Introduction

Recently, the importance of User eXperience (UX) for mobile devices has derived from spread of smartphone and tablet PC. Physical interactions between User and device are especially aroused. One of them is an input control method using touchscreen. Early smartphone has been utilized focusing on the PIMS, which can help users to manage personal schedule, write E-mail, or edit documents. As a result, the productivity of User Interface (UI) that helps users has been put on emphasis.

However, most of current users utilize smartphone as an entertaining machine. For example, watching soap opera on the bus, listening to the streaming music, playing social game, or reading e-book are them. Since such kind of tendency increases, screen size of mobile device has been considerably enlarged as well as weight increases.

In past times, ‘bezel’ has been existed for backlight emission. However, even current technology can narrow the bezel space down to several millimeters, most of mobile devices that has bigger than 7-inches, applies substantially wide bezel. And the only reason why bezel exists is the convenience of touchscreen. Bezel, surrounding over the display, is applied with the object of rejection of incorrect input on touchscreen. Minimum space to grip device is essentially needed. The wide bezel increases both the overall size of device and weight. It can hinder portability and usability. Therefore, this research presents ‘Resting Finger Rejection System’ which prevents the unavoidable input on unwieldy device.

Recognizing the direction of user’s eyeball, the system selectively allows the input. When the touch point exists on the collinear axis from eyes, it helps resting fingers to touch freely not only bezel but also touchscreen.

Hence, based on the general usage form of mobile device that people usually touch the point after check the screen with eyes, this study will improve physical usability with comfortable grip. Moreover, by reducing bezel space, manufactures could focus more on the portability of product than before.

Related works

Majority of current touchscreen rejection technology are developed for ‘Palm Rejection’ that helps a user to rest their hand on screen without activating touch screen, especially when writing or drawing with digitizer pen.

There are several methods to selectively recognize the input of pen while canceling accidental finger touch. For instance, capacitive touch sensor is deactivated when pen closes to the touchscreen [1]. And other method is about rejecting palm area with large contact area detection [2, 3]. Using Kinect, depth information with 3d posture of hand can discriminate drawing region and palm resting region [4]. These methods are concentrated on combination of pen and finger touch not on effective grip rejection over screen.
Figure 1 shows a touch rejection method which senses the touch input over the bezel space for validating whether fingers on screen are for input or grip. Contacts in edge bands around the perimeter of a touch sensor screen can be ignored [5]. This method can be useless while finger for grip is remote beyond threshold distance.

And recently, Apple Inc. has applied software featured touch rejection technology to tablet PC, iPad Mini, which has much slimmer bezel than previous products. Since ‘iOS 6’, device identifies ‘resting thumb’ by algorithm. First, if one touch point doesn’t move for a while and another finger moves up and down for a scroll, static touch will be considered as a resting thumb. Second, if user touches the screen and holds it after slight movements, it also regarded as a resting thumb. These algorithmic judgments are based on conventional user-behaviors that resting thumb will be motionless when holding a device. However, this assumptive method can often fail when resting thumb detached accidently, and long holding action conflicts with context menu triggering.

Therefore, in this paper, we utilize gaze-tracking, to distinguish unintended input from intended, and permit only the input that user observes. Based on the intuitive action that user touches the point after gaze, this study will improve the usability of mobile device as well as disadvantages of previous technologies.

**Proposed Method**

The proposed method is conceptually tested with tablet seen as Figure 2. And the major components of cancelation system are the following: A, on figure 3 is the front camera equipped above touchscreen display. It analyzes the direction of eye with image processing. After setting both position of mobile device and direction of gaze, the touchscreen B checks whether the touched point is identical with gazing area or not. D is the valid touch point and C is canceled space that user unnecessarily put thumb to grab device.

After user stop touching display, the eye-tracker works immediately by stages. First of all, it consistently traces the eyeballs. It tries to check the data between coordinate sensed at touchscreen and gazing area. If the gazing area is included in the certain threshold radius from the touch point, the input is validated. If not, eye-tracker goes back to the first step.

Nevertheless, the proposed method is not always perfect for unavoidable touch input. Therefore, depending on the content user watches, there should be diverse exceptions. For instance, if the gazing area steadily moves from top to bottom, current input can
be permitted as scroll event. In case, more than two fingers are sensed to rotate image, it will be allowed as Multi-touch gesture. Also, accidental touch has to be canceled while the saccade for documents or surfing mobile web is perceived.

**Conclusion**

In this paper, we propose the system, *Resting Finger Rejection System* based on the assumption that generally user touches the watching point. It works for users to comfortably hold their mobile devices that can be applied to them such as big smartphone or tablet PC with wide bezel. Through this system, unavoidable touch input for grip is effectively invalidated. As a result, this technology could be universally applied to devices such as kiosk, ATM(Automated Teller Machine), controllers used in the industry field even it does not equipped touchscreen. Furthermore, our future work will be conducted with development of prototypes and factual experiments.

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**References**