Accessible Haptic Objects for People with Vision Impairment

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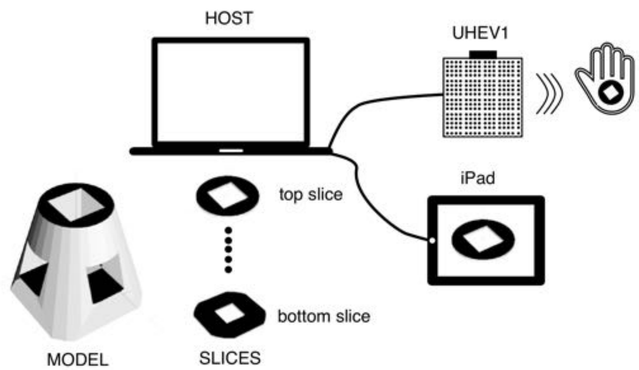

Figure 1: The system components. The 3D model is sliced into multiple graphics. The top slice is displayed on the iPad and then traced on the hand of the user, which stays on top of the UHEV1.

CHI'18, April 21–26, 2018, Montréal, Canada.

Abstract
This paper describes the use of mid-air haptic technologies with the GraVVITAS, a multi-modal system for presenting 2D graphics to people with vision impairment. We extend GraVVITAS with the UltraHaptics UHEV1, a mid-air haptic feedback device, to present 3D models and to investigate new interaction styles.

Author Keywords
accessibility, vision impairment, graphics, haptics

ACM Classification Keywords
H.5.2. [Information Interfaces and Presentation]: User Interfaces; K.4.2. [Computers and Society]: Social issues–assistive technologies for persons with disabilities.

Introduction
Access to information, in particular access to graphics, is a fundamental problem for vision impaired people. We have been working on this problem by developing the GraVVITAS system [2]. It is is a novel, practical, generic and low cost solution used to present graphics to people who are blind by using multi-touch screens augmented with haptic and audio feedback.

GraVVITAS, with its iOS app seen in Figure 2, lets blind users explore graphics with both hands, much like tactile graphics. Whenever a graphic element is first touched, the system describes the element with speech feedback. It also plays different non-speech audio for different elements to indicate the users that they are inside a particular element. When it is used with the touchRing, a wearable device, haptic feedback is provided to users fingers to indicate the boundaries of the shapes and to replicate the effects of non-speech audio in noisy or quiet environments. We currently have an app on the Apple AppStore, and an invite only authoring tool. Contents are stored on the cloud that allows almost immediate access.

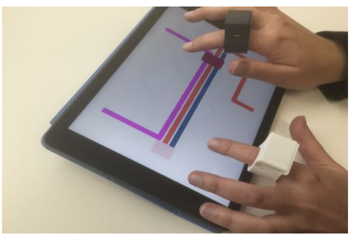

Figure 2: GraVVITAS iOS app with touchRing.

The Aim

One limitation of GraVVITAS is that it requires a multi touch screen to run. The screen size can be limited for very large graphics such as floor plans at museums and galleries. Thus our first aim is to use mid-air haptic technologies to investigate the use of GraVVITAS interaction model without a touch screen.

Second limitation of GraVVITAS is that it can not display 3D graphics. One way of presenting 3D models is to use visual properties such as perspective which requires the users having prior knowledge. 3D prints provides a more intuitive way for presentation, and there are existing research that shows the benefits of them [3]. However as tactile graphics these models require physical media and they are not easily portable. Thus our second aim is to use mid-air haptic technologies for presenting virtual 3D models on the GraVVITAS.

The System

Firstly, a 3D model is created using OpenSCAD [1], and the GraVVITAS authoring tool slices this model into multi-part graphics files. Each file contains a projection of the model on the XY plane at increasing z-values. This process allows controlling the level of detail and mimics the 3D printers which prints models layer by layer.

Secondly, the host computer provides a bridge between the GraVVITAS iOS app and the UltraHaptics UHEV1 [1]. When a graphic file is displayed on the GraVVITAS, UHEV1 starts tracing the outline of the shape on the user's hand. The z-coordinate of the user's hand measured by the UHEV1 determines the graphic file to be displayed – see Figure 1.

[1]www.openscad.org

Acknowledgements

Cagatay Goncu and Armin Kroll are co-founders of RaisedPixels which is part of the commercialisation scheme of Monash University, Australia.

References

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