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

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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

Coca-Cola vs. Verizon Stock Price

CocaCola = Piano
Verizon = Marimba

*Stock price is still indicated by pitch.
How should hands map to sound?

• Volume
• Pitch
• Timbre
• Spatialization
• Tempo
• ...

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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.

![Graph showing experience on a continuum between verbal shape description and feeling a physical shape.](image)
Future Work

- Physical attributes
- Complex objects and scenarios
- Non-visual 3D shape design framework
ShapeSonic:
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https://cragl.cs.gmu.edu/shapesonic/