Embossed Touch Display -illusory elongation and shrinking of tactile objects-

Hideyuki Ando*
NTT Communication Science Laboratories

Junji Watanabe†
PRESTO Japan Science and Technology Agency / NTT

Masashi Nakatani‡
The University of Tokyo

Tomohiro Amemiya* Taro Maeda*
NTT Communication Science Laboratories

Abstract

The Embossed Touch Display is a novel tactile display that can present any given width of objects. When we touch objects in space, we actively move our hands and fingers. Due to this active touch movement, we can perceive the shape of an object, even though the object may be larger than the fingertip. With the Embossed Touch Display, when the object is moved in the same or opposite direction of the hand movement, the width of the object is perceived to elongate or shrink. By controlling the velocity and position of the object during hand movement, any given width can be displayed.

CR Categories: H.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interface—Haptic I/O;

Keywords: Tactile display, tactual illusion, Shape presentation

1 Introduction

One way in which we explore the external world is through our sense of touch. The fingertips contain sensitive tactile sensors, and when the fingers touch an object and are moved across its surface, the information sequentially presented to the fingertips is integrated into the total shape of the object. This perceptual integration is based on the important assumption that an object is static during exploratory hand movements. However, if the object moves during the hand movement, the assumption leads to an illusory perception of the object's shape. As shown in Fig 1(a), when the object moves in the same direction as the hand movement, the object is perceived to elongate, since the width is basically judged from the initial and final positions of the moving edges. On the other hand, when the object moves in the opposite direction as in Fig. 1(b), its width is perceived to shrink. Our discovery of this phenomenon led us to develop a novel tactile display called the Embossed Touch Display that can provide any given width of an object by moving the object according to the hand movement.

The Embossed Touch Display features advanced object control performed in accordance with measured hand movements. We implemented the display with a laser distance sensor and a liner slider. The sensor measures the distance between it and the finger, and liner slider is controlled in accordance to the distance. Using this display, we can present realistically rigid edges. We can also present continuous surfaces, which is difficult for prior tactile devices.

*e-mail: (hide,t-amemiya,maeda)@avg.brl.ntt.co.jp
†e-mail:watanabe@avg.brl.ntt.co.jp
‡e-mail:nakatani@star.t.u-tokyo.ac.jp

2 Demonstration

In addition to the tactile function of the display, visual images can be presented with a slider-mounted liquid crystal display. An example is the elastic moon shown in Fig. 2. The moon changes its shape according to hand movement. When the finger is static, a static full moon is shown. When the finger moves, the moon is elongated into an ellipse. The visual and tactile edges of the moon can totally overlap. Another demonstration of this display would be to capture an image of a person's face and then have that person move their finger across the facial image to make it fatter or thinner. (Both demonstrations can be experienced at our booth.) In such ways, our display can provide new visual-tactile experiences.

In the future, we plan to present sensations of surface texture and viscosity by changing the control strategy of the liner slider. This display can be applied as a new tool for artistic expression. In addition, the novel tactile illusion from which we took the display principle is expected to have a great influence not only on the interface research but also on the scientific field.

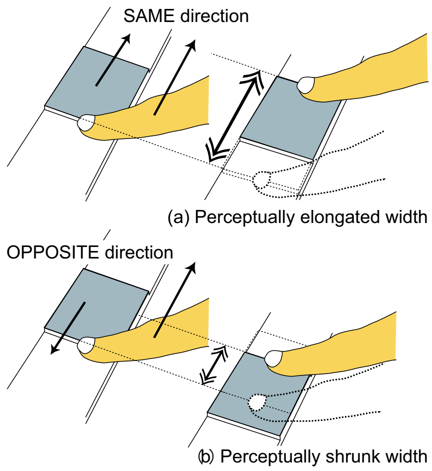

Figure 1: Conceptual figure of display principle.

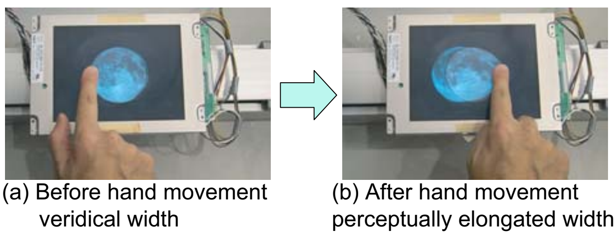

Figure 2: An elastic moon shape.