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Shifting Weight-Based Interfaces for Simulated Hydrodynamics in Mixed-Reality Fluid Vessels (SWISH)

Background

By integrating visual stimuli with perceived tactile sensation, mixed-reality haptic devices provide a critical dimension to otherwise intangible virtual content. Much of the commercial and academic efforts in this domain have focused on delivering simulated interactions with rigid objects, often through the use of vibrotactile gloves, robotic arms, and grounded devices. Currently, mixed-reality haptic systems have been unable to reproduce the physical sensation associated with handling a fluid-filled vessel. Because movement of the contained fluid causes shifting of the vessel's center-of-gravity (CoG), creating a responsive haptic representation is technically challenging. However, given the prevalence of human interaction with fluids, successful haptic simulation of fluids stands to spawn numerous mixed-reality applications. These include workforce training for fluid handling, experimentation with new fluid-handling operations, rehabilitation, gaming, and portable remote laboratories.

Invention Description

Researchers at Arizona State University have developed SWISH, an ungrounded mixed-reality system that affords users realistic haptic sensations of handling a fluid-filled vessel. The virtual fluid is visually rendered through virtual reality or augmented reality devices, while the physical SWISH vessel houses the mechanism which dynamically shifts the CoG with 3 degrees of freedom. The system prioritizes reproducibility, using electronic components and tools that are widely available. Designed parts are constructed with standard CAD tools, 3D printers, and acrylonitrile butadiene styrene (ABS) polymer. SWISH's software framework is implemented using Unreal Engine 4 for virtual scene composition/rendering and NVIDIA Flex for fluid particle simulation. Instructions for motor control are transmitted via Bluetooth.

Potential Applications

- Virtual/Mixed reality
- Gaming
- Workforce training simulation

Benefits and Advantages

- Novel – To the best of the inventors' knowledge, system is the first ungrounded haptic device to provide realistic sensation of augmented fluids
- Practical – Construction is based on readily available components and processes

Laboratory Homepage of Professor Robert LiKamWa