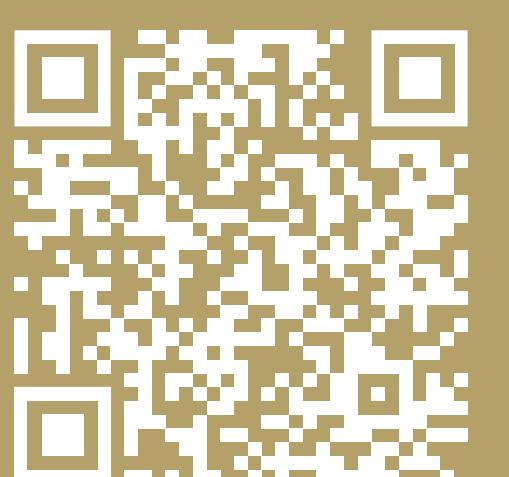


# Using mobile eye tracking for gaze- and head-contingent vision simulations

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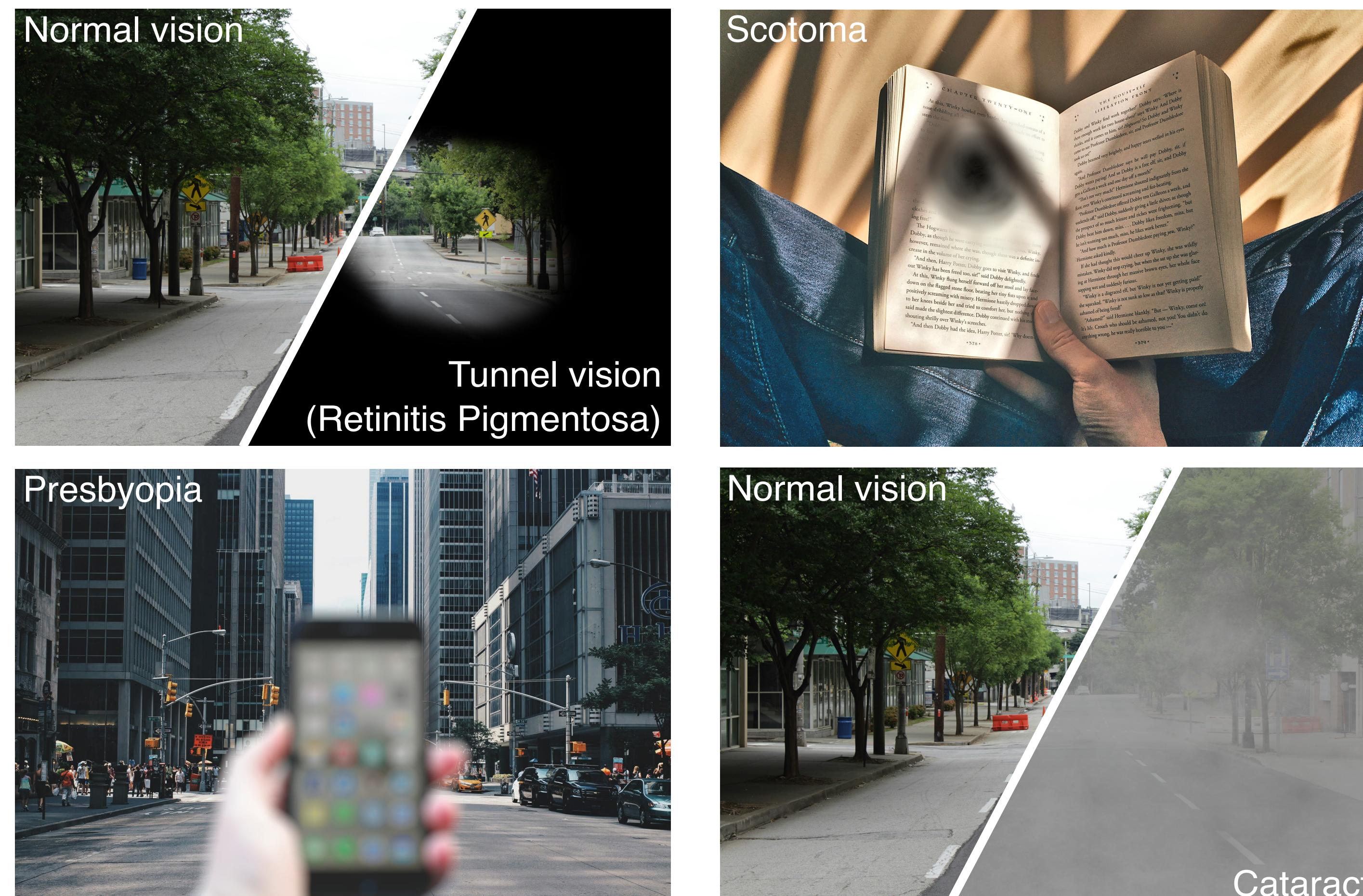


## Purpose

*How can we intuitively demonstrate the influence of visual impairments or retinal diseases on everyday life?*

- Visualizations can give a basic understanding of visual impairments. However, single illustrations lack immersion.
- For students or patients and their relatives, an immersive, gaze-contingent demonstration could help with experiencing how visual impairments impact our perception.

Typical visualizations of visual impairments and eye pathologies



VR is a promising tool for vision simulations in research and demonstrations. However, in some situations VR headsets cause problems:

- Some individuals cannot use VR headsets or feel reluctant towards them.
- The user is isolated from the instructor or physician, which can cause insecurity.

*Objective: Improvement of immersion and accessibility of visual demonstrators*

## Methods

### Mobile eye tracking



PupilLabs Core is used for head and gaze tracking for a screen-based vision simulation running in Unity.

- Fiducial markers are used to
  - map gaze on the screen
  - estimate head position

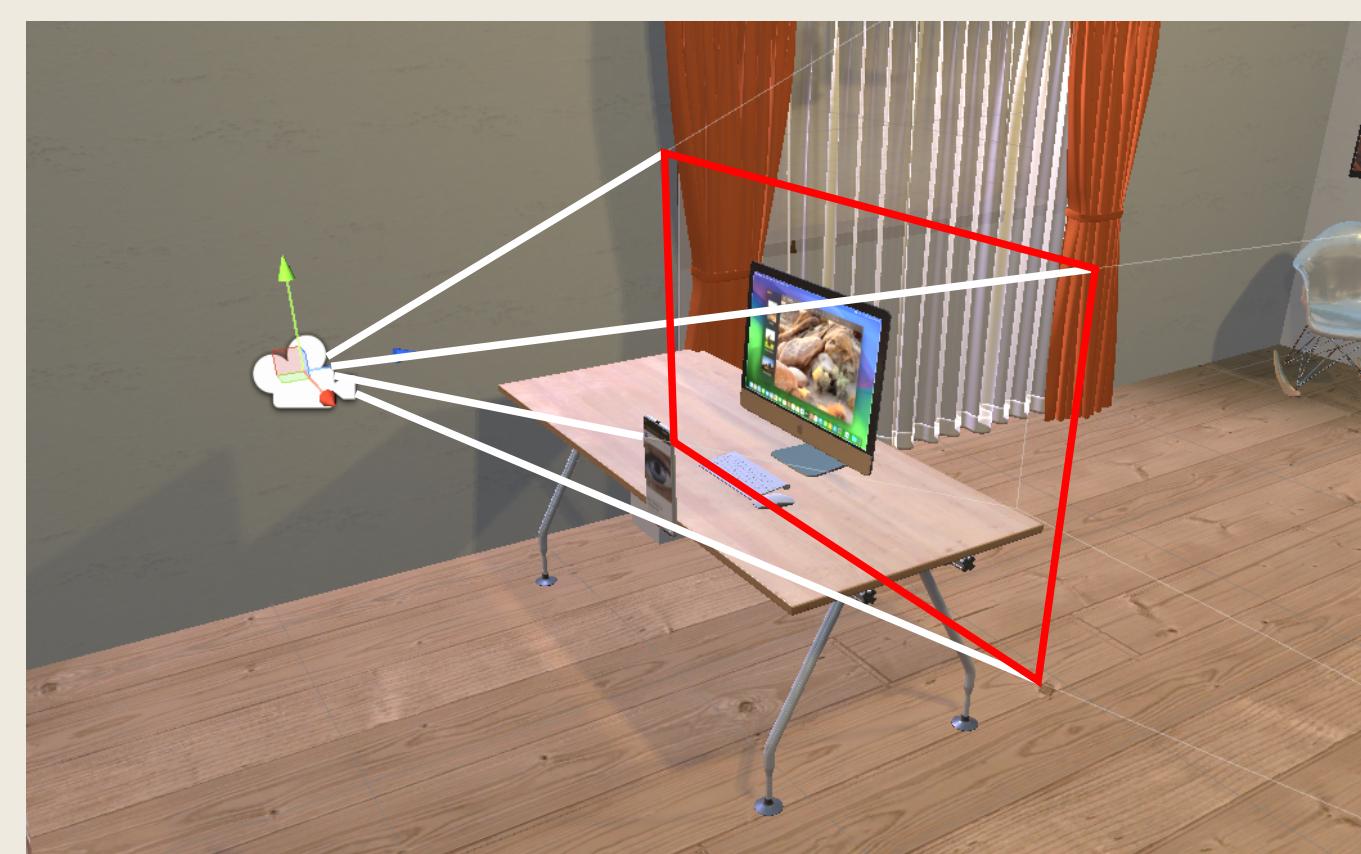
### Head tracking



Head pose relative to the screen is estimated from the fiducial marker position in the eye tracker's scene camera.

- Tracking quality could be improved using IMU or external trackers.

### Off-axis projection



The camera position in the virtual world is updated in Unity by accessing the head position via PupilLabs network API.

- The projection properties are adjusted for an off-axis projection, which simulates the view "through a window" into the virtual world.

### Gaze-contingent simulation



PupilLabs surface mapping is used to map gaze to the screen surface. In Unity, the gaze position is accessed via network API.

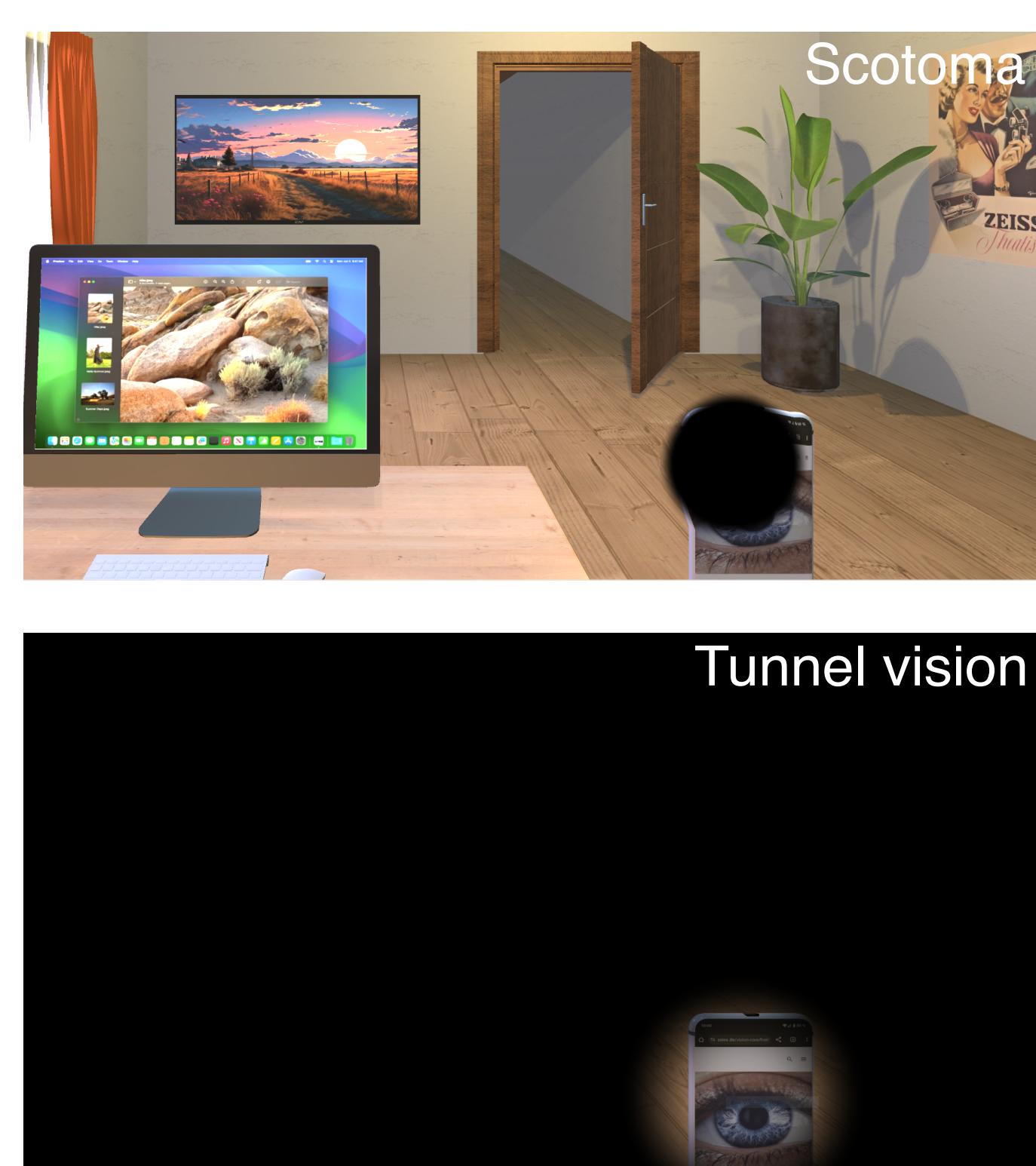
- Screen coordinates are transformed to calculate 3D gaze direction in the virtual scene.

## Results and Discussion

Simulation of gaze-contingent blur for demonstrating refractive errors



Simulation of central and peripheral visual field defects



**Advantages of off-axis projection and gaze surface mapping for vision simulations:**

- No complex VR or dome setup is necessary.
- Better suited for teaching or presenting to groups.
- User is not isolated but can still interact with the instructor.
- Existing VR gaze training could be more accessible for individuals who cannot use VR headsets.

### Video demo:

