Testing Visual Notification Cues on a Mobile Device

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Abstract
This paper discusses field-testing of visual notification cues on a mobile handheld device. Each cue consisted of three multicolored lights preceded by a tactile signal (vibration). After being customized, the cues were sent periodically to the device over a wireless network as users went about their normal activities. User personalization seemed to enhance learning and usefulness of the cues, while the additional tactile signal aided arrival awareness.

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INTRODUCTION

Our previous work [2] investigated visual notification cues consisting of one or more individual lights (e.g., LEDs), and found that a three-light design (compared to designs with more or fewer lights) had a high potential for effectively conveying notifications on small devices. This study tests the findings from [2] on a mobile device in a realistic setting. It also expands on work done with the "reminder bracelet," [1] which consisted of three red LEDs that were triggered progressively as an upcoming event drew closer. While that system proved useful, testing showed that users found themselves frequently checking to see if any LEDs were lit. We address this concern by implementing a "multimodal" system where vibration precedes a visual cue.

METHODOLOGY

Notification cues, consisting of three simulated lights (colored circles of red, yellow, or green), were sent to a mobile handheld device (a PDA) over a building's 802.11 wireless network. Subjects created customized cues by selecting any ten (out of the possible 27) color patterns and writing a message for each one. Subjects memorized the cues and carried the device as they went about their activities in the building for two hours. Notification cues were periodically sent to the device, sometimes mixed with nonsense cues that had no meaning. When the device received a cue, it vibrated for four seconds before displaying the lights. Subjects acknowledged cues by tapping on the device, then identified them from a list of their predefined messages.

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DISCUSSION

Five student volunteers (four male, one female) participated in the experiment. Each chose to use the three same-color patterns (e.g., red, red, red) for three of their messages. Of the remaining patterns available, all subjects used patterns that had one repeating color (e.g., red, red, green). Three subjects chose patterns which used all three colors at once, but did so for only one message. Most subjects seemed to group types of messages by color patterns. For example, one subject used "green, green, green" as a notification to check voice mail, and "green, green, yellow" to check email. One subject mentioned using the same-color combinations for reminders they deemed most important.

Subjects successfully acknowledged all of the messages. Of 38 total messages, 24 were identified correctly. Of the 14 incorrect answers, six were from nonsense cues. Subjects commented that the notification system was potentially useful, although it was difficult initially to assign messages to color patterns and learn the messages.

This experiment is a first step in investigating the use of "pixel-based" (i.e., consisting of one or more individual lights) visual notification cues in realistic settings. The results of this study are encouraging given the positive perception of the cues, and that the use of vibration with the visual cue seems to solve the awareness problem encountered in [1]. Customization seemed to have a positive effect on learning and use of the cues, and also addresses privacy and security concerns. For example, three blue lights on a ring, even when noticed by other people nearby, could convey a message only understood by the wearer. Additional studies with longer testing periods, more extensive testing environments (e.g., an entire campus), and alternative devices (e.g., rings) are still needed. In addition, we are conducting additional investigations into the effects of customization on learning and comprehension of different cue designs.

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