Spatial Audio Designer

Nicholas F. Polys, Noam Bendelac

Web3D 2022

Target Users

- Digital music creators
- Digital audiovisual 3D artists
- Physical audiovisual installation artists who wish to develop ideas in a virtual space
    - Inspired by the student's experience working with installation artists on a piece with limited time in a physical space

User Interviews and Requirements

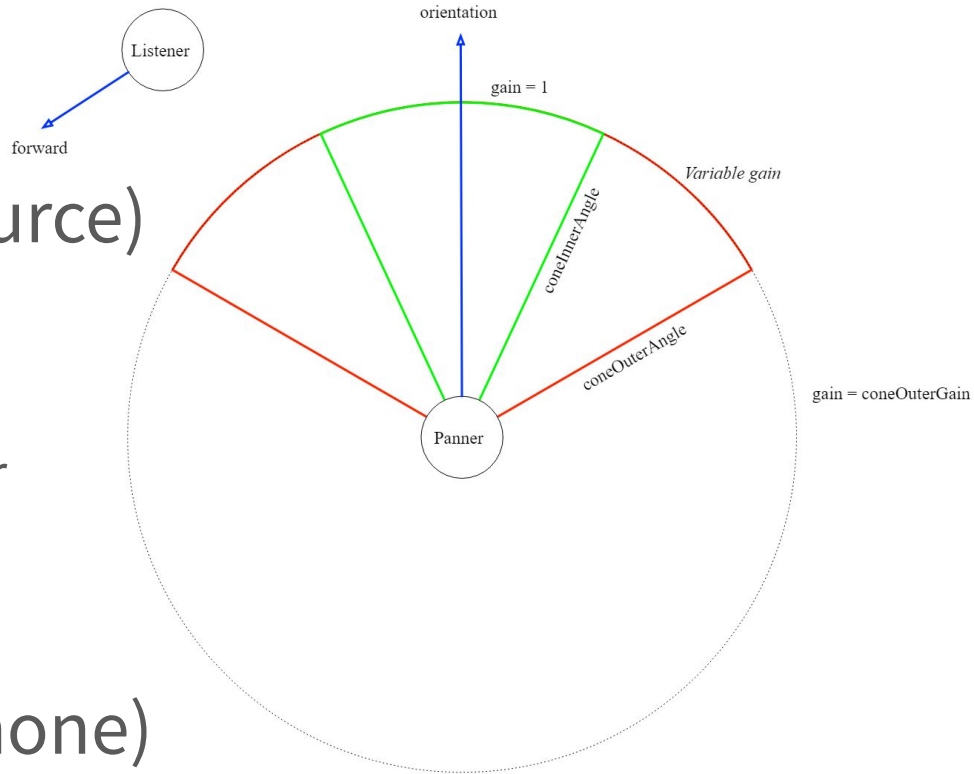Interviews with professors and practitioners in audio design provided requirements for the application

- Users can control movement of their virtual camera in the 3D space
- Users can hear the spatialized audio change due to their position in real-time
- Users can translate, rotate, and change the shape of the spatial sound field of sound sources
- The application should make it easy for non-technical artists to learn the tool and share their results
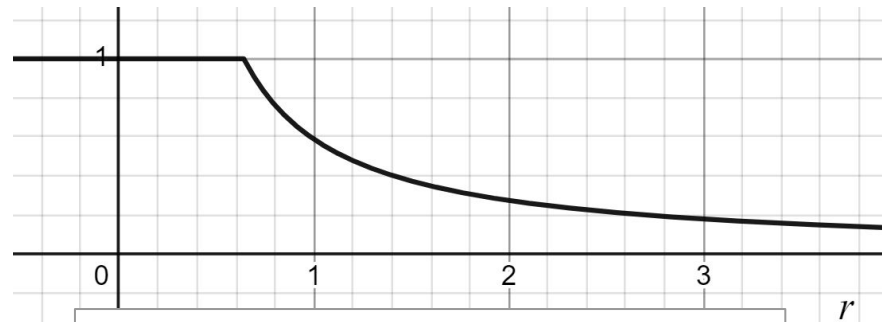
Web Audio API

- ## PannerNode (sound source)
  - Position
  - Orientation
  - Attenuation distance factor
  - Directionality (angles)
  - Outer angle gain
- ## AudioListener (microphone)

Web Audio API

orientation

Listener

θ

forward

gain = 1

coneInnerAngle

Variable gain

coneOuterAngle

gain = coneOuterGain

r

Panner

$$distanceCoeff = \frac{refDist}{refDist + rolloffFactor \cdot (max(r, refDist) - refDist)}$$

$$angularCoeff = mix(1.0, coneOuterGain, clamp(ilerp(innerAngle, outerAngle, \theta), 0.0, 1.0))$$

Design Challenges

- Parameter manipulation
  - Position, orientation
  - "Sound field":
    - Inner and outer angle
    - Attenuation distance factor
- Situated 3D handles
- vs. 2D sliders
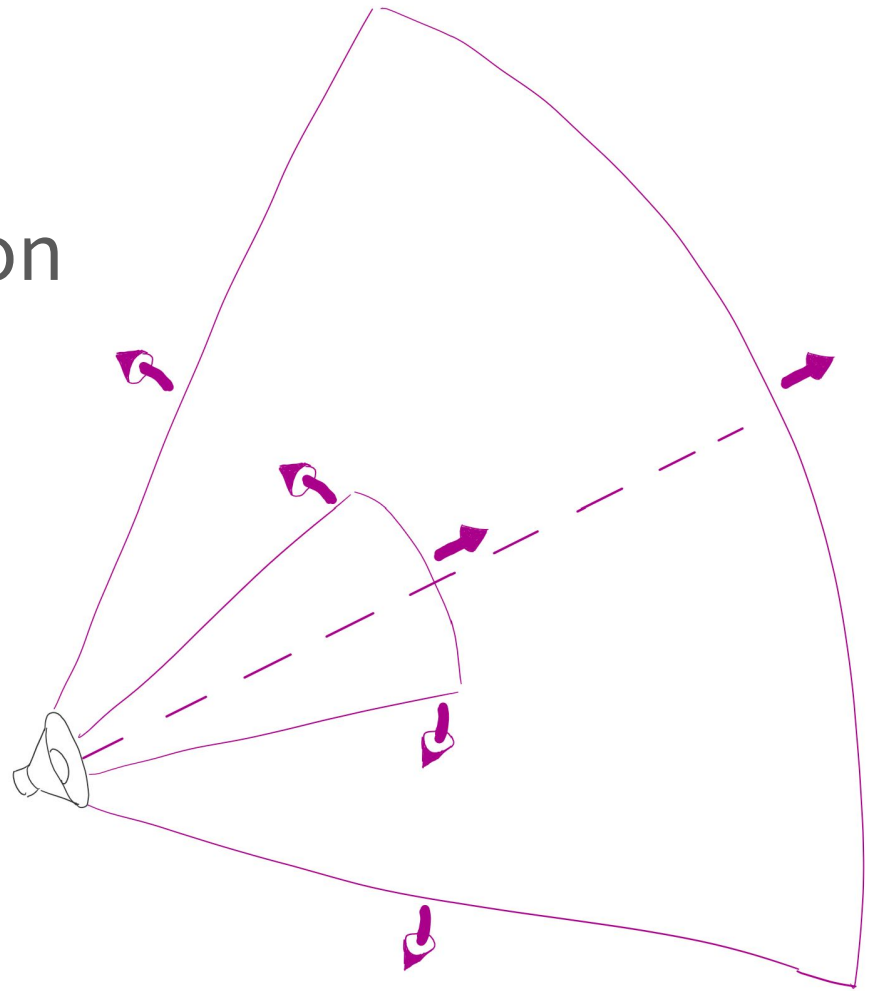
Design Challenges

- Visualization of audio
  - Sound source's reach in space
  - Sound levels and mixing combinations
- Transparent cones
  - Show boundaries well, but don't show sound combinations well
- Heatmap
  - Sources are color coded, brightness shows loudness
  - Shows relative loudness and sound mixing well
  - Impedes seeing the actual scene

Implementation Challenges

Learning curves

- Three.js
  - Shaders
  - 6DOF manipulators
- Web Audio
- React
- Typescript

Global Options

| Toggle audio field cone visualization | Toggle audio field heatmap visualization |
| Toggle between scenes | Save current scene |

Audio files may take several seconds to load, please be patient.

Controls

Left Click - Select/Deselect Sound Source

Left Click + Drag - Rotate Camera

Right Click + Drag - Translate/Move Camera

Scroll - Zoom In/Out

GitHub Repo

Sound Source Options

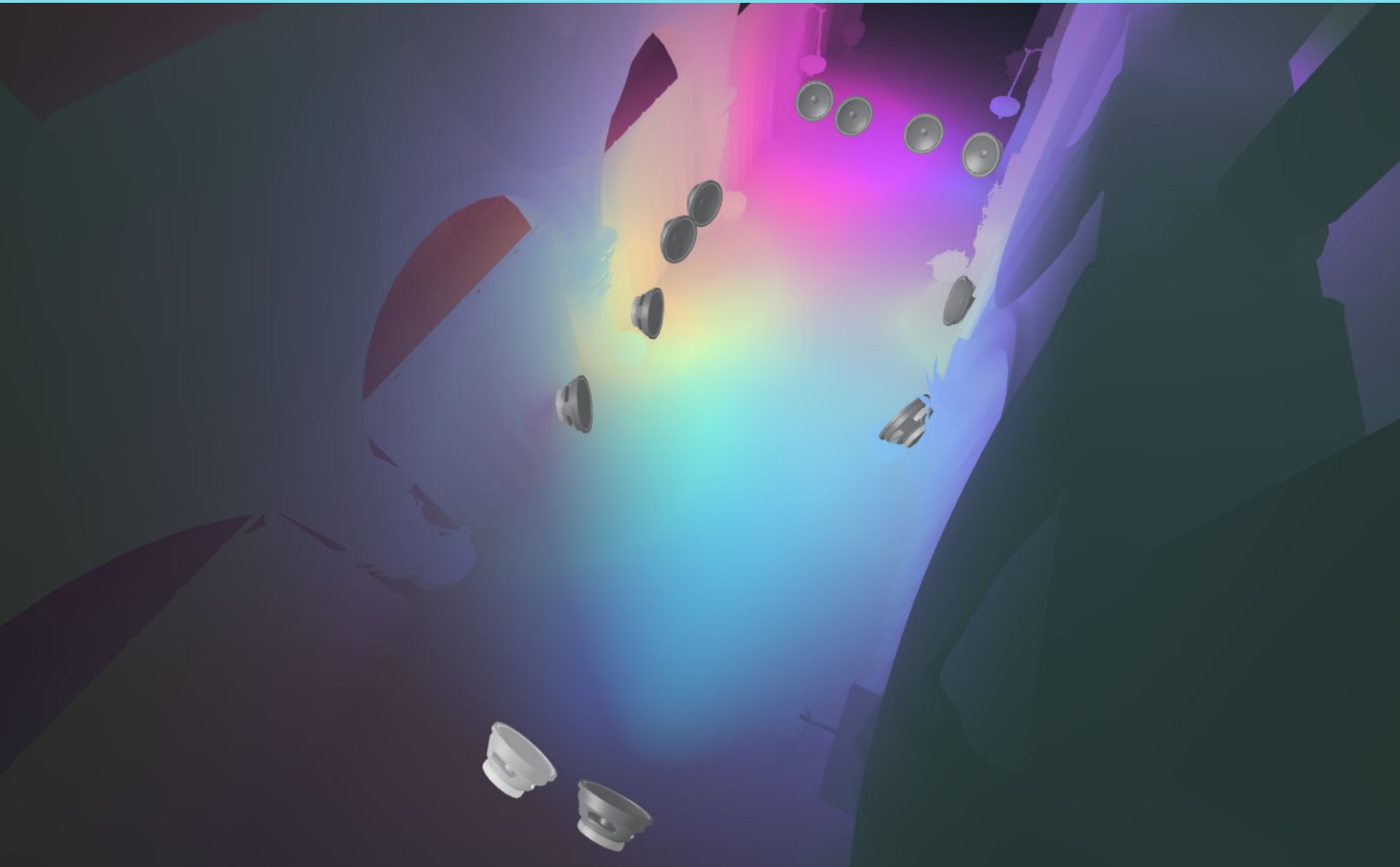### 2 - speaker 2

X: -5 ——————— 5

Y: -5 ——————— 5

Z: -5 ——————— 5

Yaw: -180 ——————— 180

Pitch: -90 ——————— 90

Cone inner angle: 0 ——————— 360

Cone outer angle: 0 ——————— 360

Cone outer level: 0 ——————— 1

Cone attenuation distance: 0 ——————— 5

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GitHub Repo

Sound Source Options

9 - Sub

X: -5 ▭▭▭▭ 5

Y: -5 ▭▭▭▭ 5

Z: -5 ▭▭▭▭ 5

Yaw: -180 ▭▭▭▭ 180
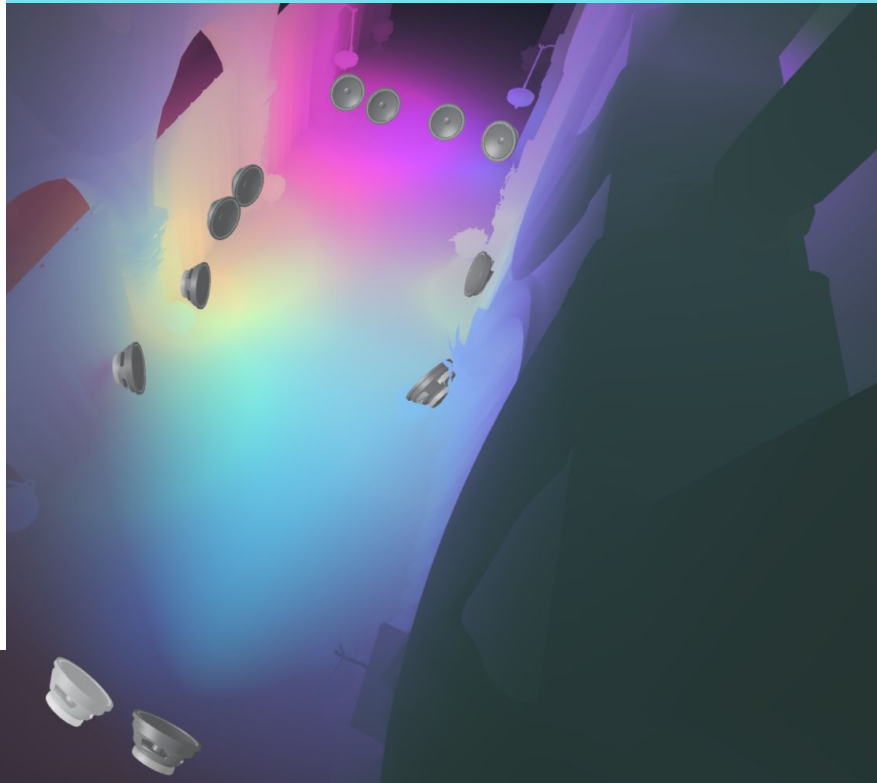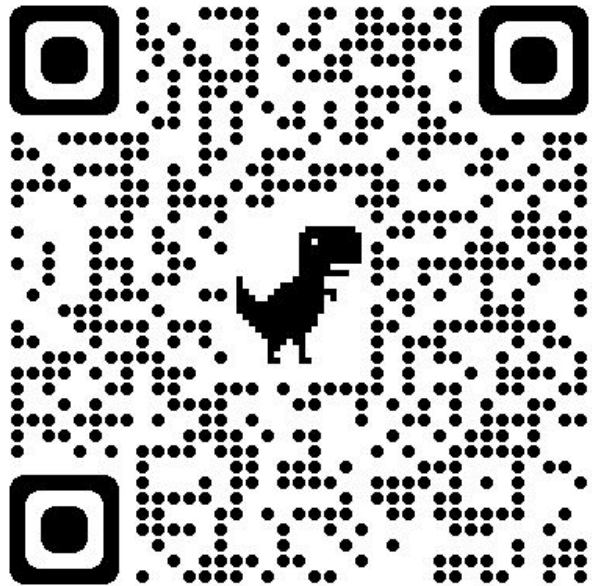
Pitch: -90 ▭▭▭▭ 90

Cone inner angle: 0 ▭▭▭▭ 360

Cone outer angle: 0 ▭▭▭▭ 360

Cone outer level: 0 ▭▭▭▭ 1

Cone attenuation distance: 0 ▭▭▭▭ 5

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