Smart Wristband: Pressure-Sensitive Wristband as a Scrolling and Selecting Input Method for a Smartwatch

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# ABSTRACT

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# Introduction

The main input methods for traditional smartwatches on the market are display touch screens and physical buttons. However, it is difficult to carry out complex tasks on smartwatches due to the limited number of physical buttons and inadequate area of touch interaction. The small screen can be partially or completely blocked by the user's finger when they interact with the device. Furthermore, selecting objects on the screen, especially small ones, can be inaccurate due to the size of the user's finger in relation to the size of the touchscreen. Our research aims to enhance users’ experience with smartwatches and increase efficiency and accuracy of scrolling and selection through extending interaction surface of smartwatch to include the wristband as an input tool.

We propose placing different types of touch sensors on the smartwatch wristband and using these sensors to identify scrolling and selection input. To scroll up and down, a user can move their finger along the long edge of the band. For long scrolls, a user can do multiple rolling strokes over and over. We will not make the wristband identify horizontal scrolls because while the touch interaction space is bigger vertically (i.e. along the wristband), usually it is not bigger horizontally, since a lot of wristbands are more narrow than the touchscreen. To select an object on the screen, a user can move their finger on the wristband and this movement will be mapped on the smartwatch by highlighting the different objects on the screen. Once the desired item is highlighted, the user can tap his/her finger anywhere on the band to select it. Our research question is: Is placing touch input on the back of a smartwatch wristband more convenient to users and will it lead to faster and more accurate object selection compared to using finger selection on smartwatch touchscreen? We argue that our input method can deliver more selection accuracy and freedom because the finger will be moving along bigger interaction area. Moreover, moving the touch interaction off the screen will allow the user to not block the display screen while interacting with the device.

While no other input methods beyond smartwatch touchscreens and physical buttons has been implemented commercially, there are several studies that researched the possibility of extending interaction surfaces beyond these two methods such as using air-magnet-pen and hand gestures. There are few studies that used the wristband as an input method, but they either focused on developing the strap only for text entry or the wristband was only sensitive on the edges where the wristband touches the watch. We are studying the possibility of making the entire wristband sensitive so we can use the whole wristband as an input surface. This will give the user the potential to perform more complex tasks with higher accuracy.

# Related work

BandSense [1] explored pressure-sensitive multi-touch interactions with a smartwatch wristband. Their device had pressure-sensitive touch sensors on the wristband on either side of the smartwatch screen. The sensors could detect tapping and flicking motions, as well as pressure input on part of the band that can be used a directional input. The device could also interpret flicking up and down motions as commands for copying and pasting. They demonstrated that this kind of device could be useful for many different tasks, although they did not conduct a user study to test the effectiveness of this device.

Funk et al. [2] experimented with two text entry methods on a touch-sensitive smartwatch wristband: sliding and multi-tapping. Both text entry layouts were a vertical arrangement of letters positioned to the sides of the watch display. The first had a narrow key for each character, and the user could slide their finger until the correct character was selected. The second had 3 letters per key, which were selected by multi-tap. They concluded that the multi-tap layout was faster in terms of words per minute, and also preferred by the study participants.

Knibbe et al. proposed extending interaction area of smartwatches to include the back of the wearer’s hand and use off-gesture interaction as input method. The proposed device supports range of bimanual gestures that translates into commands for the smartwatch. The prototype built for this experiment has infrared proximity sensors on the sides of the watch and the strap to identify different dynamic gestures which are made by the hand wearing the watch and to recognize bimanual gestures that are made by the other hand on the back of the wearing hand. There are also piezoelectric sensors positioned underneath the watch to detect taps, when the wearing hand moves, and if there are actions at the back of the wearing hand by the other hand. By adapting parts of this approach in our research, namely sensors used along the wristband, we can identify tab and some figure movement.

By using a magnetically driven input technique, Abracadabra [3] provided an unpowered wireless method for its users to interact with small mobile devices. It made use of magnetic sensing to expand the input area above the device and detect the finger’s movement along a one-dimensional polar as well as a 2D positional plane. In doing this, Abracadabra achieved high accuracy and low error rates for input selection. However, this technique requires the user to wear a magnet on their finger which is an additional component the user must manage.

WatchIt, presented a device extending interaction techniques for command selection and execution beyond the watch surface to the wristband. Their device uses two simple gestures for interaction: a pointing gesture for selecting an item in a list and sliding gesture consisting of sliding the fingertip along a half-band. Their prototype has also evaluated the usability for eyes-free interaction, to facilitate more discreet micro-interactions like silencing a vibrating ringer in a meeting. In their user study they found all the interaction techniques to be more effective with eyes-free usage scenario.

Facet, presented a multi-display wrist worn system consisting of multiple independent touch-sensitive segments joined into a bracelet. Two common form of interactions used are Pinch and rotate for Multi-Segment Screen Touch. Using each segment’s accelerometer and magnetometer, they extracted orientation like pitch, roll and yaw for each screen with respect to common coordinate system. Since, they did not conduct any user study, there is no proof of effectiveness

# Conclusion

We suggest making a touch interface on the back of wristbands to define interactions that can provide alternate methods of input selection and scrolling for smartwatches. While previous works have attempted to solve similar issues, we believe that our approach addresses some of the pitfalls associated with previous works. By providing a touch interface at the back of wristbands, we expect that we will be able to define an input technique that does not occlude the screen while still providing an intuitive, integrated, and accurate method of navigating smartwatch interfaces.

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