Augmenting Interactivity of Touch Pad by Adding Isometric Rate Control

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Abstract In this paper, we present FloatingPad, a touch pad based device with better scrolling feature and more interaction styles than a traditional touch pad. When we interact with a real object like a picture or a book, we manipulate on the object, and we also move, rotate, and flip the object. We applied this idea into a touch pad. In FloatingPad, the touch pad is not fixed to the device. It is floating on the device; it can be slid on the device. Therefore a user can have additional degree of freedom of input by shifting and rotating the touch pad while having the traditional touch pad input. By using this technique, the interactivity of the touch pad can be augmented, and better scrolling feature can be provided by reducing clutching occurs on the position scrolling devices by using the movement of the touch pad as rate control. We implemented the prototype device and conducted a user study with three applications developed for FloatingPad.

Keyword: Touchpad, Interface, Interaction Technique, Scrolling

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1. Introduction

There are many input devices to enhance user experience; some mice have many buttons to enable more interaction functionalities, some additional tools are being used to provide a rather easier implementation of special functionalities such as scrolling or task execution[4],[5].

However, because of the limitation of the space, interaction methods of mobile devices are limited, and users may not want to carry additional device with their device. Thus there have been researches to enhance mobile input device to let users not need to carry additional device. There have been researches to enhance the mobile input device is providing more interaction methods to mobile devices. Siio[8] suggested adding a mode switching interaction for handheld computing devices by using "Paperweight Metaphor", and Suzuki[9] proposed a device to enrich the interaction for stylus based touch screen device which has an accelerometer attached on the top of the stylus, thus it can provide not only traditional stylus input but also rolling and shaking stylus input. There have been researches to improve the performance of the input device on mobile device. Moscovich presented a scrolling technique which does not need additional hardware device to improve the scrolling performance by reducing clutching using a virtual scroll ring[7]. Caisiez attached a rubber ring on the edge of touch pad to enhance pointing on the touch pad by reducing clutching[2].

Our goal is to enhance user experiences with mobile devices by reducing clutching occur on scrolling and enrich interactivity on the touch pad without increasing the touch pad size.

In this paper, we introduce an interaction technique based on the floating idea and present a novel device named FloatingPad which provides new interaction styles which are shifting and rotating the touch pad, and reduces clutching occurs on the traditional touch pads on scrolling by providing an isometric rate control scrolling.

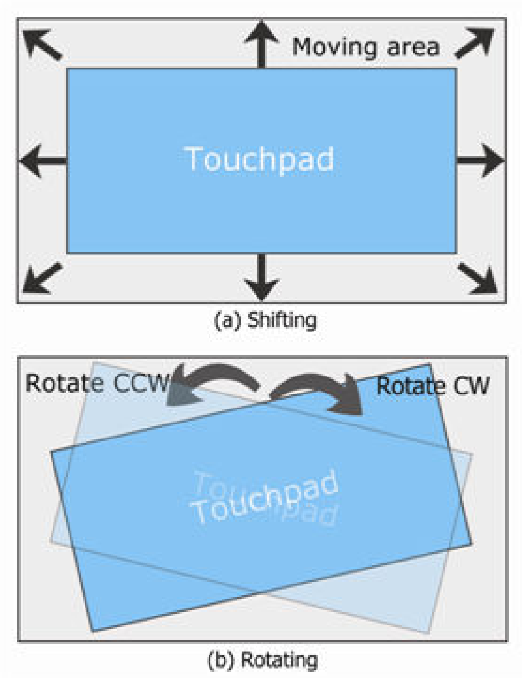

Figure 1. New interaction styles of FloatingPad
(a) shift interaction (b) rotate interaction

2. FloatingPad

When people interact with real objects, people manipulate not only on the object but also with the object itself. For example, we write a memo on the surface of the photo, and also we rotate, move, and flip the photo. Through this method, we have more types of interaction rather than just manipulating on the object. We thought that this method can be applied into mobile device to enrich the interaction, and in this paper we applied this idea into touch pad.

In general, touch pads are fixed to the device, we separated touch pad from the device. In FloatingPad, touch pad is put on the device and it can slide on the device, like an object floating on the water.

When users slide their fingers on the touch pad, touch pad does not move, and it moves cursor like a traditional touch pad. Users can move touch pad using frictional force by pressing touch pad, and then it performs isometric rate control.

There are two types of rate control based interaction styles, which are shifting, and rotating (See Fig.1). Shift interaction generally performs scrolling function like we shift paper when we are

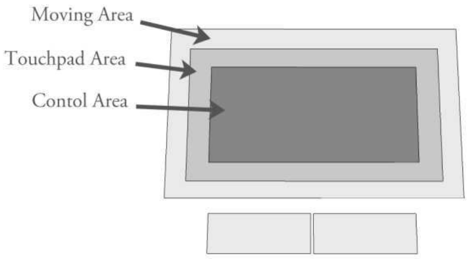

Figure 2. Area Design for FloatingPad

reading long paper documents, and rotate interaction can be mapped to rotating pictures like we rotate pictures. Those mappings can vary from application to application.

FloatingPad has three Areas, which are control area, touch pad area, and moving area. Control area is the only part shown to the user. Touch pad area is generally hidden under the palm rest of a laptop computer. The third area is moving area which is a margin which makes the touch pad able to move.

2.1 FloatingPad Device

FloatingPad is separated into three parts, which are the floating part and the touch pad part, and the controller part.

Floating part, the lower part of the device, has two joystick-typed two-axis potentiometers. These potentiometers have homing force, therefore FloatingPad can provide isometric rate control. This part supports touch pad part to float and slide.

Touch pad part is located on the floating part. This part has two holes on the bottom, thus the sticks on the potentiometers can be put. By this structure, the movement of the touch pad part can be detected. Cirque Smart Cat touch pad[3] has used for this part.

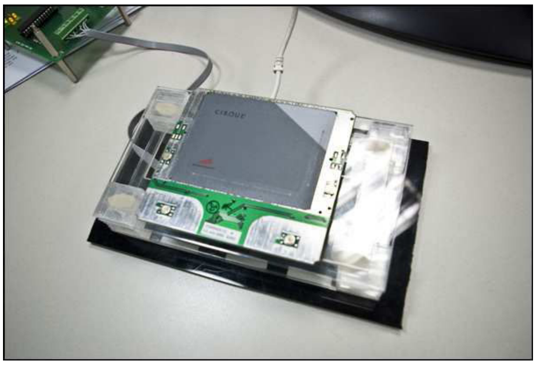

Figure 3. Prototype of FloatingPad

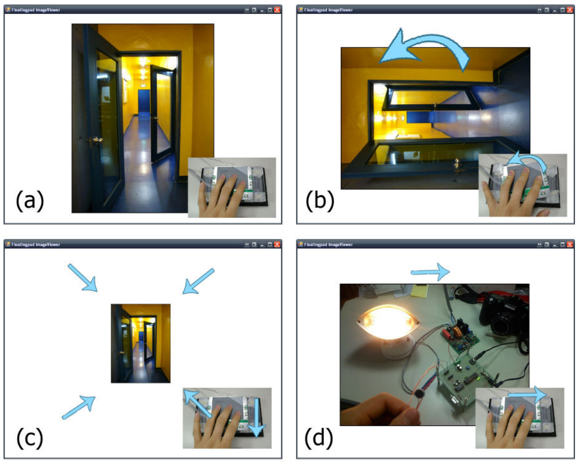

Figure 4. Picture Viewer application and operation examples. (a) Picture viewer application (b) When the user rotates FloatingPad, the picture on screen rotates. (c) When the user shifts FloatingPad down, the picture shrinks. (d) When the user shifts FloatingPad right, picture changes to the next picture.

Controller part uses PIC16F73 microprocessor to process the signal from the device. This part is connected to the computer, sends processed data via RS232 serial communication.

2.2 Applications

To evaluate the usability of FloatingPad, we have developed three applications, which are Web browsing driver, picture viewer, and music controller. Each application has own interaction mapping as shown in the table 1. Those applications are developed with C# using Apple iTunes COM for windows SDK[1] and runs on the Microsoft .Net Framework 2.0[6].

2.2.1 Web Browsing Driver

Web browsing driver has developed to evaluate scrolling feature of FloatingPad. By using this driver, users can move pointer by sliding their finger on the FloatingPad like as general touch pad, and scroll the Web page by shifting FloatingPad vertical or horizontal direction. When users rotate the FloatingPad clockwise, Web browser executes navigate forward page function, and executes navigate backward page function for twisting counterclockwise.

2.2.2 Picture Viewer

We implemented a picture viewer application which provides navigating, zoom-in/out, and rotating operation. Fig.4 shows the screenshot of picture viewer and its operation examples. In this application, users can browse pictures by shifting FloatingPad left or right side, zoom pictures by shifting up or down. By rotating FloatingPad, users rotate pictures.

2.2.3 Music Controller

Music controller provides user to control iTunes music player, user can play, pause, stop, navigate track, and control sound volume. Because FloatingPad has dual stream input, which are: position control input provided by touch pad, rate control input provided by floating part. The user can use one of two inputs to perform special function. When the user concentrating on the office work, is listening the music, the user' s screen may full of working windows and it may be difficult to control music player application. With FloatingPad, the user can use floating to perform music controlling and can control iTunes music player without activating music player application by shifting or rotating FloatingPad.

3. User Study

To evaluate the usability of the FloatingPad, we conducted a user study with three applications. Six people (4 male, 2 female) participated with a mean age of 24.5, and every participant had experiences using touch pad. User test contains two stages, which aim to evaluate scrolling feature and additional inputs designed for applications.

The first stage is designed to evaluate the scrolling feature of FloatingPad. In this stage, participants were asked to navigate Web pages. They were asked to scroll and navigate long Web pages with FloatingPad and the traditional touch pad.

In the second stage of the test, participants were asked to use FloatingPad picture viewer and music controller. They were asked to rotate, zoom in/out, browse pictures with picture viewer application, and also asked to play/pause and navigate music tracks, control audio volume with music controller application using FloatingPad.

After the test, participants were asked to respond to questionnaire on a 7-point Likert scale. Questions were about how easy and convenient to use FloatingPad for each application. Fig.6 shows the

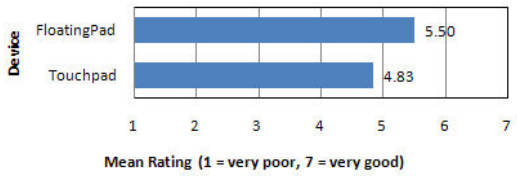

Figure 5. Mean subjective ratings for the satisfaction of each device on scrolling.

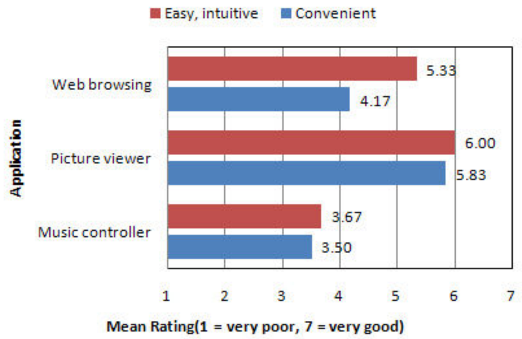

Figure 6. Mean subjective ratings for the easiness, intuitiveness, and convenience of FloatingPad for each application.

result of the questionnaire. It shows significant difference between the result of the picture viewer and the result of the music controller. We found that interaction mapping between the device and the application cause big difference in usability.

For the first stage of the test, they reported that they could find the target faster, and felt more convenient with FloatingPad rather than traditional touch pad. One of the participants reported that he suffered for the finger missing from the scrolling area on the traditional touch pad, thus he should check his finger occasionally, but it did not happen to FloatingPad because FloatingPad does not have specific scrolling area but whole touch pad can be used as scrolling area. Participants reported that it was good to not having clutching especially for scrolling long document, and they prefer to use FloatingPad scroll for the task which does not need a precision scroll. One of the participants reported that because FloatingPad has more function, he felt that FloatingPad is more complex.

For the second stage of the test, participants reported that they could easily know how to use FloatingPad for the picture viewer because the rotating and shifting behavior on the FloatingPad and the behavior of the real world are the same, it was easy and intuitive to manipulate picture with FloatingPad. However, participants reported that they could not found strong relation between the FloatingPad and the real world and it was not easy to understand how to use.

Participants were more satisfied with FloatingPad rather than traditional touch pad(See Fig.5). Five of six participants answered that they would use FloatingPad rather than traditional touch pad for scrolling tasks.

4. Conclusion and Future Work

In this paper, we introduced an interaction technique based on floating idea to enrich touch pad interaction. We implemented a prototype of touch pad based novel interface named FloatingPad. FloatingPad provides new interaction styles that traditional touch pad does not provide, and also provides rate control scrolling to reduce clutching for scrolling task. We implemented three applications to evaluate the usability of the FloatingPad and we found that the interaction mapping between the device and the application significantly affect to the usability of the FloatingPad.

As a future work, we are planning to find relation between the real world and the FloatingPad and implement applications and apply floating idea into touch screen based mobile devices.

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