

# User Authentication for Emerging Interfaces

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# Identity



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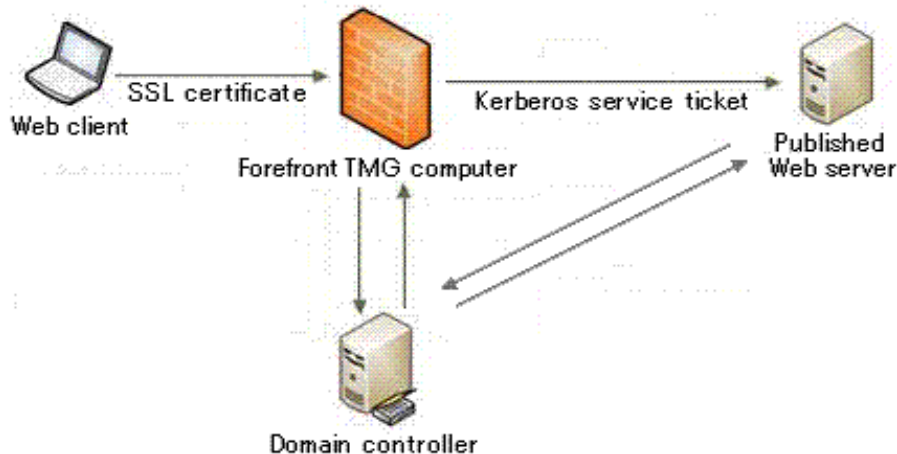
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# Identity and Authentication

- What is identity?
  - A computer's representation of an unique entity (principal).
- What is authentication?
  - Binding principal to system's internal representation of identity.
- Why do we need identity?
  - Accountability
  - Access control



# Authenticating Computers and Humans



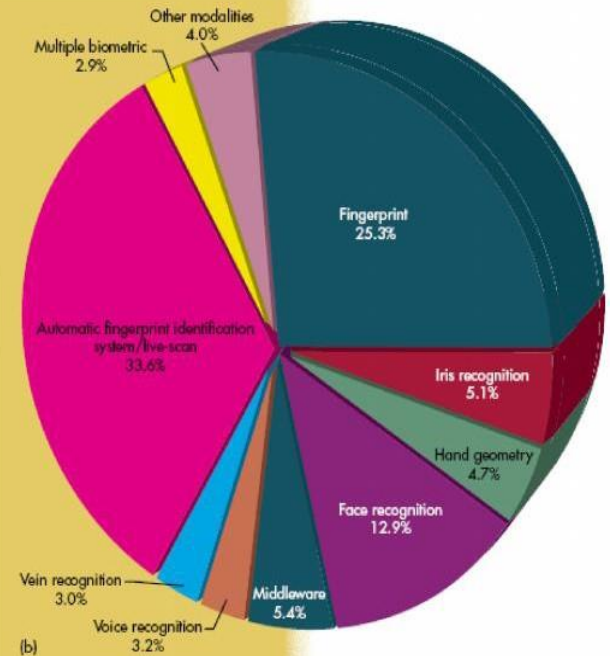
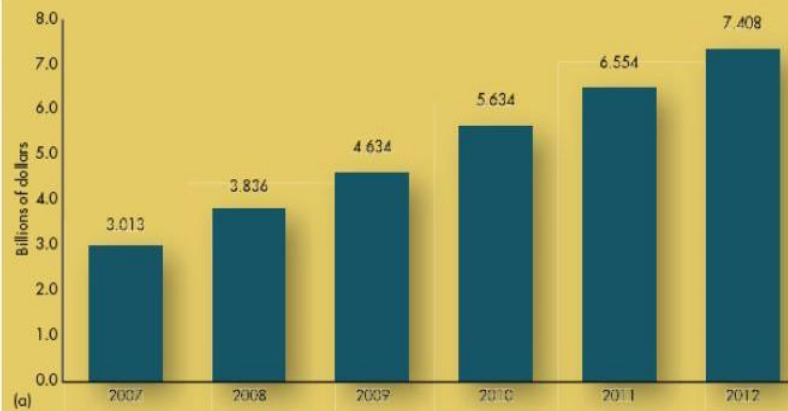
# Something-you-have



# SOMETHING YOU ARE - Biometrics



1. Revenues for biometrics industry will more than double between 2007 and 2012 (a). A range of technology modalities will be involved, with the largest share going to conventional and automated and live-scan fingerprinting (b). (courtesy of the International Biometric Group's "Biometrics Market and Industry Report 2007-2012")



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A pie chart illustrating the distribution of cases. The chart is divided into three segments: a large red segment representing 'Reused (case sensitive)', a small orange segment representing 'Reused (different case)', and a green segment representing 'Unique'. A legend to the right of the chart identifies these categories with colored squares.

Category	Color
Reused (case sensitive)	Red
Reused (different case)	Orange
Unique	Green

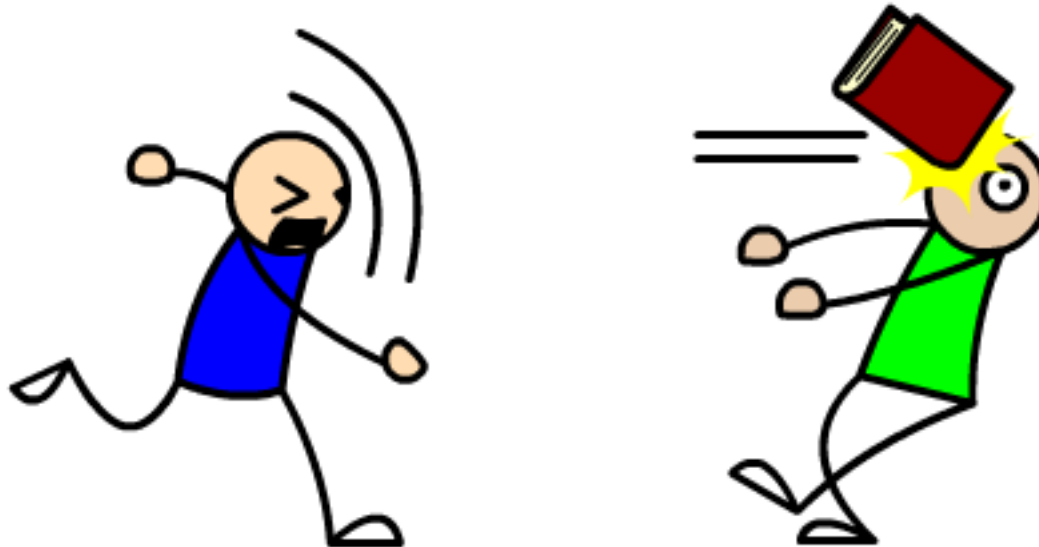
# What You Know





# Guessing Passwords

**DICTIONARY ATTACK!**





# RAINBOW TABLES ??



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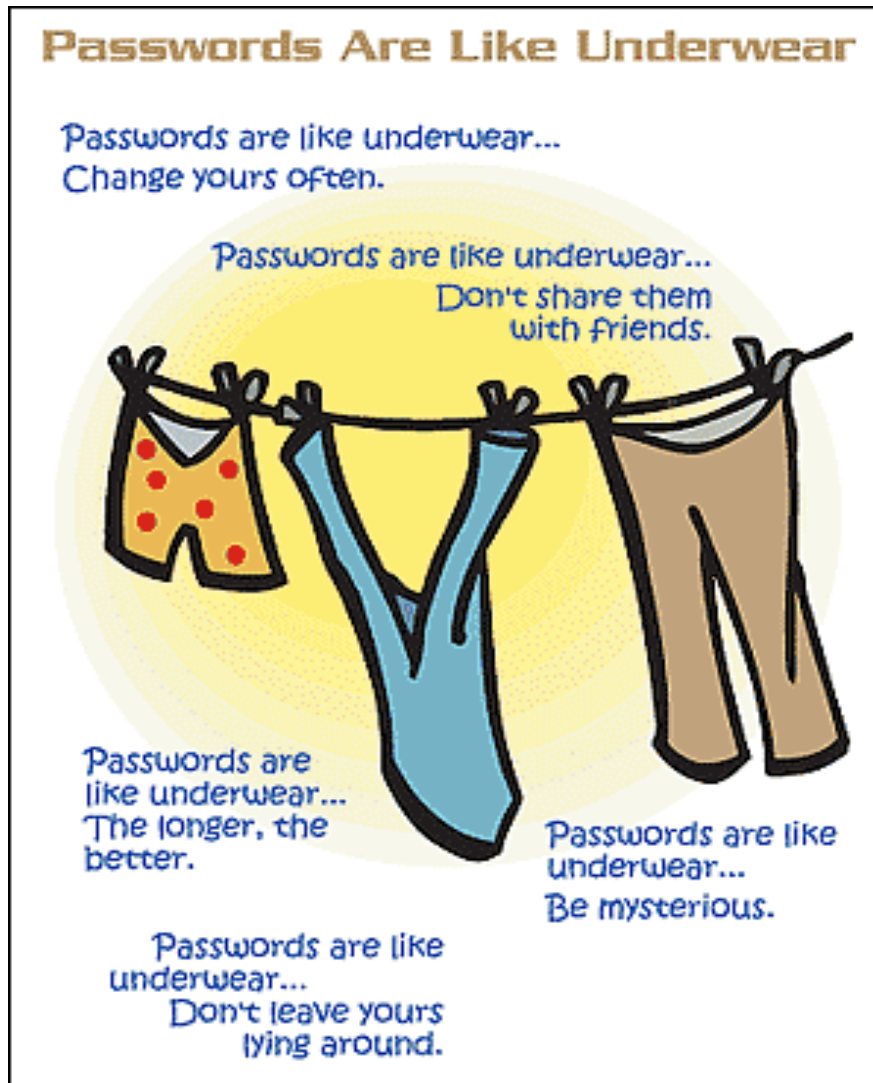
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# Recent Leaks

Site	Year	# Accounts	Hashed	Salted	Reversibly Encrypted
Rockyou [64]	2009	32m			
Gawker	2010	1.3m	✓	✓	
Tianya	2011	35m			
eHarmony	2012	1.5m	✓		
LinkedIn	2012	6.5m	✓		
Evernote	2013	50m	✓	✓	
Adobe	2013	150m			✓
Cupid Media	2013	42m			



# Password policies



# Password are hard to replace



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# Why?? Usability

- Memorywise Effortless
- Scalable for users
- Nothing-to-Carry
- Physically-Effortless
- Easy-to-Learn
- Efficient-to-Use
- Infrequent-Errors
- Easy-Recovery-from-Loss

Bonneau, Herley, Oorschot and Stajano





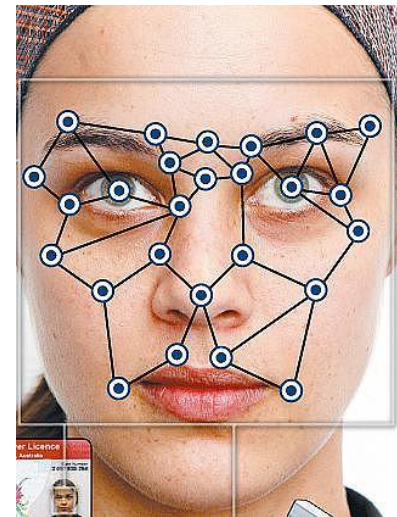
# Why?? Security

- Resilient-to-Physical-Observation
- Resilient-to-Targeted-Impersonation
- Resilient-to-Throttled-Guessing
- Resilient-to-Unthrottled-Guessing
- Resilient-to-Internal-Observation
- Resilient-to-Leaks-from-Other-Verifiers
- Resilient-to-Phishing
- Resilient-to-Theft
- No-Trusted-Third-Party
- Requiring-Explicit-Consent
- Unlinkable

# Why?? Deployability

- Accessible
- Negligible-Cost-per-User
- Server compatible
- Browser compatible
- Mature

# But it is not due to lack of trying ...



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# Google's attempt ...



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# And academics and startups ...



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# Game Changer? - Emerging Interfaces





# Emerging Interfaces



# Emerging Interfaces



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# Emerging Interfaces



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# Game Changer - Mobility



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# Continuous Authentication



# Different Approaches

		User Input					
		Finger	Hand	Face	Voice	Thought	Body
Interface	Touch Surface						
	Camera						
	Motion Sensors						
	Microphone						
	Brain Computer Interface						





# Evaluation - Security

- Random Guessing
- False positives
- Shoulder surfing
- Insider threat
- Replay attack



# Evaluation - Usability

- Memorability
- True positives
- Efficiency
- Satisfaction
- Universality



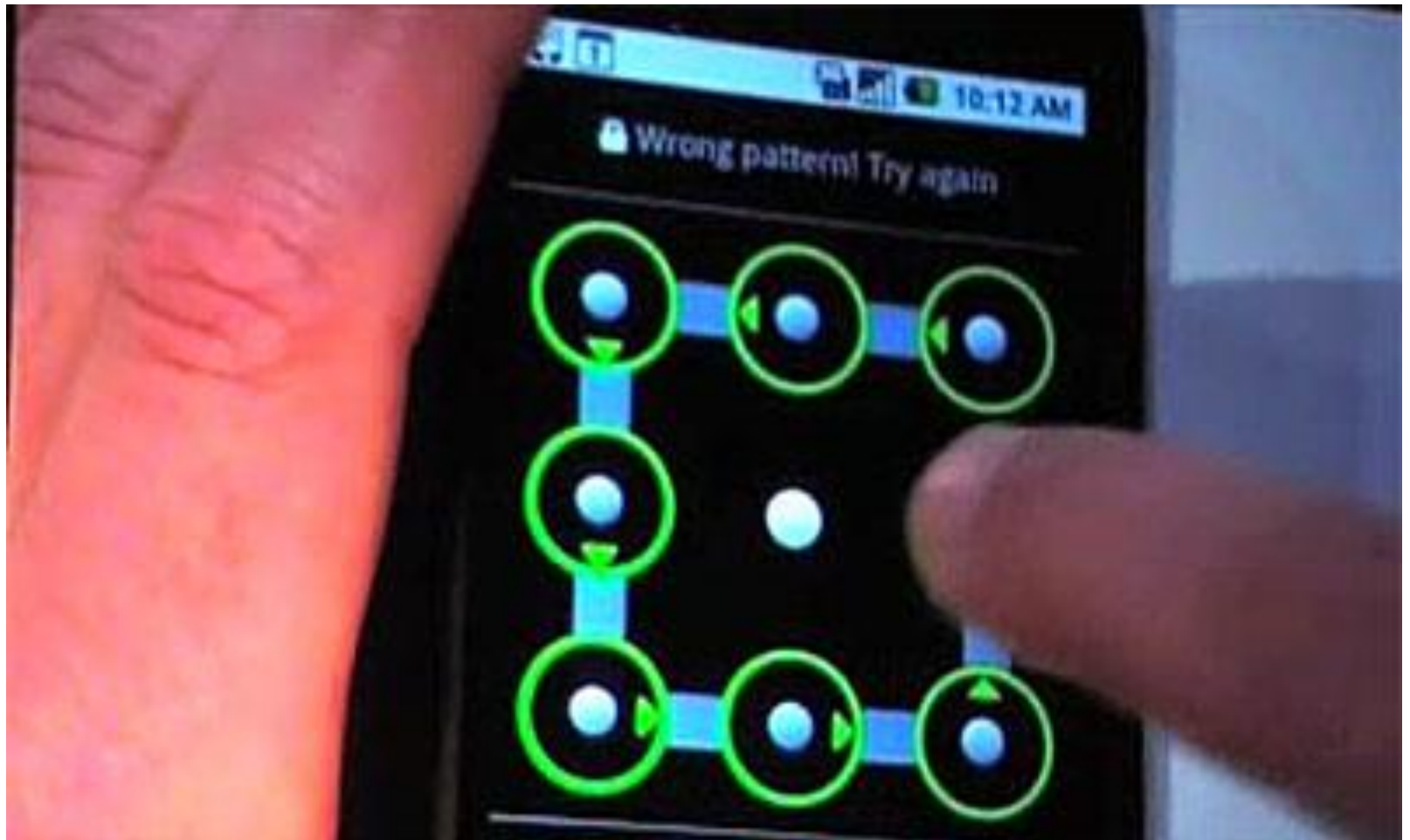
# Touch interface



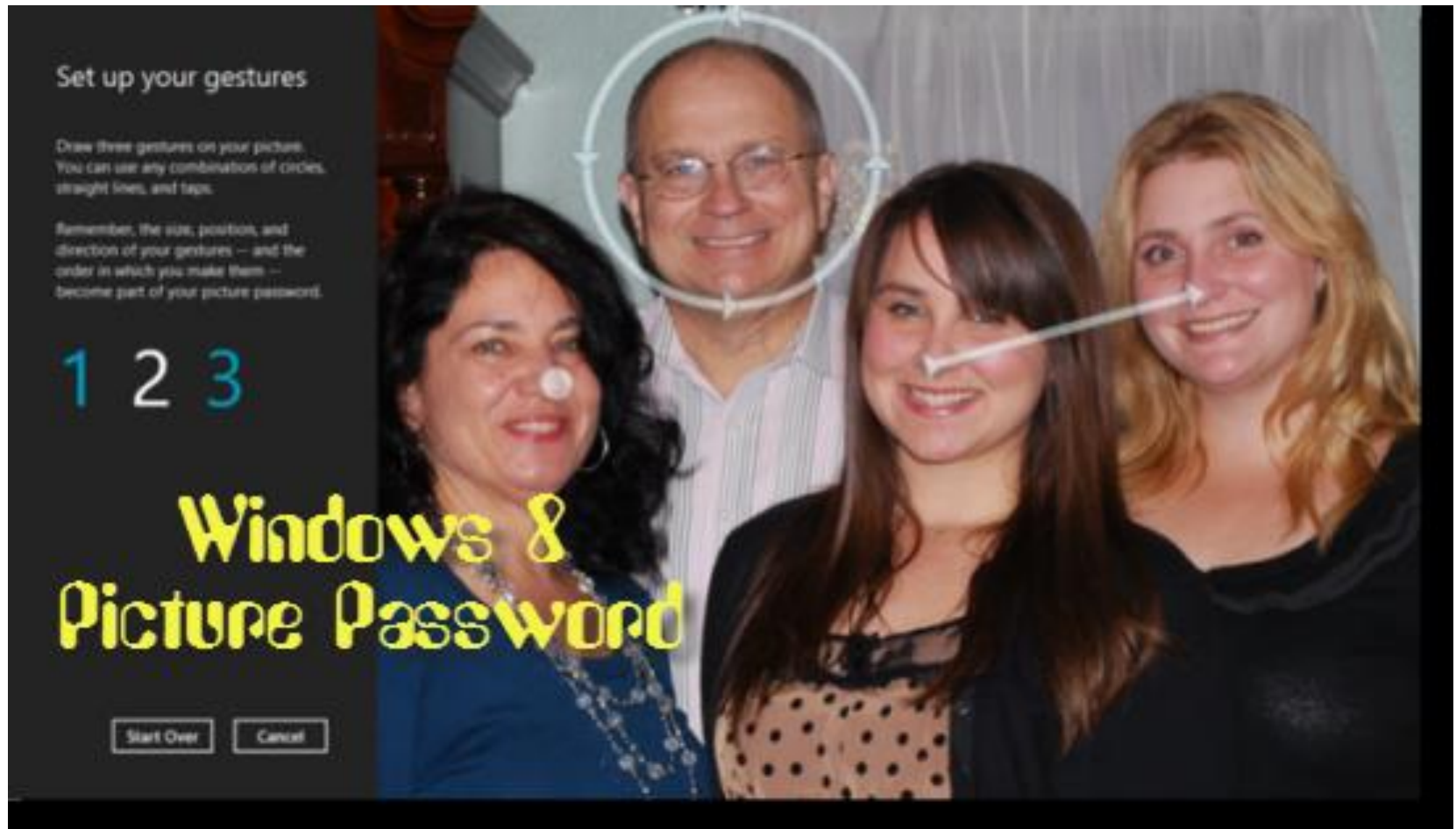
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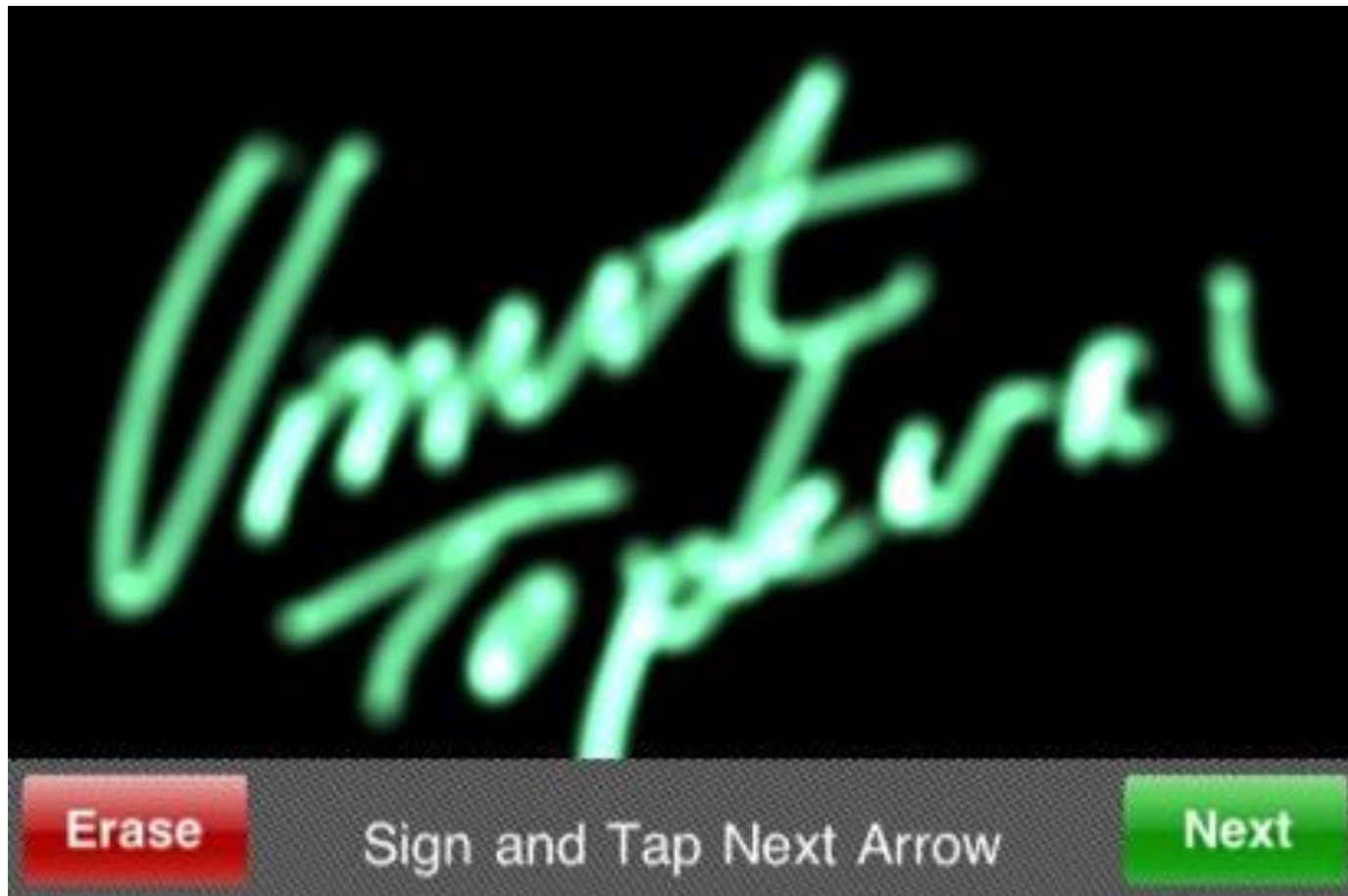
# Android Pattern Lock – Recall Based



# Windows 8 Picture Password



# Single Finger Touch – Online Signatures

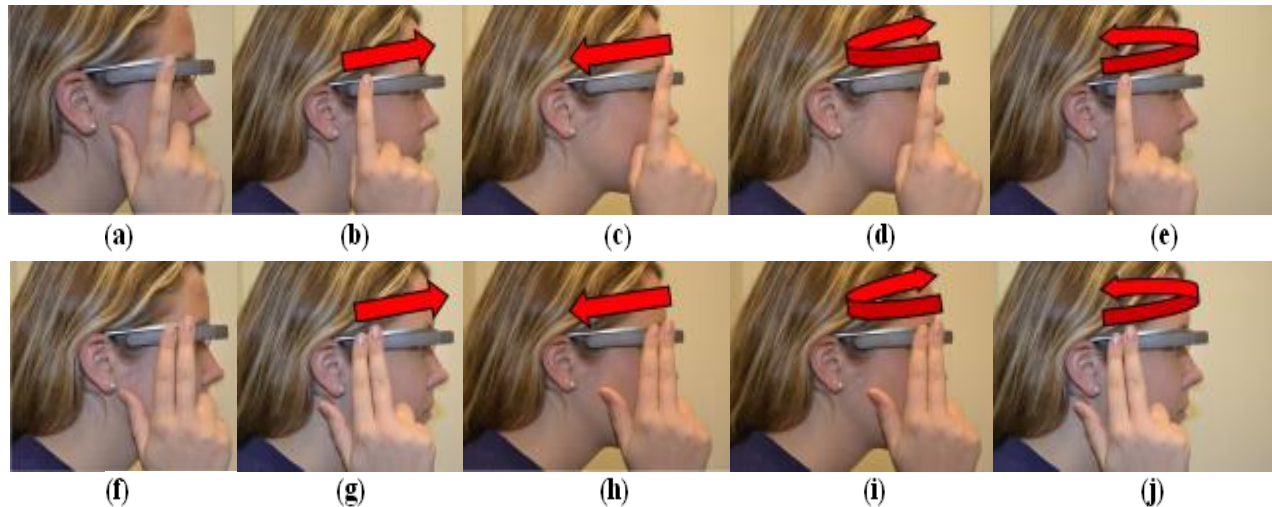




# Single Finger Touch – Draw-a-PIN



# Touch motion



**Fig. 1.** Available gesture set in the built-in authentication mechanism: (a) tap (b) swipe forward (c) swipe back (d) hook swipe forward (e) hook swipe back (f) two-finger tap (g) two-finger swipe forward (h) two-finger swipe back (i) two-finger hook swipe forward (j) two-finger hook swipe back

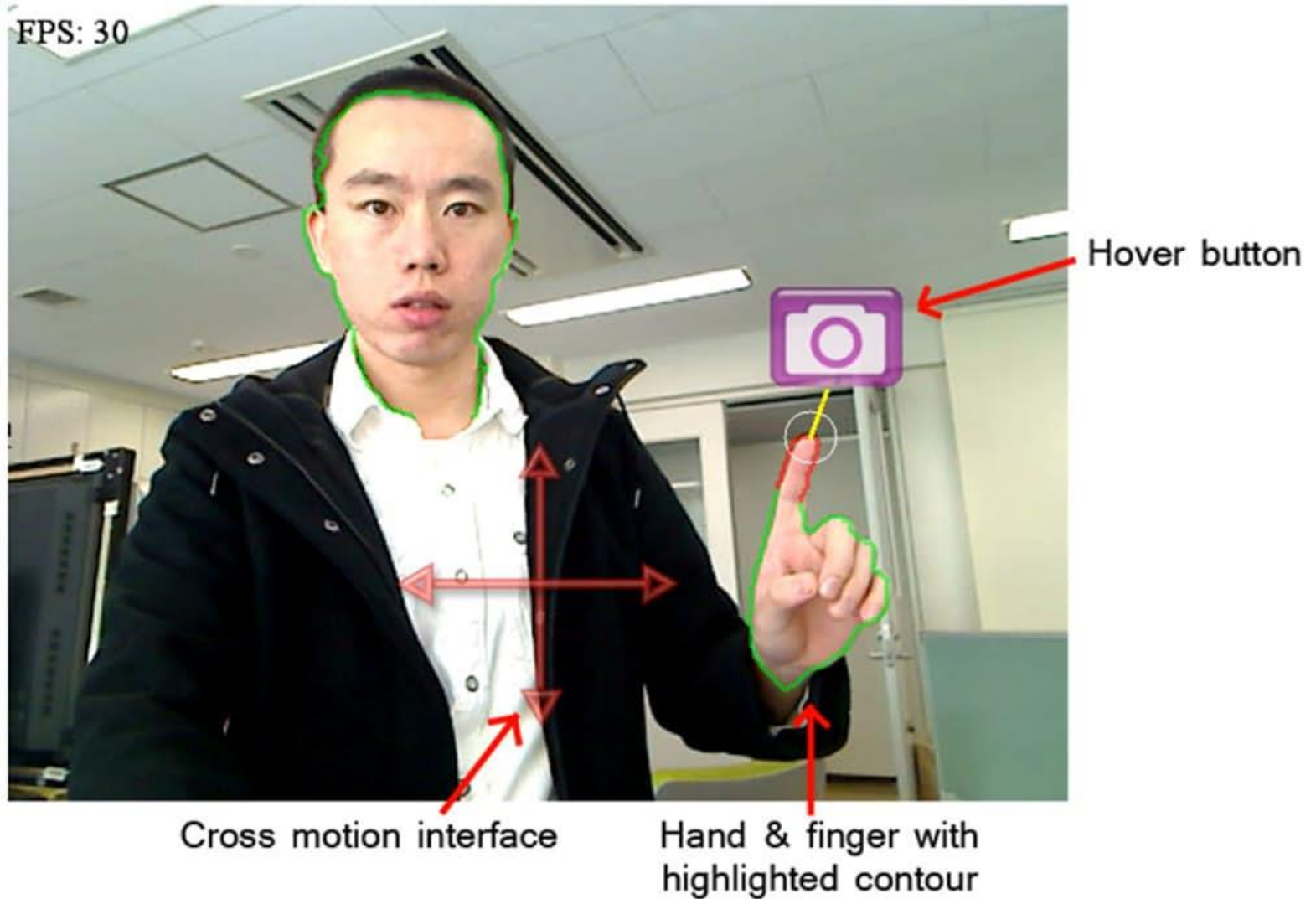
# Multi-touch gestures



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# Camera interface



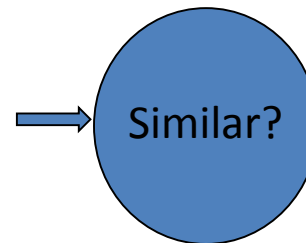
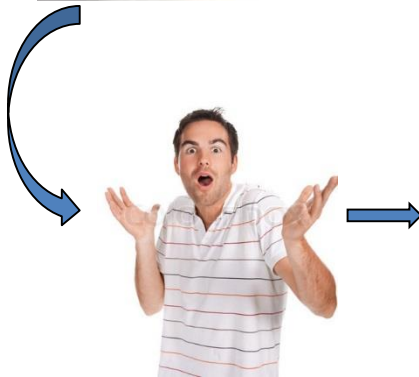
# Face Recognition



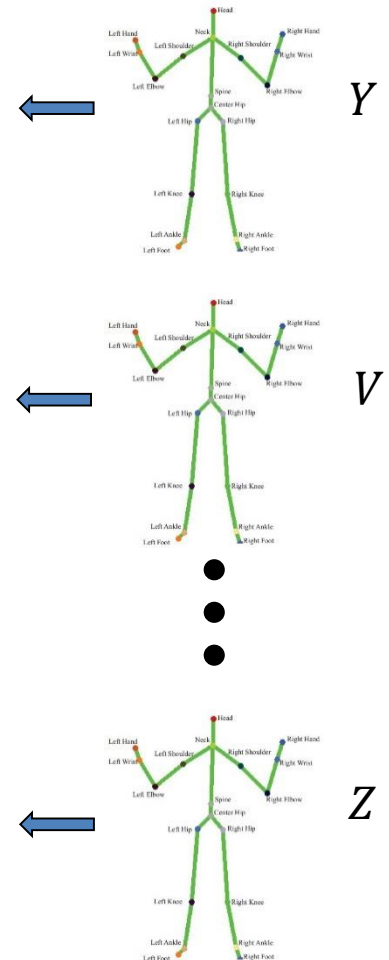


# Authentication with body gestures

Access point



Database



Slide courtesy of Konrad and Easwar



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# Hand Gestures



# Eye Gaze



# Camera and Private Display

1	7	2	5	3	2
4	6	5	0	6	3
7	8	8	1	9	4
		0	9		

(b)

2	8	1
0	3	6
9	4	7
	5	

(c)



# Motion Sensor



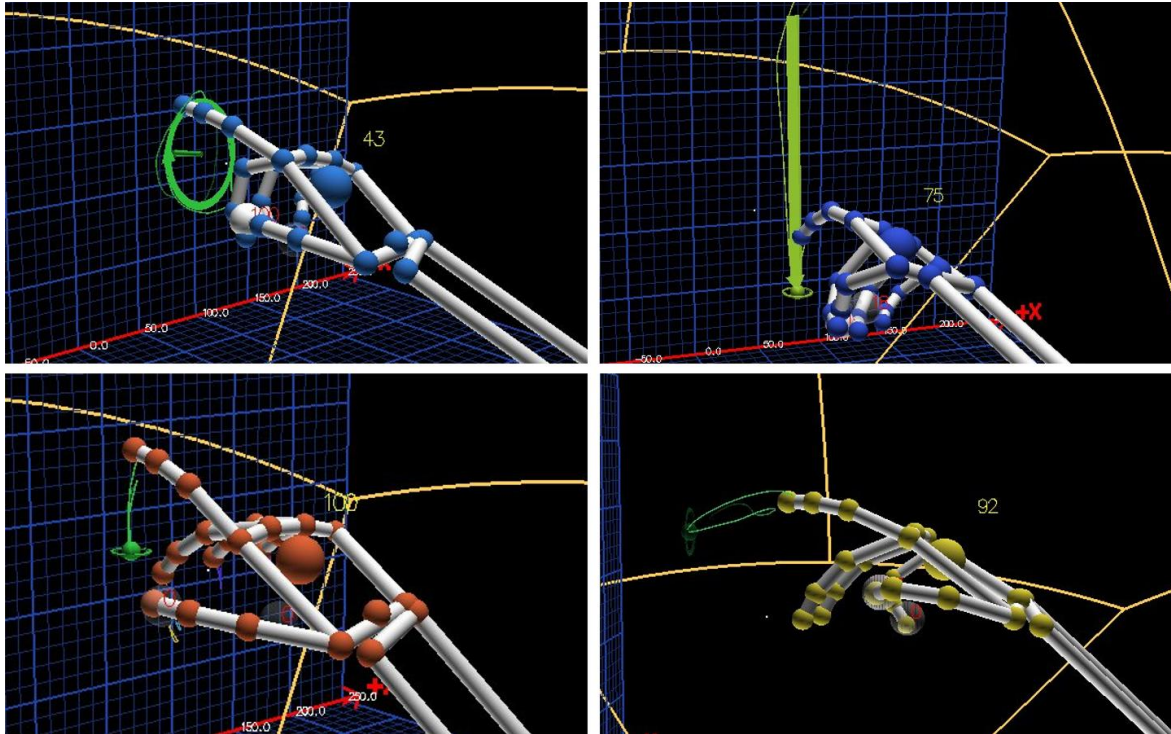
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# Motion Sensors



# Leap Motion Gestures



# Leap Motion Sensor



(a)

Digital signature

Leap Signature

maya maya      maya maya  
rich rich      rich rich

(b)

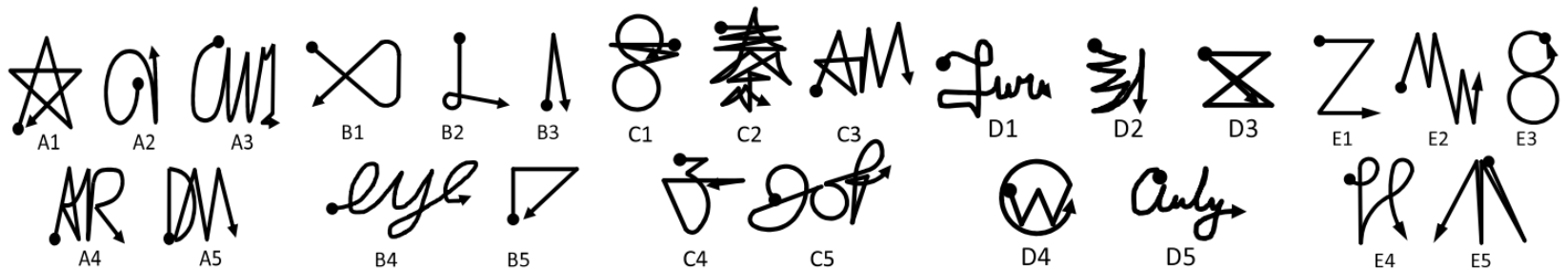


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# Waving a device



# Head Banger!

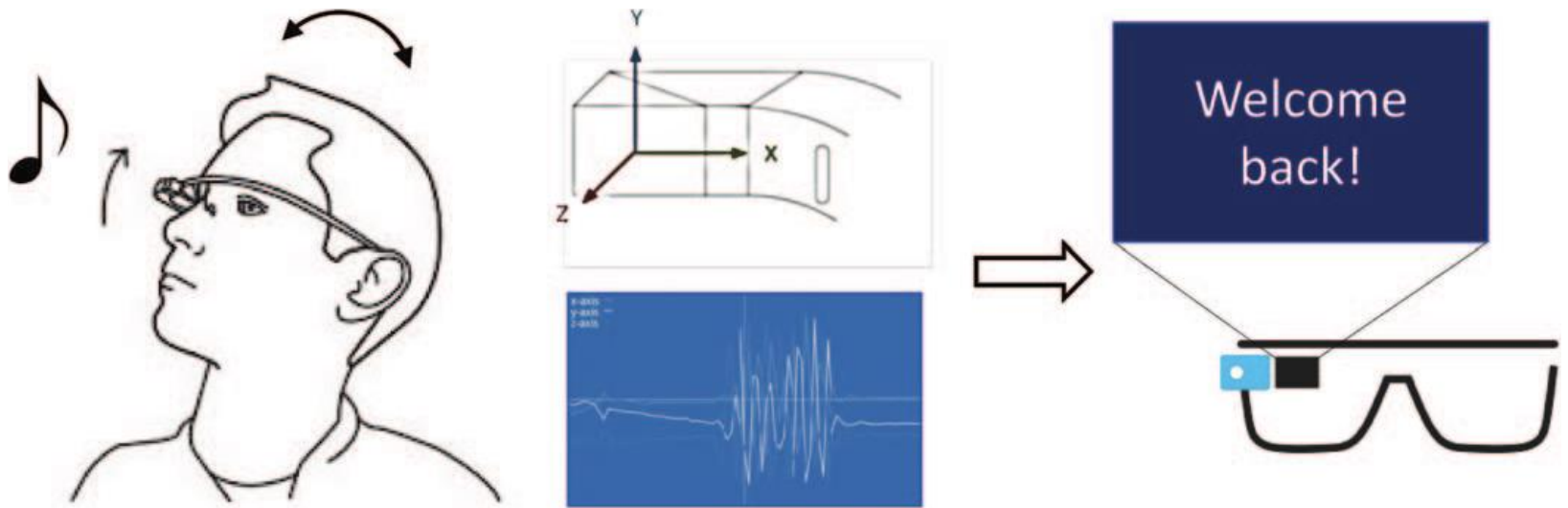
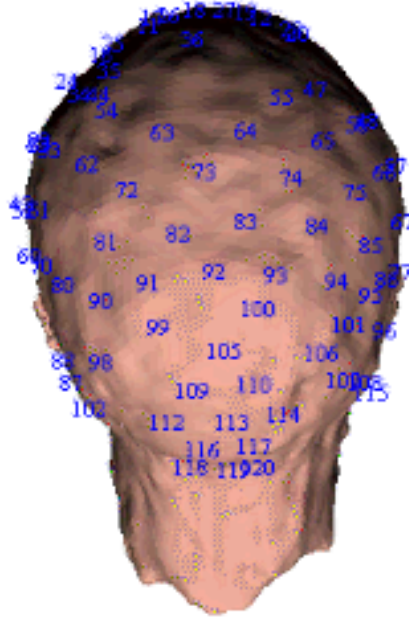
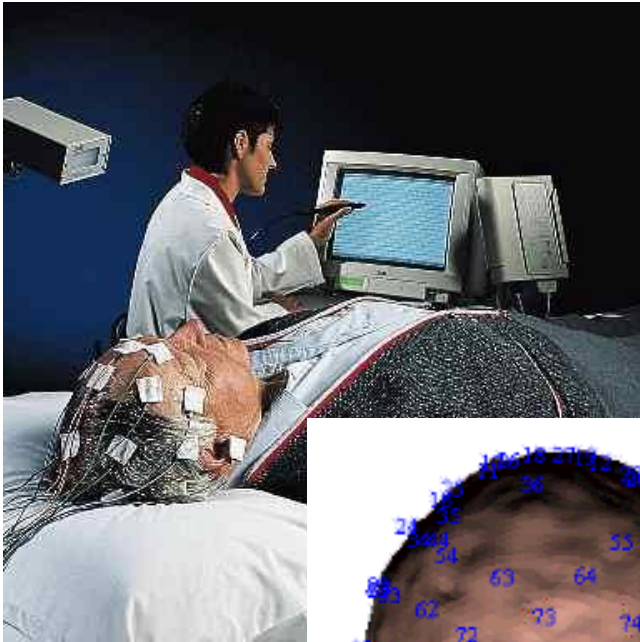


Fig. 1. Illustration of Headbanger. The head-worn device authenticates the users based on signatures generated from head-movement patterns. These patterns are created in response to an audio snapshot played on the device.

# Electroencephalograph - EEG



- Brain has continuous electrical activity that can be recorded
- Pairs of electrodes attached to scalp form distinct channels
- Weak signal  $\sim$ millivolts is sent thru amplifier
- Continuous output recorded via galvanometer.

# NeuroSky Mindset



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# Summary

Approaches	Interfaces	Eye-free	Hand-free	Environment	Hardware calibration	Public space	Surveillance devices	Verification Performance
Touch typing	Medium-size touch display	No	No	Stable motion	No	No	No	3.1% genuine error attempts for 4-digit PIN [133]
Android pattern lock	Medium-size touch display	No	No	Relatively stable motion	No	No	No	12.1% genuine error attempts [133]
Microsoft picture	Large touch display	No	No	Relatively stable motion	No	No	No	Not reported
Online signatures	Medium-size touch display	Yes	No	Relatively stable motion	No	Yes	Yes	Random forgery 3.26%EER [91]
Drawing PIN	Medium-size touch display	Yes	No	Relatively stable motion	No	Yes	Yes	PIN attack 12.5%EER [94]
Multi-touch gestures	Medium-size touch display	Yes	No	Relatively stable motion	No	Yes	Yes	8.26%EER (Gesture attack –two gestures are combined) [97]



# Summary

Face recognition	2-D camera	No	Yes	Stable motion with good light	No	Yes	No	10.9% HTER [37]
Fingerprint recognition	2-D camera	No	No	Static motion with good light	No	Yes	No	4.5% EER [43]
SignWave	Leap Motion	No	No	Stable motion with good light	Possible	Yes	Yes	Not reported
Hand pose authentication	2-D camera	No	No	Non-clutter background with good light	No	Yes	No	93.75% recognition rate (4-user study) [100]
In-air signatures	3-D camera motion sensors	Yes	No	Relatively large interactive space	No	Yes	Yes	77% TAR at 0%FAR [101] 2.5%EER (one session with 34 users) [114]
Leap Password	Leap Motion	No	No	Stable motion with good light	Possible	Yes	Yes	18.83% FRR at 1%FAR (one session with 75 users) [102]
Body gestures	3-D camera	Yes	No	Large interactive space	No	Yes	Yes	1.24%EER (one session, local threshold) [105]





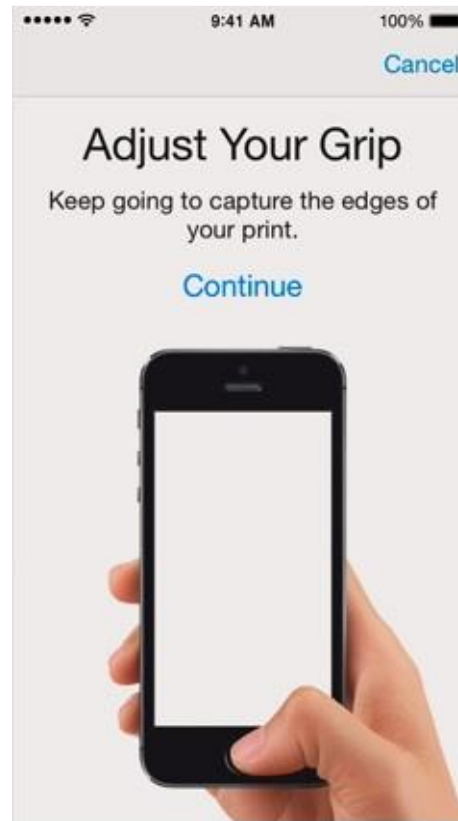
# Summary

Text-independent speaker verification	Microphone	Yes	Yes	Quiet and noise tolerant	No	Yes	Yes	3.11% EER [122]
Text-dependent speaker verification	Microphone	Yes	Yes	Quiet and noise tolerant	No	Yes	No	1-12% [134]
Whisper speaker verification	Microphone	Yes	Yes	Quiet	No	Yes	Yes	45-70% recognition rate [129]
Gaze-based PIN entry	Eye tracker	No	Yes	Stable and good light	No	Yes	Yes	9.5%-23.8% genuine error attempts [29]
Gaze-based graphical password	Eye tracker	No	Yes	Stable and good light	Yes	Yes	Yes	27%-46% genuine error attempts [109]
Gaze-based task independent	Eye tracker	No	Yes	Stable and good light	Yes	Yes	Yes	28.7-47.1% EER [111]
Pass thought	BCI Headset	Yes	Yes	Relatively quiet	Yes	Yes	Yes	12.9% HTER [77]



# Also - Fingerprint Sensors

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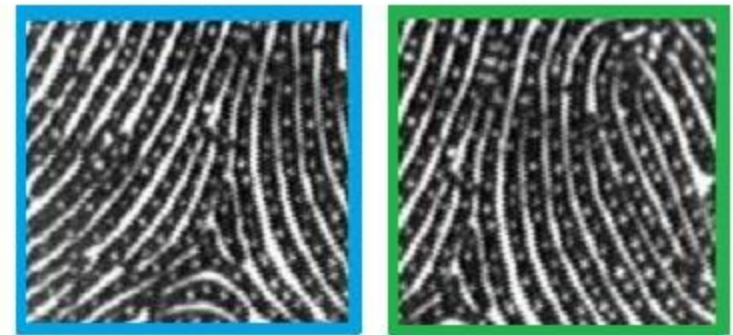


# Partial Fingerprints

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(a)



(b)

# Master Prints



# Thank you!!

Questions?  
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