

RodDirect: Using Stylus as a Peripheral Input Device

Motoki Miura

Susumu Kunifuji

Japan Advanced Institute of Science and Technology

1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan

Phone: +81-761-51-1717 Fax: +81-761-51-1775

{miuramo,kuni}@jaist.ac.jp

ABSTRACT

We designed a novel and simple interaction technique for handheld devices by using a stylus. A stylus is ordinarily utilized as a tool for tapping on a touch-sensitive screen. We employ the physical movement of a stylus as input. Both rotation and slide movement of stylus where the inside of the stylus holder can be used to adjust two parameters simultaneously. Below we describe the merits and applications of RodDirect interaction.

KEYWORDS: interaction design, handheld devices, PDAs

INTRODUCTION

Portable handheld devices such as PDAs and mobile phones inherently involve difficulties in input methods due to their compact size. Most PDAs install a display with a touch sensitive panel to provide tapping, holding, and dragging operations. The pen-based operation is versatile, but it requires precise controls for specifying smaller GUI objects, and pre- and post-actions of removing/storing a stylus disturb smooth transitions into the interaction mode.

Various approaches for introducing natural interaction into portable handheld devices have been proposed. Fitzmaurice et al. [1] employs position and orientation to navigate virtual space by using a concept involving the augmented reality technique. Rekimoto [5] employs tilting actions to navigate maps and select menus. The “posture” approach is surely simple and intuitive, but detecting the location highly depends on environment with sensors. Also the tilting approach tends to restrict the posture of the device in use, and it is not suitable for continuous precise adjustments. Other technique includes attachment of pressure/touch-sensitive sensors to capture natural gesture and handling of the device[2, 3]. However, the exposed touch-sensitive sensors essentially influence the exterior design of the device.

RODDIRECT

We propose “RodDirect,” a novel and simple interaction technique for handheld devices. RodDirect exploits the movements of a stylus in the stylus holder as an input. Typically, the stylus holder is only used to store the stylus when the

device is not in use. RodDirect brings additional interaction modality through physical metaphors rather than by conventional tapping.

Figure 1 shows an interaction style of RodDirect. Assume that the cross section of the stylus is circular. The user holds the stylus between his/her thumb and forefinger (or the middle finger) and rotates/slides the stylus. RodDirect detects the amount of the rotation/sliding movements continuously. Thus it enables the user to control two parameters simultaneously. This function can be applied for several tasks such as scrolling, pointing, and zooming.



Figure 1: An interaction style of RodDirect; A user rotates and slides the stylus to operate handhelds.

We gain two merits from the mechanism of RodDirect. Firstly, the physical constraint between the stylus and the holder makes the operation easier. That is, the user can easily manipulate the stylus with non-dominant hand rather than tapping. Secondly, the user can commonly keep the position of the stylus even if he/she releases the stylus. Because it can be hold by the friction of the stylus and it's holder.

Habitually, a user can perform simple tasks such as switching application and selecting menu with single-handed operations using buttons and a jogdial. Although more complicated tasks such as scrolling and adjustment can be performed by these operations, the user often employs tapping on the panel to perform these tasks since the single-handed operations are not suitable and efficient. As a result, the user unwillingly takes the tapping because it occupies both hands to operate.

RodDirect also requires both hands, but the user can release the stylus unless the user is operating. Thus the user can freely use a hand, and can come back quickly to the op-

eration. This is a strong point because the handheld user frequently switches operating/non-operating modes. While the tapping, the user has to put the stylus back in the stylus holder, and takes it again repetitively. RodDirect is not applicable for highly complicated tasks such as entering text and drawing handwritings, but the user can employ RodDirect for simpler scrolling/adjustment tasks.

RodDirect appends a function similar to a volume knob into a stylus in addition to its conventional use as a pen. Typically, the pulling out and rotating a “knob” are exploited for winding/regulating a wristwatch; thus, these operations are essentially suitable for small devices.

IMPLEMENTATION OF PROTOTYPE

We adopt an optical image sensor commonly installed in an optical mouse. When the stylus is rotated or slid, the optical image sensor detects the movements from the location of the optical mouse. This approach is similar to MouseField [4]. We attached the sensor board of an optical mouse (800 counts/inch) on a Pocket PC (hp iPAQ h1930). The smaller sensor can be embedded inside the device, and it does not force the exterior design. As a prototype, we used a PC to retrieve the mouse data from Pocket PC applications and we employ the normal stylus for RodDirect interaction.

Applications

We have developed several applications, which utilize RodDirect interaction. The applications are categorized by the adopted metaphors.

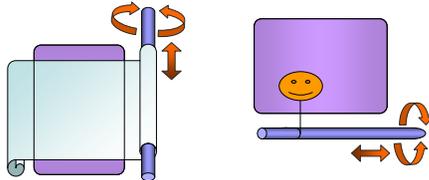


Figure 2: Metaphor of “Scrolling” (left) and “Moving Object” (right)

Scrolling Based on the “scrolling” metaphor shown in Figure 2 left, we have implemented an image/document viewer, a scheduler (Figure 3) and a map viewer. In the scheduler, the user can modify a date/time of schedule item by tapping with his/her thumb as well as scrolling. Since the range of “sliding” operation is limited, we prepared a “clutching” mechanism; and hence the user can cancel sliding while pressing a button.

Moving Object We adopt a “moving object” metaphor (Figure 2 right) to games such as, a block breaker (Figure 1) and a space invader (Figure 4). The sliding operation is common for “moving the character horizontally.” In the space invader, the rotation gesture is allocated for shooting the laser beam by controlling speed. RodDirect is suitable for games because it does not cover the display.

CONCLUDING REMARKS

We have proposed novel and simple interaction technique “RodDirect” for handheld devices using the movements of a stylus inside the stylus holder. We have shown merits and applications of RodDirect.



Figure 3: Scheduler: A “scrolling” example with a touch panel operation by thumb.

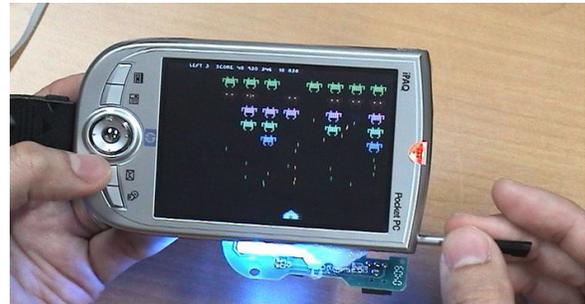


Figure 4: Space Invader: A “moving object” example

Since the basic operation of RodDirect is simple and intuitive, no special instructions are necessary. We do not say that RodDirect can cover all conventional tapping. But we introduced a temporal two-handed interaction as an alternative of one-handed and full-time two-handed ones. RodDirect is robust, and it works everywhere and at free angle of the device. We believe that RodDirect enhances the usability of handheld devices such as PDAs, cellular phones, and smartphones even if the device does not have a touch-sensitive display installed.

ACKNOWLEDGMENT Our research is partly supported by the fund from Ministry of Education, Culture, Sports, Science and Technology, Japan, under the name of Cluster for Promotion of Science and Technology in Regional Areas.

REFERENCES

1. George W. Fitzmaurice, Shumin Zhai, and Mark H. Chignell. Virtual Reality for Palmtop Computers. *ACM Transactions on Information Systems*, 11(3):197–218, July 1993.
2. Beverly L. Harrison, Kenneth P. Fishkin, Anuj Gujar, Carlos Mochon, and Roy Want. Squeeze Me, Hold Me, Tilt Me! An Exploration of Manipulative User Interfaces. In *Proceedings of CHI'98*, pages 17–24, April 1998.
3. Ken Hinckley, Jeff Pierce, Mike Sinclair, and Eric Horvitz. Sensing Techniques for Mobile Interaction. In *Proceedings of UIST'00*, pages 91–100, November 2000.
4. Toshiyuki Masui, Koji Tsukada, and Itiro Sii. MouseField: A Simple and Versatile Input Device for Ubiquitous Computing. In *Ubicomp 2004 Adjunct Proceedings (Demos)*, September 2004.
5. Jun Rekimoto. Tiling Operations for Small Screen Interfaces. In *Proceedings of UIST'96*, pages 167–168, November 1996.