Po2: Augmented Haptics for Interactive Gameplay

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1. Introduction

User gestures are important in current gaming platforms, where users' movements are tracked and their actions trigger events in the games. We introduce *Power of 2 (Po2)*, a new haptic technology that augments illusive tactile sensations on gesture-based gameplays. Po2 utilizes two vibrating actuators on two hands and renders illusory tactile motion on and across the hands. With carefully designed psychophysical studies, we determined parametric models to robustly control the perception of an illusory object and its motion on and in between two hands. These models are embedded in computer algorithms and programmed to produce cohesive multisensory experiences. Synchronized with a wide range of user gestures and interactive media, such as sound and visuals, Po2 creates highly dynamic and animated gameplay experiences with wearable and mobile handheld devices.

We explore the use of Po2 in two configurations: i) a user holding a device with two hands to feel motion across the hands through the device, and ii) a user wearing gloves to feel mid-air objects and interactions. Both configurations are common in current gameplay and allow creation of variety of animated haptic experience in games, stories and other interactive media (see Figure 1).

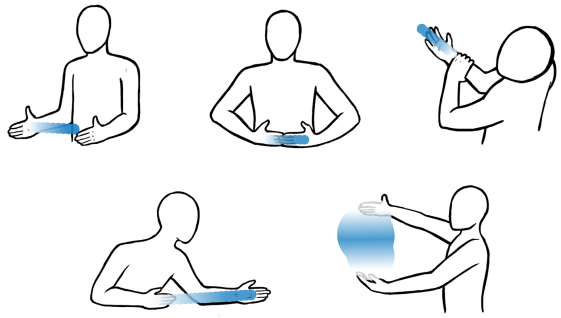

Figure 1. *Hand gestures and robust tactile illusions in between hands*

2. What is novel, how is it implemented and why is it relevant?

Tactile illusions on the surface of the skin have been well understood and several tools are available to draw *tactile strokes* on a grid of sparse vibrating actuators (e.g. [Israr and Poupyrev 2011]). Our research explores the use of two small vibrating actuators on the hands to create *out of body* illusions by holding a physical device, and *mid-air* illusions through hand-worn gloves. In our studies, we determined physical parameters that precisely control the *size*, *speed*, *direction* and *location* of these "intermanual" illusions in a variety of gestures. We have also examined tactile-visual multimodal effects in order to deliver a precise and coherent multisensory experience to users [Zhao et al. 2015] (also see supplementary material for details).

We use small, lightweight and inexpensive vibrating actuators (e.g. eccentric-mass dc-motors and/or voice-coil motors), which are common in current phones, toys, tablets, controllers, etc. They consume low power and usually require a small driver circuitry. Along with embedded electronics, these components are housed in the device contacting the skin. For example, the actuators and electronics are embedded in a tablet sleeve (Fig. 2a) and electronics are mounted on separate compartments in the glove (Fig. 2b).

Po2 can be applied to a variety of activities in games, such as objects *moving* and *bouncing* between hands, superpowers *storing* and *emanating* from a user's hands, objects *hovering* above and in between hands, and many more. We have utilized Po2 in three application scenarios as shown in Fig. 3. These effects can be added to other VR and AR applications and create engaging and expressive experiences for video games, toys and augmented gameplays.

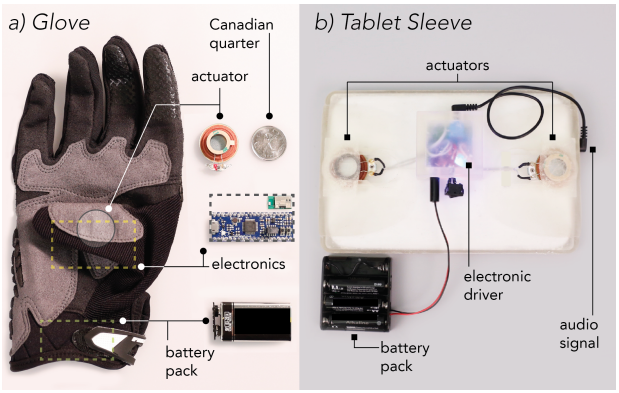

Figure 2*. A tablet and a glove.*

Figure 3*. Three scenarios of multisensory interactive gameplay*

3. Siggraph Demonstration

At the SIGGRAPH 2015 Emerging Technology exhibition we will demonstrate three types of interactive gameplays, i.e., (i) a game on a tablet in which a user thrown and balanced a ball across the hands, (ii) mid-air interactions with hovering and distant objects, and (iii) supernatural powers emanating from guests. Guest Postures are tracked by Kinect and hand-mounted sensors, visuals will be rendered using 3D projections and/or HMDs and on tablet screens; and audio will be presented through surround-sound speakers and/or preferably earphones. During these interactions, guests will also feel coherent tactile cues on and across their hands. Guests will go through two stages of a game; one, to familiarize themselves with game rules, gestures and haptics, and two, to engage in a dynamic and exciting gameplay.

4. References

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ZHAO, S., ISRAR, A., AND KLATZKY, R. 2015. Intermanual Apparent Tactile Motion on handheld tablets. In *Proc. IEEE World Haptics Conference*, IEEE.

SIGGRAPH 2015 Emerging Technologies, August 09 – 13, 2015, Los Angeles, CA.
ACM 978-1-4503-3635-2/15/08.
http://dx.doi.org/10.1145/2782782.2792489