Examining Visual–Spatial Paths for Mobile Authentication

Taehoon Lee, David Lu, Sauvik Das, Jason Hong
Motivation

- Strong passwords for existing authentication methods are difficult for users to remember/recall
- Many smartphone users have low entropy passwords that have low adversary protection
- 42% of smartphone users use no form of authentication
Main Objectives

- **Memorability**: How easily retainable is our secret

- **Security**: The security level of our authentication system

- **Adversary Protection**: How easily can someone steal the password
Memory Palace

- The user visualizes a spatial path within a virtual space (palace) to recall information

- Humans are better at remembering visual-spatial information than they are at remembering abstract information
Memory Palace Mobile Authentication App

- The user creates a password stored in the form of a path through a virtual world consisting of rooms.
- Wall decorations and items in these rooms serve as visual guides.
- The user then can authenticate his/her device by drawing the exact path that corresponds to their password.
Methodology

We decided to run two user studies to validate our idea:

1) Run an initial user study to determine the best representation of the Memory Palace

2) Run a subsequent user study to test the Memory Palace against Android PatternLock, an existing password system
Possible Representations

2D

3D

Spatial
Results/ Analysis

Study 1:

Spatial Paths Have Higher Memorability After a Week (n=14)

- 2D: 71%
- 3D: 64%
- Spatial: 100%
Screenshots

Pattern Lock

Memory Palace

- Reset Path
- Move through doors

Check if path is correct

Swipe in the direction of path
Results/Analysis

Study 2:

Users Remember Passwords Twice as Well with the Memory Palace (n=20)

- Memorability: 70% (Memory Palace) vs. 30% (PatternLock)
- Adversary Susceptibility: 65% (Memory Palace) vs. 5% (PatternLock)
Results/ Analysis

Study 2 (cont.):

Memory Palace is not only More Memorable, but also More Secure

<table>
<thead>
<tr>
<th>Authentication Method</th>
<th>Bits of Entropy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Palace</td>
<td>20</td>
</tr>
<tr>
<td>PatternLock</td>
<td>18</td>
</tr>
<tr>
<td>4-digit PIN</td>
<td>13</td>
</tr>
</tbody>
</table>
Applications

While The Memory Palace is shown to be a strong security solution, it also provides many other applications as well.

- Multi-Tiered Authentication
- Guest Passwords
Questions

- Taehoon Lee -- taehoonl@andrew.cmu.edu
- David Lu -- davidl1@andrew.cmu.edu
- Sauvik Das -- sauvik@cmu.edu
- Dr. Jason Hong -- jasonh@cs.cmu.edu