Perceiving Physical Attributes of Objects Using an Electrostatic Tactile Display

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Abstract Based on the physical principle that the Coulomb force exerted on a finger affects the attractive and frictional felt by the finger sliding through a surface, An electrostatic force tactile approached is proposed, and a related display based on Windows is also developed. With this display, not only the information of static images, including shapes, textures and softness of objects, is perceived realistically, but the contents of dynamic videos are also presented in real-time. Two typical applications referring to the primary education and the auxiliary visually impaired people are exploited to demonstrate the potential practical value of this prototype.

Keywords Tactile representation · Electrostatic tactile · Electrovibration · Touch screen

1 Introduction

Tactile display can perceive the shape, texture and softness of object displayed on multimedia terminal [1], which will improve the interaction between human and virtual world to a new stage with the three dimensional fusion of auditory, visual and tactile [2]. In recent years, tactile display is a hot research topic, and it has great potential in electronic commerce, education, entertainment, as well as visually impaired people applications [3].

Electrostatic force tactile representation is a major research direction of tactile display, and it has obvious characteristics such as real-time, low-power and high-bandwidth. TeslaTouch [4], as the most typical prototype, was designed by Olivier Bau from Disney Research in Pittsburgh [5], and has been successfully applied in

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visually impaired people application and navigation. In this study and accompanied video, we demonstrate a novel electrostatic force tactile display prototype, which realistically perceives the different attributes of the objects displayed in images and videos. In addition, eleven Interactive application software, such as the tactile representation experience software, the shape identification software and so on, has been developed to meet the requirement of different applications.

2 Electrostatic Force Tactile Display

The developed electrostatic tactile display based on Windows is shown in Fig. 1, and it consists of a Microsoft Surface, a Microtouch screen, en electrostatic tactile controlling module as well as a finger tracking module. The tactile controlling actuation generates the tactile stimuli signal and loads to the Microtouch screen, then

Fig. 1 Electrostatic force tactile display

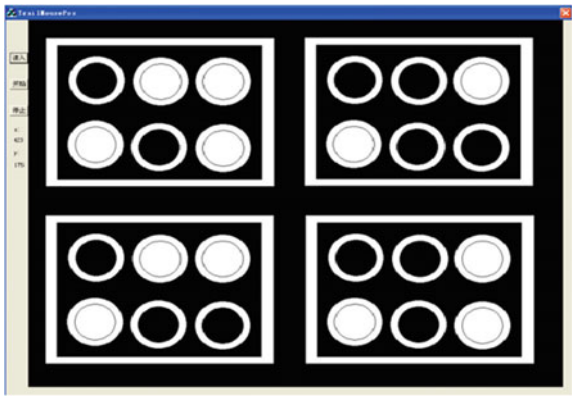

Fig. 2 Braille recognition applied in auxiliary visually impaired people

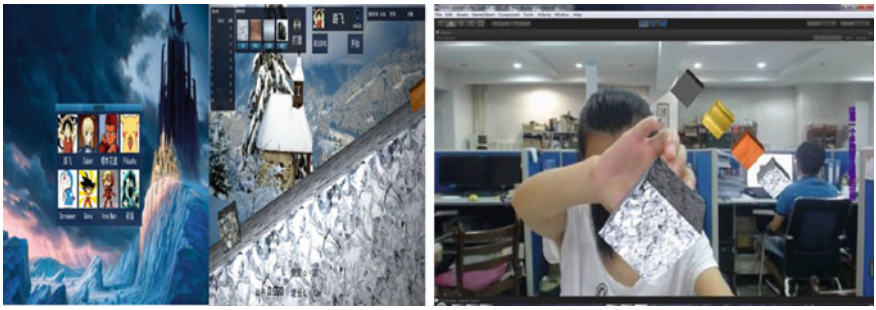

Fig. 3 Friction perception applied in primary education

the related tactile can be provided on the fingertip position. Compared to the previous works, our display makes users perceive multiple tactile by generating different stimuli signals.

3 Two Typical Applications

Braille recognition applied in auxiliary visually impaired people. As shown in Fig. 2, through touching the Braille displaying on the surface, the visually impaired people can obtain the text contents, which establishes an interaction bridge to the virtual world.

Virtual simulation applied in primary education. Referring to abstractive concepts, such as force, electromagnetic fields and thermal, which are invisible, imperceptible but objective, the virtual simulation software has been developed. Take friction perception for example, as shown in Fig. 3, through polishing the interface of different materials, the friction coefficient of the surface can be changed. After releasing the cube, students can obtain their scores. The higher these scores are, the more realistic friction force can be perceived.

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