Extension Sticker: A Method for Transferring External Touch Input Using a Striped Pattern Sticker

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ABSTRACT
A method for transferring external touch input is proposed by partially attaching a sticker to a touch-panel display. The touch input area can be extended by printing striped patterns using a conductive ink and attaching them to overlap with a portion of a touch-panel display. Even if the user does not touch the touch panel directly, a touch event can be generated by touching the stripes at an arbitrary point corresponding to the touched area. Thus, continuous touch input can be generated, such as a scrolling operation without interruption. This method can be applied to a variety of devices including PCs, smartphones, and wearable devices. In this paper, we present several different examples of applications, including a method for extending control areas outside of the touch panel, such as the side or back of a smartphone (Figure. 1).

Author Keywords
Striped pattern sticker; continuous touch input; conductive ink; capacitive touch panel.

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation: User Interfaces Input Devices and Strategies.

INTRODUCTION
Mobile devices with touch-panel displays such as tablets and smartphones are widespread; users can instinctively operate these devices by touching the display with their finger. Many tangible interfaces on touch-panel displays have been explored. The interface on a capacitive touch panel was introduced by Rekimoto [1]. In addition, interfaces may operate on the touch-panels in CapStones and Clip-on gadgets, and other studies have been carried out on the interfaces of these devices to extend the operation of the touch panel [2] [3]. However, although studies have been proposed, the environment that allows a user to create an interface requiring the user himself has not yet been realized.

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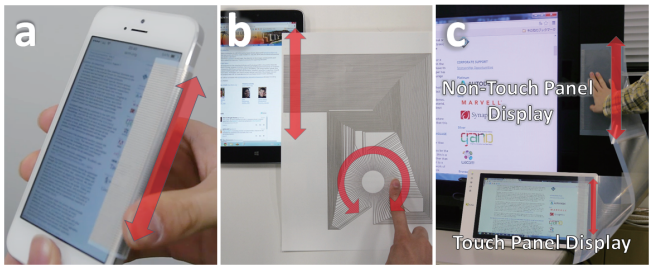

Figure 1. a) Smartphone side-input controls, b) rotation-scrolling control conversion, and c) touch controls for non-touch-panel displays

Recently, conductive ink used in prototyping has been attracting attention. In the Instant inkjet circuits proposed by Kawahara, a conductive ink was used for prototyping the circuits and sensors [4]. In addition, PrintSense has been used to create touch sensors [5].

In this study, we focused on the conductive ink and proposed a method for transferring external touch input by partially attaching a sticker to a touch-panel display. By attaching a sticker printed with a striped pattern using a conductive ink, devices may be operated without directly touching the display. By extending the striped pattern outside the display, the user can use any surface including the back or sides of a smartphone, the surface of a desk, or even the walls of a room as a touch-capable interface. Furthermore, this method is not only ON-OFF control of touch input but allows for continuous touch input such as scrolling within the scope of the attached sticker (Figure. 1).

PROPOSED METHOD
General touch-panel displays are controlled with input using human fingers. Therefore, one point can be recognized by touching an area the size of a human finger, but a touch input will not be generated if the touch area is a small point or a line less than 1 mm in width. In this paper, we propose a method for generating touch input by placing multiple lines that are too thin to be recognized by the touch-panel at intervals of a few millimeters. The user attaches the stickers with striped patterns printed using a conductive ink onto the edge of the display (Figure. 2). By touching one side of the sticker, the user can transfer the touch input to the display attached to the other side of the sticker. In addition, touch input can be generated by touching a number of closely spaced lines less than 1 mm in width. Therefore, the finger in contact with the lines of the striped pattern will be activated in order when the

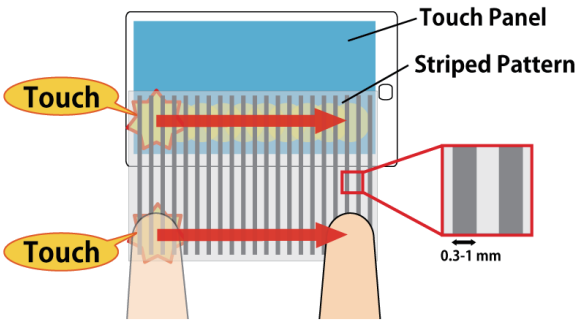

Figure 2. Striped Pattern Using a Conductive Ink

user slides his finger on the sticker. Thus, continuous touch input such as scrolling is generated without interruption.

APPLICATION EXAMPLES

In this section, we discuss examples of applications using the proposed method. Changing the form of the touch input area allows a user to create a variety of touch interfaces.

Smartphone Side-Input Controls

Stickers with striped patterns printed using a conductive ink are attached to the sides of the display and side surface of the smartphone. In this way, the user can touch the side of the smartphone to scroll and view a browser or other applications without obscuring the screen with a finger (Figure. 1a). By extending the striped pattern to the back of the smartphone, back-panel touch input can be realized for use in applications. Alternatively, the stickers could be applied to the sides of a smartwatch display equipped with a touch panel and to the watch band, thereby allowing the device to be controlled by touching the band.

Rotation-Scrolling Control Conversion

Rotation controls can be converted to scrolling controls by attaching a striped pattern printed with lines arranged in a circle, as shown in Figure. 1b. This makes it possible to create a wheel mechanism that allows for scrolling by simply attaching a sticker to a smartphone or tablet. This could be used to realize a jog dial that recreates the classic iPod controls on an iPhone.

Touch Controls for Non-Touch Panel Displays

It is possible to adjust the touch input speed difference by changing the spacing of the stripes on the input and output sides. Thus, a touch input operation using the user's hand can be converted to a touch input of fingertip size. For example, a smartphone or tablet is attached to a large non-touch-panel display and displays a reproduction of the image. By attaching the sticker onto these two displays, it is possible to scroll the side of the large non-touch-panel display by hand. Figure 1c shows the transference of touch input from the sticker attached to the large non-touch-panel display to the tablet device.

Applications for Other Devices and Equipment

This method can be applied to a variety of other devices equipped with capacitive touch panels. For example, the method could be used for a digital camera with touch-panel zoom controls. When users touch a digital camera, they tend to press the body of the camera strongly, which can shift the camera's position. By using this method to extend the touch panel to the camera's tripod, we could realize more stable controls. Air-conditioner controllers have also used touch panels in recent years, and these controllers are often located on a wall where they cannot be moved. Using this method, the user interface could be brought from the panel to the sofa or another location following the wall or floor. Because thin materials such as paper are used, they could be attached to the back of the carpeting or wallpaper. The method also allows for free design interaction with daily-use objects.

CONCLUSION

In this paper, we reported a method for transferring external touch input by using a conductive ink.

Although the portion of the display covered by the pattern is difficult to see, the touch area could be extended without reducing the display visibility by using transparent materials such as a transparent conductive ink. In addition, the printed surface is degraded while using the interface because we have used a conductive ink to create the stickers; thus, it is necessary to consider more appropriate materials.

Presently, the touch input can only be controlled in a single axial direction, but we hope to create a mechanism for controlling touch input at an arbitrary point in an x-y plane via future improvements. The examples in this paper are only a portion of the total number of applications. Because this method can be used with a variety of devices equipped with capacitive touch panels, we expect that it can be used in a wide variety of applications.

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