FuSA^2 Touch Display

Kosuke Nakajima Yuichi Itoh Ai Yoshida Kazuki Takashima
Graduate School of Information Science and Technology, Osaka University*

Yoshifumi Kitamura†
Research Institute of Electrical Communication,
Tohoku University

Fumio Kishino‡
School of Science and Technology,
Kwansei Gakuin University

Figure 1: *FuSA^2 Touch Display*

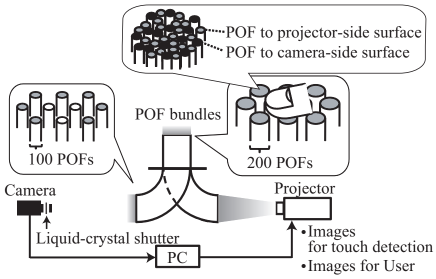

Figure 2: *System construction*

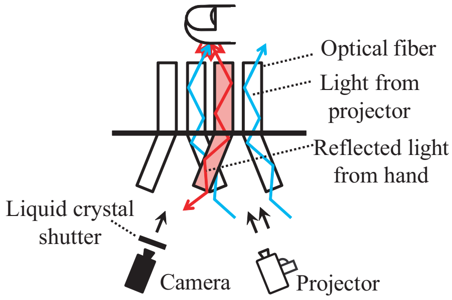

Figure 3: *Touch detection*

1 Introduction

Touching, stroking and pulling are important ways to communicate with fibratus material. Above all, stroking is one of the most representative ways to interact with fibratus material because stroking lets people feel its direction, hardness and thickness. We propose a fibratus visual and tactile display, "FuSA^2 Touch Display" (Figure 1) that gives those tactile sensations and visual feedback. In the proposed system, the visual display and multi-touch input detection technique are integrated into simple construction using plastic optical fiber (POF) bundles. We implement a multi-touch detection technique based on POF's feature and camera image, without using additional sensors. The proposed system provides the image in response to the touch input.

2 FuSA^2 Touch Display

FuSA^2 Touch Display has simple structure using POF bundles, a camera and a projector as shown in Figure 2. In order to make the flexible fibratus display, we use POFs that are long, thin and flexible like hairs. The upper-side surface of the display consists of arrayed POF bundles. A half of fibers in each bundle are led to the surface in front of a camera and arrayed in the same order as the upper-side surface. In the same manner, the other fibers are led to and arrayed in front of a projector.

In this construction, the system displays images on upper-side surface by a projector, and detects multi-touch input by using the projection light. The system projects image to the projector-side surface of the POF bundles. The projected light comes out from the upper-side surface. As shown in Figure 3, when users touch the upper-side surface, the light is reflected diffusely and gets into the POFs led to the camera-side surface. The reflected light comes out from POFs that are corresponding to the touched area. The camera captures this light from the camera-side surface, and the system recognizes the touch input from lighting area. This recognition process includes some image processing for noise reduction.

For stable input detection, the whole area of the upper-side surface always needs to be supplied an even bright light from the projector. The surface, however, is not always given an even light because of the unevenness of the projected image's brightness. Therefore, projection images are switched alternately between visual feedback and bright monochromatic light for touch input detection at a speed high enough to avoid the flicker. To capture the reflected light from the only monochromatic light, we set a liquid-crystal shutter in front of the camera. This shutter opens and closes in synchronization with projection image switching in order to prevent the camera from capturing the reflected light of visual feedback.

3 Application

We implement simple and delightful application with this system. When users touch or stroke the fibratus display, the touched areas change the color. The colored area follows the stroke, and fades away in time. Users can get a tactile feeling of the fibratus and see the visual feedback depending on stroking speed and touched size.

4 Conclusion

We proposed fibratus multi-touchable diaplay "FuSA^2 Touch Display". The proposed system with simple construction using plastic optical fiber (POF) budnles, a camera and a projector can show visual feedback and detect multi-touch input by leveraging diffusion of the projection light on the human skin. In this way, users can touch and stroke the information directly via the fibratus materials. In the future, this system can be applied to various situation, for example, robot skins, grass fields of a stadium and so on. As a next step of this work, we are planning to enlarge the size of the display, to make the resolution higher, and to develop a new input technique to sense a force on the fibers.

*email:hi-fusa@hi-mail.ise.eng.osaka-u.ac.jp
†e-mail:kitamura@riec.tohoku.ac.jp
‡e-mail:kishino@kwansei.ac.jp

SIGGRAPH 2010, Los Angeles, California, July 25 – 29, 2010.
ISBN 978-1-4503-0210-4/10/0007