



ShapeSonic: Sonifying Fingertip Interactions for Non-Visual Virtual Shape Perception

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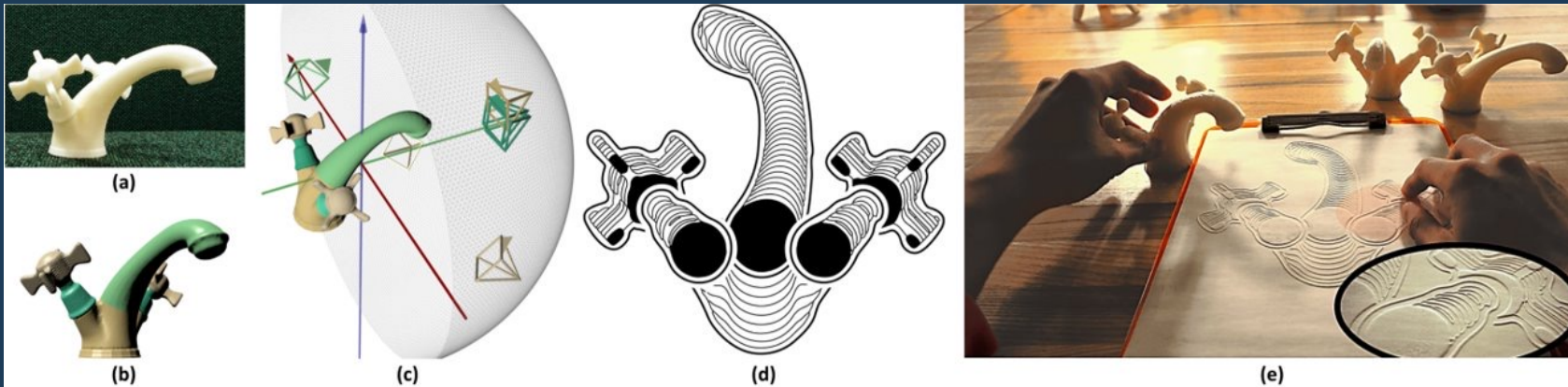
Yotam Gingold George Mason University



How can we create a non-visual interface for shape perception?



Tactile Approaches

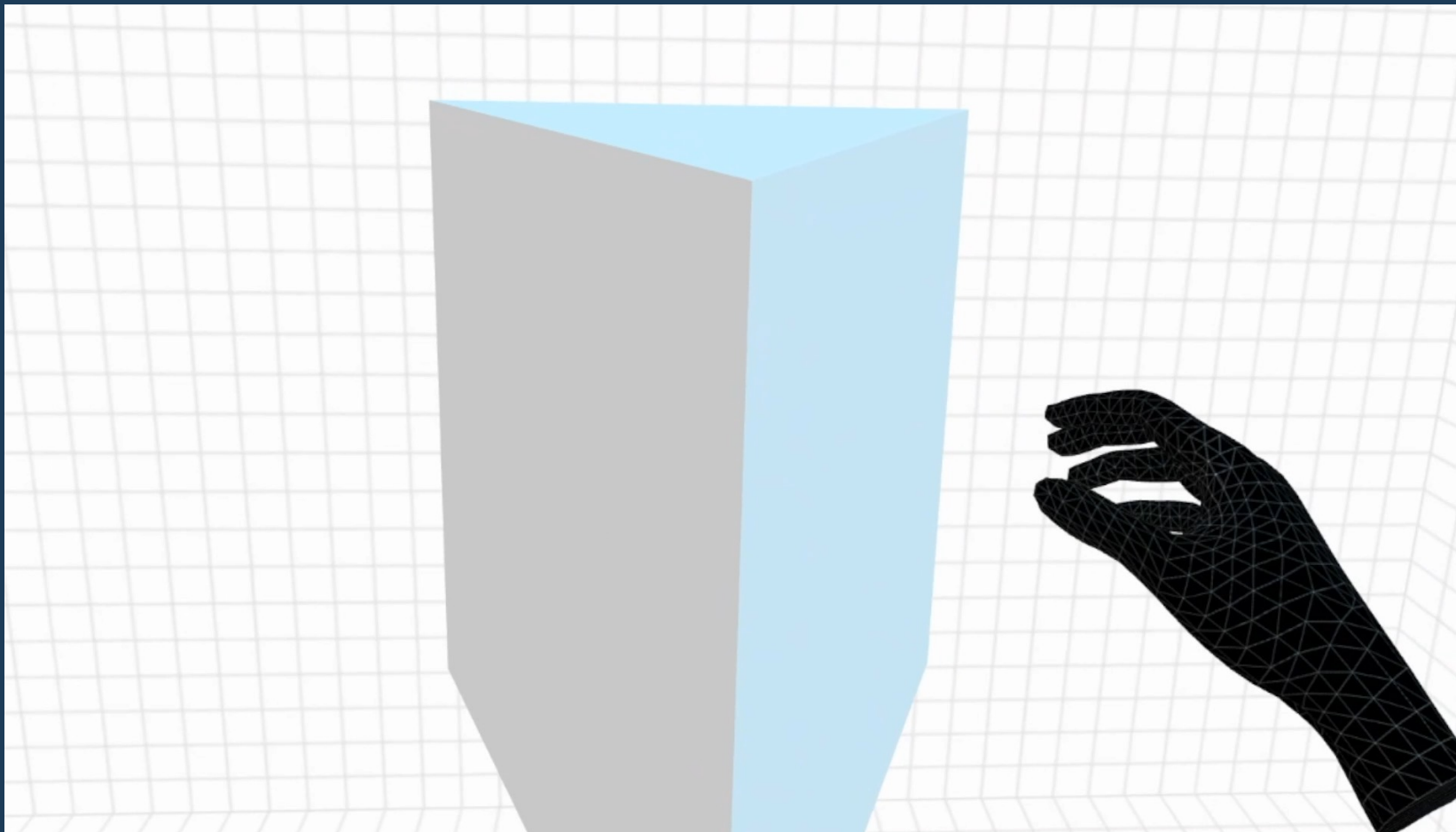


Panotopoulou et al. 2020

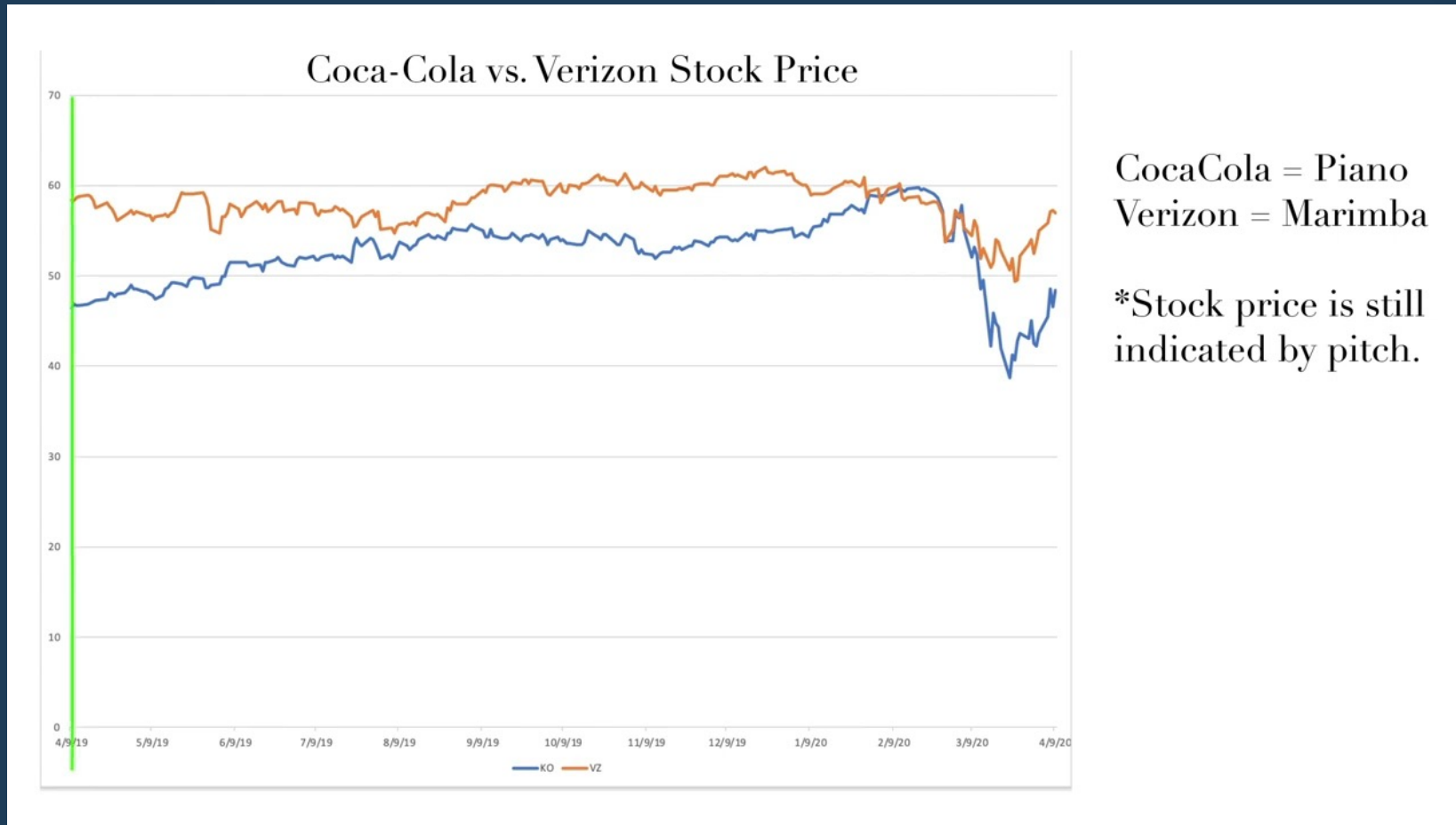


Siu et al. 2019

ShapeSonic is a sonification-based approach for perceiving shapes



Sonification is mapping information to sound

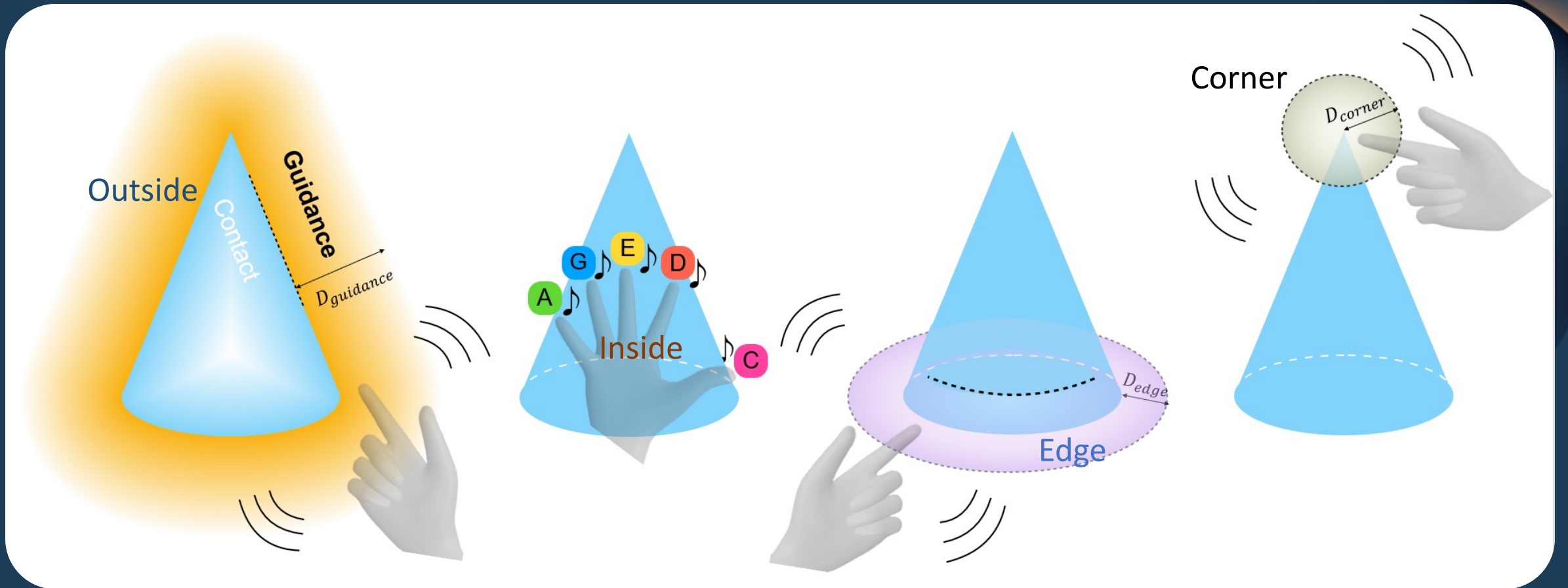


How should hands map to sound?



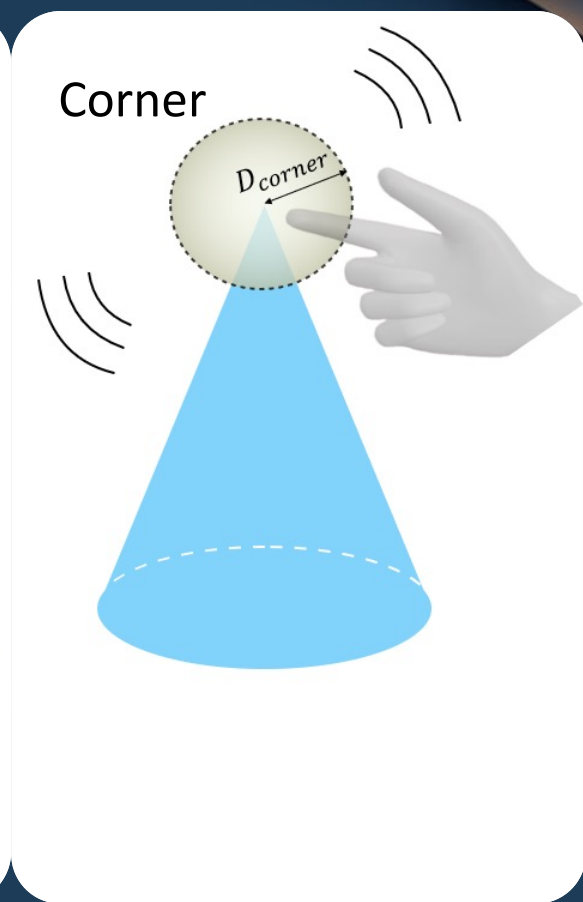
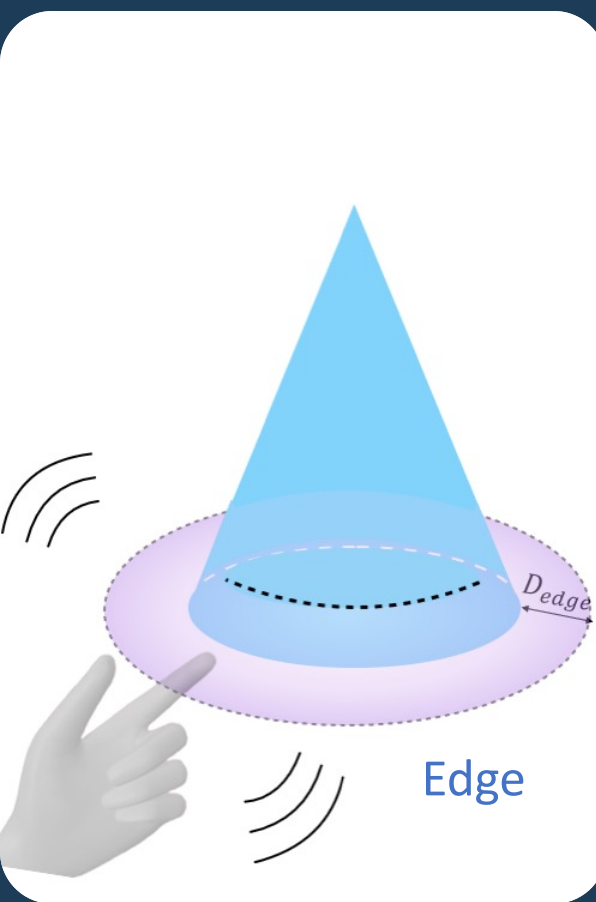
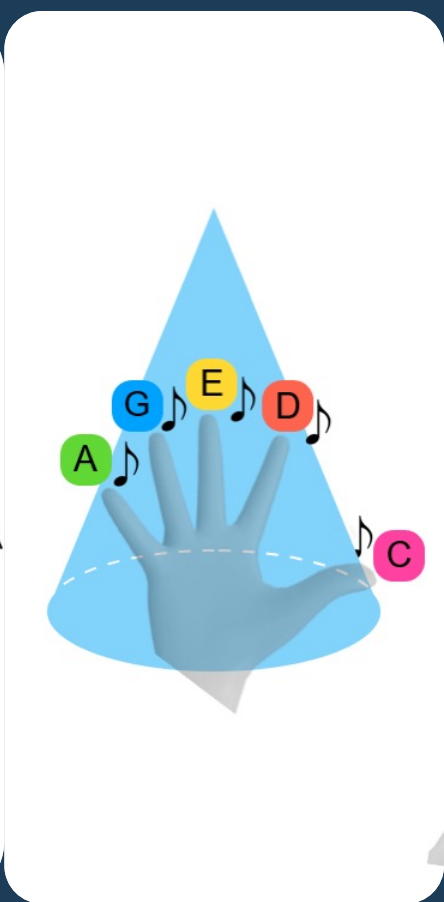
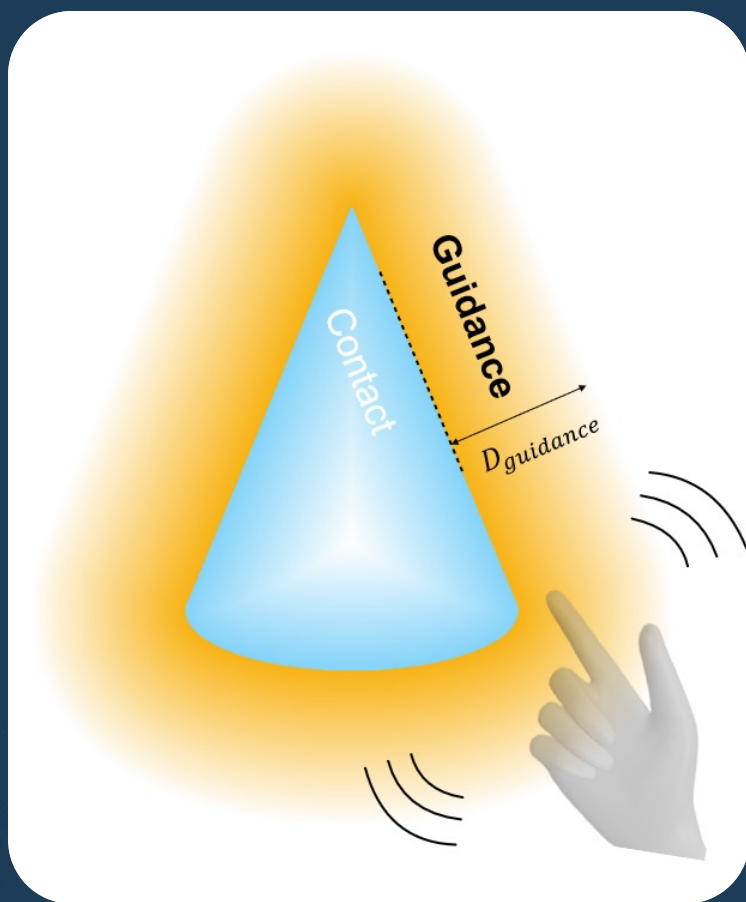
- *Volume*
- *Pitch*
- *Timbre*
- *Spatialization*
- Tempo
- ...

Sonification regions divide space around the shape into zones

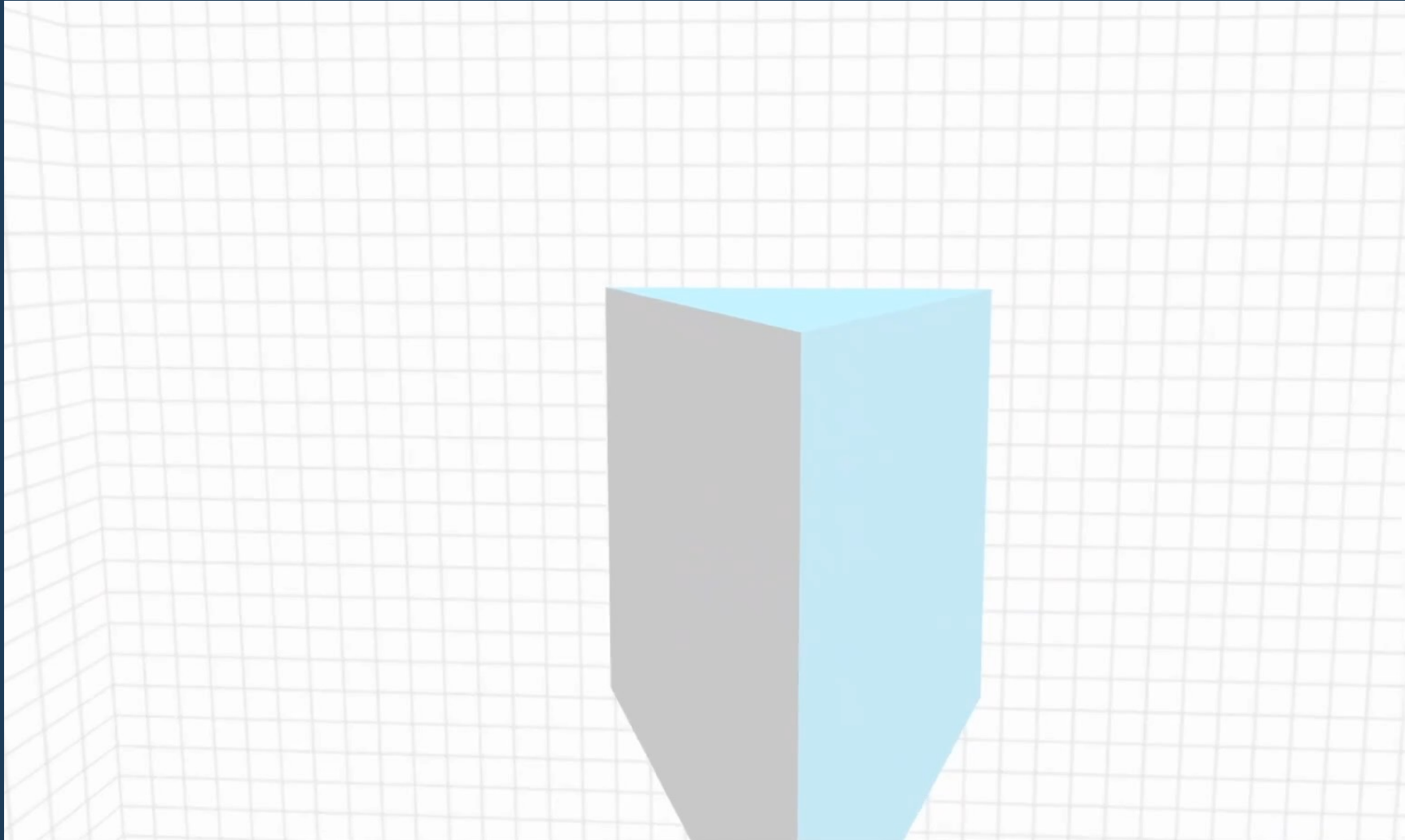


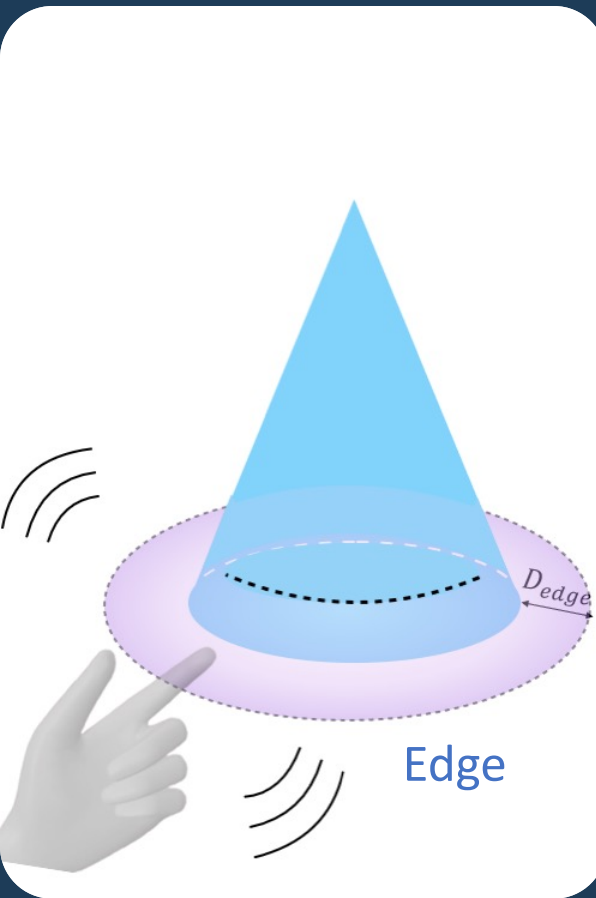
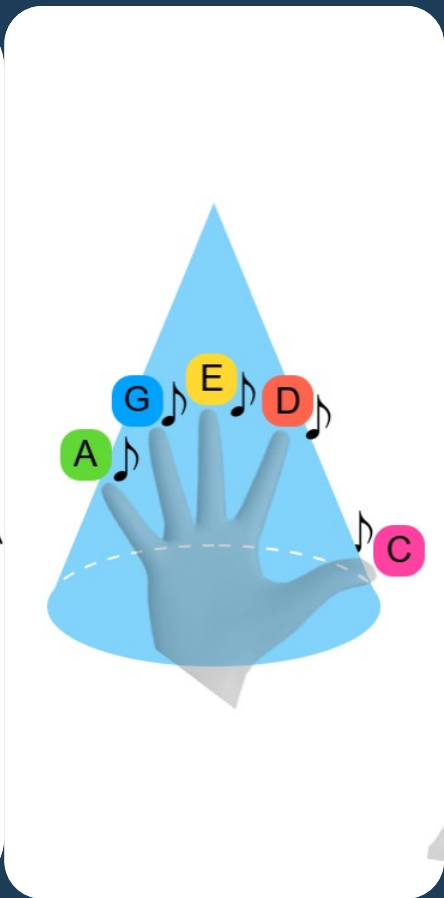
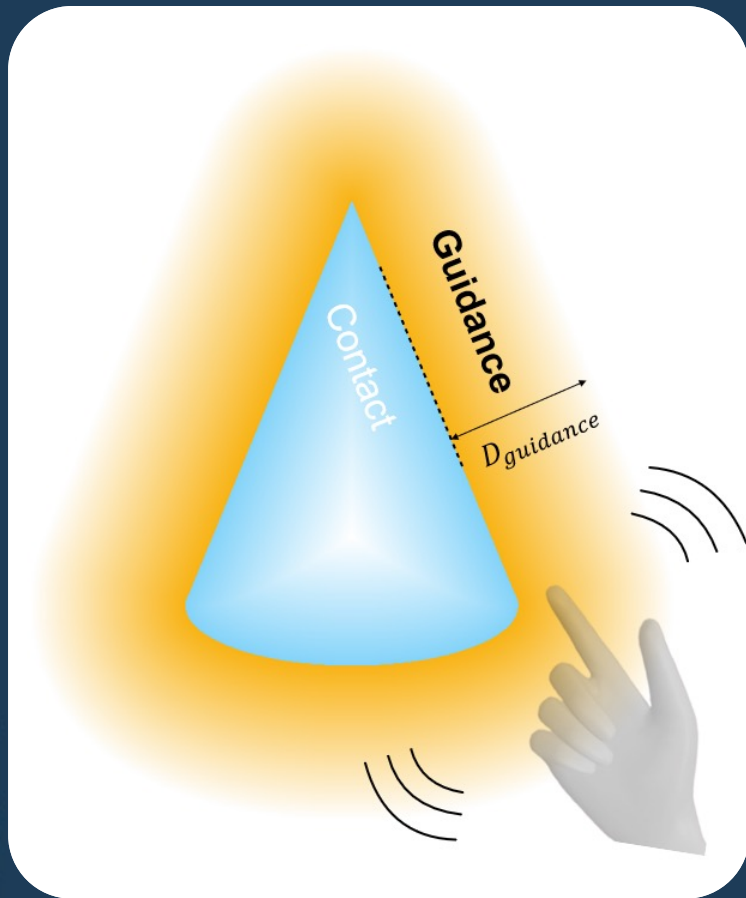
Spatialization



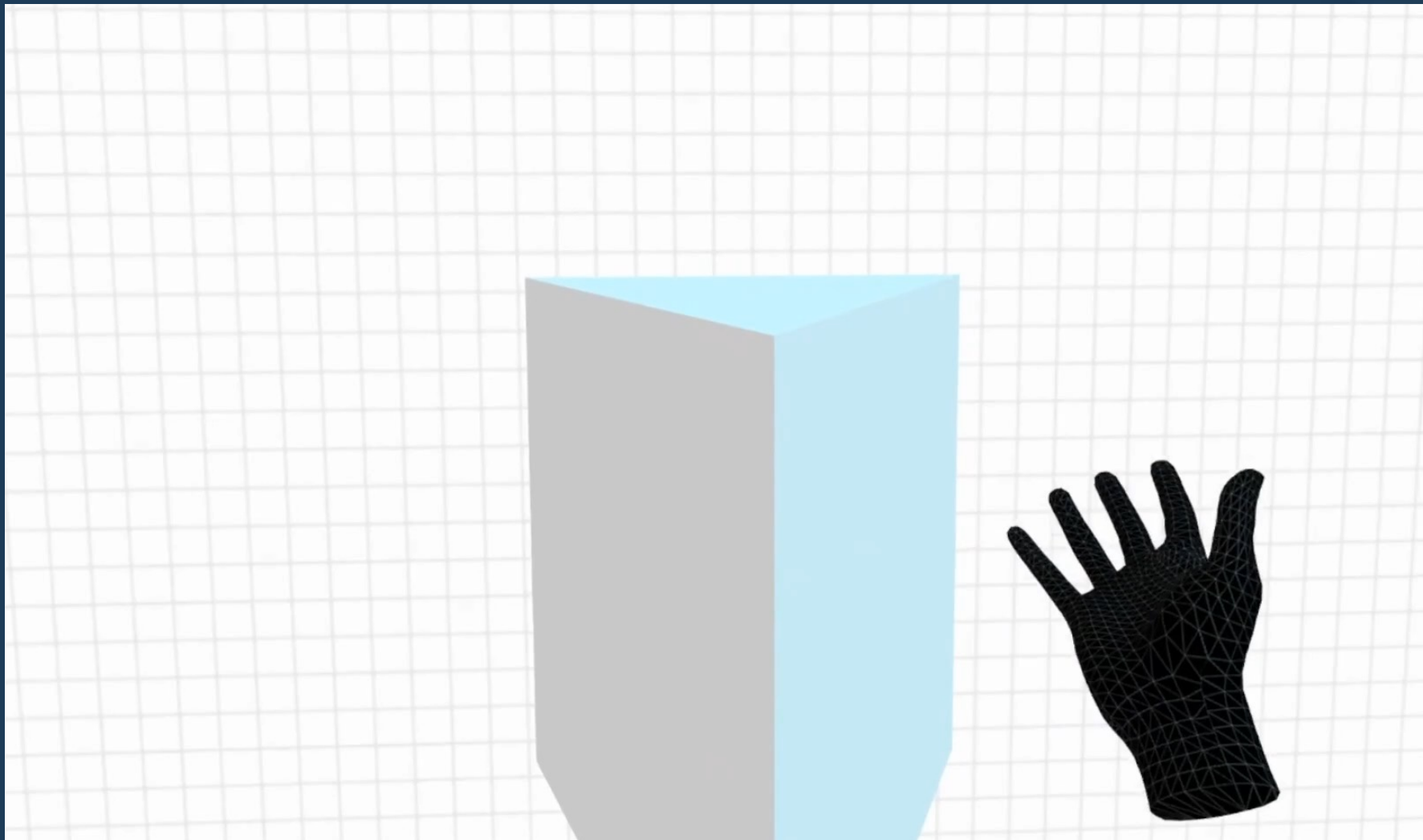


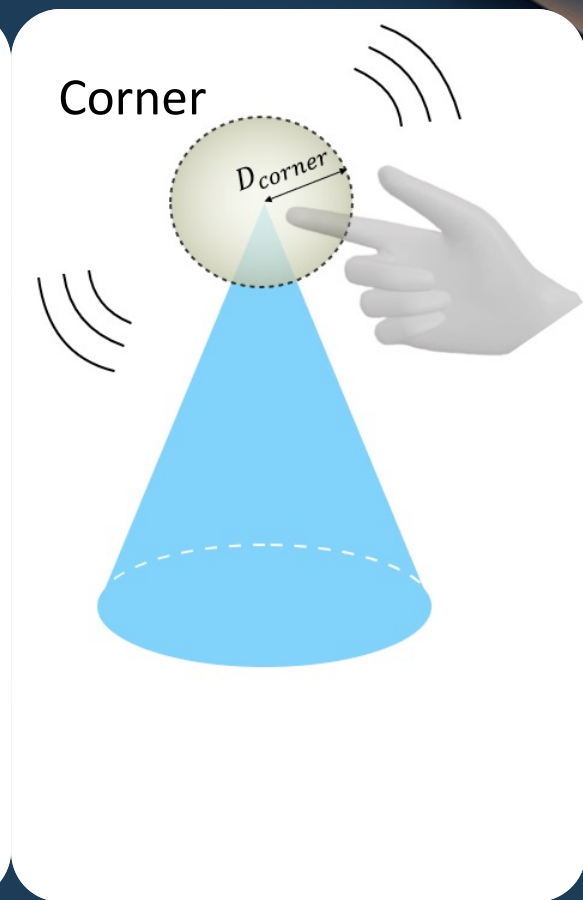
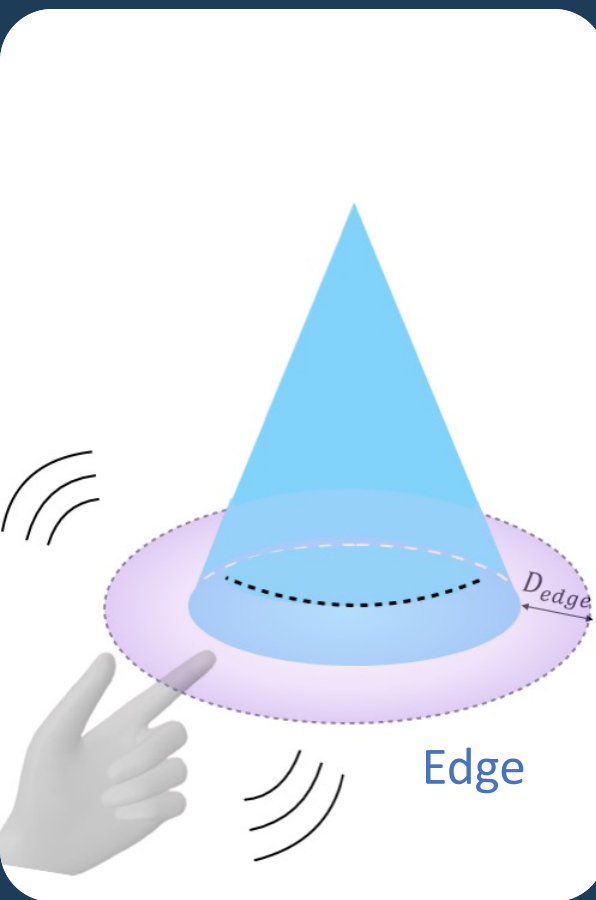
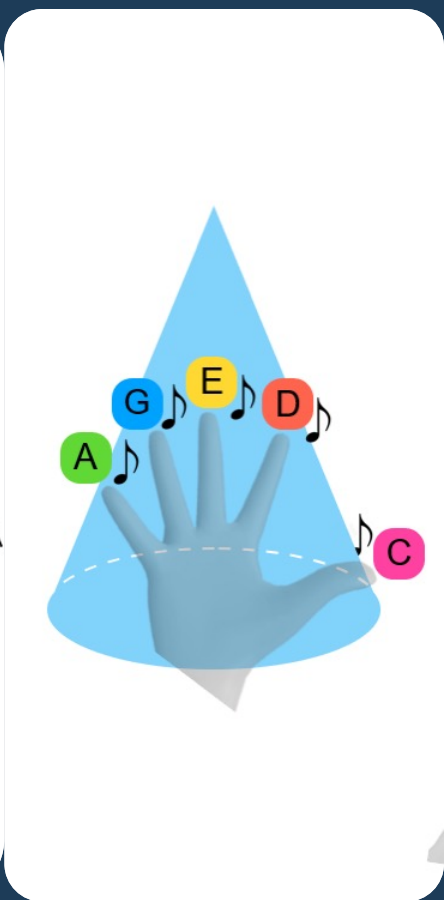
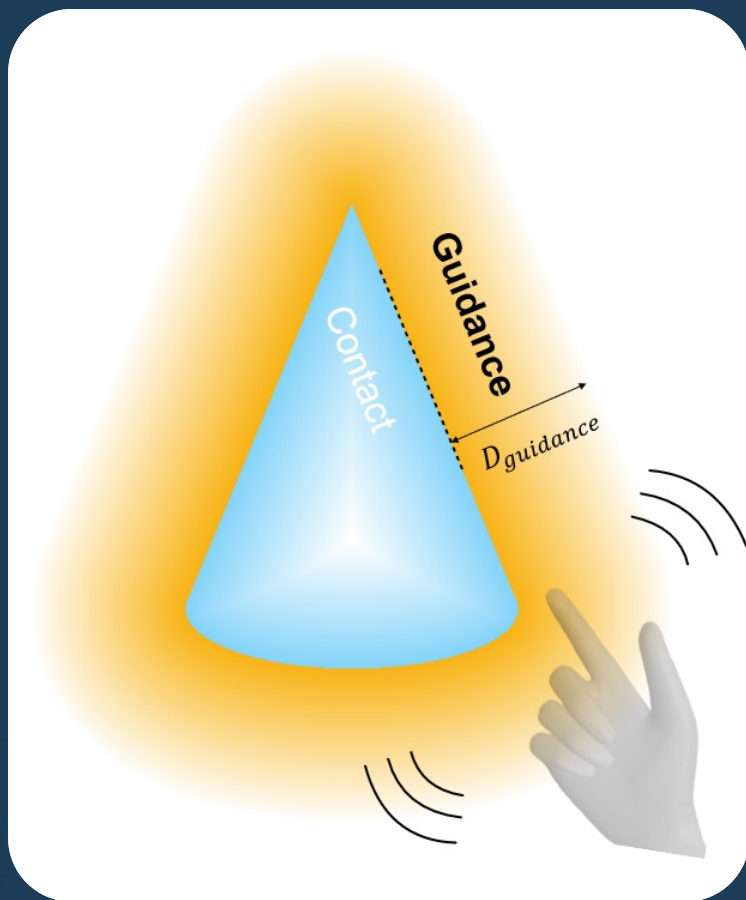
Guidance sounds play outside the shape



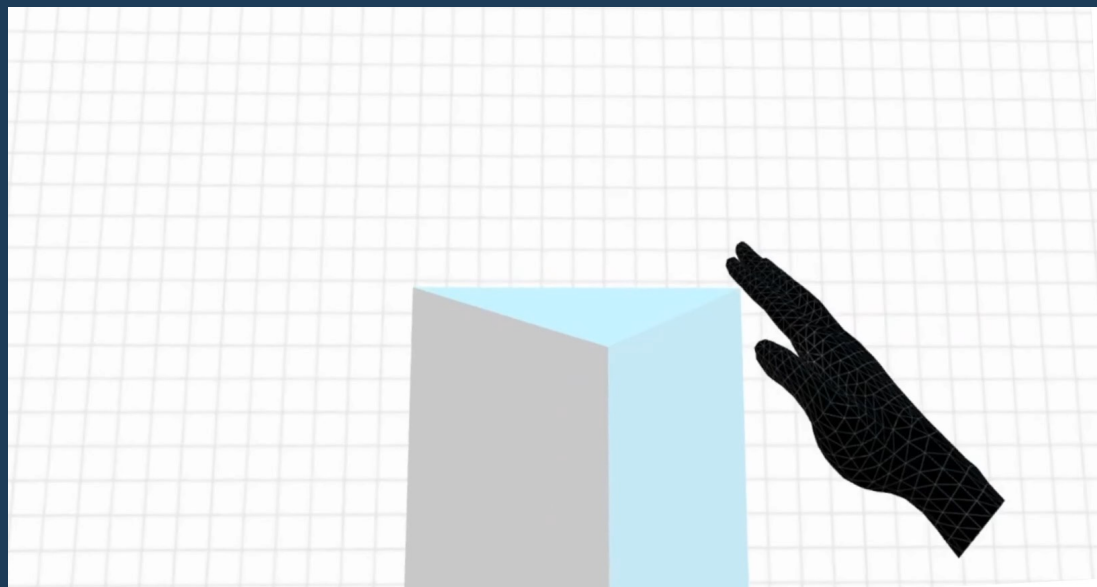


Contact sounds play on the surface and inside the shape

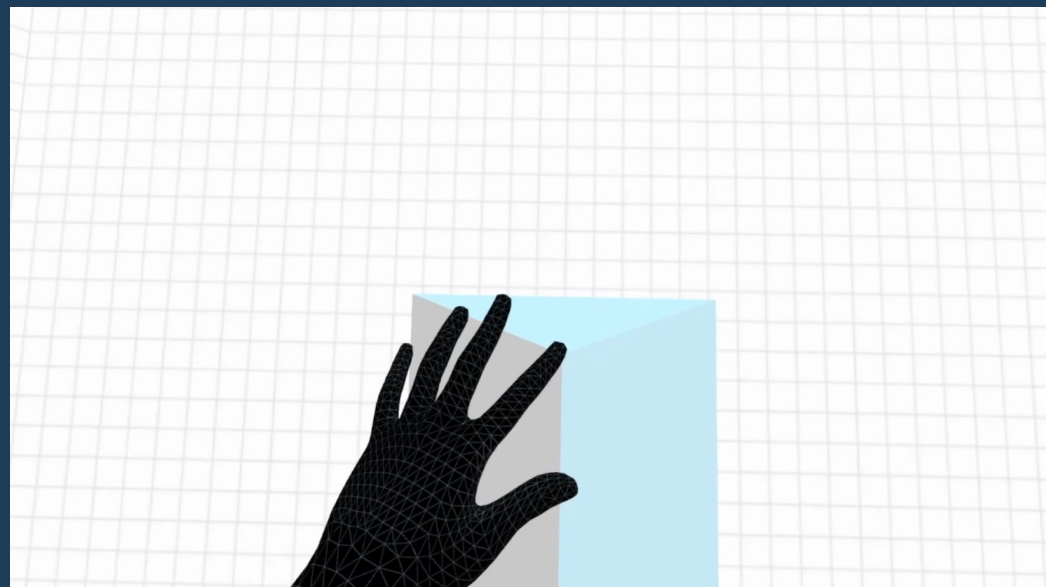




Edges and corners trigger earcons



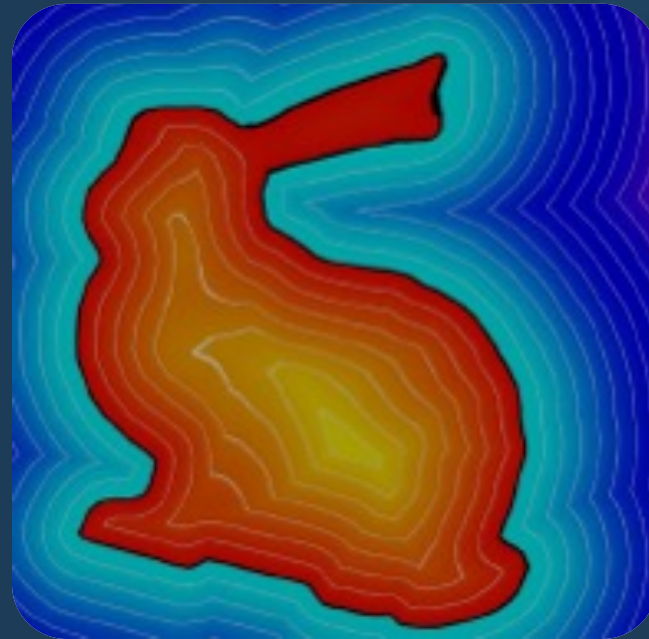
Edge Sound (right)



Corner Sound (left)

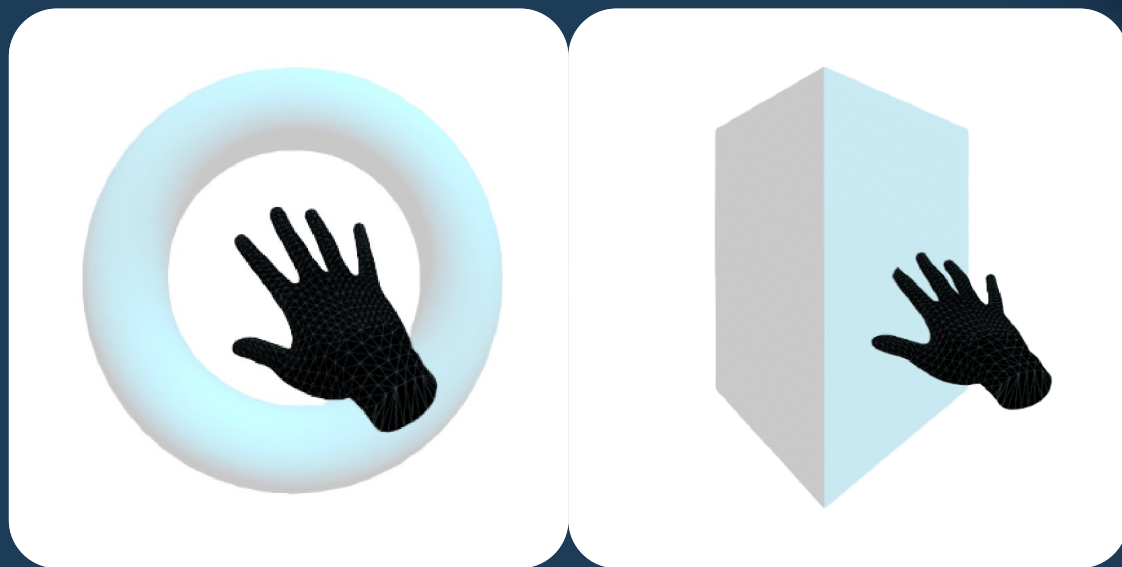
Implementation

- Meta Oculus Quest
- Signed distance field



Experiment Setting

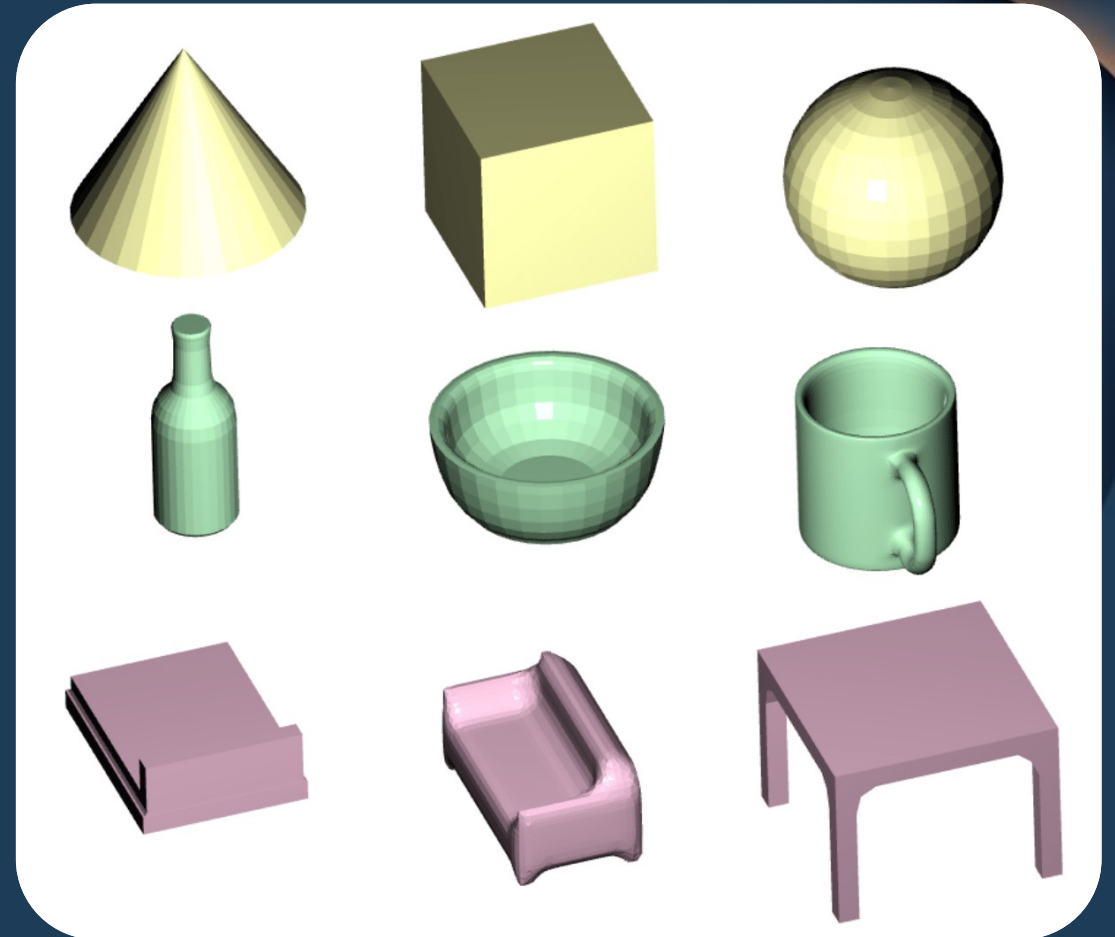
- 15 sighted and 6 BVI testers
- Two rounds:
 - Pilot Study
 - Formal Study
- Two shape perception tasks
 - Shape Recognition
 - Landmark localization



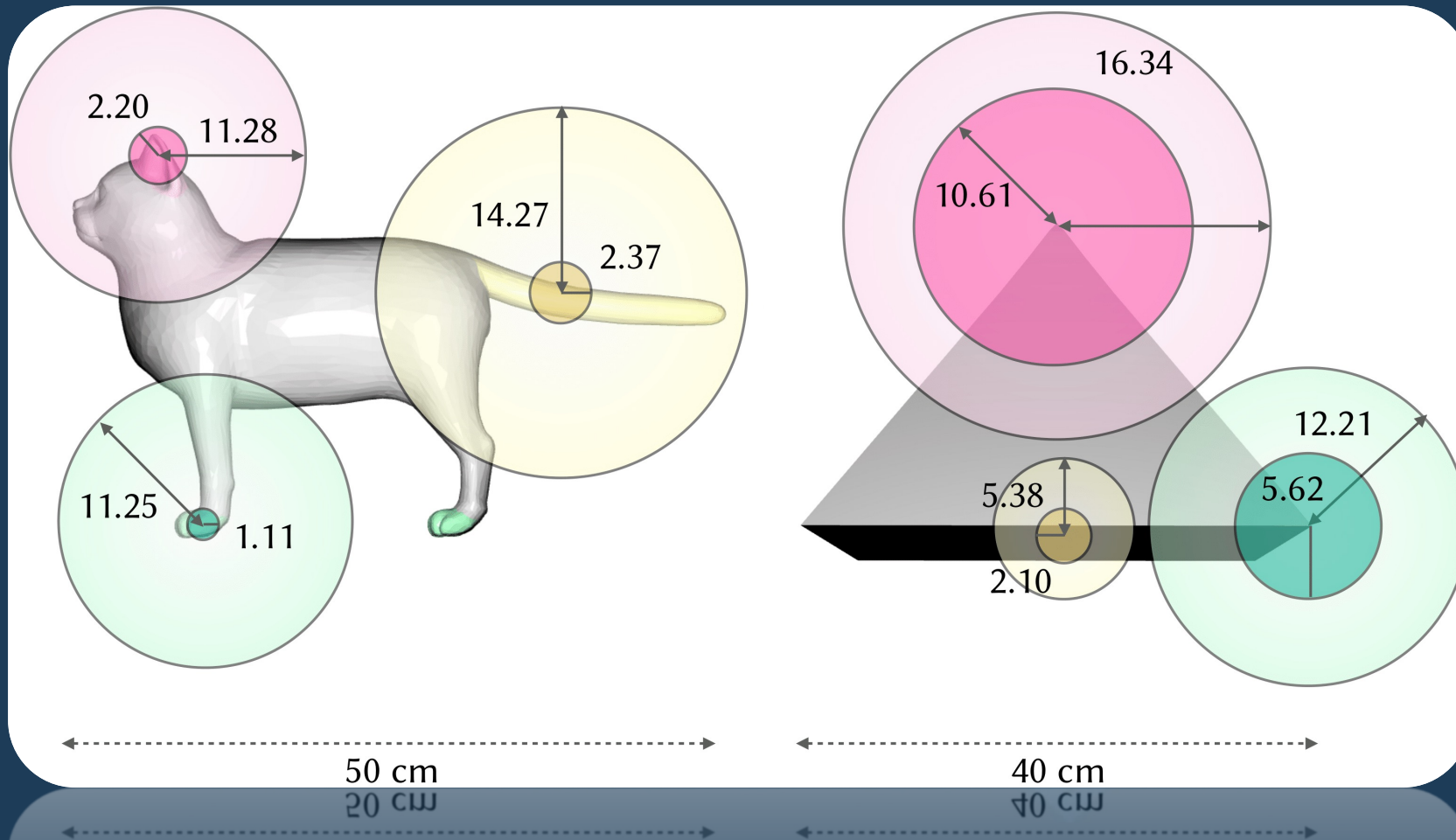
Shape elements used in tutorial

Shape Recognition Task

- Identify one of three shapes
- 37/45 ShapeSonic vs. 15/45 chance
- Sighted and BVI users had similar performance (81% vs. 83%)

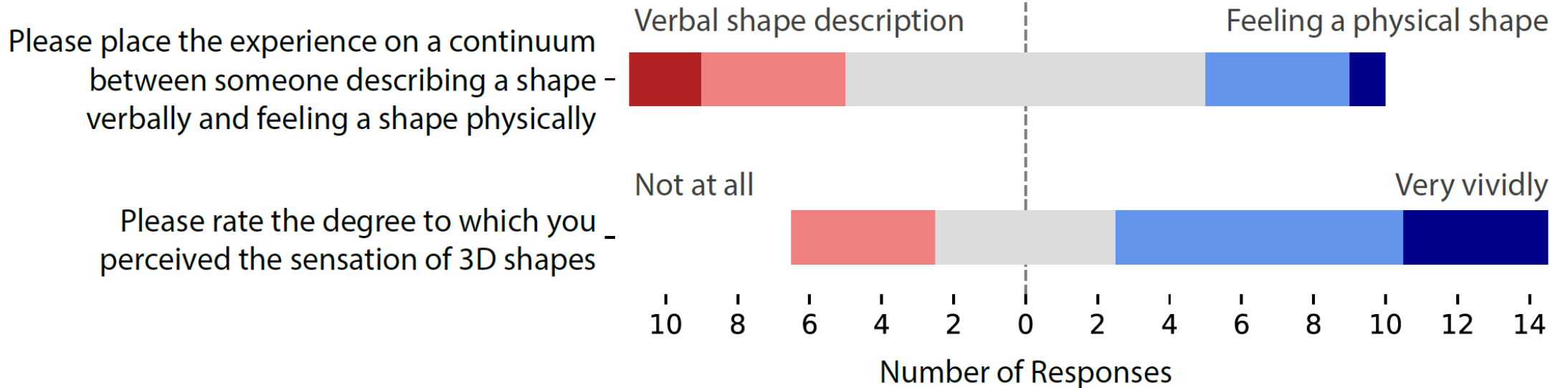


Landmark Localization Task



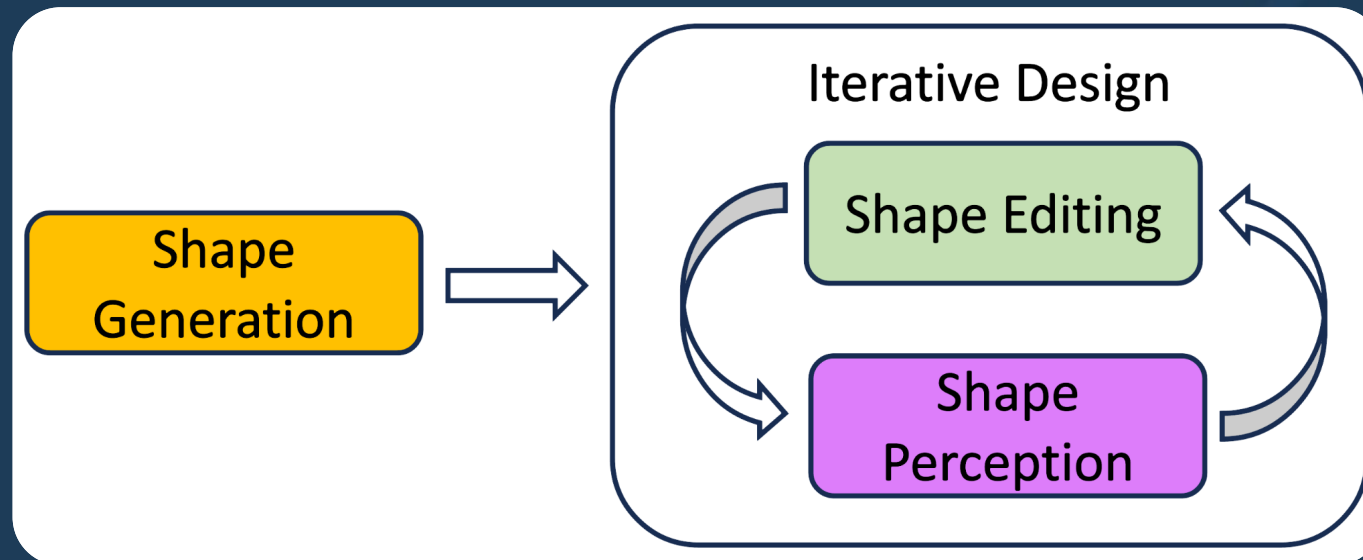
Observations

- Perceived as halfway between verbal description and feeling a physical shape.
- Haven't reached the skill ceiling.
- Hand tracking latency is an impediment.



Future Work

- Physical attributes
- Complex objects and scenarios
- Non-visual 3D shape design framework



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<https://cragl.cs.gmu.edu/shapesonic/>

