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Exploring the Design Space of Bezel-Initiated Gestures for Mobile Interaction

Wing Ho Andy Li, City University of Hong Kong, Hong Kong
Kening Zhu, City University of Hong Kong, Hong Kong
Hongbo Fu, City University of Hong Kong, Hong Kong

ABSTRACT

Bezel enables useful gestures supplementary to primary surface gestures for mobile interaction. However, the existing works mainly focus on researcher-designed gestures, which utilized only a subset of the design space. In order to explore the design space, the authors present a modified elicitation study, during which the participants designed bezel-initiated gestures for four sets of tasks. Different from traditional elicitation studies, theirs encourages participants to design new gestures. The authors do not focus on individual tasks or gestures, but perform a detailed analysis of the collected gestures as a whole, and provide findings which could benefit designers of bezel-initiated gestures.

KEYWORDS

Bezel-Initiated Gestures, Design Space, Mobile Interaction, Surface Gestures, User Study

INTRODUCTION

Bezel-initiated surface gestures have been widely adopted in mobile interfaces. These gestures are initiated by touching the bezel, which is the frame that surrounds a touchscreen. For example, on both iOS and Android, users can activate the notification list by swiping down from the top bezel of a mobile touch screen. A series of bezel-initiated gestures have been incorporated into Windows Phone, e.g., for switching between different applications. It has been reported that bezel-initiated gestures are fast and preferred by users (Bragdon, Nelson, Li, & Hinckley, 2011, p. 2011). Such gestures are complementary to primary surface gestures, since the bezel-initiated nature makes them compatible with direct-touch-based interaction techniques. Although bezel-initiated gestures have already been part of modern mobile platforms, and have been proposed by a number of researchers on designing interaction techniques (Bragdon et al., 2011; Jain & Balakrishnan, 2012; Roth & Turner, 2009), the design space of such gestures is limitedly studied.

In this paper, we present the design and the results of a modified elicitation study, which explored the users' perception on the design space of bezel-initiated gestures. Our contribution is twofold. First, we introduce a modified elicitation study. Different from conventional elicitation studies, ours is more general to tasks, and is able to encourage participants to design new gestures. Second, by analyzing the results collected from our modified elicitation study, we provide insights to a number of unanswered questions about the bezel-initiated gesture design space: (1) What bezel-initiated gestures will users commonly design? (2) What features will users mainly use for gesture design? (3) What actions are more suitably referred by bezel-initiated gestures? Our study covers the user-defined gestures for a large set of mobile operations in two types of hand-held postures. All participants managed to design proper gestures for all operations, signaling the great potential of bezel-initiated gestures beyond the

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limited applications explored in the previous works. This is also confirmed by low agreement on the elicited gestures. The results also reveal a set of bezel-initiated gestures adopted by more than 25% of the participants. This gesture set suggests that most users tended to design their gestures in a multi-dimensional design space and utilized features like location, symbolic shape, direction, and speed. We also found that bezel-initiated gestures were intuitively applicable to navigation or abstract tasks. However, it is harder to use bezel-initiated gestures to specify action targets.

RELATED WORK

Bezel-Initiated Interaction

A number of researches revealed the advantages of bezel-initiated gestures for mobile interaction. For example, Roth et al. (Roth & Turner, 2009) introduced Bezel Swipe for secondary actions like multi-target selection, copying and pasting. It was a simple single-finger swipe from the bezel towards the center of the touchscreen. They evaluated its usefulness in the context of image selection. Their participants found it to be a viable alternative to direct touch selection.

Bragdon et al. (Bragdon et al., 2011) prototyped Bezel Marks and Bezel Paths, which were single-finger gestures that start from the bezel, followed by mark-based and free-form path gestures, respectively. They found that bezel-initiated gestures were more resistant to situational impairments than soft-button-based interfaces. Serrano et al. (Serrano, Lecolinet, & Guiard, 2013) presented Bezel-Tap, which was a single-finger tap on the bezel followed by a single-finger swipe in the screen. It demonstrated the benefit of using sequential gesture combinations for designing new gestures. Bezel-initiated gestures have also been explored to address the limited thumb reach problem (Kim, Yu, & Lee, 2012; Li, Fu, & Zhu, 2016; Yu, Huang, Hsu, & Hung, 2013). Those works used a bezel-initiated gesture to activate a screen cursor for object selection, or to transform the screen space to bring faraway object closer to the thumb. They all used simple single-finger bezel-initiated swipe, without any suggestion on how to explore the design space and design bezel-initiated gestures. It is not obvious whether initiating from the bezel would be a limiting design constraint to interaction designers or end users. Instead, our work is not about the design of a specific bezel-initiated gesture for a specific task but the exploration of the multi-dimensional gesture design space.

User Elicitation Studies

Conducting user elicitation, or guessability studies, has been a popular way to conceptualize new interaction techniques. This methodology has been adopted to develop touch gestures for tabletops (Wobbrock, Morris, & Wilson, 2009), motion and touch gestures for mobile devices (Buchanan, Floyd, Holderness, & LaViola, 2013; Liang, Williams, Semegen, Stuerzlinger, & Irani, 2012; Ruiz, Li, & Lank, 2011), mid-air gestures for TVs (Morris, 2012; Vatavu & Zaiti, 2014), and body gestures for games (Silpasuwanchai & Ren, 2014). However, our focus is not to develop a gesture set that maps to specific referents. Gesture recall is not our main concern either. Our referents are mainly used as exemplar context for the experiment. Our work is more similar to the work of Oh et al. (Oh & Findlater, 2013), which is to find out the gestures preferred by the majority of the users and to understand how people perceive different properties of the gestures. Our work also helps investigate the guessability and intuitiveness of the researcher-designed bezel-initiated interactions, since user-defined gestures are found to have higher memorability (Nacenta, Kamber, Qiang, & Kristensson, 2013) and are more preferred by end users (Morris, Wobbrock, & Wilson, 2010).