AquaTop Display: A true ”immersive” water display system

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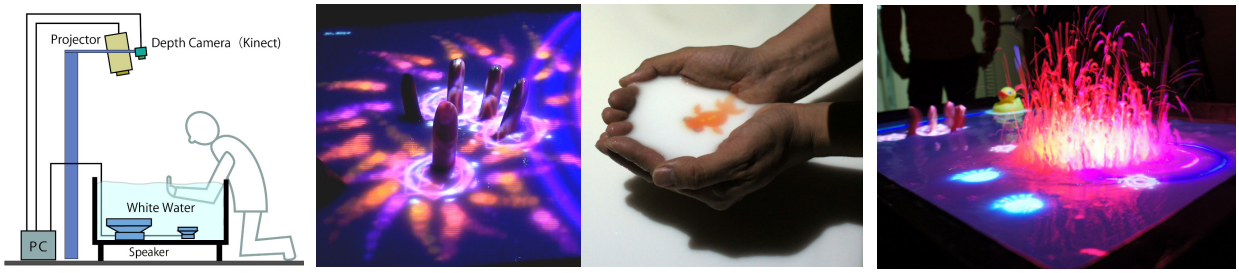

Figure 1: *(Left) AquaTop Display prototype hardware setup. (Center) Linking physical with virtual, various gestures unique to water interaction. (Right) Launched and illuminated water drops, and force feedback with vibrating water using speakers.*

Abstract

The AquaTop Display is system that uses the projection of images onto cloudy water. This system allows the users limbs to freely move through, under and over the projection surface. As the projection medium is fluid, we propose new interaction methods specific to this medium by using a Kinect Depth Sensor. Scooping up water, protruding fingers out from underneath the water surface are capable with this system. These type of interactions are not normally possible with current impenetrable rigid surfaces. Using mapped projection, AquaTop Display also augments one's limbs on the water surface, providing a environment for an 'immersible' experience, allowing the users to become one with the screen.

1 Introduction

Throughout the history of display panel technologies, including the dated CRT and now widely adopted LCD, displays have always been a solid, fixed surface. Whilst it is possible to touch these screens, physically immersing ones body into or diving into the screen similar to that of holography in cinema is not capable. Interactions with these displays were thus considered relative, as the position of the users were mapped to the coordinates of the image within the screen, for example, with current gaming systems the users movement of a virtual tennis racket using a motion controller is not one to one with real world movements. Given these two points, we propose a water display system, the AquaTop Display that allows one to one movement within a display whilst becoming one with the displayed image due to the nature of the display medium. This system introduces the idea of using water as a display medium for spatial augmented reality, suggesting true immersive interaction. AquaTop Display builds upon the previous water projection technology [Yagi et al. 2011; Takahashi et al. 2012] whilst adding new and improved interactions such as conventional touch to compliment the submerging of fingers, as well as suggestion of an interactive application game that also provides haptic feedback.

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2 Prototype

Figure 1 (Left) shows the architectural layout of the AquaTop Display. The main body of the display is a 600mm x 900mm x 250mm plastic container (the display volume). A Microsoft Kinect depth camera is mounted above the display volume surface together with a projector. Standard speakers are waterproofed and fixed to the bottom of the display volume container. The hardware is controlled by a master computer. A milky bath salt and water mix gives the water display volume a white, opaque surface which can be used for both reflecting IR light for detecting input via a Kinect, and the projection of clear images on the water's surface. As shown in Figure 1 (Center), the proposed system provides 3 interaction metaphors. One is multi-touch input using detection of fingers protruding from under the surface (Center-Left). Another is the use of palms and forearms above the fluid surface, creating a direct link with physical and virtual environments. Scooping gestures using both hands to lift' objects from the water reflecting the real-life gestures used with physical water. Additionally, conventional touch from above the surface is also possible, complimenting the ”touch” from below (submerged fingers), which allows for greater possibilities in spatial interaction on the water surface. All of these interactions provide a natural connection of physical and virtual realities that can be used in real-time entertainment and gaming. For feedback, audio and force feedback is proposed in the form of the vibration of water via a submerged speaker. Adopting the characteristics of sound wave propagation within fluids, the speakers provide water disturbance in the form of splashing and ultrasonic water vibrations as a means of providing haptic feedback.

References

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