Security and Usability of Graphical Passwords

Kyle J. Hakala

UMN Morris

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University of Minnesota
Driven to Discover℠

Introduction

Think for a moment...

How many different systems and services do you need to log into every day?

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How many different systems and services do you need to log into every ~~day?~~
week?

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month?

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year?

Introduction

...A lot.

Introduction

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...A lot.

Introduction

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FederalStudentAid

An office of the U.S. Department of Education

neopets®

...A lot.

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Username = marc
Password = password
STOCKS:
Username = marc
Password = password

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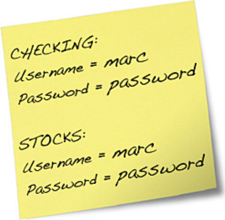

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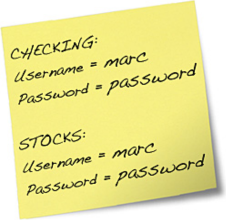

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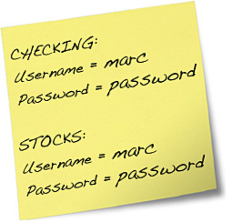

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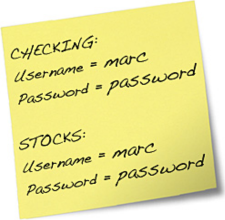

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We want a means of authenticating that is:

- secure

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We want a means of authenticating that is:

- secure
- memorable

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You aren't alone!

We want a means of authenticating that is:

- secure
- memorable
- practical

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How about graphical passwords?

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- ...provide a more memorable approach to authentication
- ...can be used as a component of two-factor auth systems
- ...can be implemented in many varying styles

Introduction

Popular Implementations

- Windows 8 and 10; users draw shapes over an image

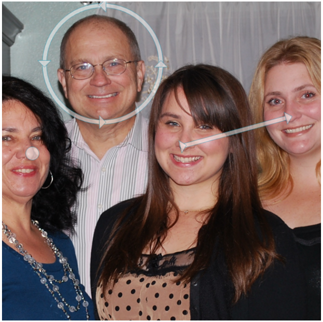

Figure 1: Windows Picture Password

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Popular Implementations

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- Android phones; users draw a pattern by connecting a series of points.

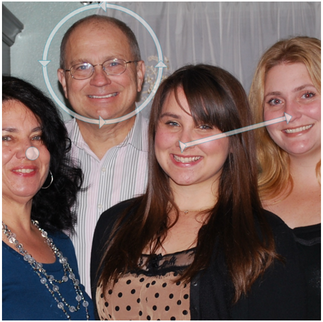

Figure 2: Windows Picture Password

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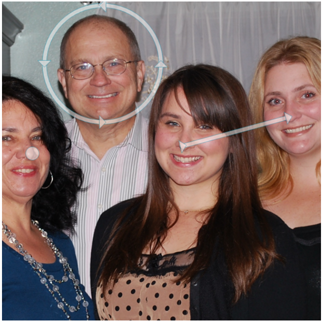

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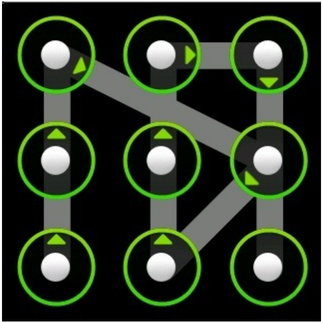

Figure 3: Android Pattern-Lock

Outline

1. Background
   - Components
2. Analysis
   - Security
   - Usability
3. Conclusion

Components

A graphical password consists of two main components:

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  - a point, series of points, or set of points
  - a shape, series of shapes, or set of shapes

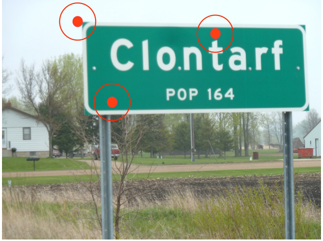

Figure 4: Set of points, selected in any order

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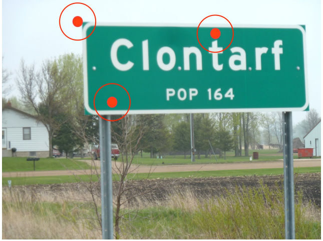
  - a shape, series of shapes, or set of shapes



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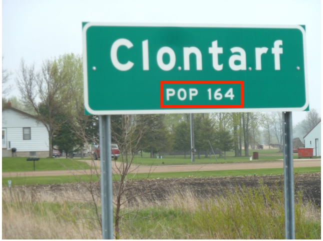

Figure 5: Single shape drawn over image

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- an image upon which a user interacts

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    - can be either user-provided, or system-provided

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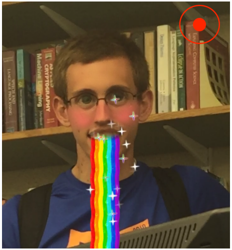

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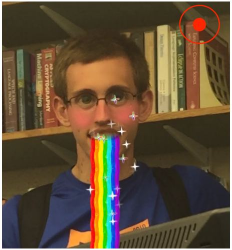

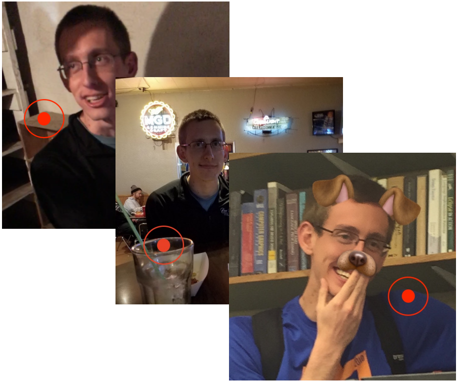

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the practice of spying on the user of an ATM, computer, or other electronic device in order to obtain their personal access information

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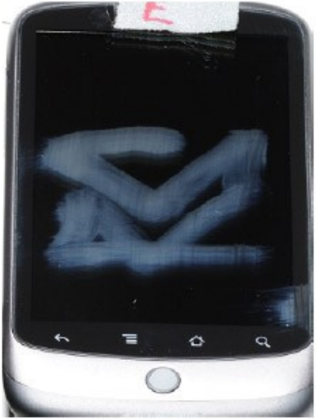
- GPs are more visual than text
- They are not obscured like text
- Must be large enough for interaction

Security



Smudging

residual marks left behind in the shape of a graphical password indicating what was entered

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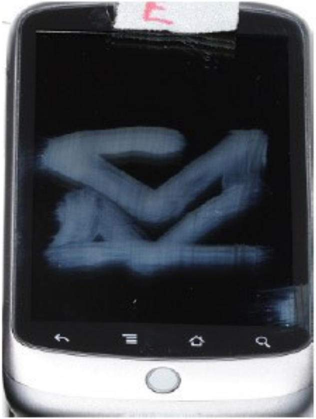

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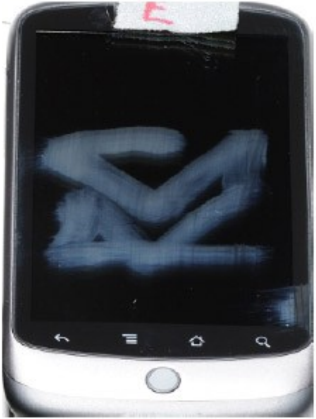

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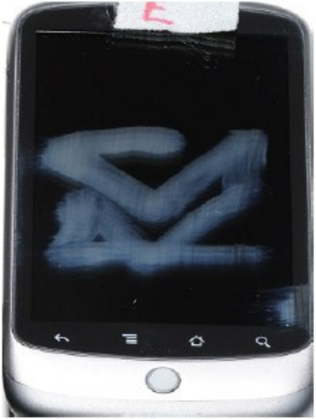

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residual marks left behind in the shape of a graphical password indicating what was entered

- Prominence depends upon length of usage session
- Can indicate direction and location
- Varies between devices

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Hotspots

a hotspot is a feature of an image that a user is more likely to base a GP component on

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- Cued Click Points (CCP)
    - User is presented 5 images in series
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- Persuasive CCP (PCCP)
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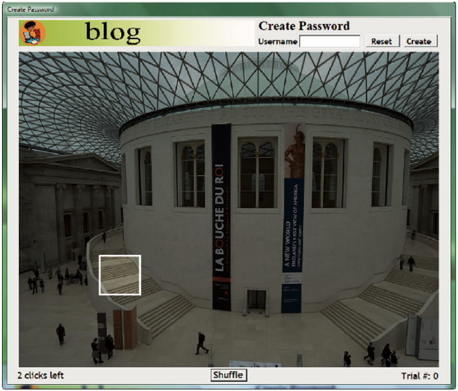

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Let’s use brute force!

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S. Widenbeck et al. note in research on PassPoints:

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	Image size	**Alphabet size***	**Length**	**Key-space**
Alphanum.	N/A	64	8	$2.8\text{x}10^{14}$
Alphanum.	N/A	72	8	$7.2\text{x}10^{14}$

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Graphical	1024x752	3928	5	$9.3\text{x}10^{17}$
Graphical†	1024x752	1964	5	$2.9\text{x}10^{16}$

* *Alphabet size* for the GP is determined by taking the area of the image (in px) and dividing by the area of (in px) tolerance square; for a text based password, it is the set of all characters permitted.

† GP where half of screen is considered usable space

Usability

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- Great for children

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- Great for children
- Difficult to recall when many GPs exist

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- Can become unusable if too strict

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Tolerance	Image size	Alphabet size*	Key-space
14x14	1024x752	3928	9.3x10^{17}
20x20	1024x752	1925	2.6x10^{16}
26x26	1024x752	1139	1.9x10^{15}

**Alphabet size* is *Image Size* ÷ *Tolerance size*

** Assumes 5 click points are chosen

Usability Overview

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But... it's not text...

S. Widenbeck et al. note in their research that PassPoints users:

- easily created a password
- reasonably recall and input their GPs even after weeks without use

Conclusion

Graphical passwords present a welcome alternative to text based authentication.

Pros of GPs

- Larger password-size space
- More memorable

Cons of GPs

- More susceptible to softer attacks
- No standard form

Acknowledgments

Thank you to KK, Elena, and Justin Mullin (alumni reviewer) for all of the great feedback!

Questions?