SeeingHaptics: Visualization for Preview, Examination, and Display of Haptic Designs

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ABSTRACT

Haptic feedback has been extensively explored for decades and over a wide range of applications. These efforts were invested into two primary directions: 1) toward the generation of realistic haptic feedback, *e.g.*, aiming realism for virtual reality and 2) using haptic feedback as informative display, *e.g.*, communicating symbolic or affective information. More recent research explored new ways to facilitate haptic design, for instance, using direct manipulation to create 2D haptic animations [2]. For the first type of works, various dimensions of haptic feedback were proposed for enhancing the immersion of virtual reality, *e.g.*, SoEs [1] provides vibrotactile, airflow, and thermal feedback. However, current editing tools for developing virtual environment only allows developers to access haptic feedbacks by touching the actuators, which makes it difficult to overview the design effectively.

First, we attempt to present a haptic authoring tool designed with visualizing haptic feedbacks as its core. The design of haptic visualization is displayed in Figure 1. Two design goals are considered in our design: 1) effective area of a certain feedback and 2) enabled types of haptic sensation. For the effective area, we introduce 3D shapes in the VR environment to clearly specify the area of haptic feedback, *e.g.*, once your hand reaches into the capsule area of the scalding pan, you will receive the vibrotactile feedback (Figure 1e). The area of haptic effects is displayed as a mesh wireframe, which provides a clearly geometry of the mesh shape (Figure 1a). For the second goal, we include various types of haptic feedbacks in our design including thermal, vibrotactile and airflow, represented as 2D iconic patterns with a circular white background (Figure 1b). According to the haptic sensation, different properties are considered, such as the intensity and frequency of a vibrotactile feedback, and the direction of airflow feedback, whose visualizations are augmented surrounding the icon image (Figure 1b).

According to previous description, we present a proof-of-concept implementation of the toolkit, SeeingHaptics. Within the 3D environment, Haptic feedbacks generated by virtual contents are implemented as Haptic Source components, and the haptic properties will be visualized. To provid similar feedbacks for planning desired haptic feeling, Haptic Proxy was proposed as a prototype of the final device. The application of haptic feedbacks in VR scenes are also discussed.

A user study was conducted to demonstrate the usability of SeeingHaptics. Nine participants attended with Unity development experience as prerequisite, and asked to design haptic experiences associating with single objects and a whole environment to observe the participants' design processes and considerations. As a result, visualizing haptic feedbacks facilitates the design process by revealing haptic areas and by providing intuitive GUI operations. A series of haptic designs regarding a kitchen scene were created by participants to demonstrate the capability of the toolkit.

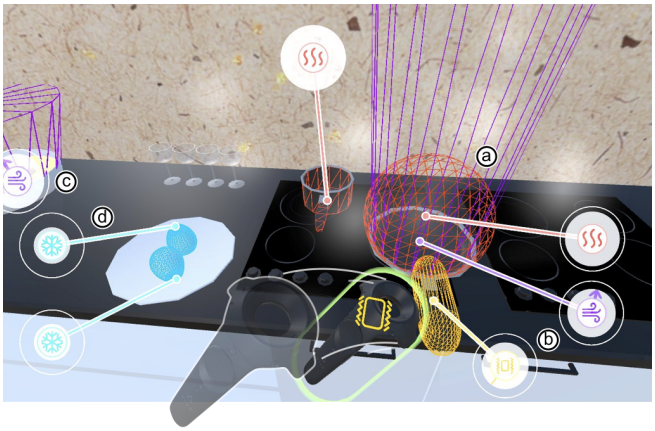

Figure 1. The visualization design of SeeingHaptics. (a) Wireframe of haptic area. (b) Haptic type and properties shows on an Icon. (c) Reposition outside icon. (d) Radially shift inside icon to peripheral vision.

Author Keywords

visualization, haptics, interface, authoring, virtual reality

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

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