At Your Fingertips: Considering Finger Distinctness in Continuous Touch-Based Authentication for Mobile Devices

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Science and Technology Directorate

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Our Personal Assistant

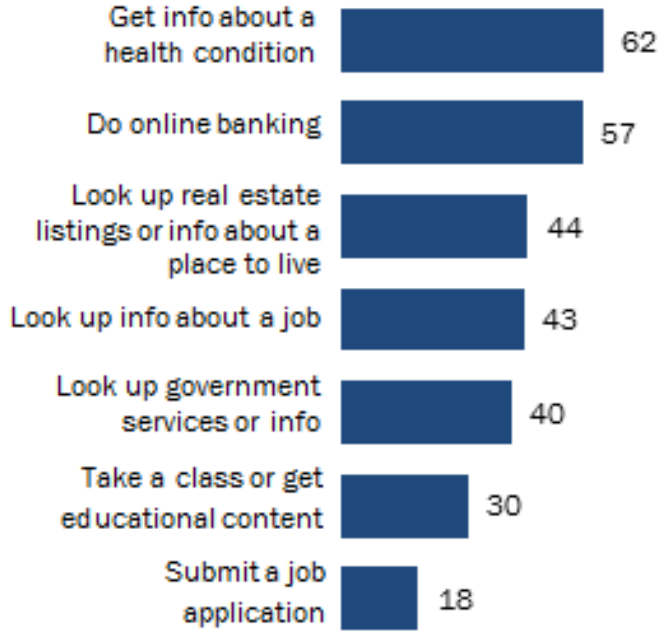
6.1B

Smartphone subscriptions by 2020

[13]

More than Half of Smartphone Owners Have Used Their Phone to get Health Information, do Online Banking

% of smartphone owners who have used their phone to do the following in the last year



[12]

64%

Users use no authentication

[3]

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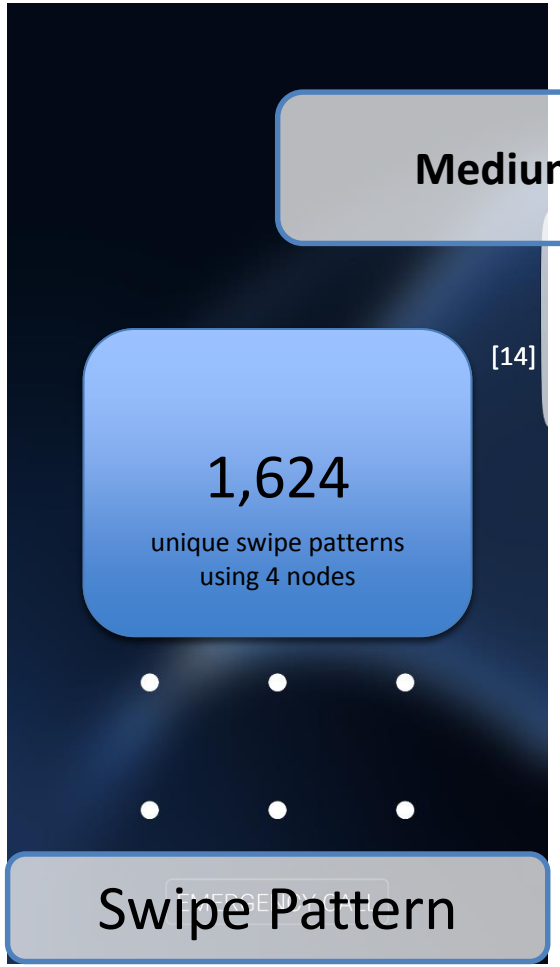
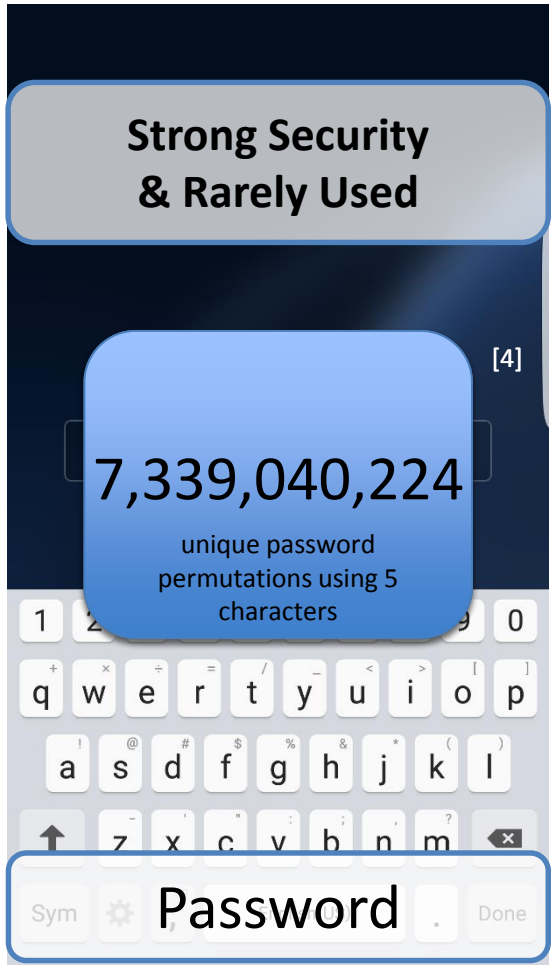
Active Authentication





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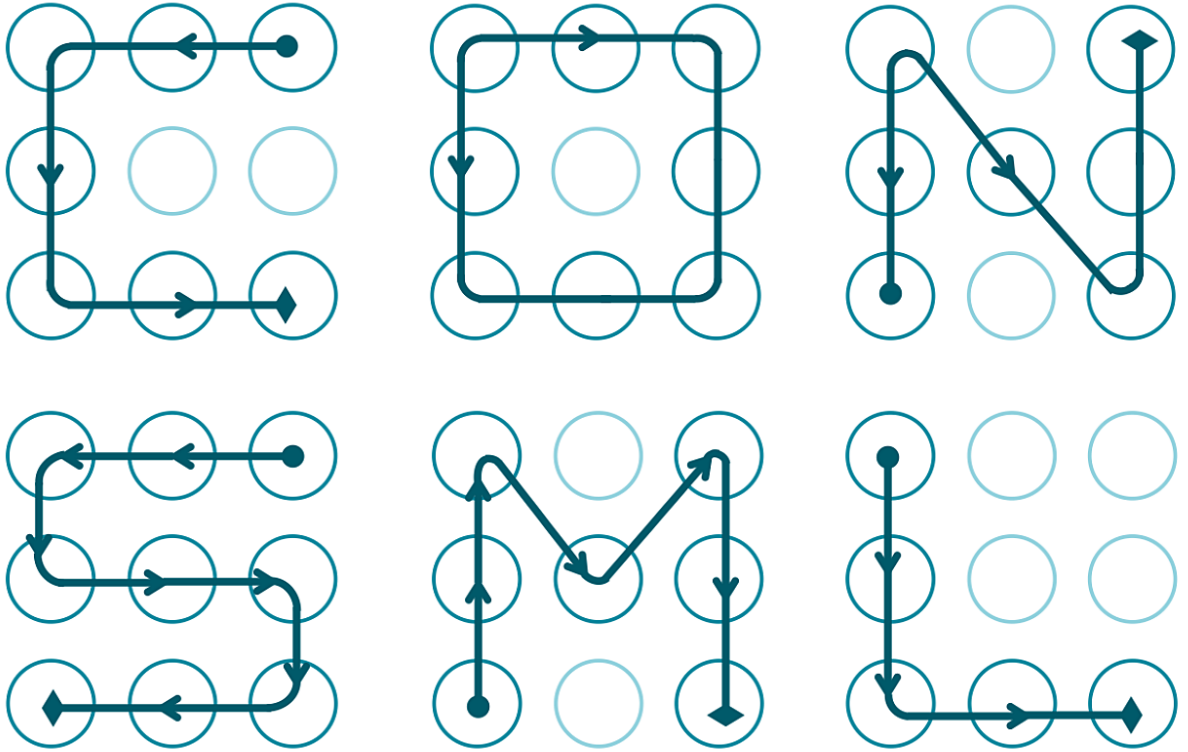
Active Authentication

Single-Factor Authentication
(Only Using One Group)

- Knowledge
  - Passwords
  - PINs
  - Patterns
- Possession
  - Token
  - Key Card
- Inherence
  - Retina
  - Fingerprints



[14]

Example of Common Weak Swipe Patterns

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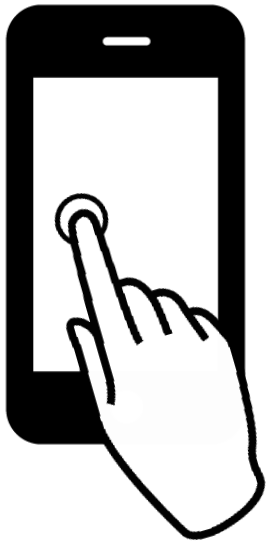
Passive Authentication

Gesture on Device



Collectable Features

- Time (ms)
- X-Coordinate
- Y-Coordinate
- Pressure
- Size

Distinct Data

Time (ms)	X-Coordinate	Y-Coordinate	Pressure	Size
500176	172.9635	626	0.282353	0.282353
504485	258.4167	559.0695	0.298039	0.298039
507079	319.4074	467.0485	0.286275	0.286275
508157	554.0085	611	0.27451	0.27451
509971	175.8468	576.6588	0.258824	0.258824

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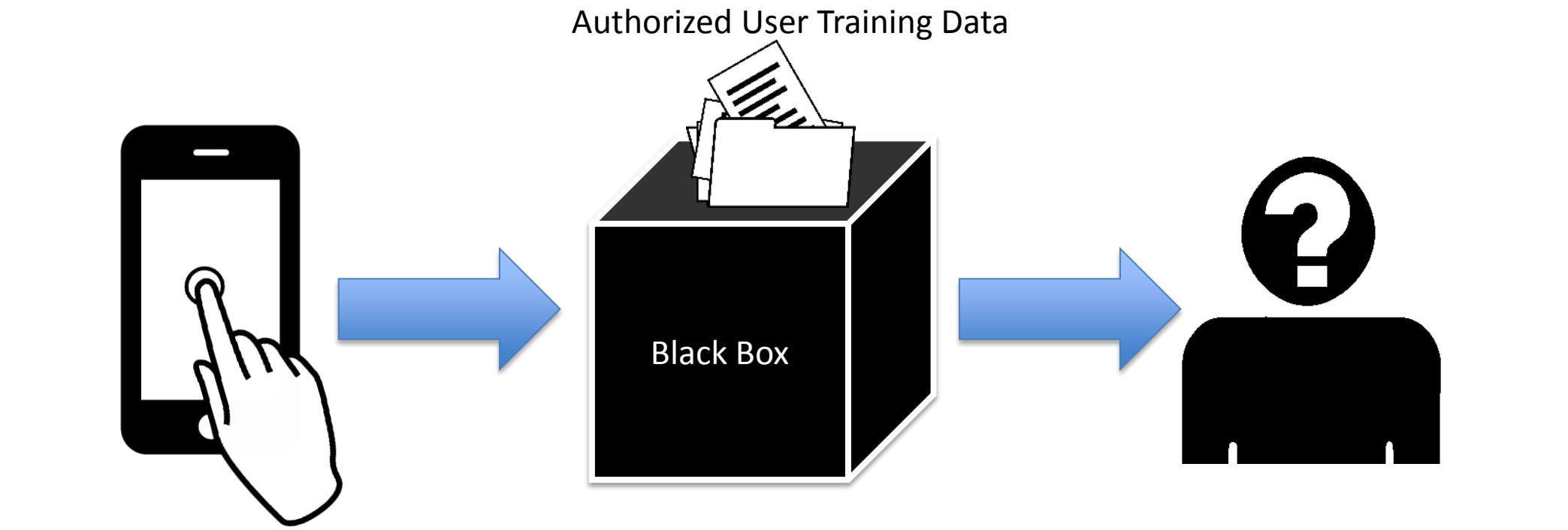
Passive Authentication



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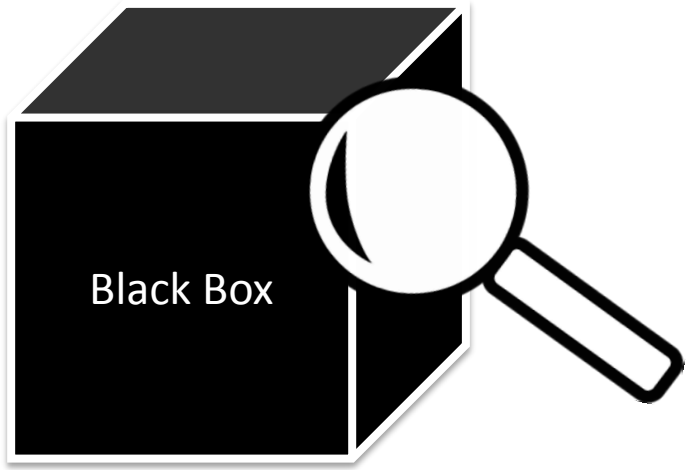
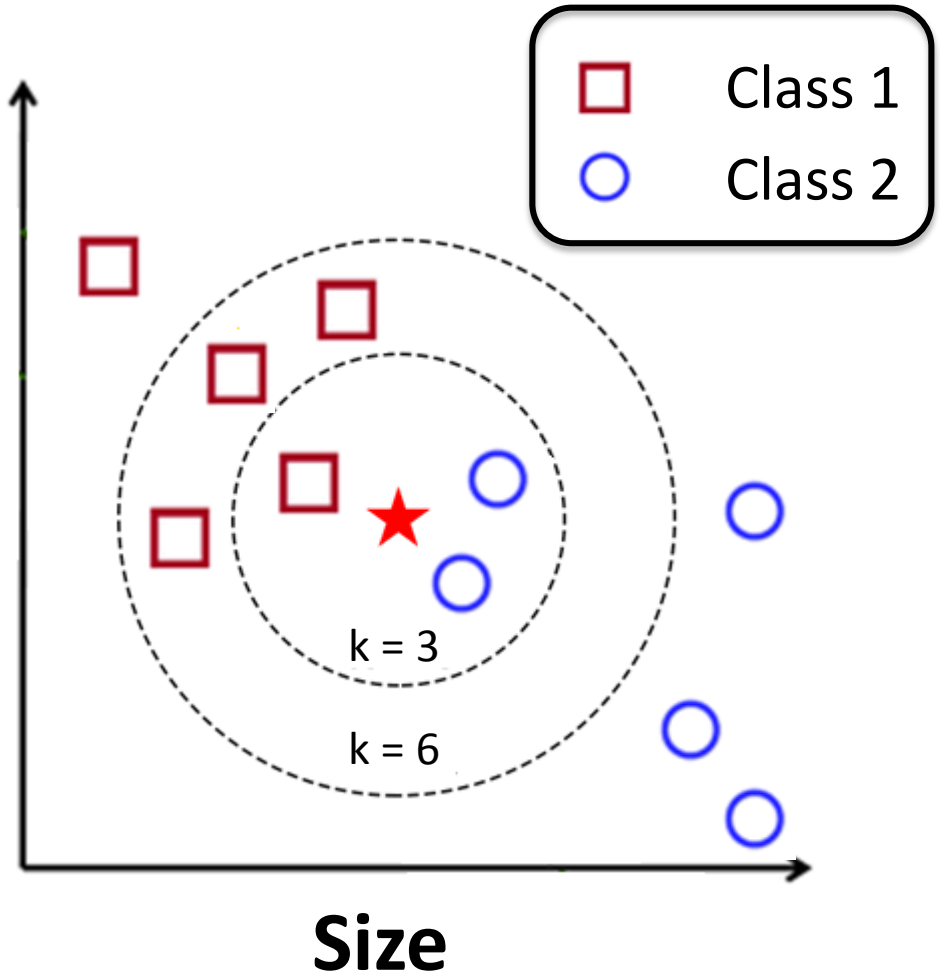
k-Nearest Neighbor





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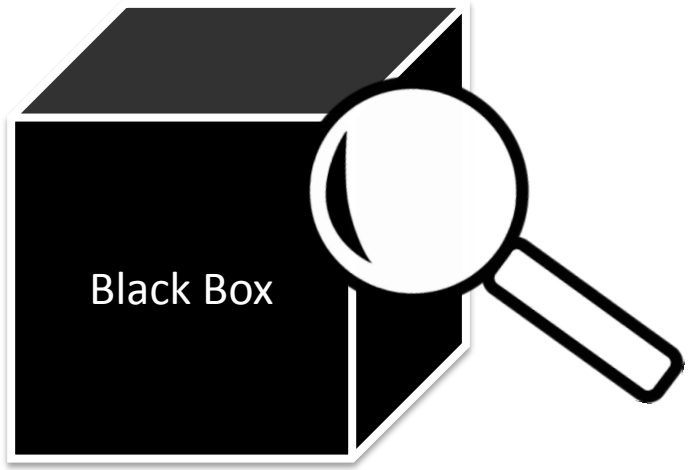
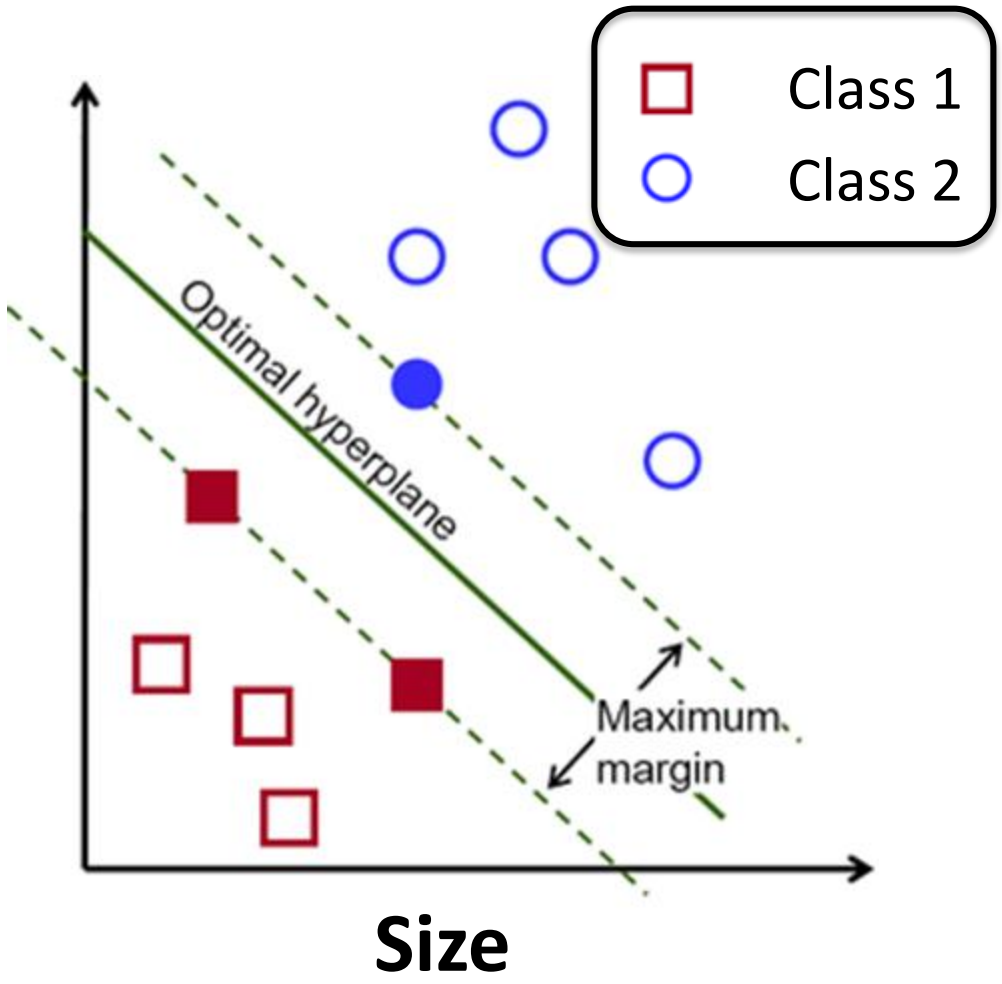
Support Vector Machines





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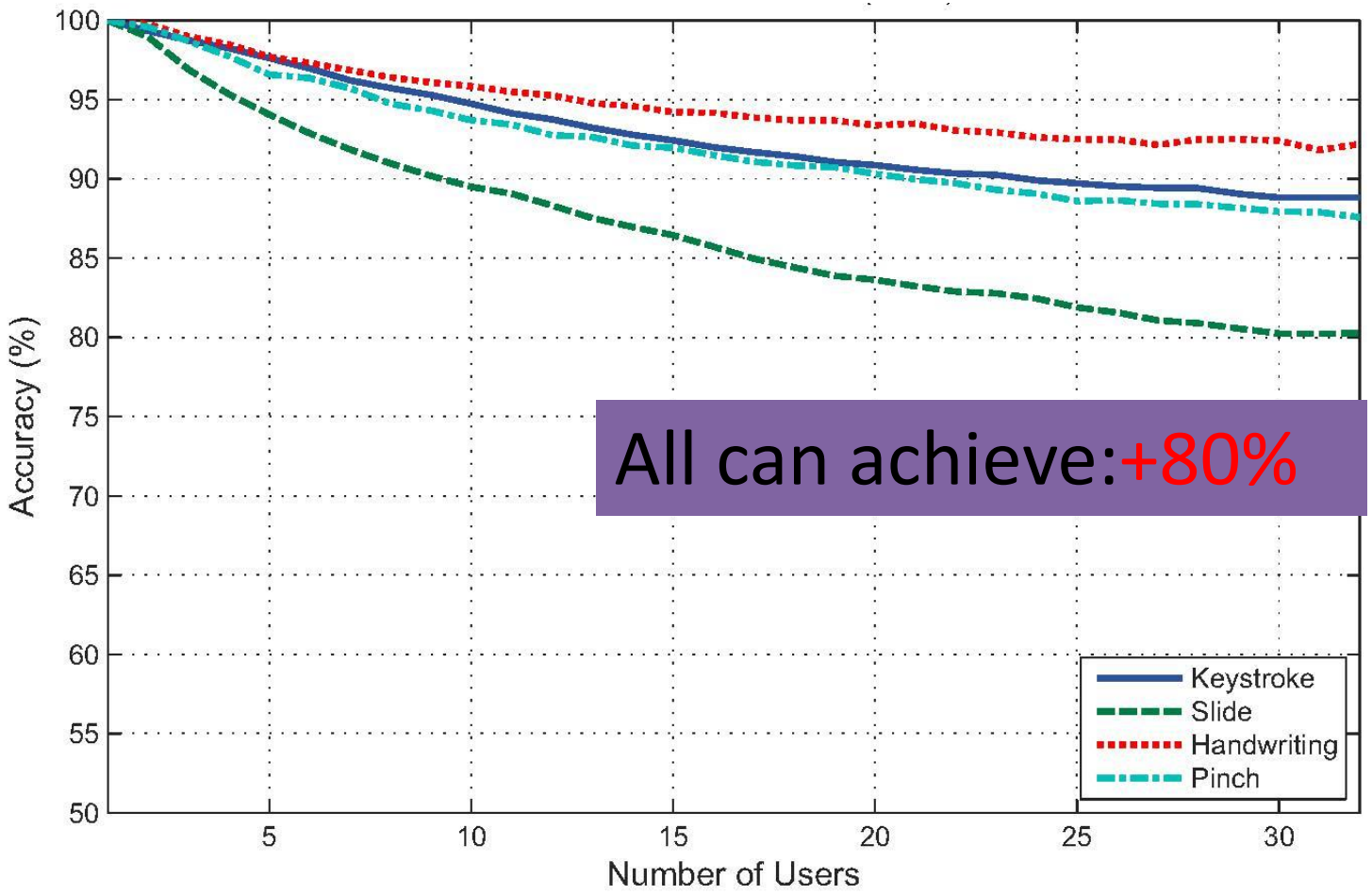
State of the Art: SVM

Study by Xu et al.

- Used SVM with Radial Basis Function (rbf)
- Accuracy Declined With More Users
- Assumed Users Always Used the Same Style



[14]

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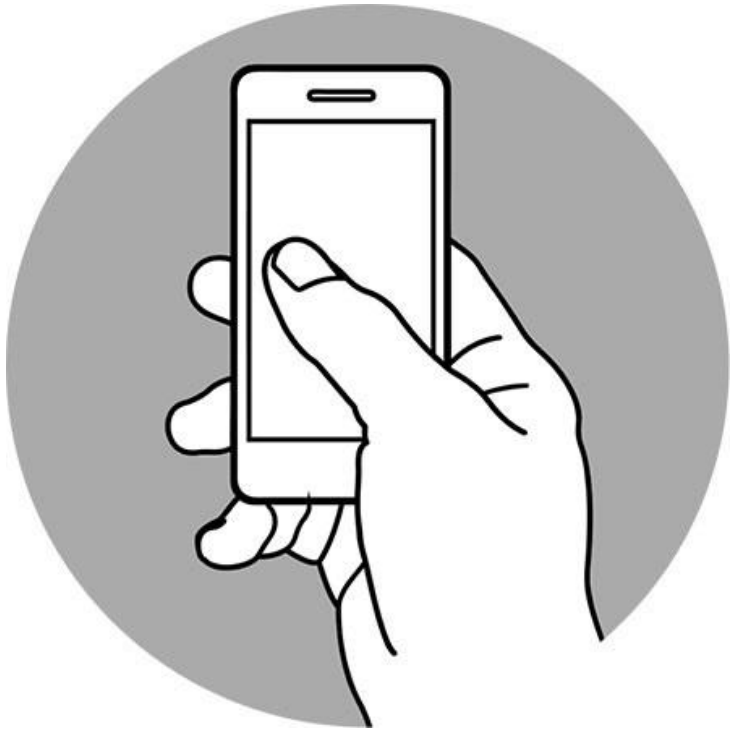
Operation Styles

[10]

Cradled – 36%



One handed – 49%

Two handed – 15%

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Operation Styles

[10]

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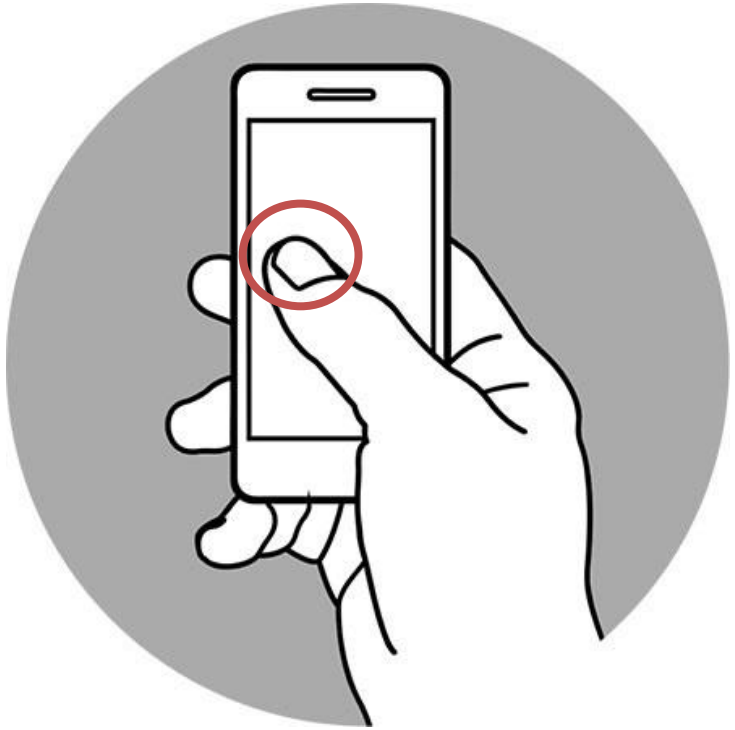

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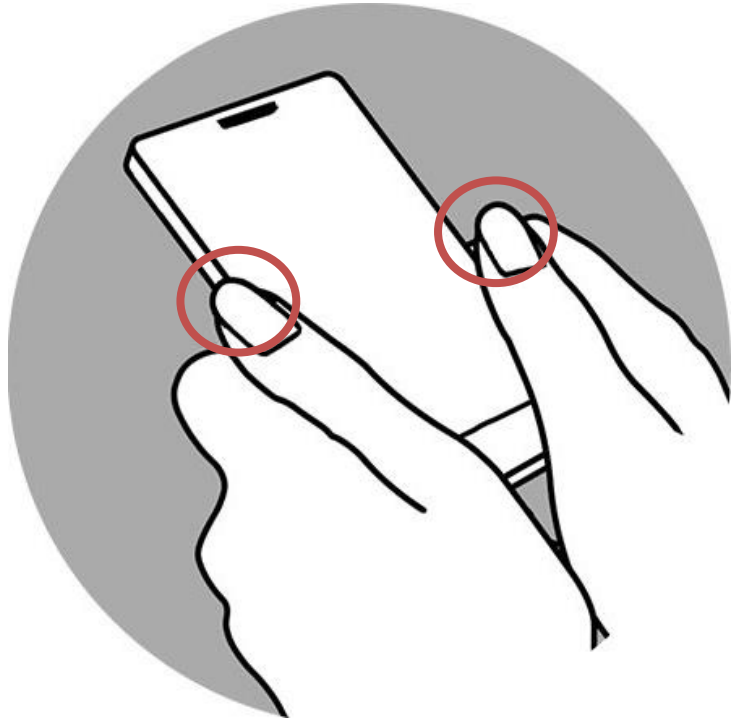

Two handed – 15%

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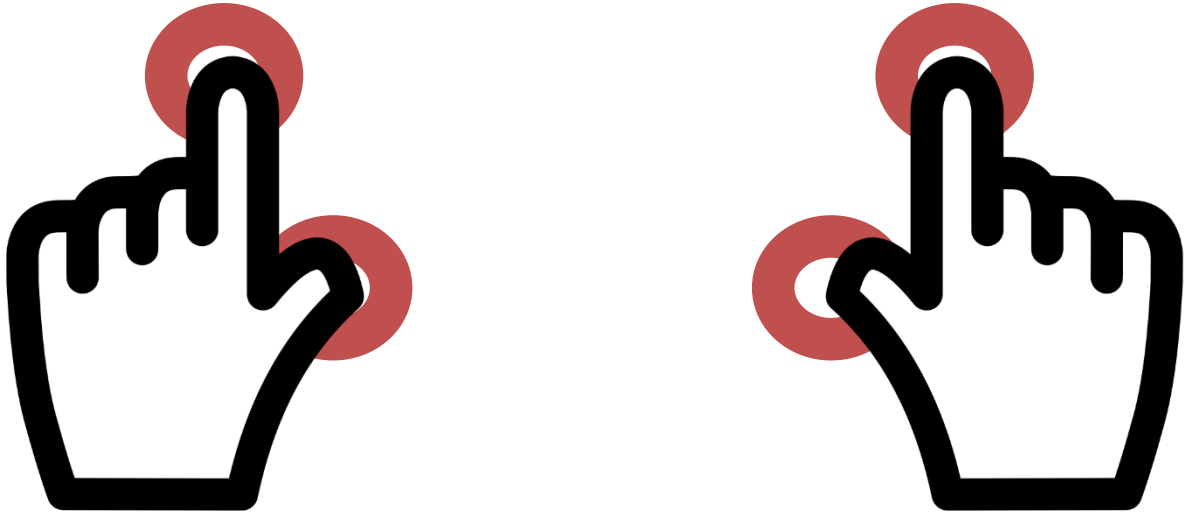
Motivation

- Does authentication accuracy improve by training with several of a user's fingers?



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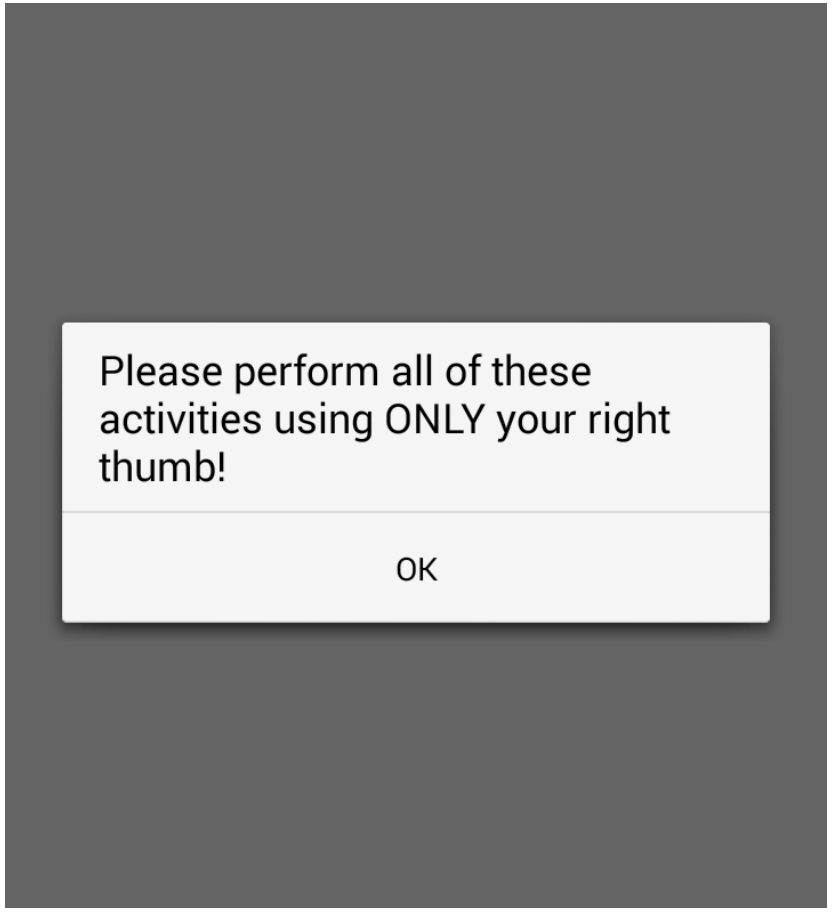
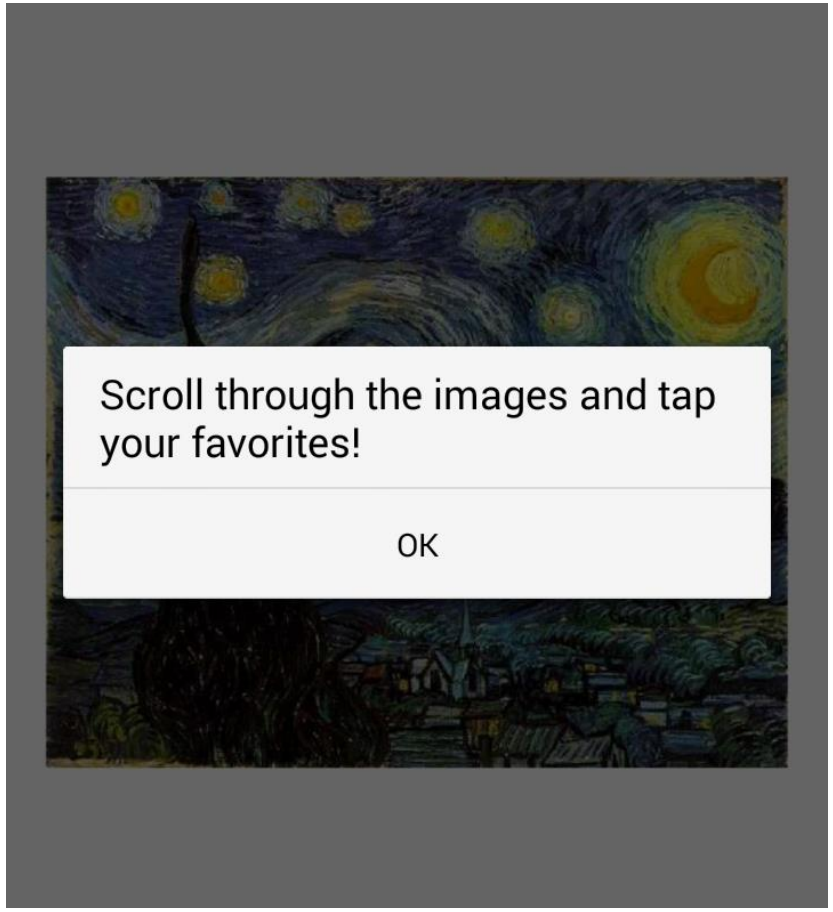
App Development





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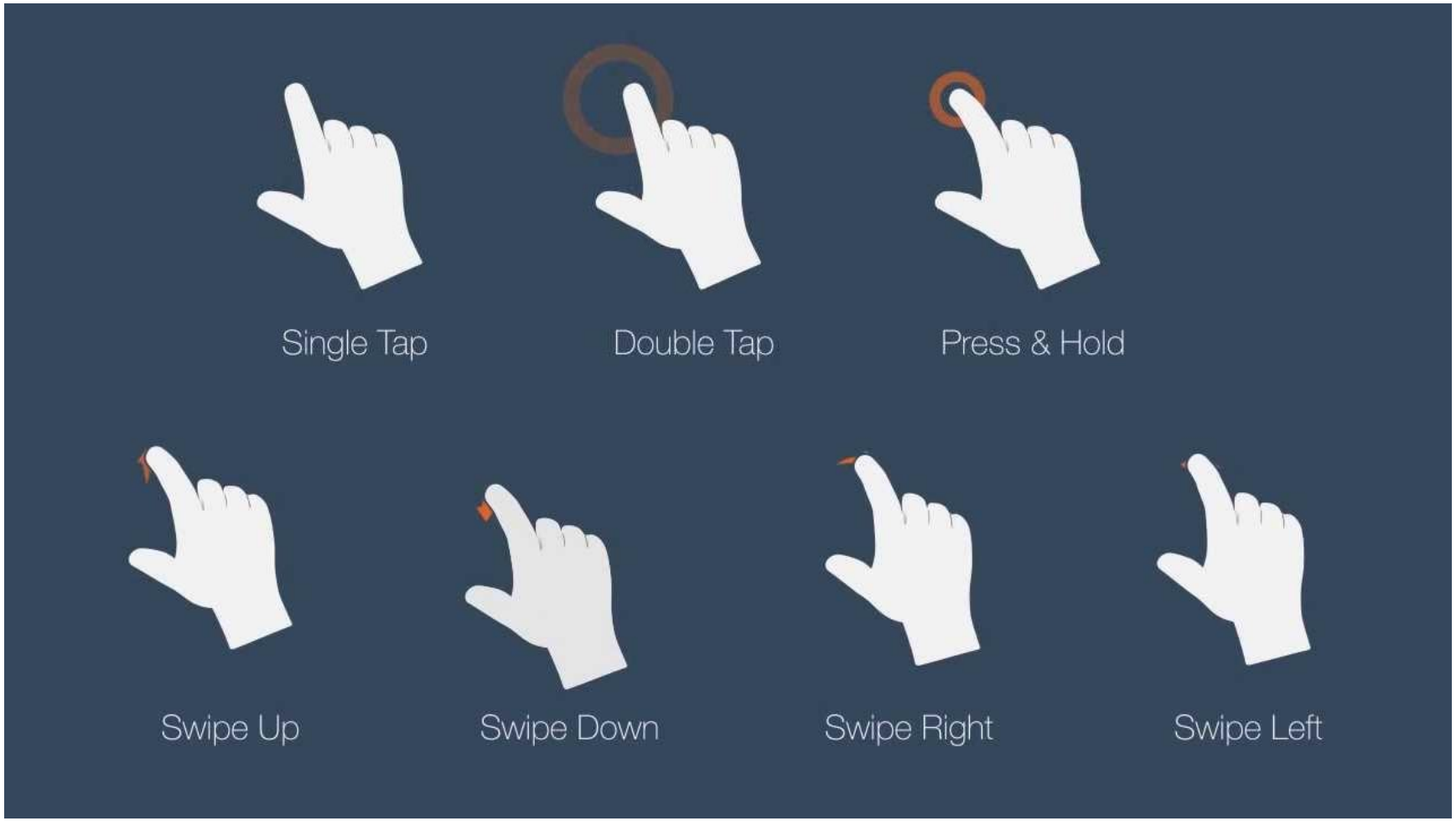

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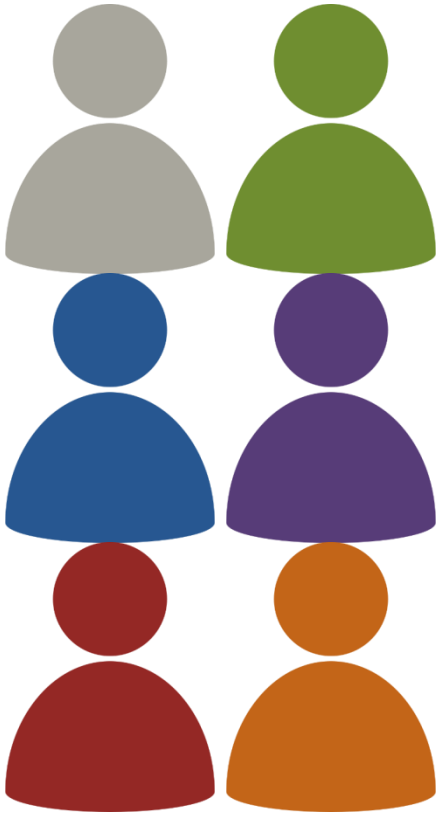
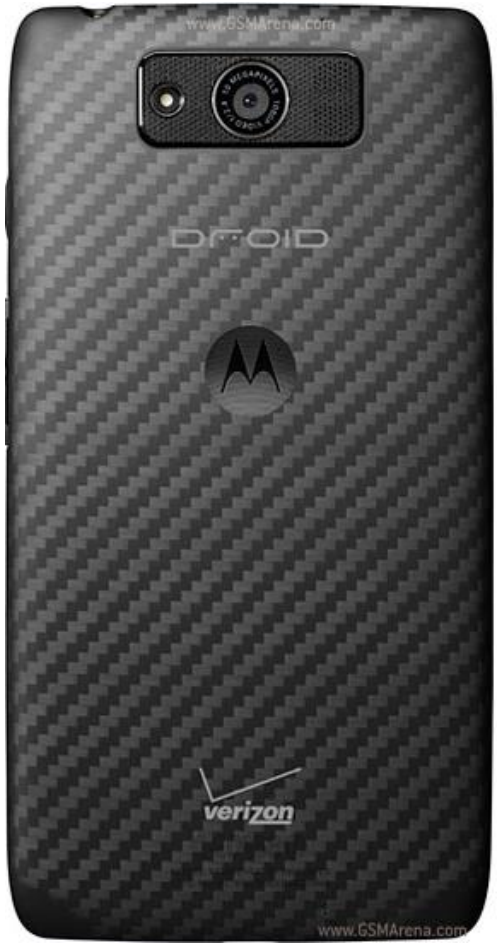
Pilot Study Setup



- Online advertisement and snowball sampling
- 6 participants (3 male, 3 female)
- Droid Maxx Devices
- 5 Days



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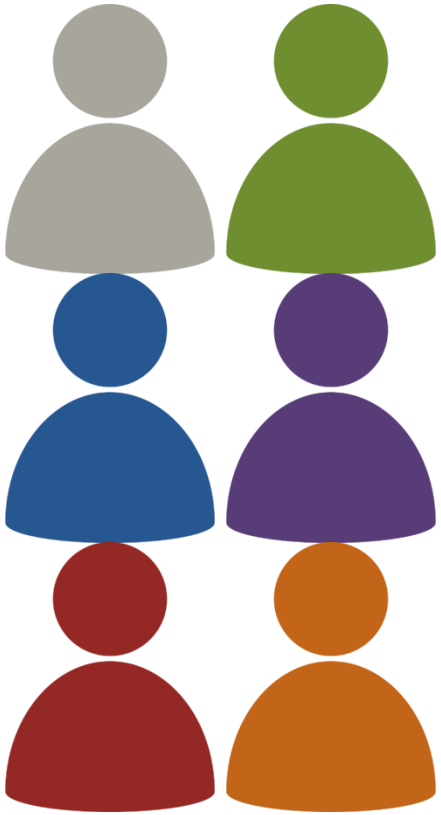

Distinct Data

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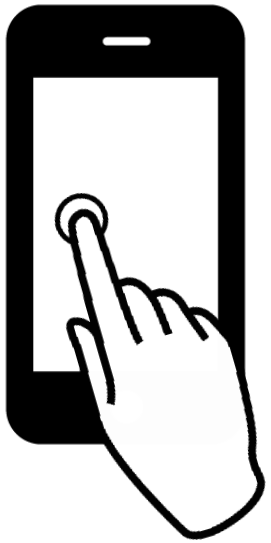
Preprocessing

MotionEvent → SensorEvent

Gesture on Device



Data Stored in Vector

Time (ms)	X-Coordinate	Y-Coordinate	Pressure	Size	X-Accelerometer	Y-Accelerometer
548476	422	522	0.282353	0.282353	1.474828	5.152322
548514	427.4653	568.3857	0.298039	0.298039	1.474828	5.152322
548525	429	618.5961	0.298039	0.298039	1.474828	5.152322
548541	426.0154	676.2451	0.290196	0.290196	1.474828	5.152322
548557	417.4294	745.6889	0.278431	0.278431	1.474828	5.152322

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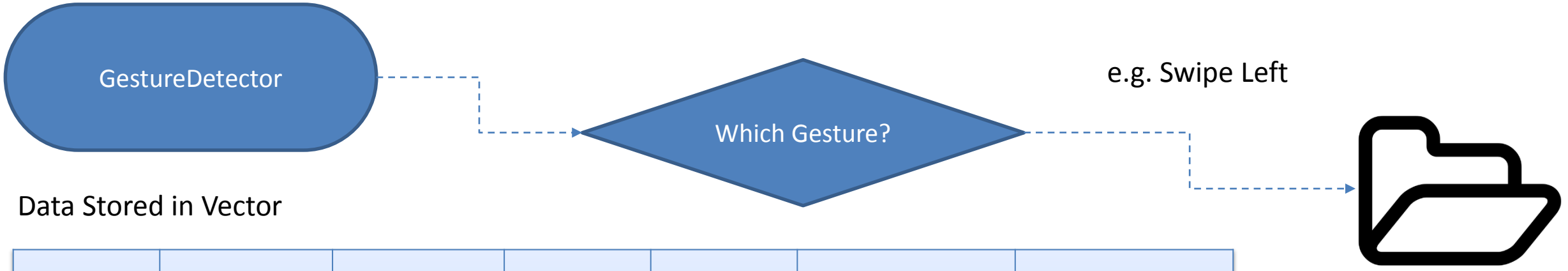

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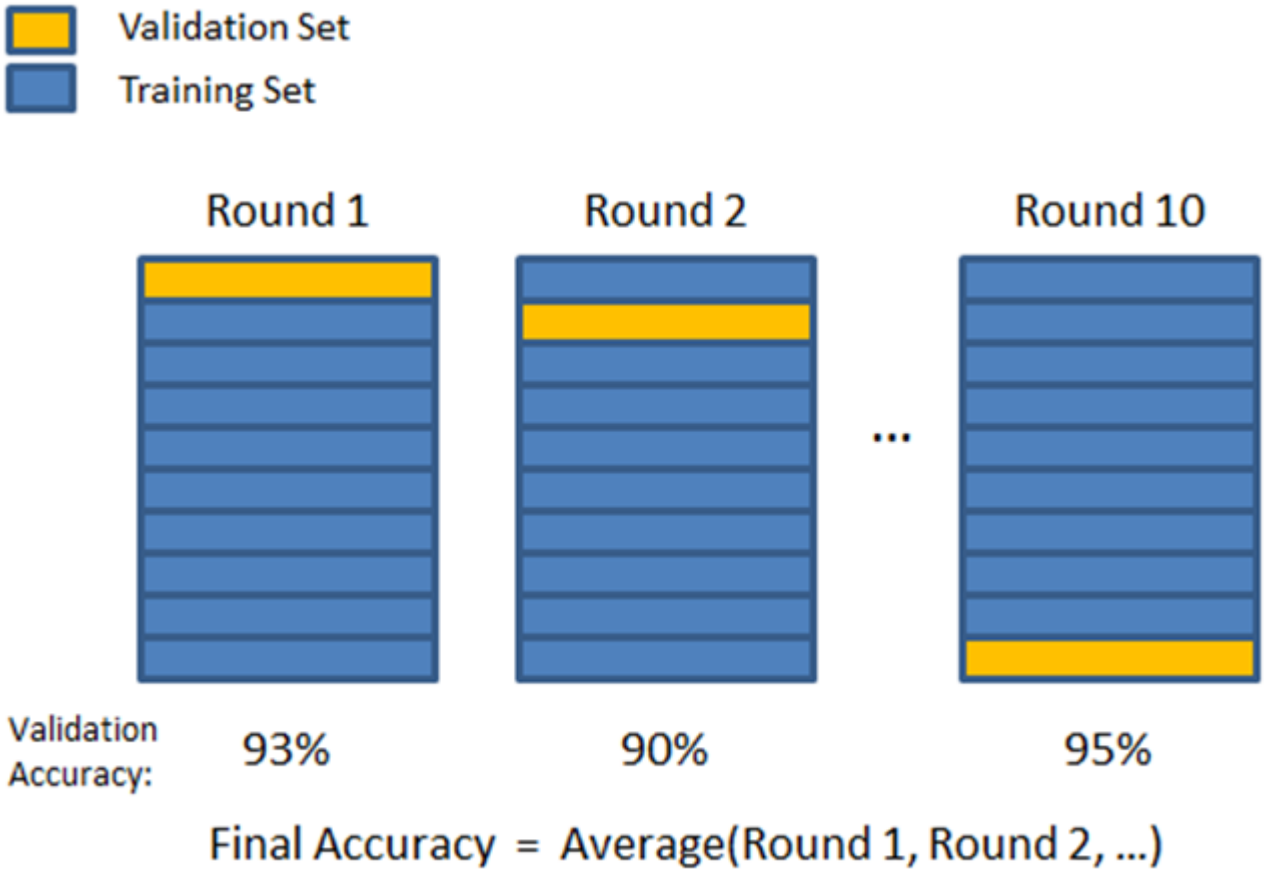
Our Approach

- SVM with Radial Basis Function (rbf)
- 10-fold Cross-Validation to Compute Accuracy



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Data Analysis

$$Accuracy = \frac{Correctly\ Classified\ Points}{Number\ of\ Testing\ Points}$$

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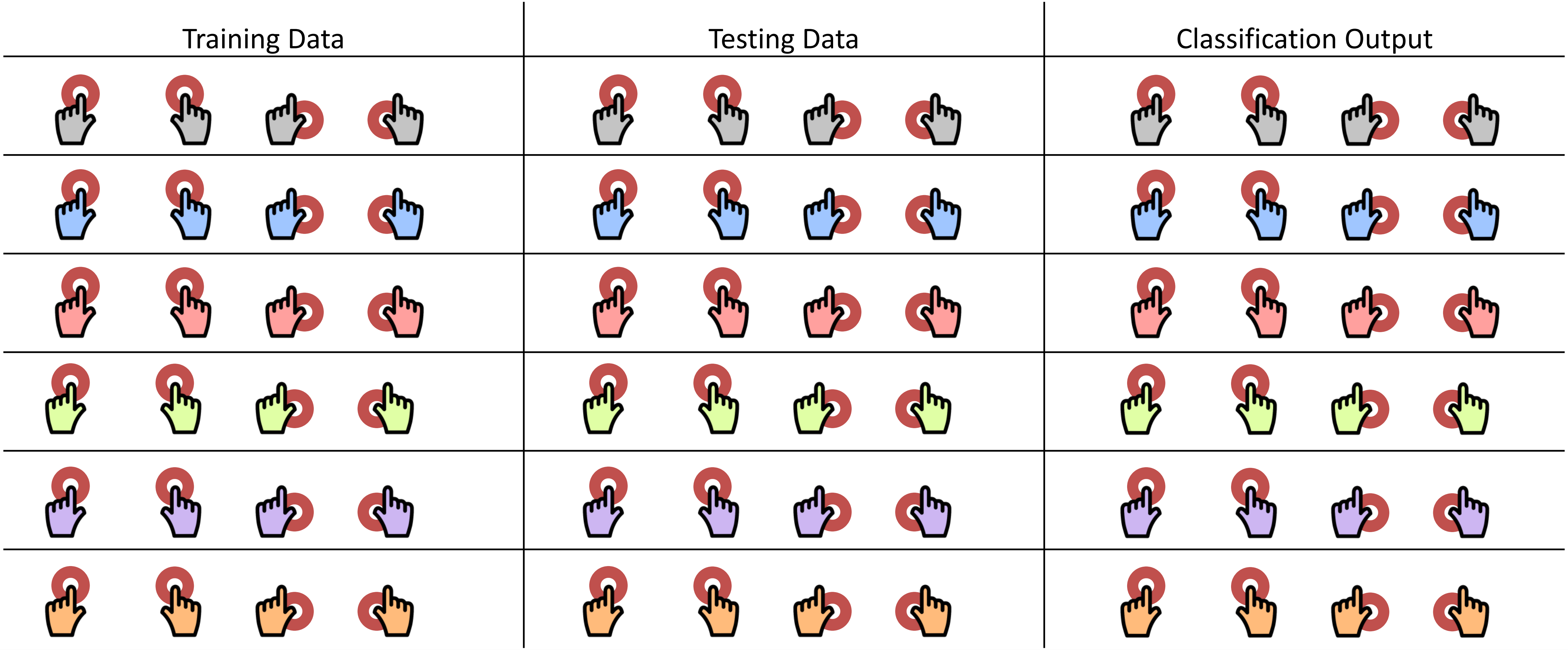
Are the Fingers of an Individual Distinct?



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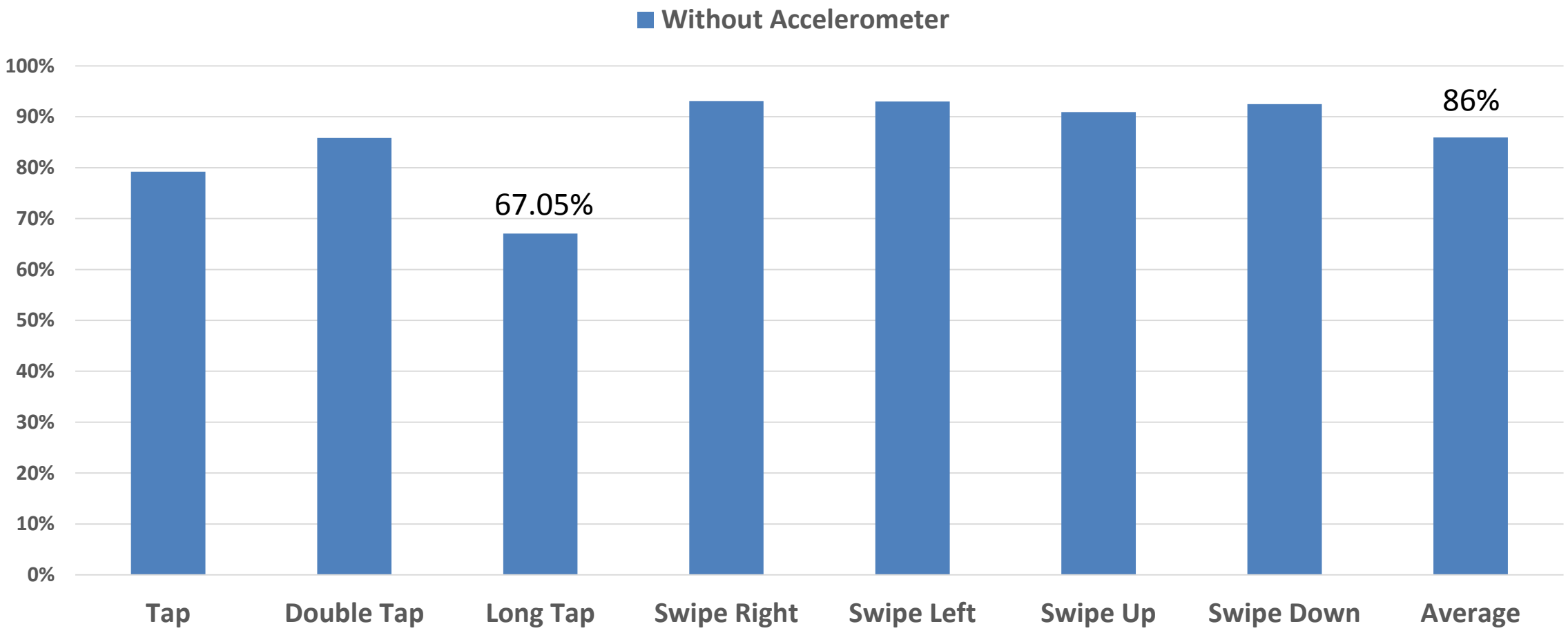

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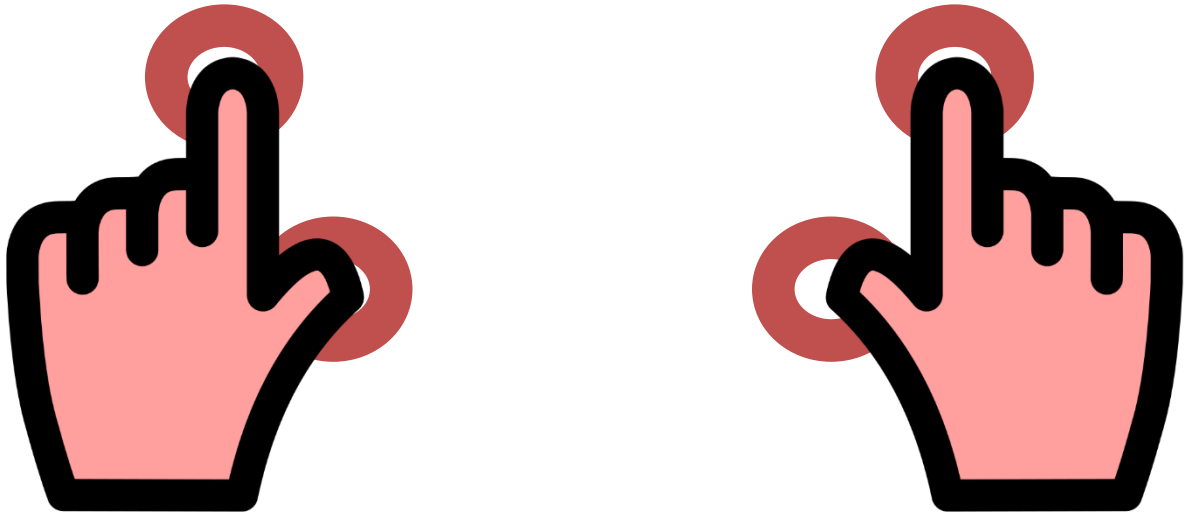

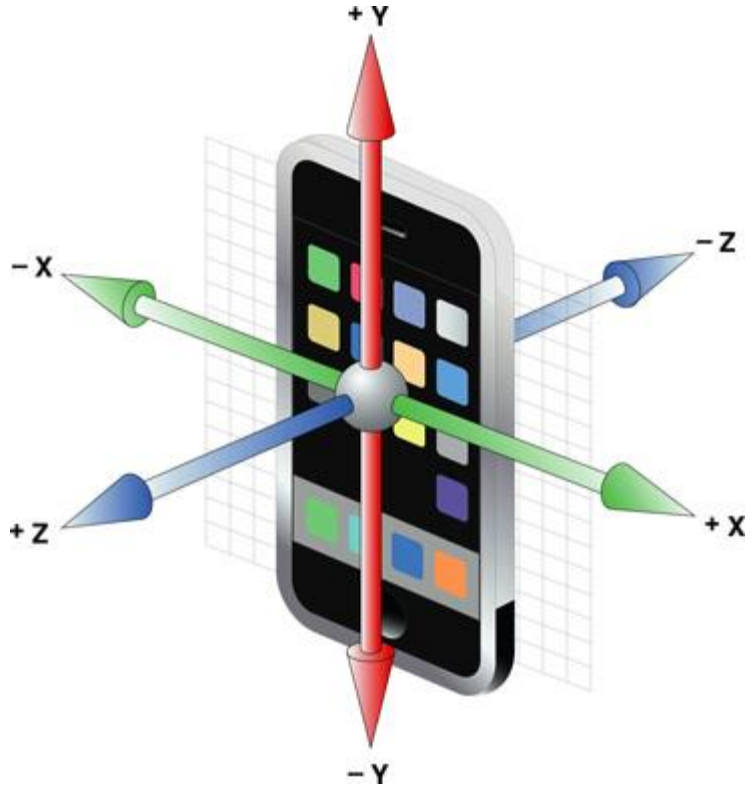

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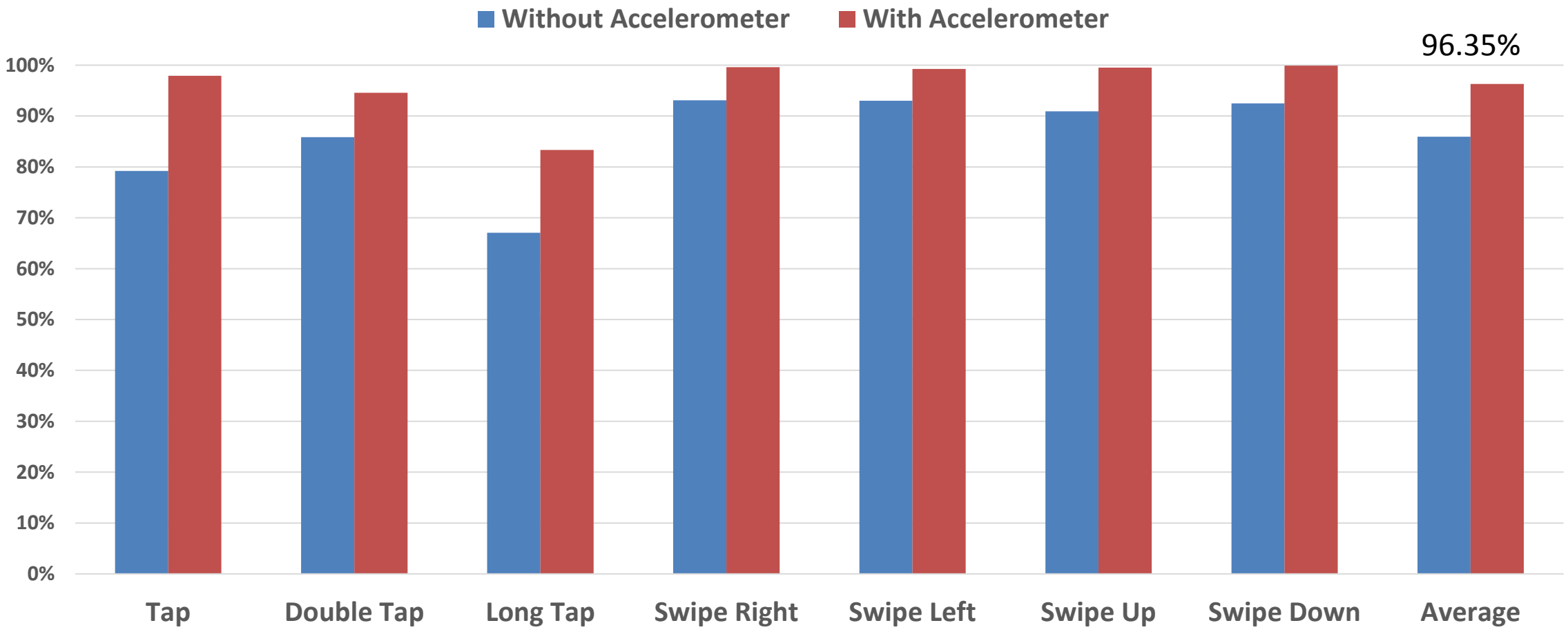

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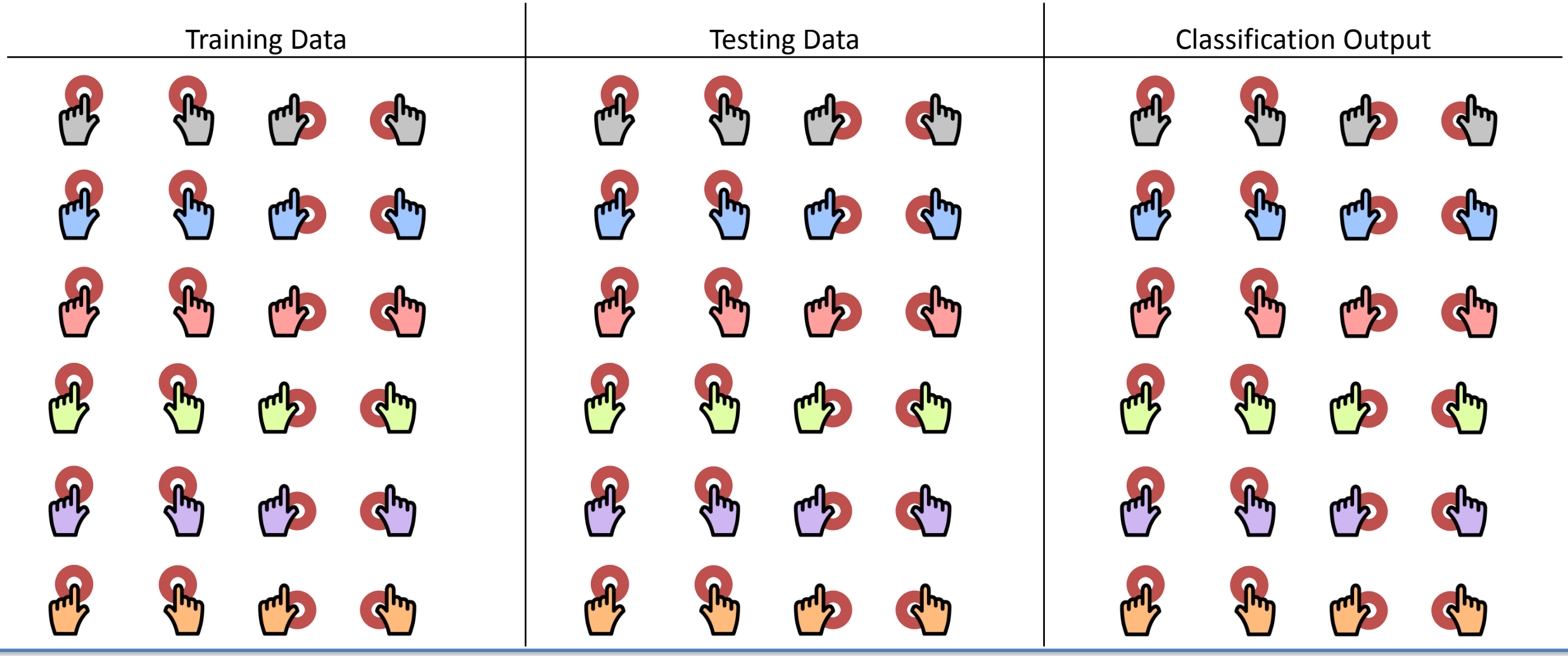

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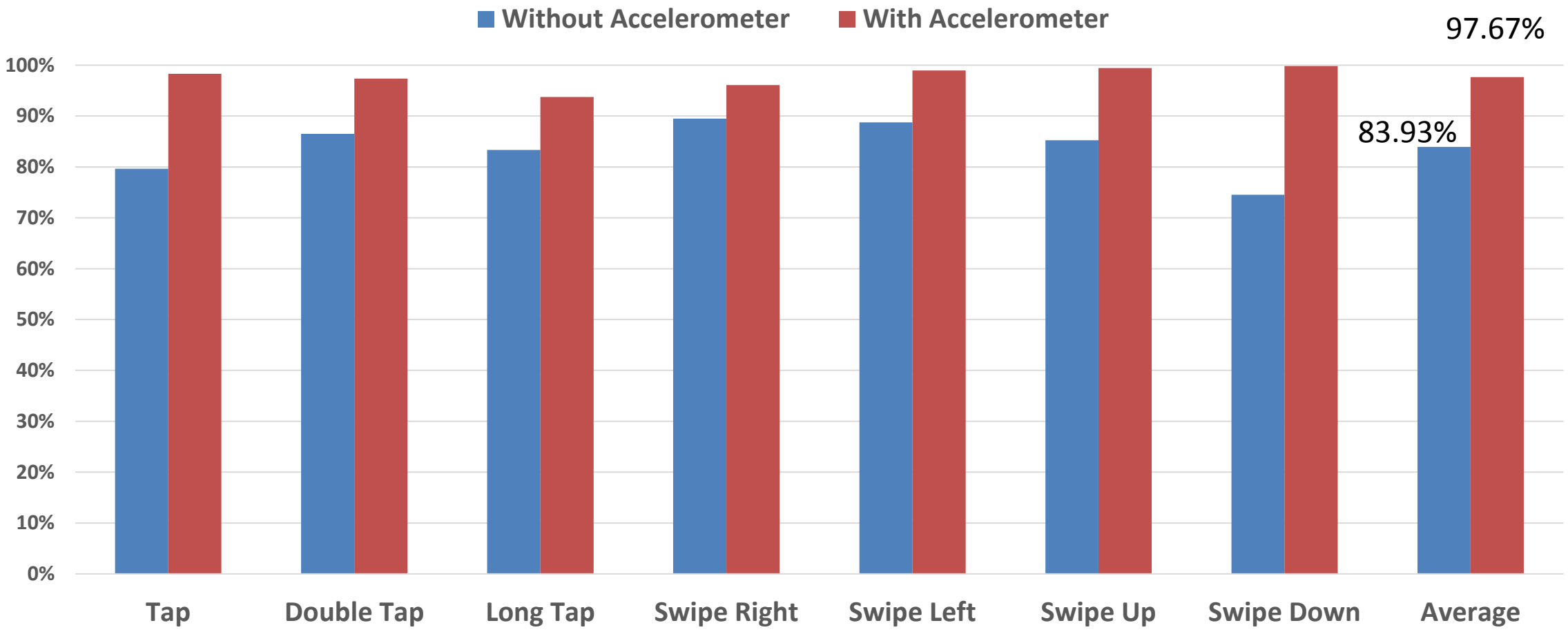

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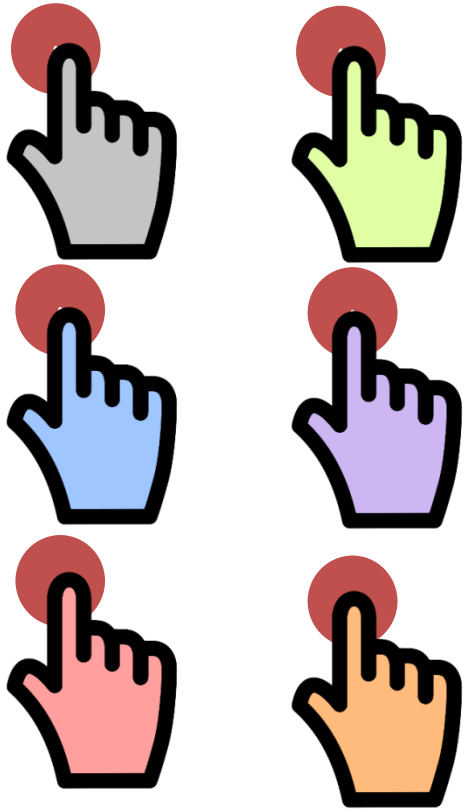
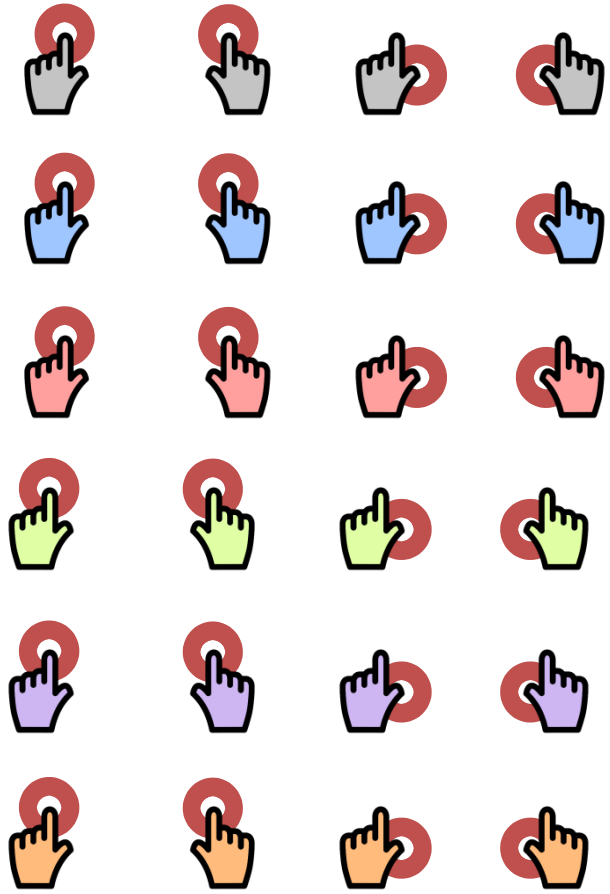
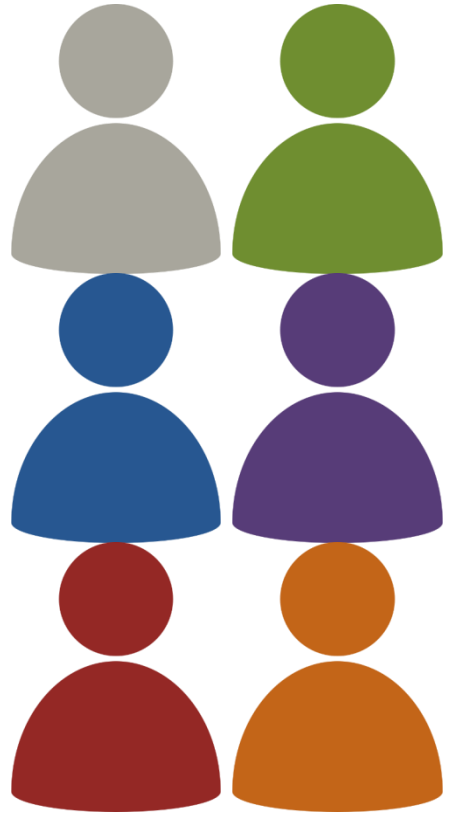
Should Training Data Include Only One Finger?

Training Data	Testing Data	Classification Output
		

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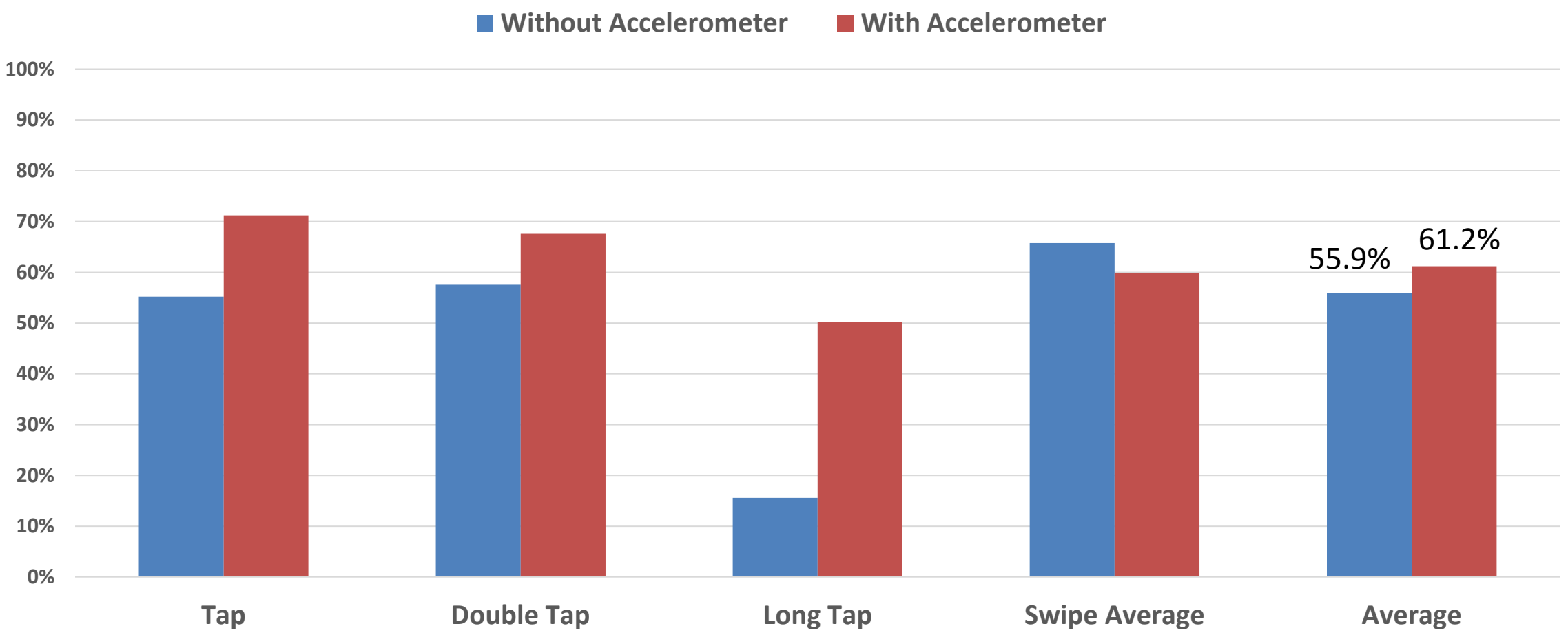

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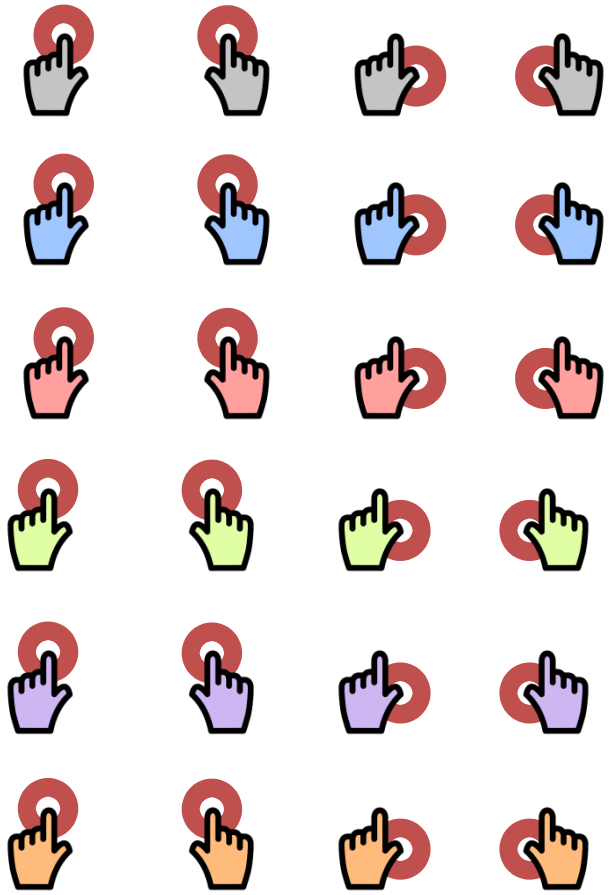	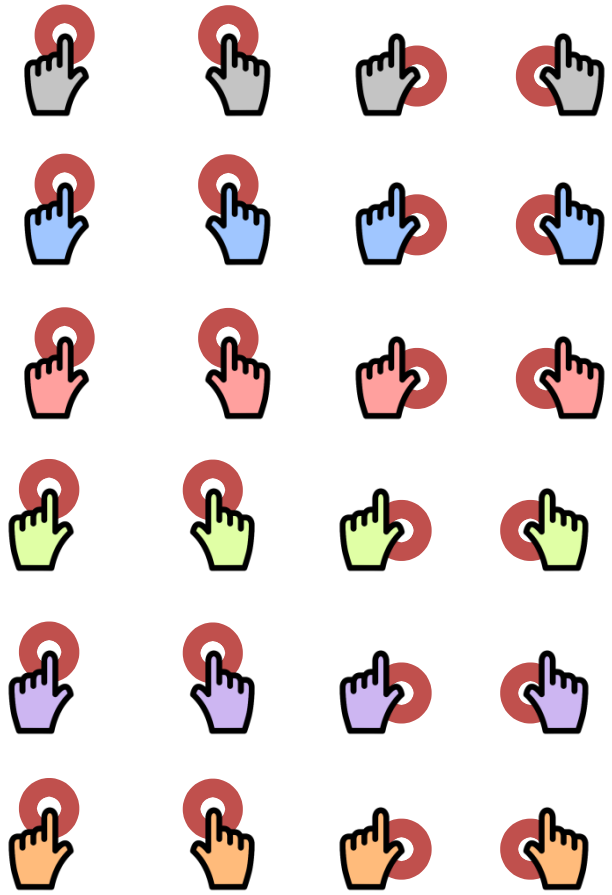	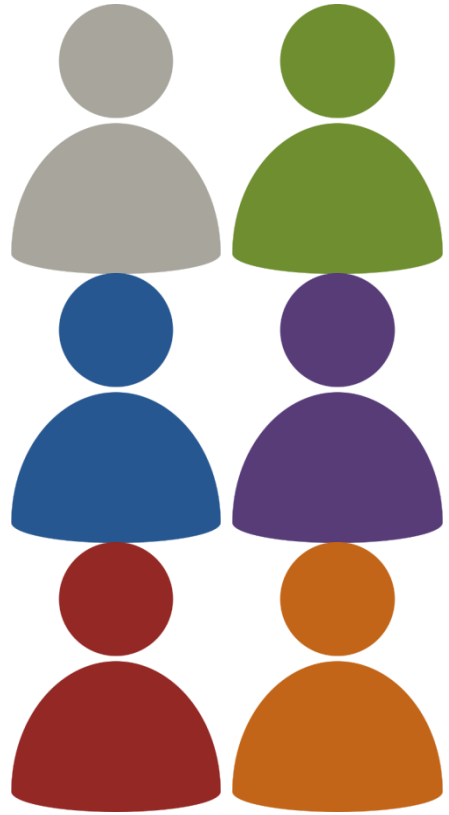

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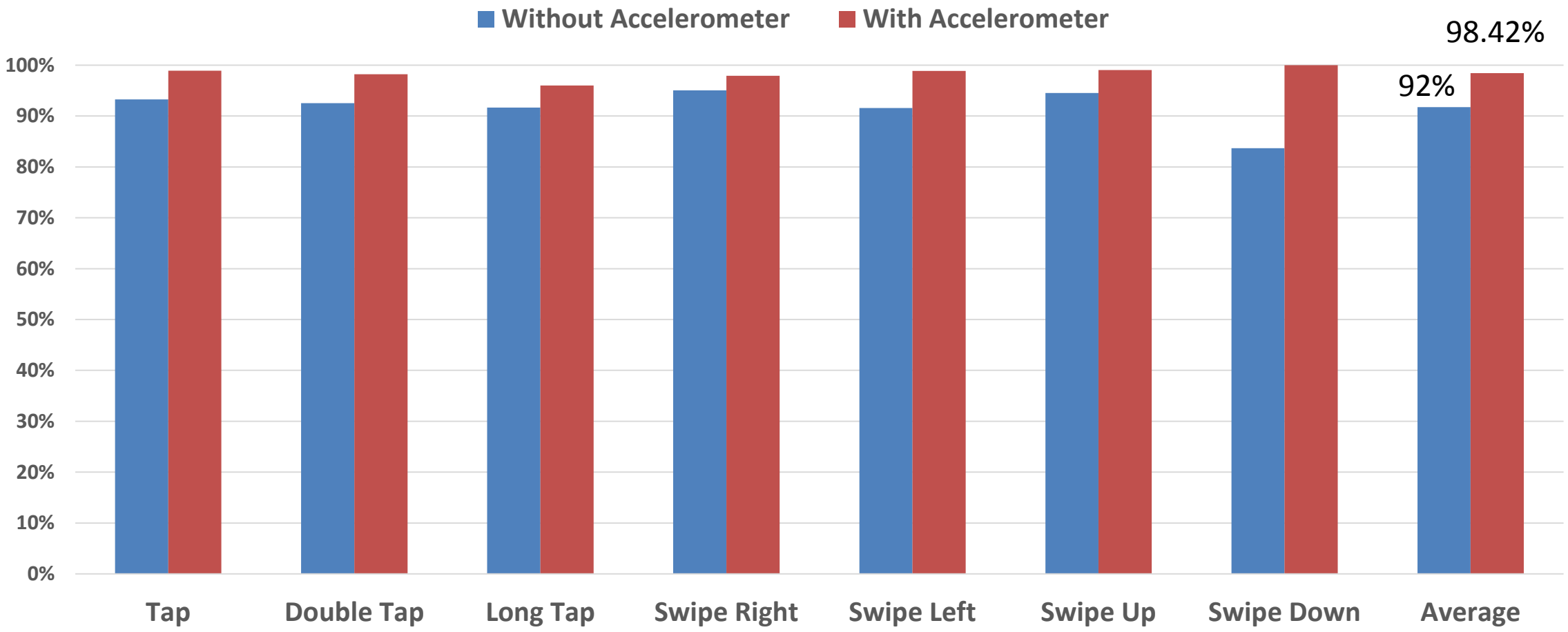

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Lessons Learned

- Active Authentication is Annoying
- Fingers are Distinct
- Training Data Should Include Several Fingers

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Future Work

- Address potential limitations related to the number of participants in our pilot study through a more expansive study
    - more users
    - wider range of gestures
    - longer period of time
- Analyze effects of training data set sizes
- Latency of real-time classification on mobile devices

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Thank You!

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Broad Agency Announcement

Amendment 21
(HSHQDC-16-R-B0006 A000001)
(https://www.fbo.gov/spg/DHS/OCPO/DHS-OCPO/HSHQDC-14-R-B0005/packages.html)

http://www.cvent.com/d/wfqtz4 for details and to register. This event is complimentary, however, space is limited. **Please note:** Registration closes June 7.

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Questions?

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[2] Y.-L. Chen, W.-C. Ku, Y.-C. Yeh, and D.-M. Liao, “A simple textbased shoulder surfing resistant graphical password scheme,” in Next-Generation Electronics (ISNE), 2013 IEEE International Symposium on, Feb 2013, pp. 161–164.

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