Surveying Expert-Level Gesture Use and Adoption on Multi-Touch Tablets

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ABSTRACT

Multi-touch interaction on mobile devices typically consists of taps and swipes - simple gestures that don't exploit the full range of technical and human capabilities. Some devices offer more sophisticated, expert-level gestures, but these haven't yet been widely adopted. To determine what factors might be preventing widespread adoption of expert-level gestures, we examine the use of multi-tasking features on the iPad as representative of widely available, but optional, expert-level gestures. We survey a group of 106 iPad users about their device habits, awareness of expert-level gestures, and how they are used in everyday tasks. We determine that users have a fairly high awareness of expert-level gestures, and willingness to perform them, but often find them difficult to discover and challenging to learn. We conclude with design implications for future research.

Author Keywords

multi-touch; tablet; expert-level gestures; online survey.

ACM Classification Keywords

H.5.2. User interfaces; interaction styles.

INTRODUCTION

Users of modern multi-touch devices such as smartphones and tablets have a relatively high level of skill in using multi-touch gestures to interact with them [14], but the multi-touch gesture sets used are typically restricted to a small subset of one and two-finger gestures, e.g. tap, double tap, drag/flick and pinch/spread (Figure 1). However, modern multi-touch smartphones and tablets are capable of accepting at least ten simultaneous points of contact [17,18], and human kinesthetic models suggest that humans are capable of richer and more expressive forms of interaction that utilize multiple fingers [4]. This suggests a gap between the technical capabilities of multi-touch devices, the kinesthetic abilities of end-users, and the gesture sets that have been implemented for these devices.

There have been attempts to introduce more sophisticated interactions through the use of expert-level gestures: Apple provides trackpad-swipe gestures on their MacBook Pro [17,18], Microsoft has implemented bezel-swipes on the Surface Pro [19], and numerous research projects have attempted to improve multi-touch functionality by adding targeted expert-level gestures [3,7,12]. These include systems such as BiTouch [15], Cyclostar [7] and ZoomPointing [1,11]. The Apple iPad is an example of a commercially successful multi-touch input device with an limited set of extended multitasking gestures [20]. We call these expert-level gestures *enhanced gesture sets*, and define them as gestures not included in common gesture sets (such as Figure 1).
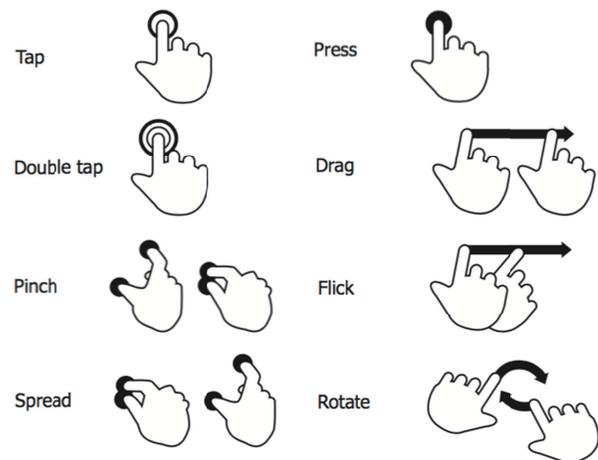

Figure 1: Typical Gesture Set

While expert-level gestures may be initially challenging to recall and perform, with appropriate time and training, user performance improves significantly [6]. Despite the benefits and the availability of enhanced gesture sets, in observations of user interaction on multi-touch platforms [8,14] it appears that these gestures are used infrequently.

In this paper, we examine the use of three enhanced, direct multi-touch gestures on an iPad, which we consider a realization of an enhanced gesture set. To examine real-world usage, we designed and ran an anonymous survey on SurveyMonkey, where we recruited experienced iPad users and asked them questions about their device usage. First, we attempted to determine if end-users were already aware of the existence of these gesture sets. Second, we explored

how frequently they used these advanced gestures. Finally, we explored user perceptions of the enhanced gesture set, and willingness to adopt them post-survey.

Overall, our goal is to validate the perception of slow adoption (to verify whether users really are slow to adopt such gestures) and, if so, to determine some of the causes for this slow adoption rate. For example, are new awareness mechanisms needed? Are gestures too complicated to learn or use? Do users perceive the current set of gestures as adequate and see no need for enhanced gesture sets? This paper summarizes the survey results and the design implications for multi-touch gesture sets.

SURVEY DESIGN

A number of authors have attempted to describe the population of iPad users, but have typically focused more narrowly on characterizing application use [2,16]. We are not aware of any attempts to determine how users interact with their iPads; this lack of data motivated our survey.

We chose an online survey as a data collection method for the same reasons proposed by Kjeldskov et al. [5]: external validity. Our goal is to collect responses related to software features used "in-the-wild" during day-to-day interactions, which is difficult to accomplish in a controlled lab environment. A similar approach was taken by Snowdon et al. [13] when assessing a mobile map navigation technique.

In our survey, we focus on three specific expert-level direct-touch gestures on the iPad: Multitasking, App-Switching and Pinch-to-Home. Multitasking on the iPad allows a user to display a list of all running applications, and either switch to that application or close it. It can be activated by either double-pressing the home button on the iPad, or via an expert-level gesture, swiping-up with four fingers. Pinch-to-Home exits the currently running application and returns the user to their home screen. This can be accomplished by single-pressing the home button, or performing a four-finger clutch gesture. Finally, App-switching allows a user to switch to the next or previous running application. This is activated by swiping left or right with four fingers, for the previous or next running applications. This feature can only be activated with these gestures.

The advantage of focusing on iPad gestures is consistency in the implementation: Apple has made these gestures available in the same form, across a large number of devices. These gestures also provide *optional* functionality; users that have adopted these gestures had to deliberately seek out and learn how to use them.

Apparatus and Participants

Our survey was created and hosted on SurveyMonkey [21]. Data was collected in two sessions: Dec 1 2015, 3:13 to 4:45 PM EST, and Jan 13, 2016, 11:00 PM to Jan 14, 2016 10:31 AM. Data collection was spaced across two different time periods, to get a broad spectrum of respondents who may be using the devices in different contexts. A target

number of participants was specified in each case, and SurveyMonkey automatically closed the survey once the target was reached for a given period. SurveyMonkey advertised the study ("task"), handled recruiting and managing participants, and supplied anonymized results after data collection was complete. We recruited 123 participants; 17 participants stated that they "did not own an iPad" and their responses were discarded. Our remaining 106 participants (55F, 35M, 16 unreported), had a mean age of 43.1 years (SD 15.4).

Survey Design

Our survey design was guided by Muller et al. [9,10]. Our survey contained 35 questions across 5 sections (Figure 2). After answering the first question about device usage, participants were allowed to skip any of the remaining questions that they did not wish to answer.
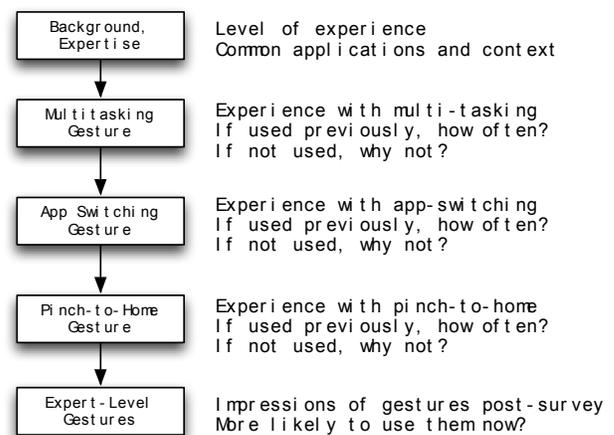

Figure 2: Survey Design

Section one asked demographic questions and general questions about iPad usage. The second through fourth sections of the survey asked questions about the three specific expert-level gestures of interest noted earlier: Multitasking, App-Switching and Pinch-to-Home. For each expert-level gesture, we asked about a participant's familiarity with that gesture, and branched based on their response: if they had used a gesture previously, we asked about frequency of use, preference compared to non-gestural activation method, and general satisfaction; if they were unfamiliar with a gesture, we explained how to use it, asked them to attempt it on their iPad, and then polled them on ease-of-use and and impressions. This branching is a technique suggested by Muller [9,10]; it is well-suited to online surveys, and allows us to vary questions based on level of expertise. Finally, the last section of the survey asked about revised opinions of expert-level gestures.

In our analysis, we report both raw scores (e.g. mean Likert scores), and significant results from Pearson's Chi-squared "goodness of fit" tests performed against various measures. Unanswered questions are excluded from the results.

RESULTS

Introduction

From the first section of the survey, we were able build a profile of an average iPad user. 72.6% of respondents use full-size iPads with a 9.7" display (77/106), 22.6%, use an iPad Mini with a 7.9" display (24/106), and 4.7%, use an iPad Pro with a 12.9" screen (5/106). 59.4% of participants reported devices from 2013 or later (63/106). All of the iPads reported support the expert-level gestures of interest to us in our survey.

Our users are relatively experienced: 60.8% have owned an iPad for at least 2-3 years (62/102), while 15.7% have owned it for a "longer period" (16/102). Daily usage was high: 72.6% use it for at least 30 minutes (77/106), and 41.5% use it for more than 60 minutes each day (44/106). As expected, most users use their iPads for media consumption and social media (Figure 3). Although there was no correlation between age and experience-level (X^2=17.1, NS), there were differences in usage patterns: for instance, younger participants watched more videos (X^2=15.9, p<0.01), while participants age 30-44 used social media features the least (X^2=15.8, p<0.01).
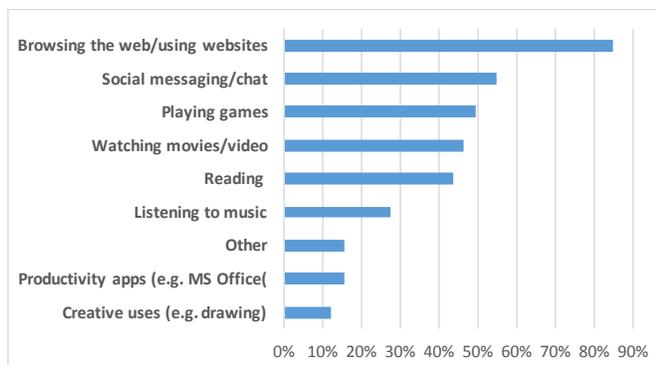

Figure 3: Common applications reported

We asked users about their satisfaction levels with the device on a 5-point Likert scale: 61.3% "strongly liked" their device (65/106), 29.2% "liked" it (31/106), and 9.4% were neutral (10/106). When asked what Apple could change to "make it a better device", common answers were to make the device cheaper (11/83), more durable (7/83) or improve connectivity (6/83). A number of respondents suggested minor software changes (11/83). The largest category were satisfied with current features (19/83). There was no correlation between age and satisfaction (X^2=8.1, NS) or gender and satisfaction (X^2=2.9, NS).

Prior Knowledge

Multitasking is the ability to bring up a list of running applications, either by double-pressing the home button or swiping-up with four fingers. Participants were asked about their prior experience with the multi-tasking gesture: 6.7% had used only swipe-up (7/104), 32.7% had used the home button (34/104) and 34.6% had used both activation mechanisms (36/104). 10.6% were aware of the swipe-up

gesture but hadn't used it previously (11/104), and 15.4% had never heard of the feature (16/104). There was a positive correlation between iPad and multitasking experience (X^2=51.8, p<0.01), suggesting that experienced users are more likely to use this gesture.

App switching is the ability to quickly switch between running applications, without needing to activate multitasking or return to the home screen. This feature can only be activated as an expert gesture, by performing a three-finger swipe left or right from within a running application. 52.0% of participants had used this feature previously (51/98). 24.5% had heard of the feature but never used it (24/98), and 23.5% had never heard of it (23/98). There was no correlation between overall iPad and app-switching experience (X^2=17.4, NS).

Pinch-to-Home is the ability to exit and application and return to the home screen of the iPad. This can be accomplished by single-pressing the home button, or performing a four-finger clutching motion while an application is running. 43.0% of participants had used this feature (40/93), 25.8% had heard of it but never used it (24/93), and 31.2% were previously unaware of the gesture (29/93). There was no correlation between overall iPad and app-switching experience (X^2=17.1, NS).

Usage

Respondents who had used swipe-up to multitask performed the gesture infrequently: 49.4% rarely used it (38/77), 29.9% occasionally used it (23/77), and only 15.1% used it frequently (16/106). When given the choice, 76.6% preferred to use the home button to activate multitasking (59/77), 11.7% used the swipe-up gesture (9/77), and 11.7% used both mechanisms (9/77). Open-ended comments suggested that the swipe-up was sometimes "difficult to activate" compared to the home button (16/41). The physical button, for many participants, was easier to activate (14/41) and more familiar (12/41). Participants who did not use multitasking appear to have been mostly unaware of the feature: 65.4% didn't know it existed (17/26) and only 23.1% claimed that they don't need this functionality (6/26).

Participants who reported using app-switching, tended to use it infrequently: 39.2% used it rarely (20/51), 41.2% used it occasionally (21/51), and only 19.6% used it frequently (10/51). Participants who didn't use it appear to have been unaware of the gesture: 62.2% reported that they didn't know that it existed (28/45), 15.6% claim that they don't need this functionality (7/45), and 5.9% found it difficult to use (3/51).

Participants who used pinch-to-home also used it infrequently: 35.0% used it rarely (14/40), 45.0% used it occasionally (18/40) and 20.0% used it frequently (8/40). However, most respondents prefer the home button: 70.0% used the home button exclusively (28/40), 20.0% used both methods (8/40), and only 10.0% (4/40) used the pinch-

gesture exclusively. Reasons for this preference included familiarity (9/20), ease-of-use and convenience (8/20).

Impressions

Multitasking was viewed favorably, with 82.5% neutral or higher (31/97 "neutral", 39/97 "like", 10/97 "strong-like"). It was generally considered easy to use, with 84.5% neutral or higher (31/97 "neutral", 39/97 "easy", 12/97 "very easy"). App-switching was also viewed favorably, with 82.0% rating it neutral or higher (26/89 "neutral", 35/89 "like", 12/89 "strong like"). It was generally reported as easy to use, with 85.4% rating it neutral or higher (26/89 "neutral", 34/89 "easy", 16/89 "very easy"). Pinch-to-Home was viewed very favorably: 92.0% of participants rated it neutral or higher (39/88 "neutral", 35/88 "like", 7/88 "strong like"), and 87.5% found it easy to use (27/88 "neutral", 38/88 "easy" and 12/88 "very easy"). Across each of these gestures, there was a positive correlation between experience and user satisfaction with that specific gesture (multitasking $X^2=41.1$, $p<0.05$; app-switching $X^2=64.2$, $p<0.01$; pinch-to-home $X^2=102.0$, $p<0.01$).

Post-survey impressions of expert-level gestures were very favorable: 94.5% were neutral or higher (29/91 "neutral", 42/91 "like", 15/91 "strong like). This is higher than any single gesture score, suggesting that overall impressions improved as the survey progressed. Open-ended feedback was generally favorable, with many respondents indicating that the gestures required no further changes (14/36 for multitasking, 15/28 for app-switching and 13/31 for pinch-to-home). Complaints were that the gestures were complex and difficult to learn for some (8/41 overall), or difficult to discover (2/36 for multitasking, 6/28 for app-switching). As one respondent stated, "how do you find out about any of these? you have to accidentally run into them or spend hours googling ipad shortcuts" (sic).

Adoption

With multitasking gestures, 15.2% claimed that they are more likely to use them in the future (15/99), with 31.3% (31/99) suggesting that they would be interested to "try it and see". There was a significant positive correlation between prior multitasking experience and satisfaction ($X^2=41.1$, $p<0.05$), and between satisfaction with the gesture and a willingness to continue using the gesture post-survey ($X^2=96.4$, $p<0.01$).

With app-switching gestures, 12.1% (11/91) claimed that they were more likely to use swipe-left and right to app-switch following this survey; 36.3% (33/91) claimed that they would be interested to "try it". There was a significant positive correlation between prior app-switching experience and satisfaction ($X^2=64.2$, $p<0.01$), and between satisfaction and a willingness to continue using them post-survey ($X^2=102.4$, $p<0.01$).

With pinch-to-home gestures, 19.3% (17/88) of participants suggested that they were more likely to use pinch-to-home after being made aware of it. 34.1% (30/88) suggested that

they might "try it and see". There was also a significant positive correlation between pinch-to-home experience and satisfaction ($X^2=102.0$, $p<0.01$), and between satisfaction and a willingness to continue using this gesture post-survey ($X^2=120.4$, $p<0.01$). When asked afterwards if the survey would impact use of these gestures in the future, 18.6% (17/91) of participants reported that they expected to use them more, and 35.1% (32/91) thought that the survey "might" have some impact.

DISCUSSION

Our respondents are experienced iPad users, using their devices frequently for media consumption, playing games and interacting on social media. This aligns with previous studies of consumer behavior [16]. However, despite this casual-use profile, our participants reported occasional-to-frequent use of expert-level gestures: 45.0% used swipe-up for multitasking, 60.8% used swipe-left/right for application switching and 65.0% used the pinch-to-home gesture. Familiarity with gestures was high, with awareness of 51.9% for swipe-up, 76.5% for swipe left/right and 68.8% for pinch-to-home. This is surprising, given that these features are not well-advertised.

After exposure during the survey, user impressions of these gestures were relatively high, and actually improved to 94.5% by the end of the survey (novice participants were asked to attempt them, which may have influenced this result). User satisfaction was directly correlated with experience level, suggesting that these gestures may require effort to master, and that users need time to effectively learn to use these gestures. Open feedback suggests that participants initially found these gestures difficult to discover, but that they worked well after some practice.

Significantly, 53.7% of respondents thought that increased awareness provided through this survey might increase their likelihood of using these gestures, suggesting that lack of awareness was an obstacle preventing adoption. These results suggest we need clear awareness mechanisms to make novices aware of these gestures, understand how they work and what options they might provide. Over time, these awareness mechanisms become less valuable, and may be hidden or curtailed as users gain proficiency.

CONCLUSIONS

Expert-level gestures afford an opportunity to expand the capabilities of multi-touch devices towards more complex tasks, but their adoption is hampered by discoverability issues, particularly for novice users. Future work should consider the effectiveness of different awareness mechanisms in helping novice users to learn to effectively utilize advanced gestures.

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