

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

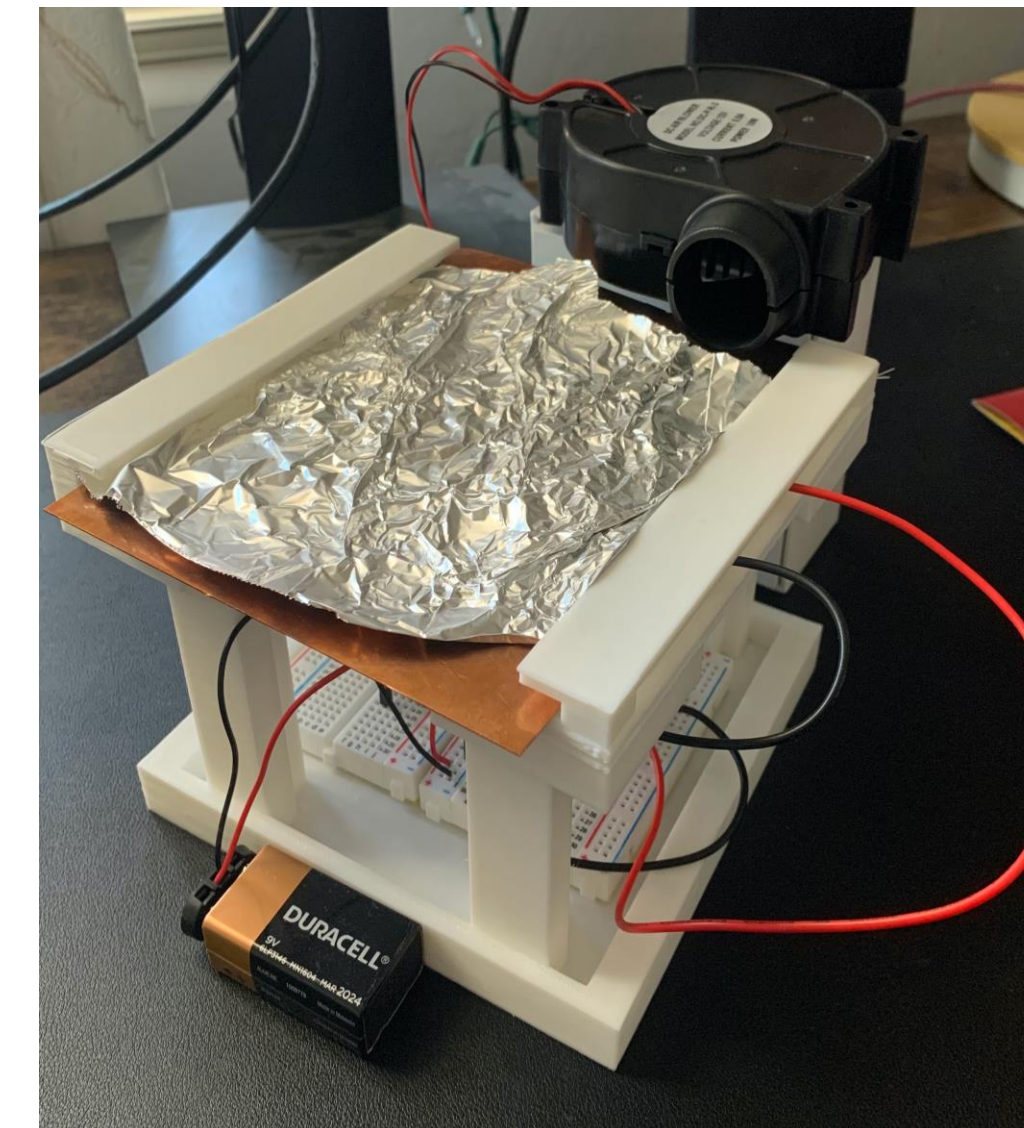
We propose a mixed reality haptic interface:

Composition

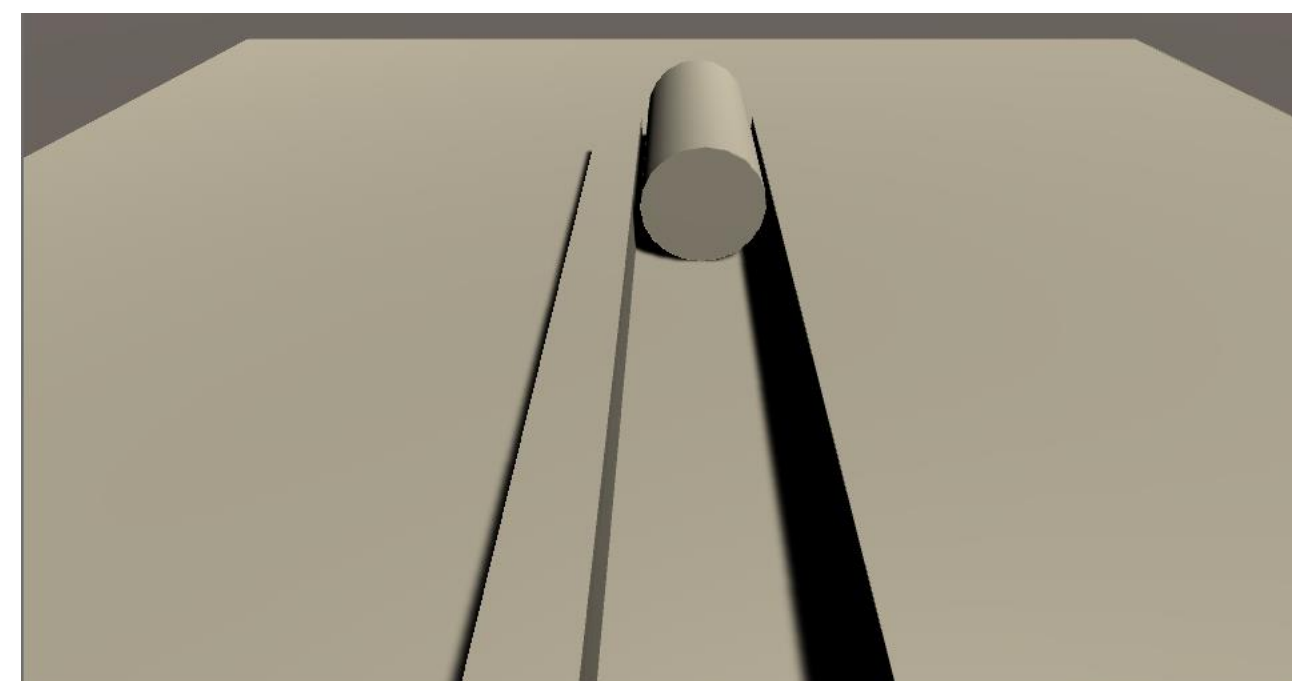
- Arduino fan and Peltier cooler circuit
- Interactive virtual environment

Capabilities

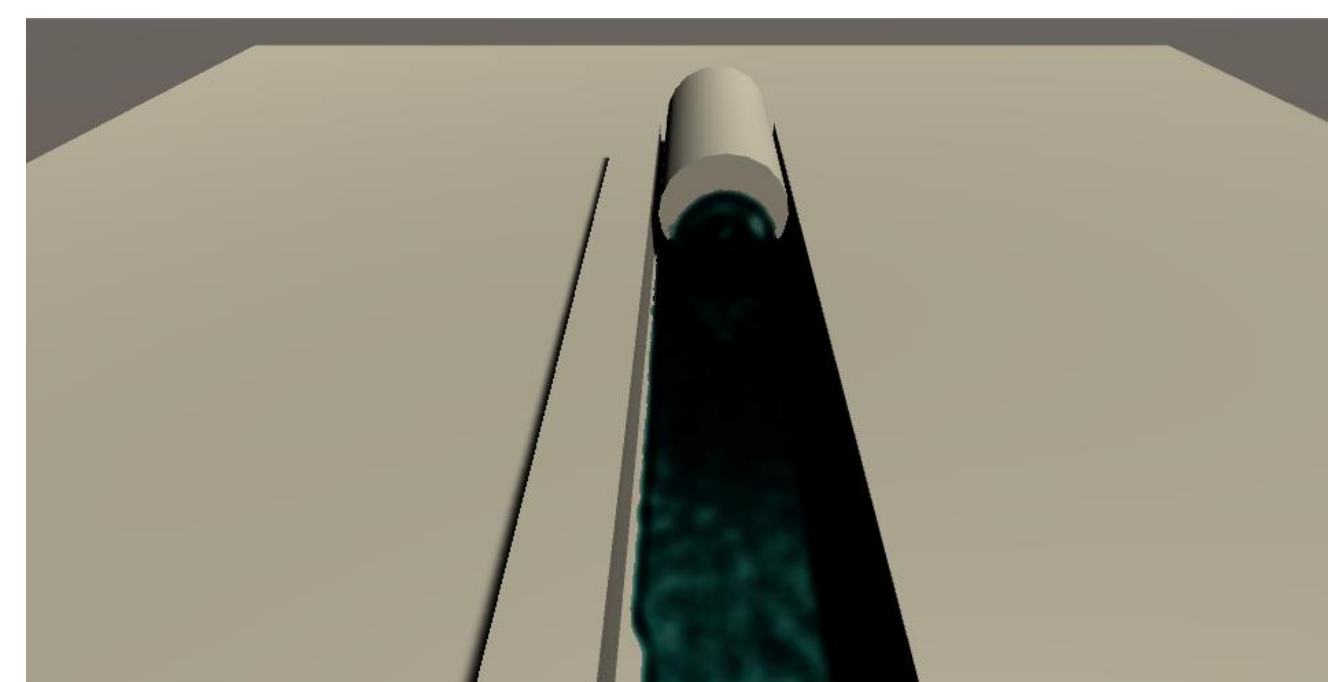
- Basic fluid motion recreation
- Allows for visual observation of fluid motion



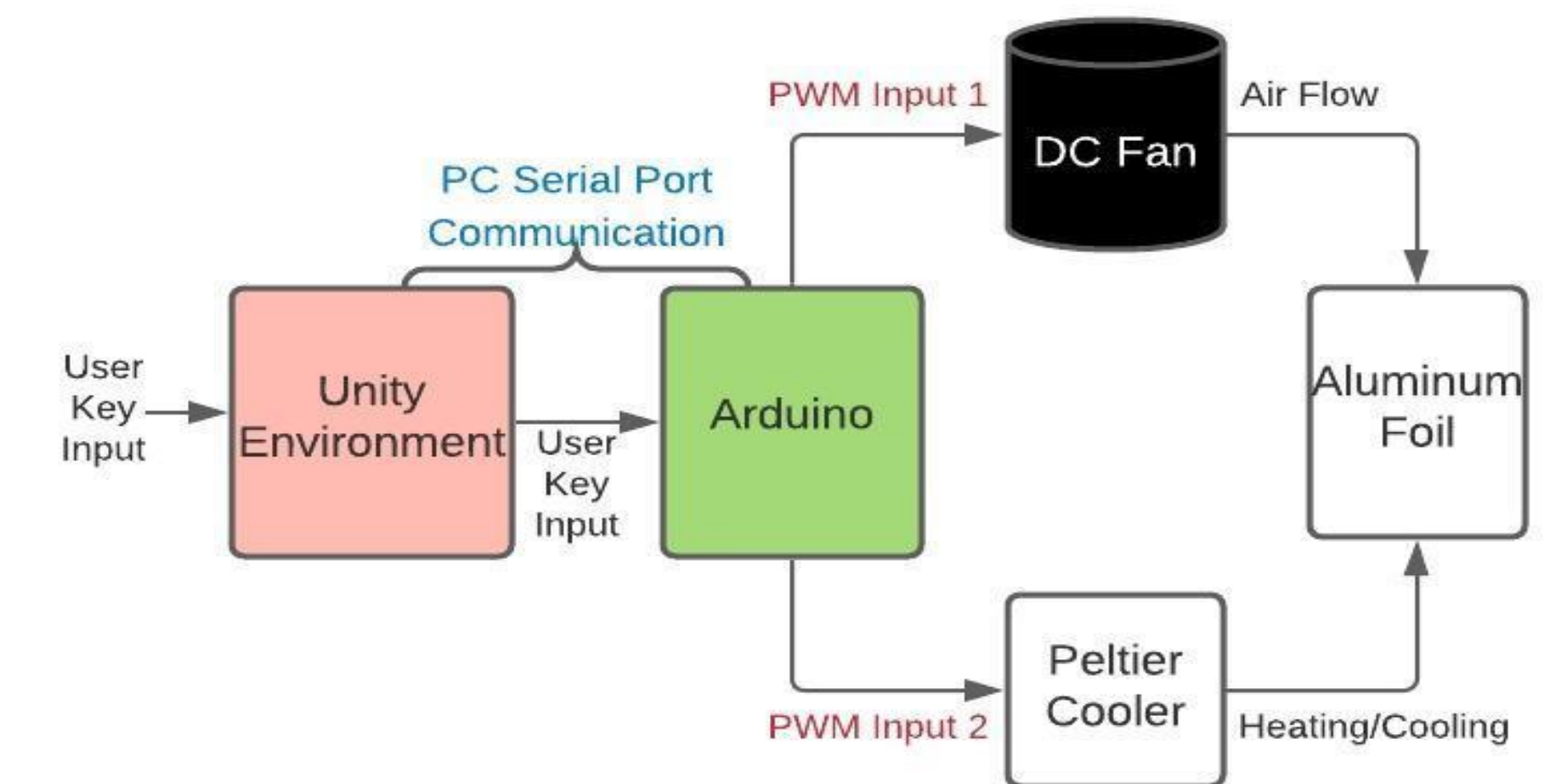
Unity Scene: Fluid Emitter Off State



Unity Scene: Fluid Emitter On State



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?

References

- [1] Reem, A. A., Alnatour A., Alnuaimi K., Alzoubi F., Almomani M., Othman, A. (2018). Effects of interactive teaching on university students' knowledge and attitude toward reproductive health: a pilot study in Jordan. *Journal of Multidisciplinary Healthcare*, vol. 11, pp. 211-221.
- [2] Han T., Anderson F., Irani P., Grossman T. (2018). HydroRing: Supporting Mixed Reality Haptics Using Liquid Flow. *ACM Symposium on User Interface Software & Technology 2018*, pp. 913-925.
- [3] Chen S., Huang J., Jian K., Ding J. (2015). Analysis of Influence of Temperature on Magnetorheological Fluid and Transmission Performance. *Advances in Materials Science and Engineering*, vol. 2015, Article ID 583076, 7 pages.
- [4] Jansen Y., Karrer T., Borchers J. (2010). MudPad: localized tactile feedback on touch surfaces. *ACM International Conference on Interactive Tabletops and Surfaces*, vol. 11-14.