

DoubleFlip: A Motion Gesture Delimiter for Mobile Interaction

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Figure 1: Illustration of the DoubleFlip gesture.

ABSTRACT

In order to use motion gestures with mobile devices it is imperative that the device be able to distinguish between input motion and everyday motion. In this abstract we present DoubleFlip, a unique motion gesture designed to act as an input delimiter for mobile motion gestures. We demonstrate that the DoubleFlip gesture is extremely resistant to false positive conditions, while still achieving high recognition accuracy. Since DoubleFlip is easy to perform and less likely to be accidentally invoked, it provides an always-active input event for mobile interaction.

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General Terms: Human Factors

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INTRODUCTION

A major technical barrier for adopting motion-gesture based interaction is the need for high recognition rates with low false positive conditions. This obstacle limits the potential of good interaction design since many proposed physical motions (i.e. flipping [2] and tilting [2,3,5,8,10]) are indistinguishable from everyday motions. Hence, these gestures suffer from the inherent difficulty that they generate a large number of false positives.

While modeless interaction for motion gestures is ideal, it is not practical for general interaction situations. The dilemma that we encounter here is the same for other types of interactions, i.e., inking versus gesturing in pen-based user interfaces [4,6,9]. Previous work has often relied on hardware buttons [2,8,10] or the use of additional sensors in order to determine the context of use [3,5]. Although successful, these mode-switching techniques either require a

designer to use interaction context (which is often hard to infer) or a user to switch input modalities (i.e., from motion input to pressing or touching a button).

We designed DoubleFlip to tackle the challenge of separating gestural input from normal motion. DoubleFlip is a unique motion gesture that acts as a delimiter for other motion gestures, and hence, separates normal mobile phone motion from a user's intended input. In addition, the gesture gives users the control to activate motion gestures without any hardware modifications to existing devices. The gesture is quick to perform and can be performed in a limited amount of physical space.

As part of this work, we implemented a recognizer for the DoubleFlip gesture. Based on a collection of over 2,100 hours of motion data captured from the phones of ninety-nine volunteers, we found that our DoubleFlip recognizer is extremely resistant to false positives — on average less than one false positive every 8 hours of phone use. Thus, the DoubleFlip gesture and recognizer can be used as a building block for other systems to provide motion-gesture interactions.

DESIGNING DOUBLEFLIP

We set out to create a delimiter that is not dependent on a touchscreen or hardware buttons, but instead, uses the commonly available sensors in today's smartphones. Therefore, we decided that the delimiter should be a motion gesture that meets the following requirements. First, the gesture should be resistant to false positives against the ambient motion. Second, the screen must be visible after completing the gesture to allow the user to interact with the screen. Third, the physical space required to perform the gesture should be limited so that the gesture can be performed in a crowded space. Finally, the gesture should be

