SonarWatch: Appropriating the Forearm as a Slider Bar

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1 introduction

Human bodies become an emerging type of human-computer interfaces recently. Not only because our skin is a surface that is always available and highly accessible, the sense of how our body is configured in space also allows us to accurately interact with our bodies in an eye-free manner. Hence, this method is suitable to be applied on extending the interaction space of mobile devices [Harrison et al.] or providing more degrees-of-freedom for enhancing gaming experiences[1]. Nevertheless, the additional gesture detector may be obtrusive or hard to be portable for users in daily life.

Based on this insight, we're motivated to design *SonarWatch*, a wristwatch equipped with an ultrasonic rangefinder and a capacitive touch sensor, to appropriate an user's forearm as a readily available input interface. By wearing the *SonarWatch*, a user can slide on an arm or tap on the watch for performing corresponding operations with passive haptic sensation on the skin. Three applications, photo browsing, music playlist controlling and gaming, are then developed to demonstrate the effectiveness of using *SonarWatch* in our daily life. We believe this more implicit design can facilitate body-sensing based interaction techniques.

2 System Overview

Our system consists of two components: SonarWatch and its server. Following we discuss the implementation details and gesture recognition of this two parts.

2.1 Implementation

SonarWatch consists of a low-power consumption Devantech SRF10 ultrasonic rangefinder, which provides distance readings from $6cm$ to $6m$, and a capacitive touch sensor are mounted for detecting user events. Sensor outputs are retrieved by connecting to an ATmega328 microprocessor employed by the Arduino Mini platform, which can be also attached on the watchband. Raw data is transfered to the server part through serial connection.

The server is implemented by Java. Once a raw data string is received, it would be analyzed by the gesture recognition procedure. After a gesture event is recognized, it would be transferred to the client application by XML sockets for further processing.

[1]http://www.xbox.com/kinect/

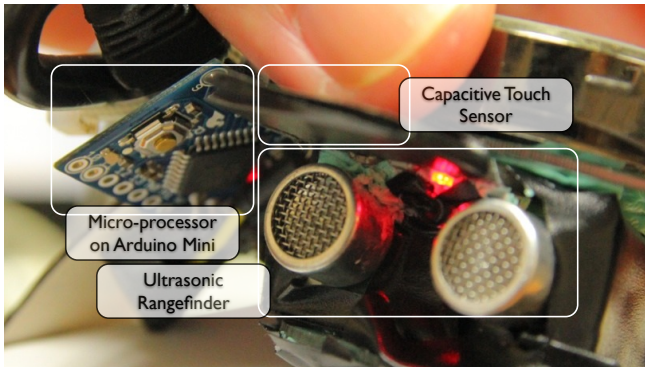

Figure 1: *SonarWatch, a wristwatch equipped with an ultrasonic rangefinder and a capacitive touch sensor. Sensor outputs are retrieved by the Arduino Mini platform*

2.2 Gesture recognition

Our gesture recognition procedure is illustrated as Figure 2. When user touch or pinch the capacitive touch sensor, the sensor would output in high, which can be regarded as the "ready" signal. Once the capacitive touch sensor is released and the ultrasonic rangefinder reveals that no finger is within the $20cm$ range of detection, a Click gesture (Figure 3(a)(b)) can be immediately determined. Otherwise, the ultrasonic rangefinder would start sampling in $15Hz$ in 1 second, and user is allowed to perform their gesture in this period. In the end of sampling, a Slide gesture can be determined. Advanced Click gestures such as Single-click and Double-click; Slide gestures such as Slide-Up, Slide-Down, and Slide-to-Select can also be determined by simple classification (Figure 3(c)(d)(e)) on sensor values.

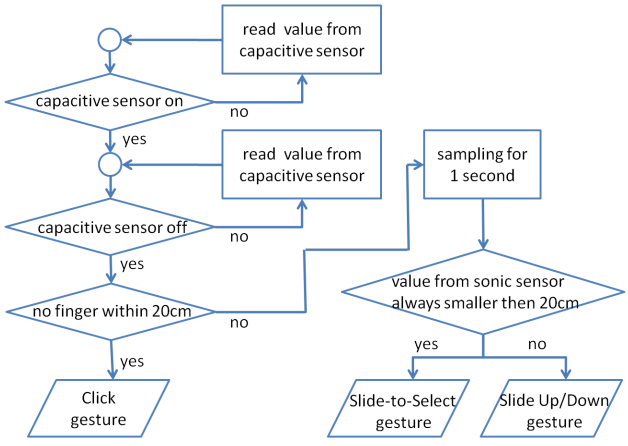

Figure 2: *The gesture recognition procedure for processing raw data to gestural events in the gesture recognition server.*

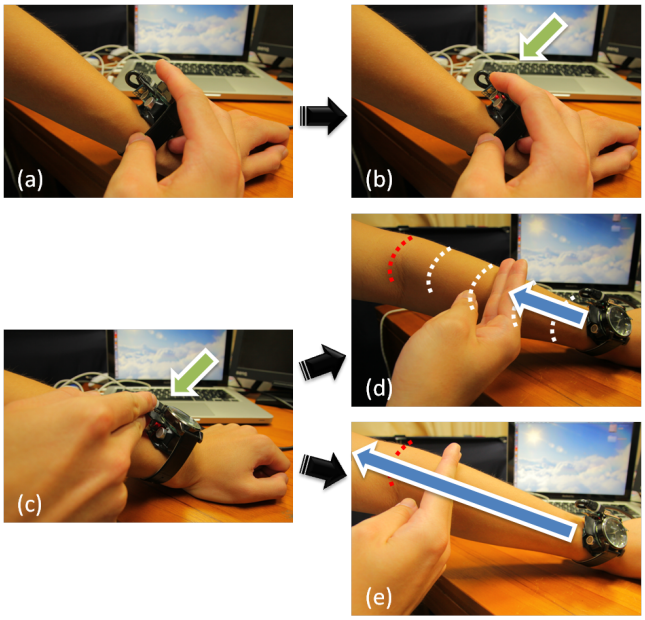

Figure 3: *Gestures supported by SonarWatch. (a) and (b) are Click gesture. (c) and (d) are Slide-to-Select gesture. (c)and (e) are Slide-Up gesture.*

3 Application

We implement three different applications for demonstrating the effectiveness of our approaches: photo browsing, playlist controlling, and augmenting Kinect for gaming. The first two applications are implemented by ActionScript 3.0 and Flash, and the third application is implemented by OpenCV and OpenNI[2].

3.1 Photo browsing

Rich gestures can help user browse photo more efficiently. In our photo browsing application, user can Slide-Up/Down for turning pages up/down, Slide-to-Select thumbnail for browsing photos, Single-click to enter selected album, and Double-click to return.

3.2 Playlist controlling

User may want to control background application such as their music player in an eyes-free manner. In playlist controlling application, user can Single-click to play/pause the music, Slide-to-Select to adjust volume, and Slide-Up/Down for switching to the next/previous song.

3.3 Augmenting Kinect for gaming

Utilizing body as controller may somehow lack-of-haptic sensation. Hence, our proprioception can be utilized as complement. We use the Angry Birds[3] game for illustration. By using Kinect to capture user's arm position, user can adjust the angle of bow. For launching, user can Slide-to-Select the desired intensity, then remove their finger to launch the Angry Birds.

[2]http://www.openni.org
[3]http://www.angrybirds.com/

4 Conclusion

We present *SonarWatch*, a less-obtrusive, wearable gesture detector. By equipping an ultrasonic rangefinder and a capacitive touch sensor on the wristwatch, user's forearm can be appropriated as a readily available input surface for interacting with computers. Several click and slide gestures are allowed to be performed by users. To demonstrate the possible applications and the effectiveness of this approach, three applications: photo browsing, music playlist controlling and augmenting Kinect for gaming, are developed for the *SonarWatch*. We believe that this work can facilitate the skin-sensing technologies in our daily life.

References

HARRISON, C., TAN, D., AND MORRIS, D. Skinput: appropriating the body as an input surface. In *Proc. ACM CHI '10*, 453–462.