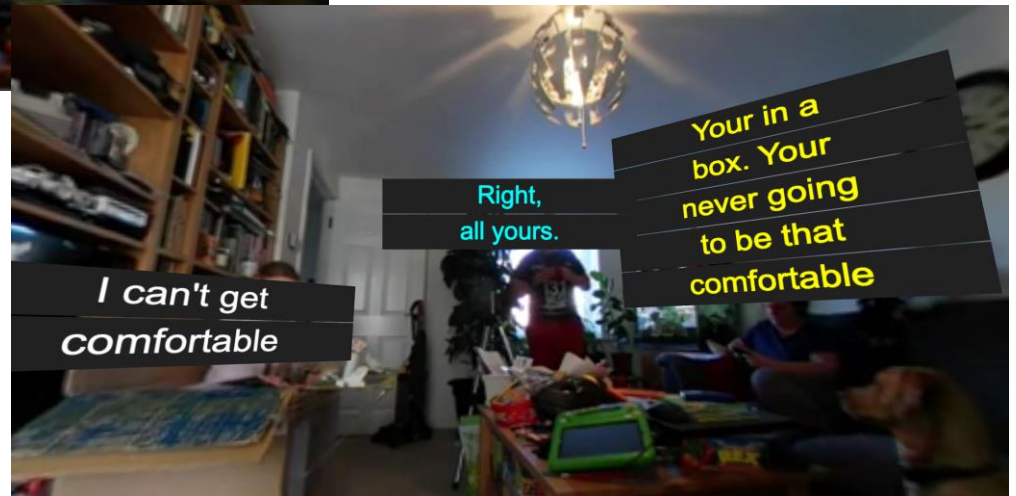
Hier werden die Reporter geschickt und festgelegt,



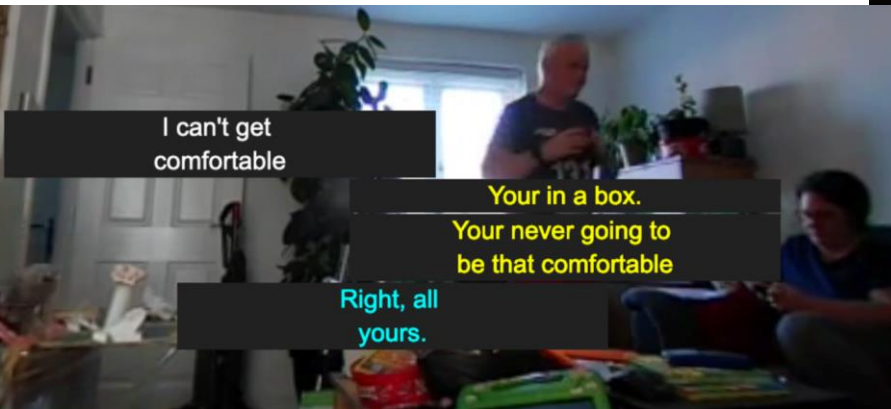
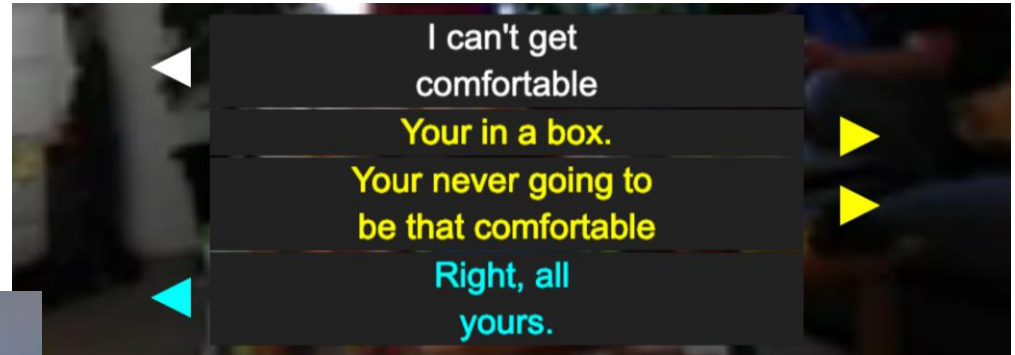
Hier schlägt das Herz der Abendschau, im zentralen Redaktionsbüro.

Hier werden die Reporter geschickt und festgelegt, welche Themen es in die Sendung schaffen.

Responsive (Customization)



Guideing



User Trials – Lessons learnt

- User tests yield limited results unless you can put a working product in front of the user
 - If you offer a paper prototype it is possible to cause confusion
 - Often leads to users saying they prefer what they already have.
- In this area many technologies have a learning step
 - You cannot ask a user to evaluate a prototype while they are learning
- The content is important
 - If the users have no interest in what is being presented it will not be a fair test

Henry Ford – on the invention of the motor car:

“If I had asked people what they wanted, they would have said faster horses.”

New Observation

- Users don't know what they do:
 - If you ask them if they read a subtitle or saw an object they often don't know if they did or not.
 - Possibly these tasks are done subconsciously.
 - Possibly the user doesn't remember.
- Eye tracking doesn't lie...

Eye Tracking in 360

How to do tracking in 360

- Conventional eye trackers are high speed cameras which need a clear view of the users eyes
- Traditional eye tracking is done in a fixed position in 2D
- After market eye tracking for HMD's is clunky!

HTC Vive Eye Pro

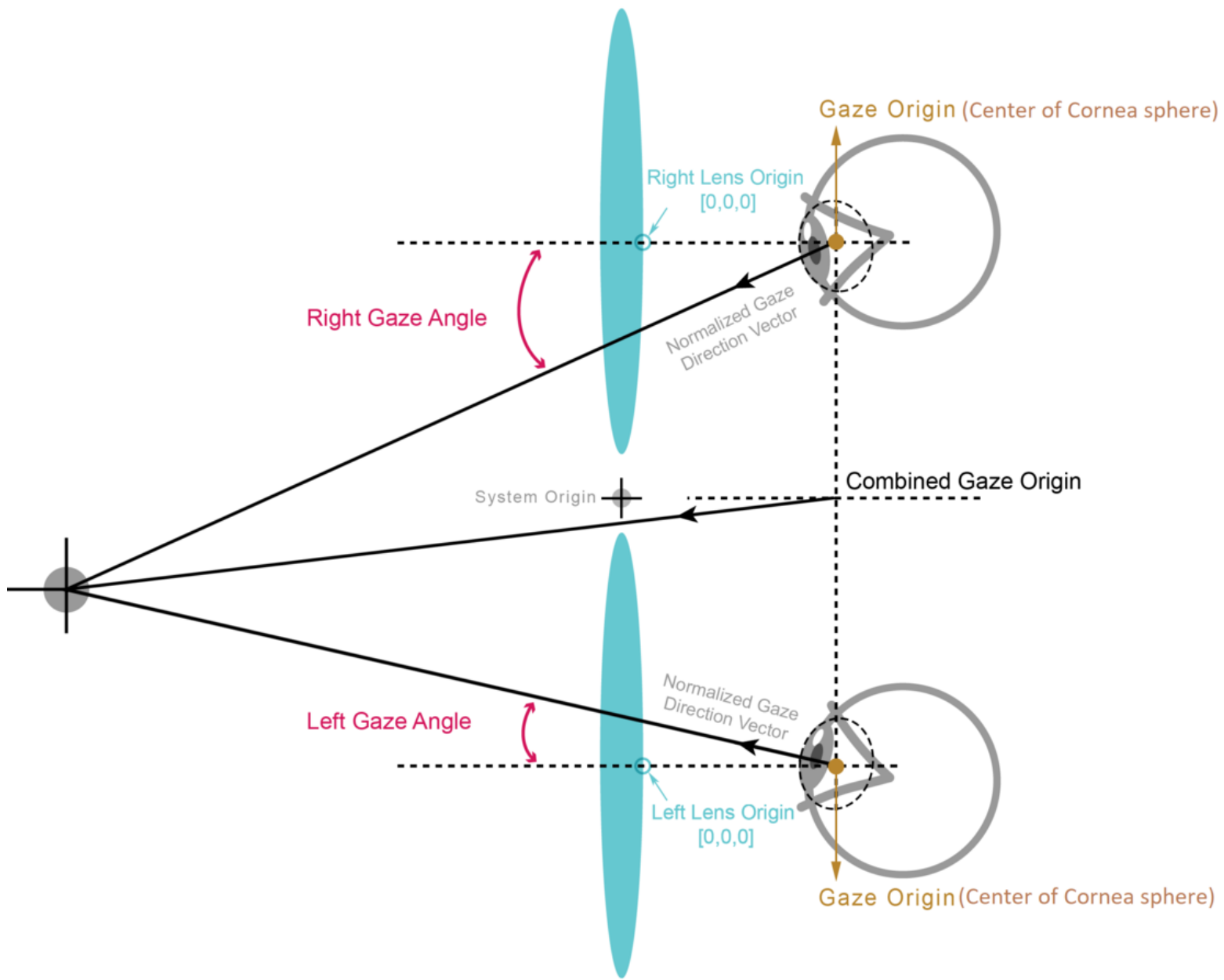




- 120Hz Eye tracking

SRanipal API

- SDK from Vive
- The SRanipal SDK allows developers to track and integrate users' eye and lip movements, empowering developers to read intention and model facial expression.
- The SRanipal SDK includes the required runtime which runs in the notification tray to show the current eye tracking status for VIVE Pro Eye.
- Plugins for Unreal and Unity are included



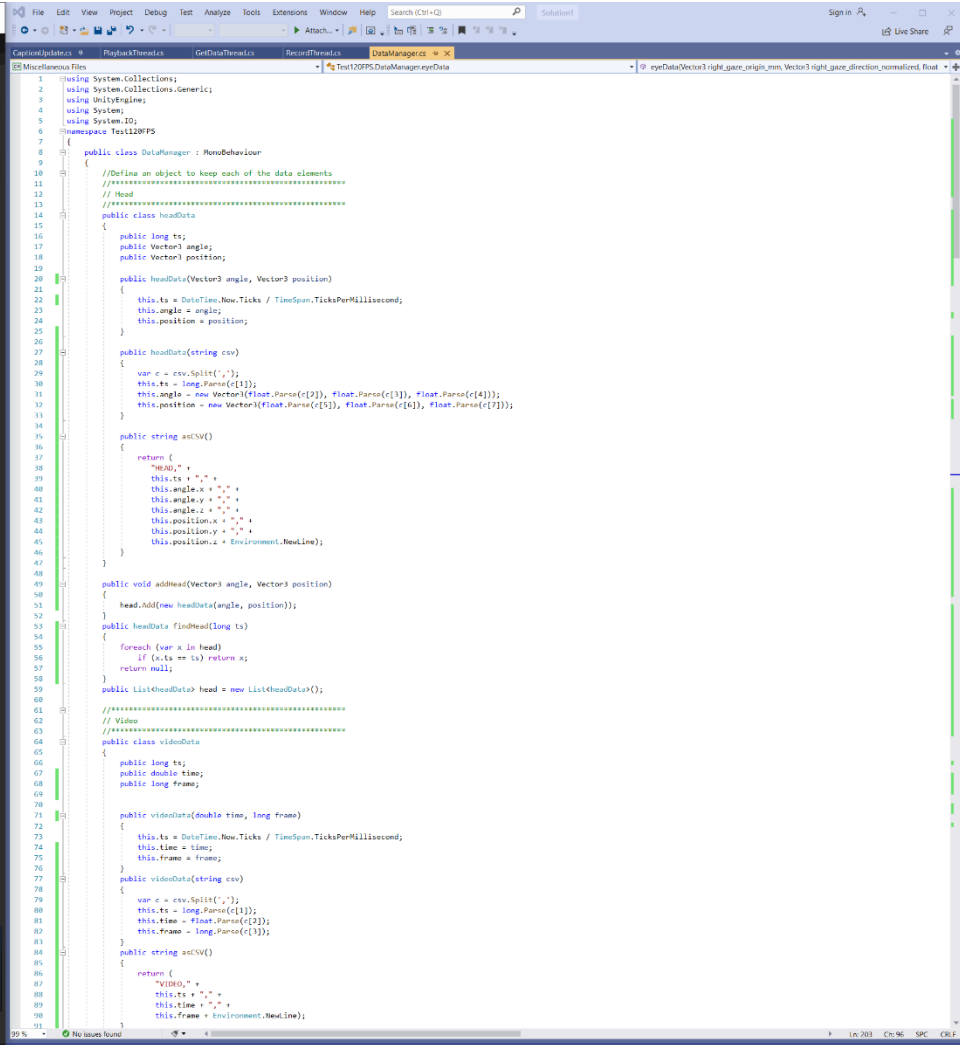
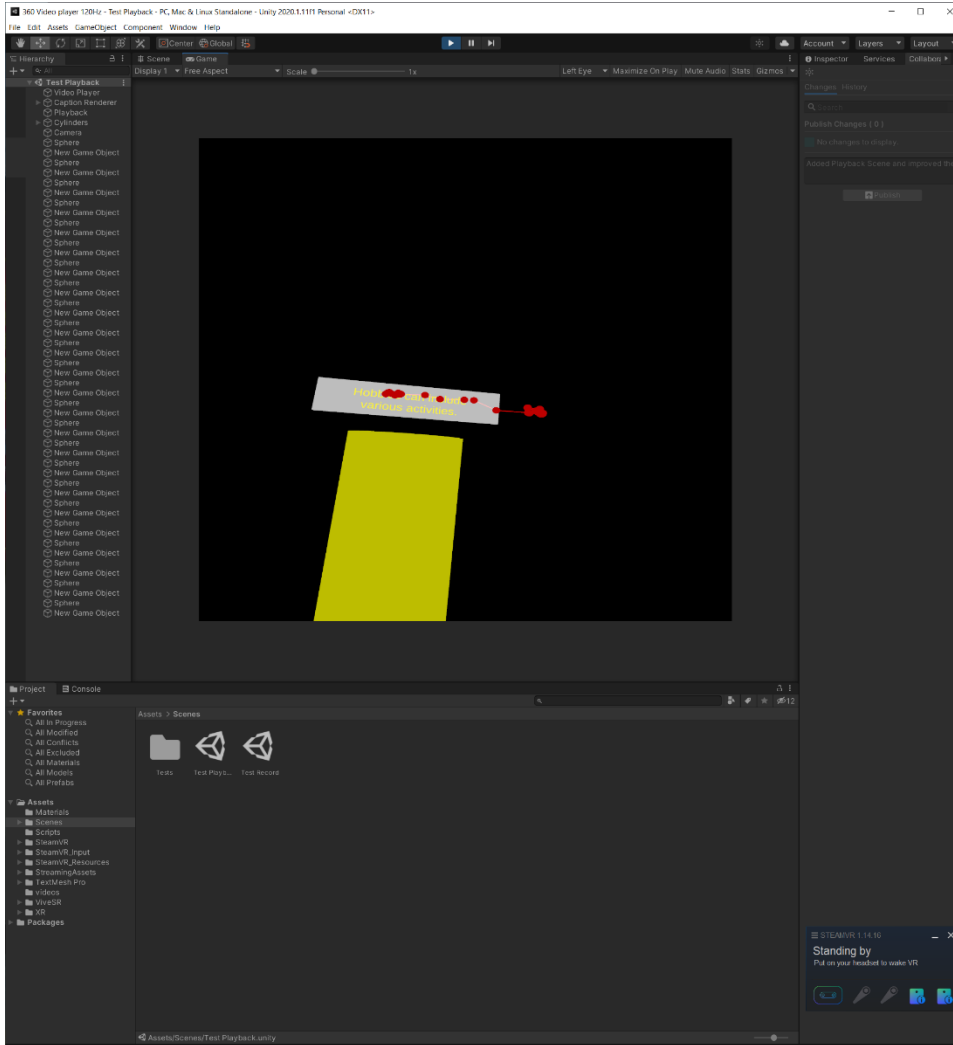
Key Data

- Gaze origin mm
 - Gaze direction normalized
 - Pupil diameter mm
 - Eye openness
 - Pupil position in sensor area
-
- .. for both eyes

Unity



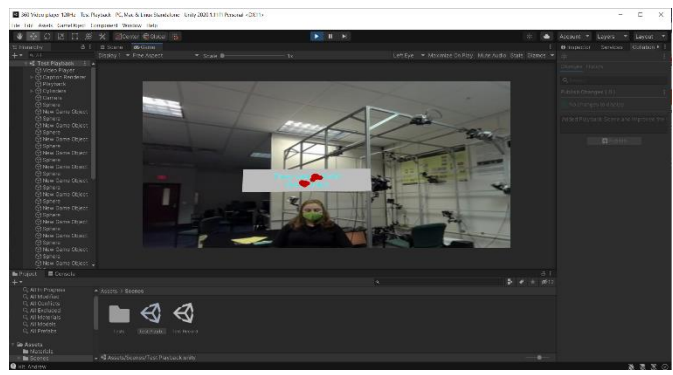
unity



Architecture



120Hz Thread
Capture Eye
Tracking Data



90Hz Unity Test
Recorder

Head Orientation
Video Position
Caption State

Data Manager

Head Orientation
Video Position
Eye Data
Caption State

Unity Playback /
Analyser

Caption
Manager

File
Management

Eye Data



Demo

Eye Tracking

In 360 Video

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