Exploring Games for Improved Touchscreen Authentication on Mobile Devices

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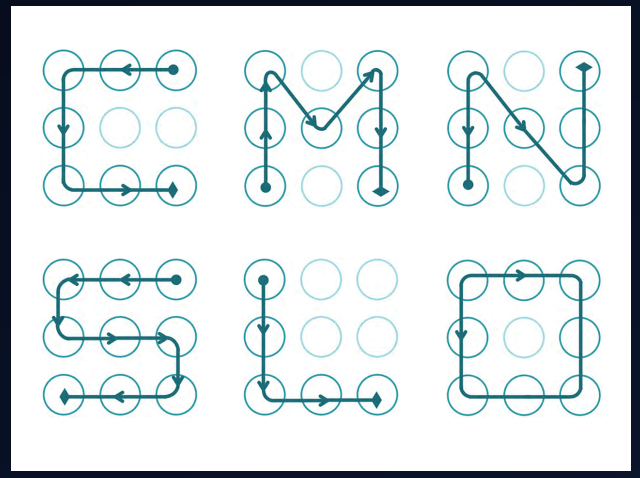
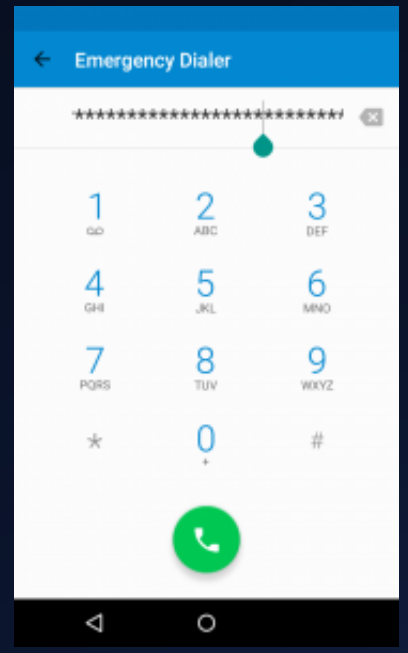
Mobile Devices Need Strong Authentication

- Mobile devices increasingly responsible for sensitive information
- Their form factor makes them easily stolen
  - 3.1 million devices stolen in 2013 [8]
- Data loss from mobile devices ranked the largest threat to mobile computing [4]

Mobile User Authentication is Not Easy

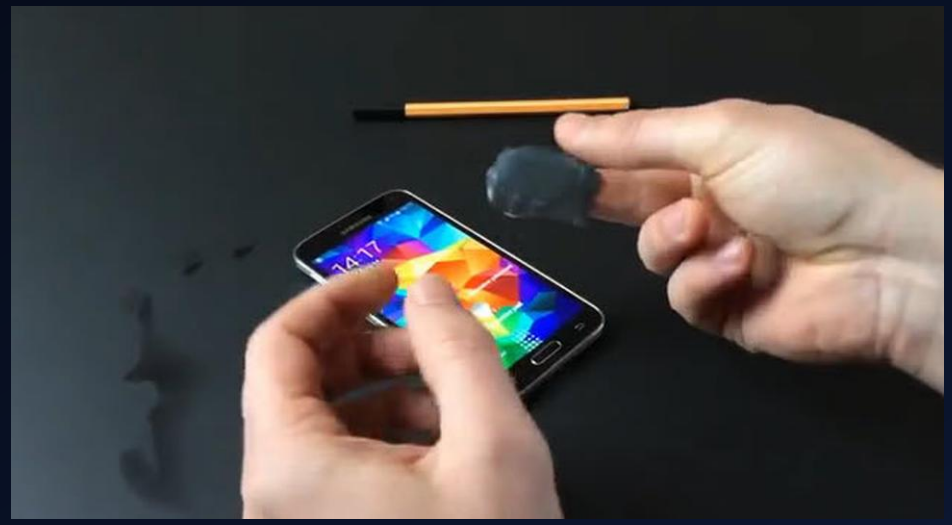
- Mobile authentication is vulnerable to observation attacks [6]
- Usability concerns prevent adoption of existing methods
- 47% of smartphone owners don’t use a PIN, password, or unlock pattern [8]
- 34% take no security precautions with their mobile devices [8]
- Solutions must be resource efficient





Biometrics to the Rescue?

- Devices can verify user identity by measuring distinctive characteristics
- Traditional biometrics measure physical traits
- Advantages:
  - Not vulnerable to observation
  - Harder to lose
- Disadvantages:
  - Requires specialized hardware
  - Usability issues
  - Only performed at session start



Behavioral Biometrics

- Can users be authenticated based on the manner in which they use a device?
- Improves usability
  - Natural device usage
- Active authentication for improved security
  - Verify identity throughout a session
- Potential modalities:
  - Stylometry [1]
  - Application usage [5]
  - Device movement [7]
  - Touchscreen dynamics [9]

Behavioral Biometrics

- Challenges:
  - Small resource footprint
  - Privacy consciousness
  - Detection time
  - Modality relevance

Idea: Use Gameplay for Authentication

- Can users be authenticated by how they play a game?
  - Are a person's gameplay habits consistent?
  - Degree of variation between users?
- Why games?
  - Natural usability benefits [2][3]
  - Widespread popularity
  - Privacy friendly
  - Encourage rapid and distinct input

A (Very) Preliminary Evaluation

- Developed a touchscreen input sensor for Android
- Installed on a Samsung Galaxy along with 3 popular games:
  - Angry Birds
  - Flow Free
  - Fruit Ninja
- Conducted IRB approved study with 12 participants
  - Played each game for 5 minutes

Gameplay Analysis

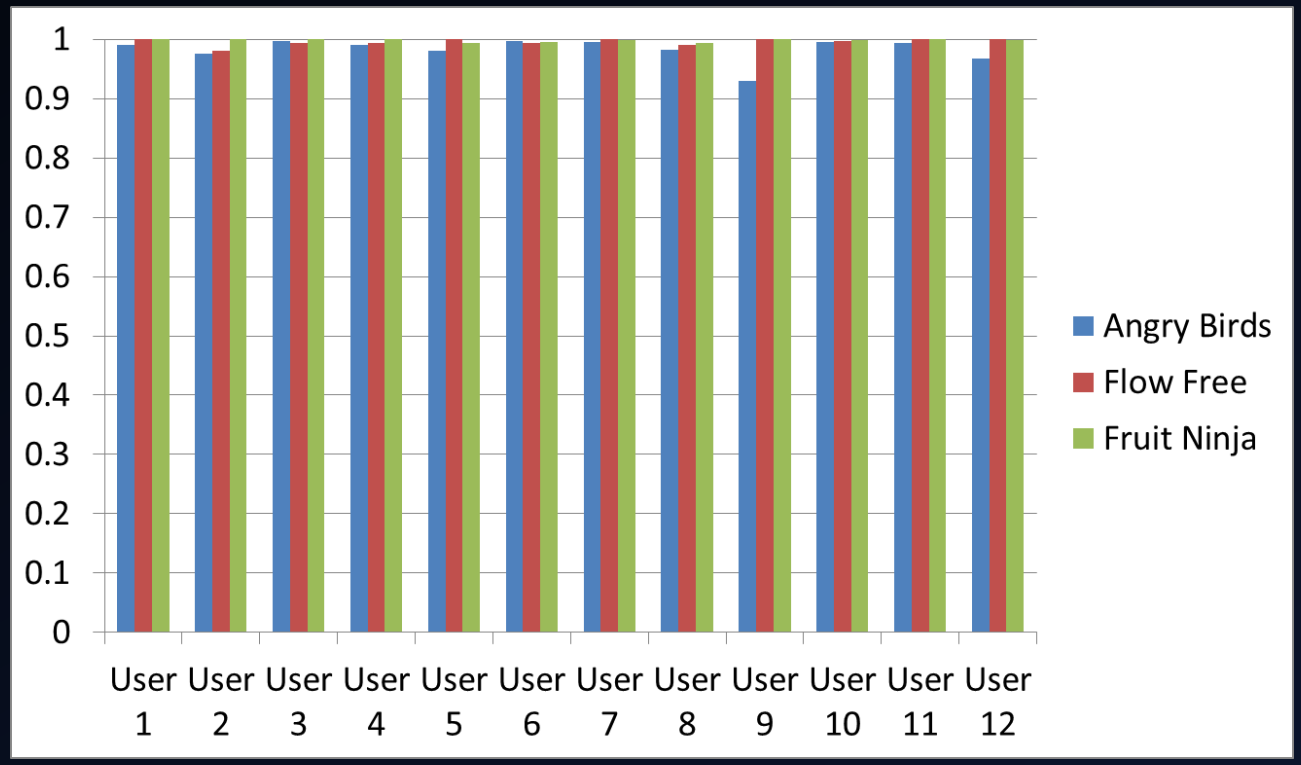
- Randomly selected 300 distinct gestures per user per game
- Derived 17 properties of touchscreen interactions:

1) Initial X coordinate
2) Initial Y coordinate
3) Final X coordinate
4) Final Y coordinate
5) Pressure
6) Area covered
7) Finger width
8) Gesture length along X axis
9) Gesture length along Y axis
10) Distance
11) Direction
12) Speed along X axis
13) Speed along Y axis
14) Speed along trajectory
15) Velocity
16) Angular velocity
17) Finger orientation

- Applied a Support Vector Machine to gesture features per game
  - Trained with Sequential Minimal Optimization
  - Tested with 10-fold cross validation

Results

Game	TP Rate	FP Rate	Precision	AUC
Angry Birds	92.17%	0.70%	92.41%	0.983
Flow Free	98.86%	0.10%	98.87%	0.996
Fruit Ninja	99.45%	0.05%	99.46%	0.998



Area Under the ROC Curve for each Combination of User and Game

Conclusion

- Behavioral biometrics are a promising approach to mobile authentication
- Users can potentially be authenticated by how they play touchscreen games
- Further research planned into how games impact authentication usability and speed
- Future work:
  - More comprehensive study
  - Comparison of a wider variety of application usage
  - Susceptibility of gameplay to attack (observation, mimicry, etc.)

Thank you!

References

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