Presentation Title:

*Evaluating the Effect of Multi-Touch Behaviours on Android Unlock Patterns*

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Introduction

User authentication is an important topic regarding computer and network security.

- The most commonly used method: **text-based password**, in which users are required to input their own user names and text passwords for authentication.

  *SplashData*: 123456 is the worst password for 2013.

- **Graphical passwords** have been proposed as an alternative to text-based passwords.
Graphical Passwords on PC

-PC Windows 8

-Choosing one image out of 3 images
-Click on three points of the selected image
Graphical Passwords on Mobile Phones

Touch-screen mobile phones become very common in our daily life: smartphone based on **Android OS** or iPhone using **iOS** (e.g., 80% share in the current market).

*The Android Unlock Patterns (AUPs) is an Android authentication application which requires users to unlock their phones by inputting the correct patterns.*
Our Motivations

More and more people store sensitive information on their phones and use them for sensitive applications:

- Credit card number
- Personal password
- Personal photos
- Mobile banking

With the touch-enabled screen, users can perform more actions on mobile phones such as multi-touch.

**Multi-touch**: users can touch the screen with multiple fingers at the same time.
Our Targets and Goals

The action of multi-touch provides more specific behaviors in creating a graphical passwords:

- Pinch open.
- Pinch close.
- Rotate.

Q: Whether the multi-touch can benefit in creating a graphical password like Android Unlock Patterns?
Potential Impact of Multi-Touch

For example, if drawing a pattern like “W”

-Single finger:

pattern \(\{1,4,7,2,9,6,3\}\)

-Two fingers:

- Pattern \(\text{multi}\{(1,4,7), (3,6,9)\},\{2\}\)

- We can image that by using two fingers, more types of patterns could be generated.

- For a certain pattern, there will be more than one way to generate.

- Intuitively, multi-touch can improve the password space of Android Unlock Patterns.
User Study-Implementation

**Platform:** Google/HTC Nexus One (resolution 480x800 px)

The major advantage of using this particular phone is that the stock Android operating system can be replaced with a modified customized-Android-OS version. We updated the phone with a modified Android OS version 2.2 based on CyanogenMod.

The modification consists of changes to the layer of *application framework* to record raw input data from the touchscreen such as the types of inputs and the timing of touch inputs, and installation of a log application.
User Study-Participants

In the evaluation, we conducted an in-lab user study which consisted of two major experiments with totally 35 participants. All participants are volunteers in the study with diverse backgrounds including both students and senior people. All participants are regular mobile phone users and ranged in age from 20 to 50 years. The detailed information of participants is shown in Table 1.

Table 1. Participants’ information.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>30-40</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>40-50</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
User Study-Methodology

In the user study, we introduced our objectives for the user study and gave a detailed description of how our system logs their inputs. Every participant can complete 2 practice trials for each scheme to get familiar with the platforms before they start to complete real trails.

**Experiment1:** Each participant can create 5 AUPs using one finger.
- Step1: AUP creation.
- Step2: AUP confirmation.
- Step3: Feedback. All participants are required to complete a feedback form about the password creation and confirmation.

**Experiment2:** Each participant can freely create 5 AUPs using either one finger or two fingers.
- Step1: AUP creation.
- Step2: AUP confirmation.
- Step3: Feedback. All participants are required to complete a feedback form about the password creation and confirmation.
User Study-Feedback Analysis

Ten-point Likert scales were used in each feedback question where 1-score indicates strong disagreement and 10-score indicates strong agreement. Several collected questions and scores are shown in Table 2.

Table 2. Several questions and relevant scores.

<table>
<thead>
<tr>
<th>Question</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I could easily create an AUP in experiment1</td>
<td>8.8</td>
</tr>
<tr>
<td>2. I could easily create an AUP in experiment2</td>
<td>8.6</td>
</tr>
<tr>
<td>3. I believe that my AUPs are different from others in experiment1</td>
<td>7.4</td>
</tr>
<tr>
<td>4. I believe that my AUPs are different from others in experiment2</td>
<td>8.5</td>
</tr>
<tr>
<td>5. I prefer to use multi-touch</td>
<td>8.3</td>
</tr>
<tr>
<td>6. I do not prefer to use multi-touch</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Discussion:
- The multi-touch will not lower the usability in creating an AUP.
- The multi-touch may increase the AUP in the aspect of security.
User Study-Preliminary Pattern Analysis

After collecting the patterns during the experiments, we calculate the average number of selected touch points under two situations: 1) Situation1: using one finger; 2) Situation2: using two fingers (multi-touch). The results are presented in Table 3.

Table 3. The average number of selected touch points.

<table>
<thead>
<tr>
<th>Situation1: one finger</th>
<th>Situation2: two fingers (multi-touch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.4</td>
<td>15.7</td>
</tr>
</tbody>
</table>

Discussion:

- Intuitively, a bigger number of selected touch points can positively increase the security of graphical passwords where attackers should spend more time in cracking it.

Therefore, the initial pattern analysis validates that the behavior of multi-touch can enhance the creation of Android Unlock Patterns.
Conclusion

- We mainly attempt to evaluate the effect of multi-touch on creating Android Unlock Patterns (AUPs). In particular, compared to a traditional one-finger touch movement, we select a two-finger based touch movement as multi-touch actions in creating AUPs and conduct a user study with 35 participants.

- We show the results by analyzing the received feedback from two specific experiments. The results provide some useful information and indicate that the use of multi-touch can make a positive impact on creating AUPs.

- In addition, we also identify that the effect of multi-touch gestures will be affected by specific graphical password schemes.
Future Work

- Analyzing the specific password space by integrating the behaviors of multi-touch and containing more types of multi-touch in creating an AUP.

- Analyzing the patterns generated by users to validate the practical effect of multi-touch on creating graphical passwords.

- Evaluating the multi-touch based graphical passwords under several attacks like Brute force and shoulder surfing.

Open Discussion.

Would you like to create a pattern using multi-touch?
THANK YOU

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