A Mixed Reality Haptic Interface for the Simulation of Fluid Sensations
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Research Question
How can interactive learning experiences be replicated to offer the same depth and immersion virtually as opposed to regular in-person learning?

The Issue With Current Fluid Haptics Systems
Interactive learning in a laboratory environment is immensely important for knowledge acquisition [1], yet many current experimental fluid haptics systems are too high cost or too technically and computationally extensive.

Challenges for Replicating Fluid Sensations
- Accurately replicating real-time tactile fluid sensations is challenging due to the difficulty of synthetically reproducing detectable feelings of fluid motion and density.
  - HydroRing [2] requires an extensive conglomeration of wearable components in order to properly convey tactile sensation.
  - Magnetorheological fluids are functionally limited given their temperature dependence [3], and their inability to provide localized haptic feedback [4].

Our Solution: Dual Fan-Thermoelectric Interface
We propose a mixed reality haptic interface:
Composition
- Arduino fan and Peltier cooler circuit
- Interactive virtual environment
Capabilities
- Basic fluid motion recreation
- Allows for visual observation of fluid motion

System Block Diagram

Applications and Future Exploration
Applications
- Virtual chemistry/science experiments
- Enhanced VR video game immersion
Exploration
- Air Flow: What kinds of wind patterns better simulate rushing water?
- Fan Design: Do different fan blades produce better fluid sensations?
- User Studies: How do different individuals register fluid haptic sensations?

Unity Scene: Fluid Emitter Off State

Unity Scene: Fluid Emitter On State

References