Accessing Mobile Apps with User Defined Gesture Shortcuts: An Exploratory Study

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Abstract
Smart phones have become the hub of people lives due to the overwhelming number and extensive range of apps available in app stores that are available to support their daily tasks. On average, smart phone users have around 100 apps installed on their devices and the number is ever growing. Thus, it becomes crucial to make sure they can quickly access these apps. In this paper, we present an exploratory study to understand users' memorability of their self-defined gestures for 15 frequently used mobile apps. The results show that although participants recalled their self-defined gestures most of the time, there are still certain factors that can influence their recall. The paper further analyses the underlining reasons and discusses how such issues could be addressed from a technical perspective.

Author Keywords
Smart phones; gesture interface; gesture shortcuts; user-defined gestures; recall; memorability

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

With the support of an enormous number and extensive range of apps available in app stores, smart phones have become the hub of people's live [12]. In the UK, two-thirds of adults now own smart phones and use them for nearly 2 hours a day to support their daily activities [10]. On average, smart phone users have around 100 apps installed on their devices and this number is ever growing [14]. With only system-defined mechanisms such as searching [1] and browsing, accessing an app can become very time-consuming and inconvenient [4]. For example, the performance of searching an app via built-in/third-party search tools for a smart phone relies on how accurate a user can remember the name of the app. Similarly, the performance of locating an app through browsing the app list on a smart phone interface is determined by user's familiarity with the app as well as the way how the app list is organized [3].

Recent research on touch screen gestures has acknowledged the convenience of using gesture shortcuts to access system functions (e.g., wireless on/off), execute system commands (e.g., rotate) [8] [13] and even perform specific tasks (e.g., web browsing) on touch screen devices [2]. Further to this, several studies have noted that user-defined gesture shortcuts are easier to be memorized by users when compared with system-defined gesture shortcuts [9].

Despite the merits of user-defined gesture shortcuts, current studies only focus on system functions. So it is still unclear whether similar approaches can also be applied to mobile apps. One may argue that the representation of system functions is very similar to the representation of mobile apps on the smart phone user interface (e.g., icons with/without textual information).

Strategy	Icon	Gesture Shortcut
Visual		
Textual		
Functional		
Other		

Table 1. Examples of Definition Strategy.

The fact is, apps present a much higher degree of complexity and diversity than system functions as users can choose what apps to install, how many they want to install and even how many similar ones they want to install (e.g., Skype and LINE are both commonly installed as instant messengers). The "freedom of choice" can trigger an immediate question, which is: although the user can define a gesture shortcut for a mobile app freely, can they always recall the gesture easily?

In this paper, we present an exploratory study that aims to understand user memorability of self-defined gesture shortcuts for accessing mobile apps. Starting with 15 commonly used mobile apps to identify several factors that may influence the recall performance and discussed how the performance could be improved from a technical perspective.

Methodology

Gesture shortcut definition strategy

A previous study on understanding how users define gesture shortcuts for common tasks on mobiles has noticed that users are selective but they tend to use only certain strategies instead of drawing gestures randomly [11]. These strategies can be differentiated into three types: name based strategy, system icon based strategy, and function/purpose based strategy. Accordingly, we add "other" strategy to cover these gestures with unknown user behaviors and define four definition strategy categories based on the ways mobile apps are displayed as well as their purposes, as given in Table 1.

Gesture shortcut capture

Several attempts related to using gesture shortcuts to access apps have been made [5, 7] but there is no

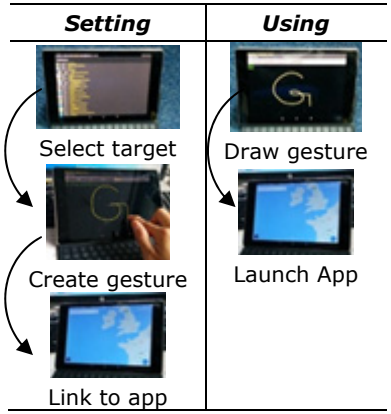

Figure 1. Workflow of Agile Search app. *Setting* and *Using* are two working modes and can be toggled by a button on the right top of the app.

Category	Name	Abbreviation
Communication	Wechat	wcht.
	Messenger	msgr.
	Whatsapp	wapp.
	Facebook	fb.
	Skype	skyp.
	Chrome	chrm.
	Outlook	otlk.
	Gmail	gml.
Travel	Tripadvisor	trip.
	Booking	bk.
	Maps	map.
Entertainment	YouTube	ytub.
Finance	PayPal	pp.
Photography	Instagram	ins.
Shopping	Amazon shopping	ashp.

Table 2. Apps selected for the experiment.

native support for user-defined gesture shortcuts offered by current smart device systems. In order to enable the support and capture user-defined gesture shortcuts, we developed the Agile Search, a standalone Android app that allows the user to define gesture shortcuts to launch associated apps. Agile Search uses Google's gesture recognition algorithm [6] so it supports defining and recognizing uni-stroke and multi-stroke gestures [15].

Two steps are needed to pre-define a gesture shortcut under the *Setting* mode. First, a user needs to select an app that they intend to access via gesture shortcuts among the installed apps' list populated in Agile Search. Second, the user draws a gesture shortcut for the app and confirms whether they are satisfied with the gesture. If the user is not satisfied with the gesture shortcut, they can redraw it. Once the gesture is confirmed, Agile Search opens the target app and saves the gesture as PNG files locally. After defining the gesture, the user can launch the app by redrawing the gesture in Agile Search under the *Using* mode. If the gesture matches what the user defined earlier, Agile Search will then launch the app associated with the gesture (see Figure 1).

App sampling

Due to the diversity and a large number of installed apps, it is impractical to ask users to draw gestures for each installed apps for this exploratory study. A user survey aims to sample the apps was developed, in which participants were asked to select the apps they use for at least once a day from a list of 40 apps extracted from Google Play's top downloads chart. 67 students responded to the survey. Eventually, 15 apps commonly used by 33 students were selected, as shown in Table 2. The categories in this table are based on Google Play's categorization. These 33 students were also invited to participate in the experiment later.

Measurement

To understand users' recall of their self-defined gesture shortcuts and explore factors that may influence their recall, two measures are defined: (1) gesture shortcut recall rate and (2) definition strategy recall rate. For (1), it is defined as the proportion of gesture shortcuts for a specific number of apps that are recalled successfully by a specific number of users. For (2), it is defined as the proportion of definition strategy for gesture shortcuts that are recalled successfully by users. Note that this calculation does not consider whether a user has successfully recalled gesture shortcut or not.

Experiment design

Participants

During the app sampling process mentioned in the Methodology section, 33 university students who studied different subjects nominated 15 common apps. These students were then invited to take part in this experiment. They are all active smart phones and tablets users for over 3 years and own at least one smart phone or tablet.

Testing device

A Google Nexus 9 tablet with Agile Search pre-installed was given to the participants during the experiment to avoid compatibility issues when installing the app on their own devices.

Procedure

Participants were asked to familiarize themselves with the device first if they had not used a Nexus 9 tablet before. After that, they were demonstrated the use of

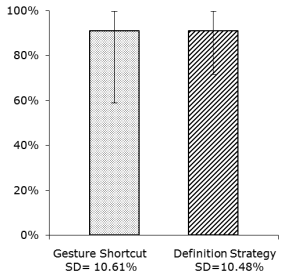

Figure 2. Overview of Participants' Recall Rate on Gesture Shortcut and Definition Strategy.

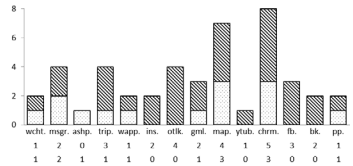

Figure 3. Detailed Breakdown of Gesture Shortcut Recall Failures. over Apps.

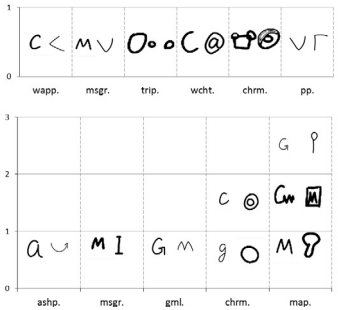

Figure 4. Detailed Breakdowns of Incorrect Gesture Shortcut Pairs based on Different Definition Strategies.

Agile Search and offered a 15-minute self-practice session to try Agile Search with five apps (not included in sample apps' list) installed on the device. The experiment began when participants confirmed that they were ready for the test after the practice. Then the participants were asked to draw or recall the gesture by Agile Search. Each participant was asked to come to the lab for 2 consecutive days to complete a trial consisting of three sequenced phases: gesture shortcut definition (Day 1), reinforcement (Day 1) and next-day recall test (Day 2). The time interval between the two days was set to 24 hours.

Results

Gesture shortcut recall

The overview of participants' gesture shortcut recall rate is shown in Figure 2 (left bar). The averages recall rate is 90.9% (SD= 10.61%, range of 60% to 100%). Out of 33 participants, 16 correctly recalled all gesture shortcuts, they defined and for the rest of them, only two had a recall rate under 80% (P11: 60%, P23: 67%).

Definition strategy recall

The overview recall rate of participants' gesture shortcut definition strategy is shown in Figure 2 (right bar). The averages recall rate is 91% (SD=10.48%, range of 73.3% to 100%) indicating most participants remember the strategy used for defining gesture shortcuts. In detail, 12 participants remembered all strategies they used correctly while 4 participants remembered less than 80% of the strategies they used.

Recall failures over apps

Figure 3 shows the detailed breakdown of gesture shortcut recall failures over apps. The bar chart is divided into two parts: the top part represents the number of failures resulted from the same gesture shortcut definition strategy and the bottom part represents the number of failures resulted from misremembered strategies. Note that the height of each bar represents the total number of failures registered for each app among 33 participants in the recall test.

Figure 4 shows the detailed breakdown of failures in the recall of the gesture shortcut pairs (definition vs. recall) recorded for apps when definition strategies were misremembered. The results reveal that 8 recall failures were the cases that participants misremembering the textual strategy used in the definition phase as the visual strategy in recall test phase, and 6 failures were related to misremembering visual strategy as functional strategy.

Figure 5 shows the detailed breakdown of failures in the recall of the gesture shortcut pairs (definition vs. recall) recorded for apps when the definition strategies were remembered. There were 17 failures related to the textual strategy, 6 failures related to the visual strategy and 5 pairs related to the functional strategy. Note there were also 3 failures related to "other" strategy that is not presented in the figure but they are discussed in next section.

Discussion

The experiment results show that participants recalled the gesture shortcuts effectively in most of the time. This indicates the effectiveness of using self-defined gesture shortcuts to access frequently used mobile apps. However, the failures should not be ignored as they were found with almost all apps (14 out of 15) in the sample list. After examining the link between

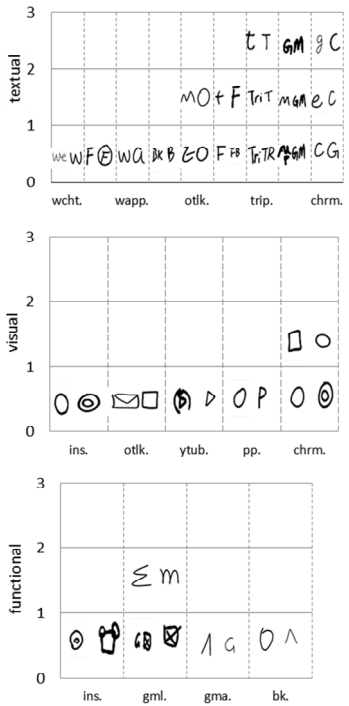

Figure 5. Detailed Breakdowns of Incorrect Gesture Shortcut Pairs based on Same Definition Strategy.

definition strategy recall and gesture shortcut recall, we found that when participants remembered the definition strategies they used, they were very likely to remember the gesture shortcuts they defined (gesture shortcut recall rate: 96.4%); otherwise, the recall rate dropped significantly to 31.1%. This suggests that a mechanism to help users better remember the definition strategy they have used is needed to improve their gesture shortcut recall. For example, if users' choices of strategies can be limited to just one option, the option can be provided as a hint when a user is trying to recall the gesture shortcuts.

It was also found that many failures were related to the textual strategy (i.e., app's name) as participants could not remember the exact letter they used when defining the gesture shortcuts. For example, "G" was defined for Google Map but it was recalled as "M" or "GM". The cases suggest that the gesture matching algorithm for any interface like Agile Search should be more flexible to allow the use of either capital or lowercase of a letter, and any letter or combinations of letters from an app's name as correct gesture shortcuts, regardless of what was defined as the initial gesture shortcut.

Participants' confusions with uni-stroke and multi-stroke were another cause of recall failure. For example, the circle gesture shortcut was first drawn for Instagram but then changed to a nest circle gesture shortcut later. This suggests that only allowing uni-stroke gesture could be used to reduce the probability of gesture shortcut recall failure.

It is also worth to mention that a very few number of failures were related to the "functional" and "other" strategy (e.g., PayPal in Figure 4). Unlike the textual and visual strategy where cues can be easily drawn from app's name and icon, the "functional" and "other" are very vague. For example, users may think Google Map is a map app but they can change their mind to think it as a navigation app over time depending on their main usage (Figure 4). Therefore a possible solution is to limit the definition strategy to the textual and visual only to avoid the confusion.

Limitation and future work

This exploratory study has some limitations due to the controlled environment the experiment has.

First, the time interval for running the recall task was set to 24 hours for all participants. This does not seem to represent the real life scenario very well as in reality, users may be able to launch an app using their self-defined gesture shortcuts more often, which may help them remember the shortcuts better. Therefore, different intervals based on user's actual app use behaviors need to be considered in future experiments to obtain a more accurate understanding of their memorability of self-defined gesture shortcuts.

Second, the sample apps in this exploratory study were the most frequently used apps by participants. It remains unclear whether such findings can be applied to infrequently used apps as users may have more memorability issues with these apps.

Third, in this exploratory study, our analysis was mainly focused on strategies that were clearly identified such as visual strategy, textual strategy and functional strategy. Although "other" strategy was also used, we did not look into these strategies due to the very small number of incorrect gesture shortcut pairs presented. In the future, we may also look into this category when more sample apps are used in the experiment.

Last, the recall of definition strategies was only checked within 24 hours. It remains unclear whether users would change their definition strategies after a period of using or which definition strategy is more effective. Therefore, future experiments focusing on single strategy need to be considered.

Conclusion

An exploratory study has been conducted to study users' abilities on recalling their self-defined gesture shortcuts to access mobile apps as well as understanding the strategies based on which they used to define these gesture shortcuts. The results were quite promising with an average recall rate of 90%, which demonstrated the effectiveness of using self-defined gesture shortcuts to access an app. Certain factors that may influence users' recall rate have also been noticed in the experiment and possible solutions to improve recall are also discussed. Despite the findings, the study clearly has some limitations. So our further study will focus on addressing these limitations and aiming to provide recommendations on the design of gesture shortcut definition interfaces and icon designs.

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