Chapter 3.22
Unobtrusive Movement Interaction for Mobile Devices

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ABSTRACT

Gesture control of mobile devices is an emerging user interaction modality. Large-scale deployment has been delayed by two main technical challenges: detecting gestures reliably and power consumption. There have also been user-experience-related challenges, such as indicating the start of a gesture, social acceptance, and feedback on the gesture detection status. This chapter evaluates a solution for the main challenges: an event-based movement interaction modality, tapping, that emphasizes minimal user effort in interacting with a mobile device. The technical feasibility of the interaction method is examined with a smartphone equipped with a sensor interaction cover, utilizing an enabling software framework. The reliability of detecting tapping is evaluated by analyzing a dataset collected with the smartphone prototype. Overall, the results suggest that detecting tapping is reliable enough for practical applications in mobile computing when the interaction is performed in a stationary situation.

INTRODUCTION

The source of innovations in a mobile device user interface lies in combinations of input and

output technologies that match the user's needs. In the mobile context, movement sensing, and haptic feedback as its counterpart, offers a new dimension to multimodal interactions. There are use cases where traditional interaction modalities are insufficient, for example, when the device is placed in a pocket or a holster, or if the user is wearing gloves. In these situations the user cannot press or see buttons to interact with the device. Instead, small motion gestures can be used as a limited, but convenient, control modality. The movement of the device can be captured with a 3-axis accelerometer, and the resulting acceleration signal can be used to detect the movement patterns for controlling the device.

One of the main questions in the application of a movement-based interface is how to distinguish gesture movements the user performs from those movements that are produced by various other activities while carrying and using the device. Reliability can be argued to be the most important challenge in developing a mobile device gesture interface. This chapter presents a reliability evaluation of an unobtrusive event-based gesture interface by analyzing a multiuser dataset collected with a smartphone prototype. Another main challenge has been the relatively high power consumption from the continuous measurement of acceleration, which is not acceptable in mobile devices. Novel accelerometers are capable of producing interrupts based on exceeded thresholds; therefore, the detection, initiated by a hardware interrupt, can be implemented as event based and low power. The technical feasibility of event-based tapping detection is examined with a smartphone equipped with a sensor interaction cover, Figure 1, and an enabling software framework. Furthermore, the chapter addresses the issue of flexibly customizing the gesture interface and feedback modalities relevant to aiding the user.

There are various ways of implementing a gesture interface. This chapter focuses on analyzing the tapping interaction, which shows potential as a significant application of accelerometers in future mobile devices. More specifically, the chapter addresses the movement pattern where the

Figure 1. Smartphone prototype equipped with the sensor interaction cover