Watch Commander: A Gesture-based Invocation System for Rectangular Smartwatches using B2B-Swipe

Yuki Kubo, Buntarou Shizuki, and Shin Takahashi
University of Tsukuba
Tennodai 1-1-1, Tsukuba, Ibaraki 305-8573, Japan
{kubo,shizuki,shin}@iplab.cs.tsukuba.ac.jp

ABSTRACT
We present Watch Commander, a gesture-based invocation system for rectangular smartwatches. Watch Commander allows the user to invoke functions easily and quickly by using Bezel to Bezel-Swipe (B2B-Swipe). This is because B2B-Swipe does not conflict with other swipe gestures such as flick and bezel swipe and can be performed in an eyes-free manner. Moreover, by providing GUIs that display functions assigned with B2B-Swipe, Watch Commander helps the user memorize those functions.

Author Keywords
Ultra-small device; wrist-worn device; watch applications; shortcut; eyes-free; bezel swipe; watch GUI.

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces – Input devices and strategies, Interaction styles.

INTRODUCTION

In most smartwatch interfaces, selecting and invoking a function, including starting an application, is performed by tapping a soft button or an icon (e.g., an app icon on the application menu). However, owing to the fat finger problem [7] and occlusion, tapping precisely on an icon is difficult to accomplish on the small touch screen. This problem is even more pronounced for command selection on the small screen. On the other hand, swipes, including bezel swipes [6], are more promising for such selection, because they do not require the user to precisely point the finger at a specific touch area. However, existing swipes including bezel swipes cannot be assigned to new functions because these gestures have been already used as basic operations on a smartwatches.

Previously, methods that increase input vocabulary of a smartwatch have been explored. For example, Beats [5] combines tapping and release patterns with two fingers, which can only be used on a multi-touch screen. Lafreniere et al. [3] proposed *WristTap* that utilizes multi-touch and *TwoTap*, that consists of two rapid and sequential taps; while implementing *WristTap* needs a multi-touch screen and *TwoTap* cannot be performed in an eyes-free manner. While methods that increase input vocabulary by using sensors have been proposed [1, 4], these methods need additional sensors.

Figure 1. Watch Commander. Users can invoke a function by using B2B-Swipe. (a) Invoking a staring command that starts a timer application. (b) Invoking a starting command that starts a messenger application.

In an attempt to overcome these limitations, we present Watch Commander, a gesture-based invocation system for rectangular smartwatches (Figure 1). In this system, the user is able to easily and quickly invoke a function in a smartwatch using Bezel to Bezel-Swipe (B2B-Swipe) [2].

B2B-SWIPE

B2B-Swipe is a single-finger swipe gesture that starts and ends at a bezel. In rectangular smartwatches, 16 B2B-Swipes are available because there are four bezels. Experiments showed that B2B-Swipe does not conflict with the bezel swipe or flick. Moreover, the user can perform B2B-Swipe in an eyes-free manner. Furthermore, B2B-Swipe requires only a single-touch screen, because it is a swipe made with a single finger.

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This large input vocabulary of B2B-Swipe provides the user with a rapid selection/invocation of many functions that are available in a smartwatch. Specifically, the vocabulary allows us to organize *global functions* (i.e., functions available on all applications) and *local functions* (i.e., functions unique to individual applications) strategically: we assigned *global functions* to two specific bezels and *local functions* to the remaining two bezels.

WATCH COMMANDER

Watch Commander is a gesture-based invocation system for rectangular smartwatches. In this system, the user can easily and quickly invoke *global functions* by using B2B-Swipes that start at two specific bezels and *local functions* by using B2B-Swipes that start at the remaining two bezels. In addition, Watch Commander displays GUIs that help the user memorize the assignments.

Global Functions

In Android smartphones, functions such as "Back," "Home," and "Recent Apps" can be performed by using soft buttons in any applications. If these functions can be realized in smartwatches, selection of application will be easier and faster. Thus, we assigned these functions to B2B-Swipes that start at the bottom bezel (Figure 2a-d). This design contributes towards the reduction of impact at the side where the user wears the smartwatch (e.g., when the smartwatch is worn on one's left wrist, the left bezel becomes a deep side, and performing a B2B-Swipe that starts from the left bezel becomes difficult).

Moreover, we assigned functions such as "Do not disturb," "Theater mode," and "Settings" to B2B-Swipes that start at the top bezel (Figure 2e-g), similar to the menu of Android Wear OS invoked from the top bezel swipe.

Local Functions

We strategically assigned *local functions* in the following manner: functions that can be categorized under a single group are assigned to B2B-Swipes that start at the same bezel. This will help the user remember the assigned functions better. For example, functions for time and text are assigned to the left and right B2B-Swipes, respectively.

GUI for Memorization

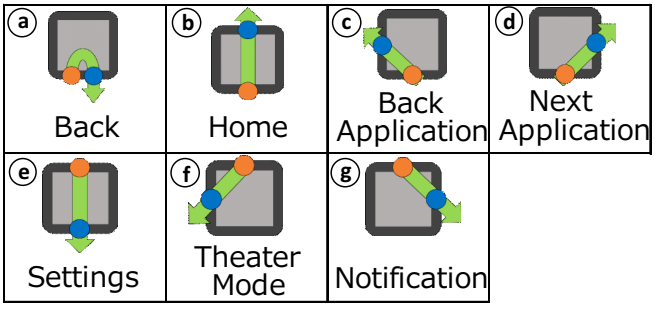

Figure 2. Global Functions. (a) Back: Return to the previous display. (b) Home: Return to Home. (c) Previous Application: Return to the previous application. (d) Next Application: Change to the next application. (e) Settings: Smartwatch Settings. (f) Theater Mode: Switching to the theater mode. (g) Notification: Manage notifications.

Figure 3. GUIs for memorization, showing the assigned functions. When the user stops a finger after crossing a start bezel, the functions assigned to the start bezel are displayed on the GUI. These figures show the GUI showing the functions assigned to B2B-Swipes that start at the left and right, respectively.

Since memorizing all the functions assigned to B2B-Swipes is difficult, we designed GUIs to help the user search for the assignment and memorize it. When the user stops a finger after crossing a start bezel, the functions assigned to that bezel are displayed in the GUIs on the smartwatch (Figure 3). Now, the user can examine the functions that have been assigned. Once the user locates a desired function, he or she move the finger further towards the corresponding end bezel to invoke the function. On the other hand, the user can simply release the finger to cancel the B2B-Swipe. It is to be noted that a quick B2B-Swipe does not show the GUI. This design allows the user to memorize the assignments gradually.

IMPLEMENTATION

An ideal implementation of Watch Commander would be a system daemon that captures all the touch events to invoke both *global functions* and *local functions*. However, in this demonstration, we implemented a prototype of Watch Commander that assigns all the implemented functions to *local functions* to present a proof-of-concept of Watch Commander.

APPLICATIONS

In this section, we show the some example assignments of *local functions*.

Home

A user can invoke eight different applications as *local functions* in one step.

Timer

Because B2B-Swipes can be performed in an eyes-free manner, the user can set the timer without looking at the screen of the smartwatch. We assigned the minutes and seconds timers to the left and right B2B-Swipes, respectively.

Messenger

Text input is difficult in smartwatches. We implemented a messenger application where the user can send some frequently used messages (e.g., "Why don't we have lunch?" or "Sorry"). The user can select a typical text as a *local function*, and subsequently send the message by tapping on the screen.

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