Computer security

Identification and Authentication
Biometrics

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You will hear about:

- *ACL – access control list (extra)*
- Authentication vs authorization
- Biometrics
  Basics / Characteristics
  Difficulties with biometrics
  Biometric techniques
  Attacks on biometrics
  Future – Present in biometrics

Access Control List (ACL)

- A table (list) that defines which access rights a user (group) has to a particular object
- Example: John Doe, deny/read/write/full/execute/full/ … (-/r/rw/x)

	Title	Owner Control	Promote Version	Modify Content	Modify Properties	View Content	View Properties	Publish	Remove
	#AUTHENTICATED-USERS					✓	✓		☐
	HR Managers		✓	✓	✓	✓	✓		
	OSAdmins	✓	✓	✓	✓	✓	✓	✓	☐
	PWDesigner					✓	✓		☐

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Access Control Entry
ACE

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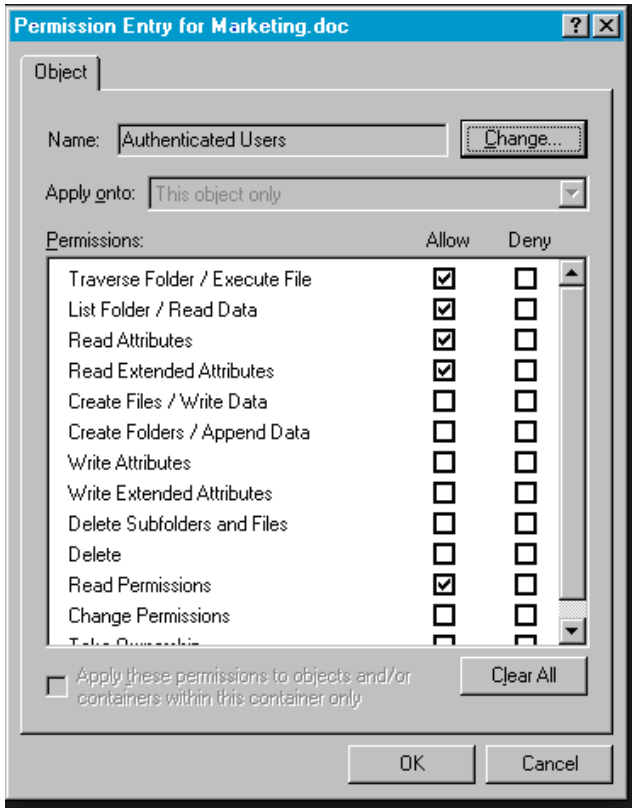
	HR Managers		✓	✓	✓	✓	✓		
	OSAdmins	✓	✓	✓	✓	✓	✓	✓	☐
	PWDesigner					✓	✓		☐

Access Control List (ACL)

- Good control to check if user is authorized to a resource
- Difficult to manage



Authentication vs. Authorization

- Authentication
  Verifying the **identity** of a user
- Authorization
  controlling **what** resources a user has access to after authentication
- Authorization is **not** authentication

Authentication vs. Authorization

Step 1

Authentication by/via

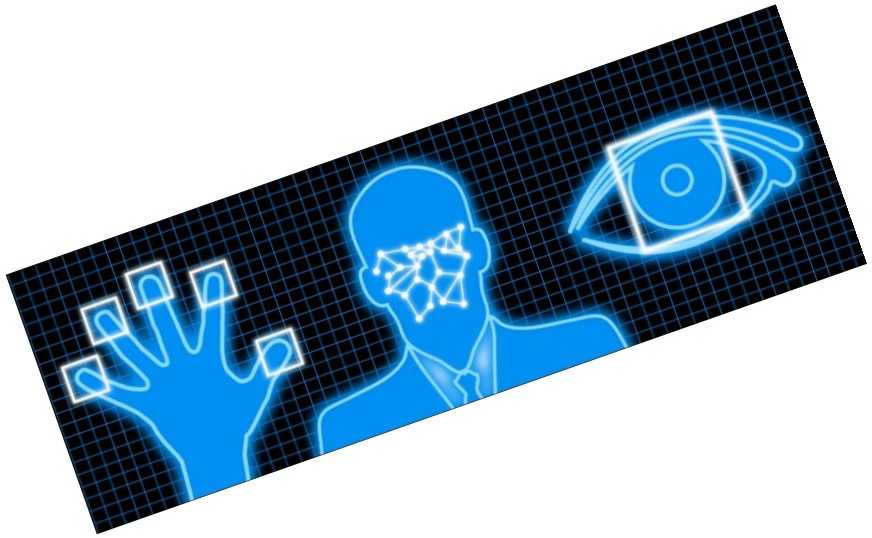
- login user/pwd
- ID-token/PIN
- certificates
- Other authentication methods

Step 2

Authorization
Decision about permission to access a certain resource.
ACL

Authentication modes

- **Something you know**
  (passwords, PIN, . . .)
- **Something you have**
  (keys, badges, tokens, smart card, . . .)
- **Something you are**
  biometrics (handwriting, fingerprints, retina patterns, . . .)



Biometrics

The science of using biological properties to identify individuals

www.lexias.com/html/glossary1.html

Identification of people by measuring some aspect of individual anatomy or physiology, some deeply ingrained skill, or other behavioral characteristic, or something that is a combination of the two

www.primode.com/glossary.html

Characteristics for biometrics

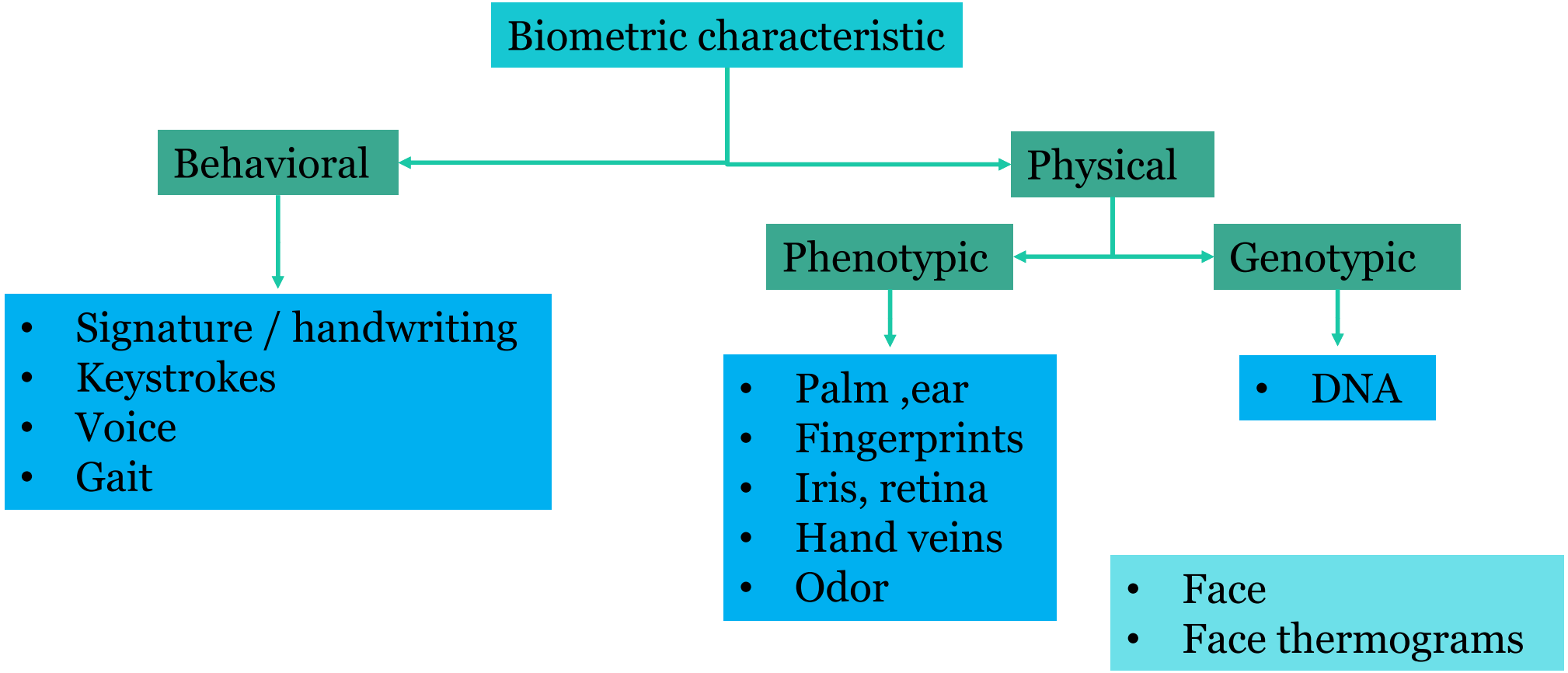
- Basic requirements

- **Uniqueness** - a property must be distinct for different individuals (not a blood group etc.)
- **Permanence** - a property cannot change over time
- **Universality** - everyone (almost) must possess such a property
- **Collectability** - it has to be possible to measure (easily) a property
- **Immunity to circumvention** - it has to be hard to fool the system

Characteristics for biometrics

- Additional requirements
- **Acceptability** - physical contact considerations, privacy considerations, religious issues, ...
- **Efficiency** - of acquisition, recognition, storage

Characteristics for biometrics

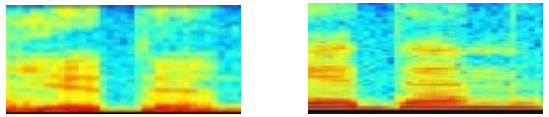


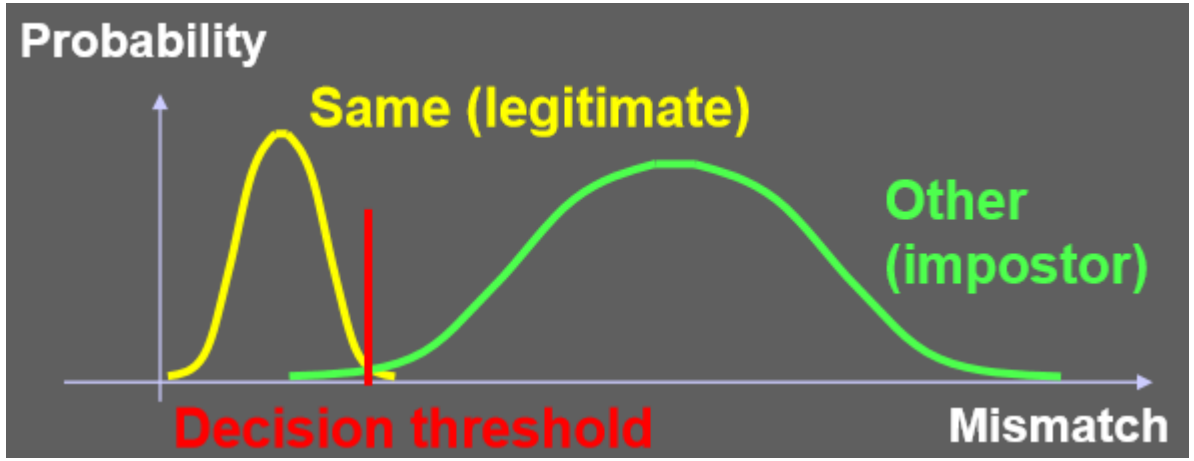
Difficulties with biometrics

- Expectations – fast and reliable recognition
- Reality
- Samples are never exactly the same

Same face?

Same speaker?

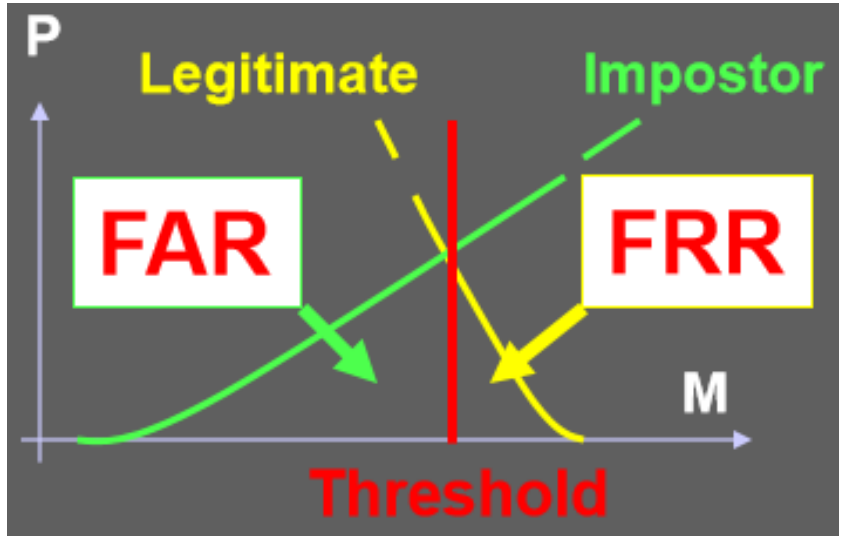




Difficulties with biometrics

False rejection / False acceptance

- Denying access to legitimate users is called false rejection
- Allowing access to illegitimate users is called false acceptance
- The probabilities of these two failures decide the quality of the biometric system



FAR = False Acceptance Rate
FRR = False Rejection Rate

Difficulties with biometrics

- Enrolment not accepted or to complicated
- People without index fingers
- Injury makes authentication impossible
- Human iris change with age
- . . .

An overview of biometric techniques

www.liu.se

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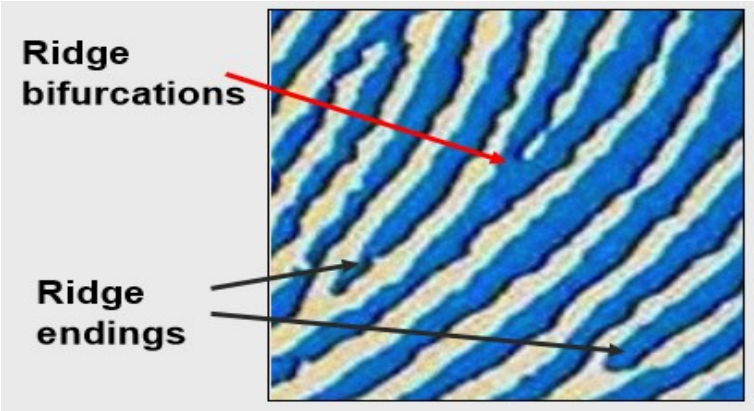
Fingerprint based recognition

- Major current technology
- Earliest records - authentication imprints on clay tables - Babylon, 1700 B.C
- Approved to be a forensic method in Great Britain in 1901



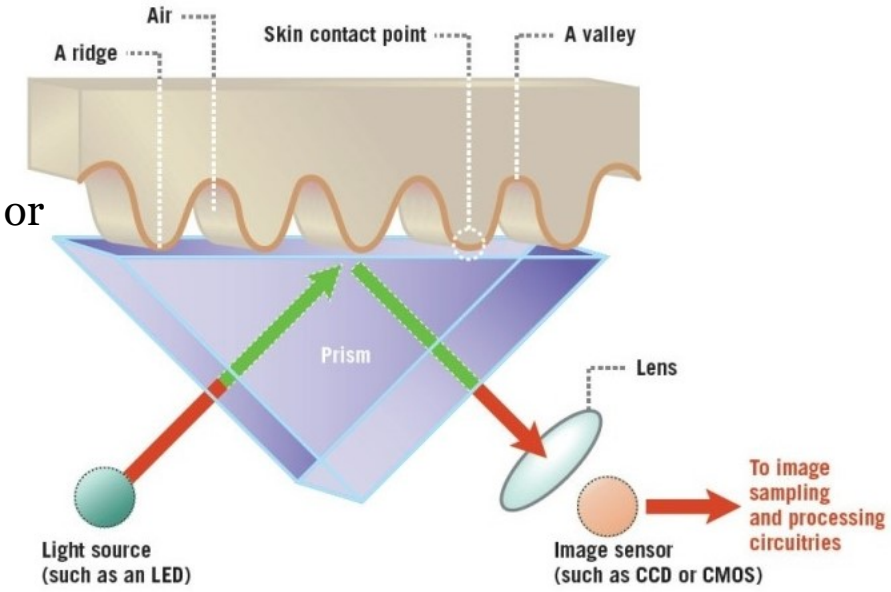
Minutiae features

- No identical fingerprints found among recorded hundreds of millions – uniqueness
- Completely forms in early natal period and remains unaltered permanence
- Most of us have it – universality
- Easy to collect in an acceptable way (subject's cooperation)

Fingerprint acquisition

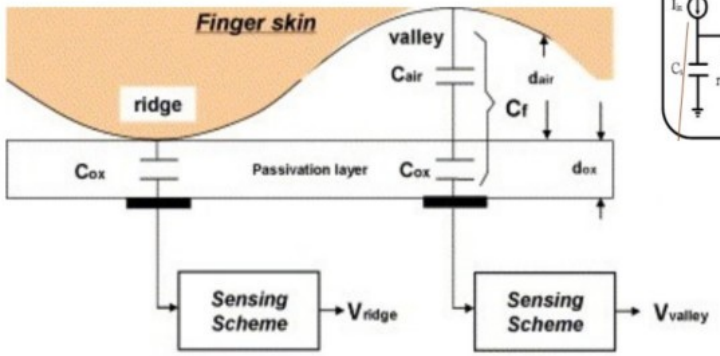
- **Optical readers**
- Inexpensive
- Easy to fool (not all types) – photos etc
- Image quality can become low due to dirt (reader or finger), residual imprints etc
- Low-cost, low security systems – PC access

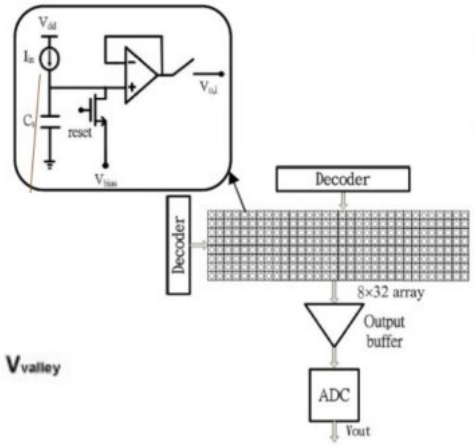
An optical sensor.



Fingerprint acquisition

- **Capacitive readers**
  - Skin surface - a capacitor's electrode
  - Quality - usually good
  - Rather inexpensive (common on most mobile devices)
  - Hard to fool
- **Thermal readers**
  - A difference in a temperature of ridges (warmer) and valleys (colder) or the air inbetween
  - Rather inexpensive, hard to circumvent
  - Quality depends on ambient temperature (finger temperature)

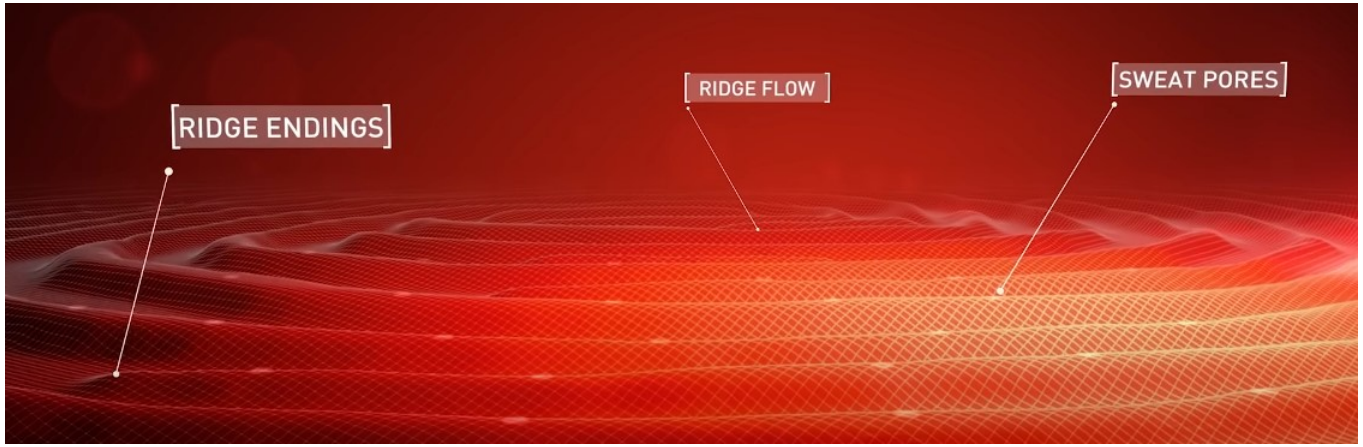




Fingerprint acquisition

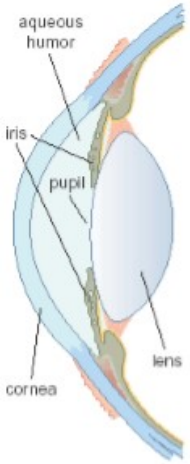
➢ **Ultrasound readers**

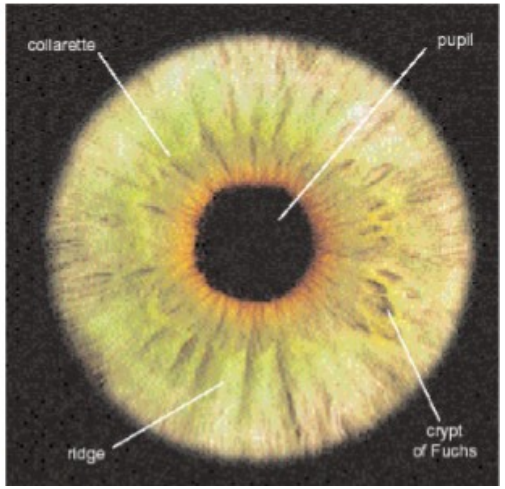
- Inner layers of skin are subject to scanning by ultrasound
- Expensive
- Considered to be the most difficult (impossible) to circumvent Inner layers of skin are subject to scanning

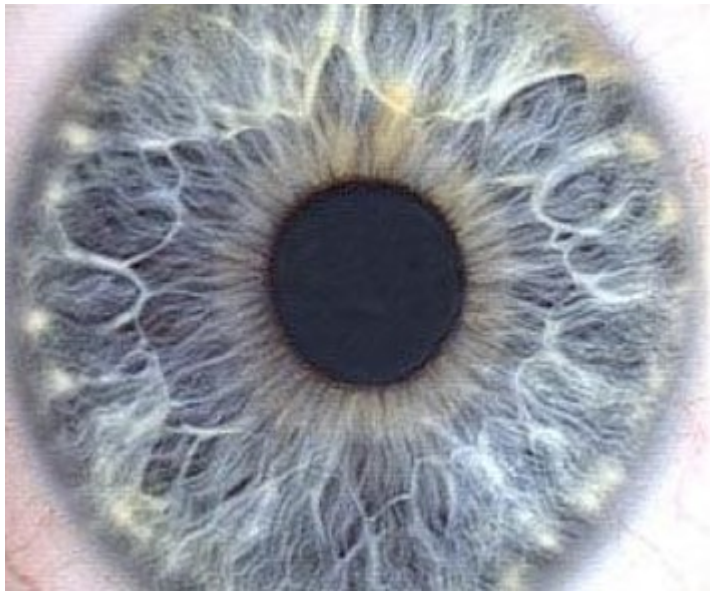


Iris-based recognition

- **Major prospective technology**
- No identical irises found among recorded hundreds of millions – uniqueness
- Completely forms in early natal period - permanence





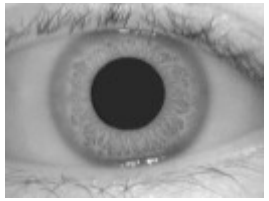


- Most of us have it – universality
- Easy to get – collectability
- No physical contact nor cooperation required - acceptability
- Hard to circumvent

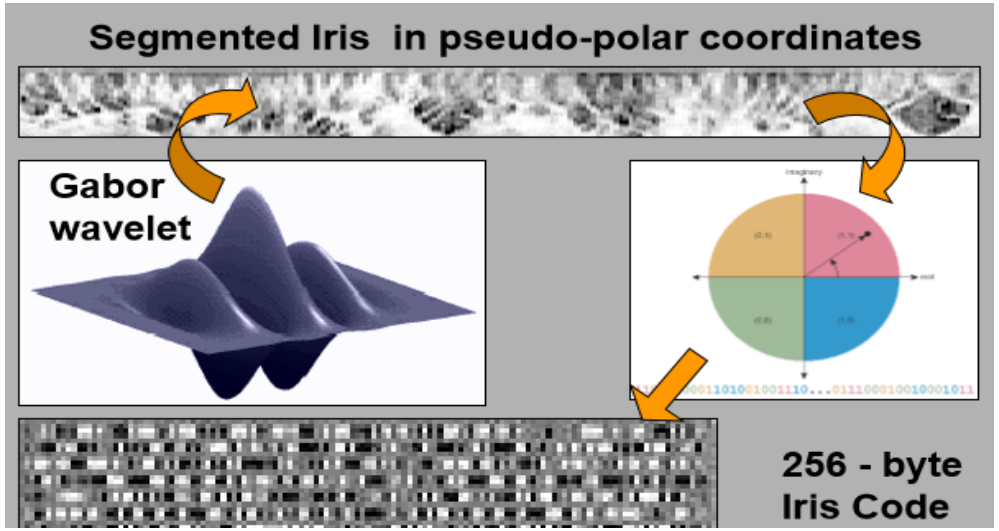
Iris-based recognition

Iris analysis

Visible light 

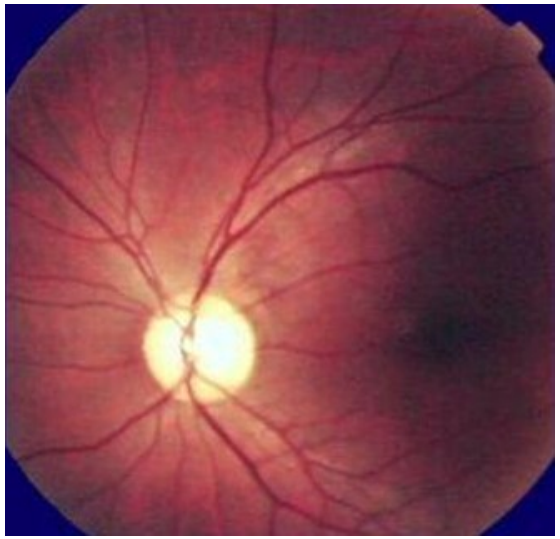
Near infrared 

J. Daugman's algorithm (the IrisCode)



Retina-based recognition

- Considered to be the most credible
- No identical retinas found so far - uniqueness
- Completely forms in early childhood (later changes possible) - permanence
- Most of us have it - universality
- Possible to scan – collectability
  … but: physical contact required
  - low acceptability
- Objects of interest: veins



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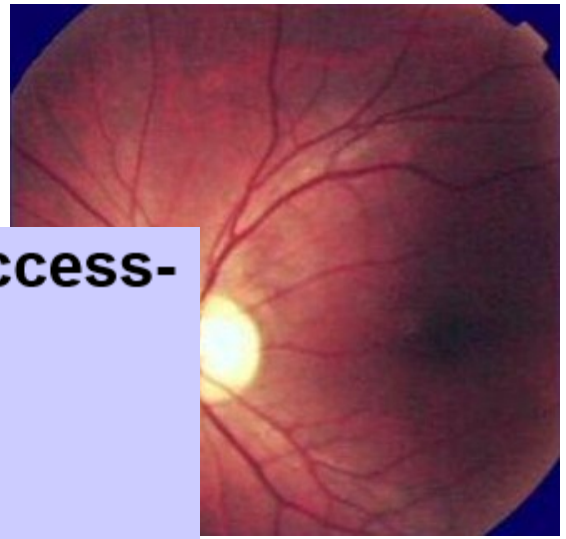


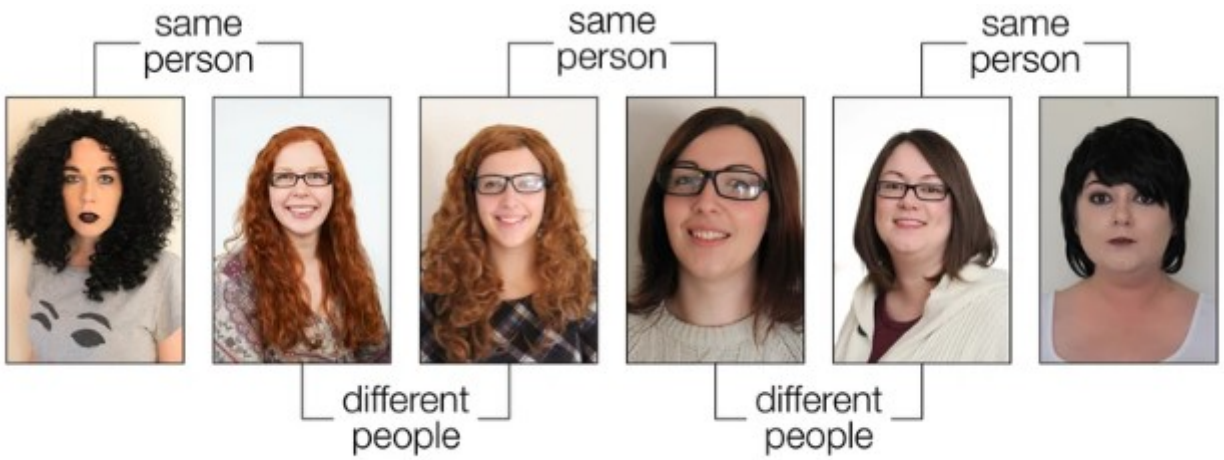
Performance in access-control systems

- Very good
- Natural liveness tests - considered impossible to circumvent
- High-security facilities

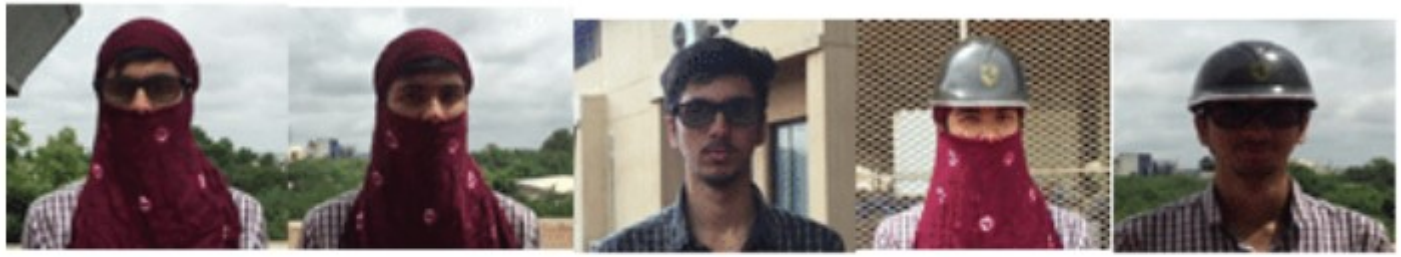
Face-based recognition

(facial recognition)

- Challenges for recognition software
- AI based learning for facial recognition using deep learning algorithm
- Can reach human level of recogniotion



EILIDH NOYES AND ROB JENKINS, UNIVERSITY OF YORK



Different Disguises Used in the Experiments

Face-based recognition

(facial recognition)

- **The most acceptable**
- Surveillance and monitoring systems
- Permanence: aging, diseases

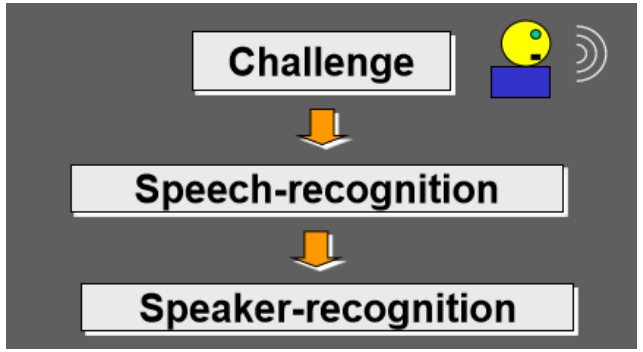
Sharbat Gula, 1985 : 2002

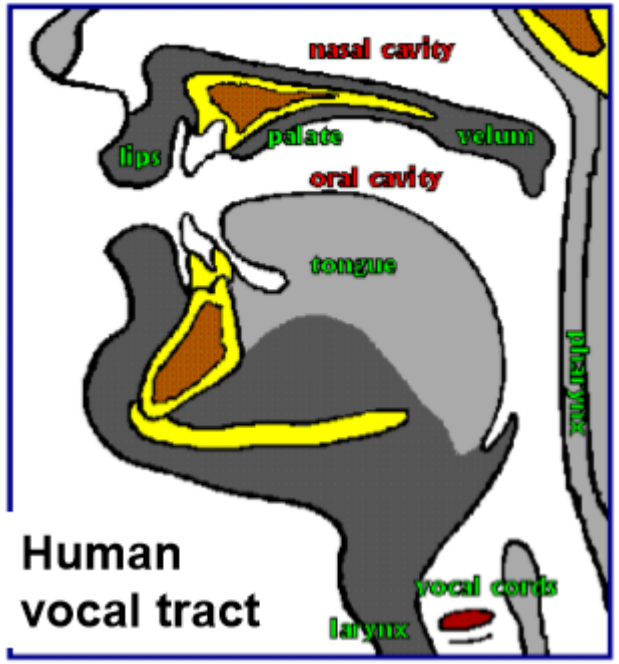
- **Other challenges**
- Face localization (detection)
- Acquisition errors – illumination, background
- Uniqueness: twins, beard, facial expressions, make-up …

- **Huge security market (CCTV)**
- Massive deployments in airports after 9/11

Voice-based recognition

- **Highlights**
- Most of us have it - universality
- Easy to acquire (no cooperation)
- Gets changed (aging, health…)
- Uniqueness hard to be proved
- Combination of individual physical properties and learned elements



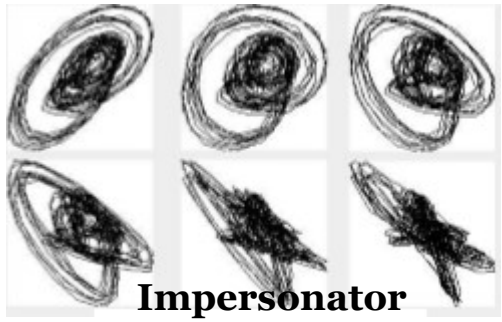


- The only means for remote applications
- Successive increase in recognition confidence level

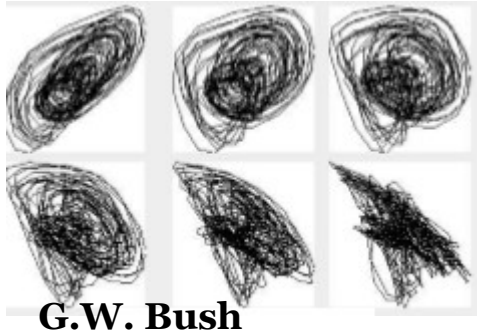
Voice-based recognition

- **Other challenges**
- Deliberate imitation
- Noise
- **Features**
- Adopted from speech recognition (LPC; linear predictive coding)
- Pronunciation
- . . .

https://youtu.be/u5DpKjlgoP4



Impersonator



G.W. Bush

Voice-based recognition

- Used for more than just recognition
  https://www.dw.com/en/how-ai-can-detect-diabetes-with-a-10-second-voice-sample/a-67400425

HEALTH | GLOBAL ISSUES

How AI can detect diabetes with a 10-second voice sample

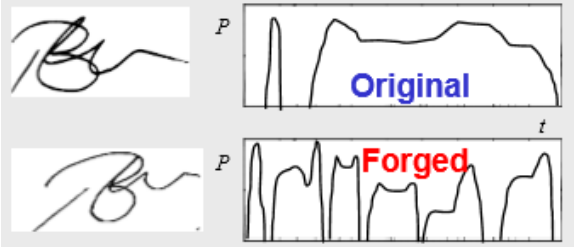
Alexander Freund

11/14/2023

Artificial intelligence can analyze speech patterns to detect type 2 diabetes with astonishing accuracy. The method could prove to be a useful diagnostic tool. But it comes with a warning label.

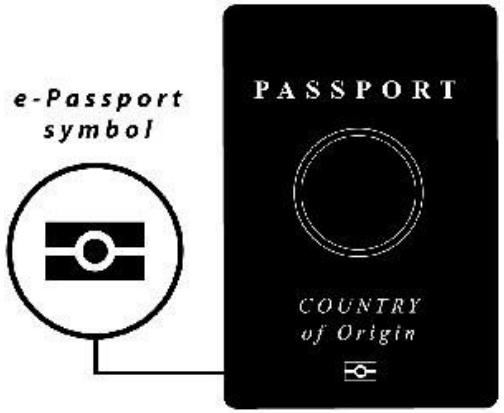
Other biometric techniques

- **Palm**
  - Popular access control technique
  - Acquisition of frontal and side view
  - Cooperation required (can be hard for persons with arthritis - system of pegs)
  - unique but not applicable for large-scale systems
- **Signature**
  - Significant variations for the same individual
  - Static and dynamic verification
  - Forgery of signature dynamics is almost impossible
- **Ears, gait, odor, DNA …**



Biometrics irl

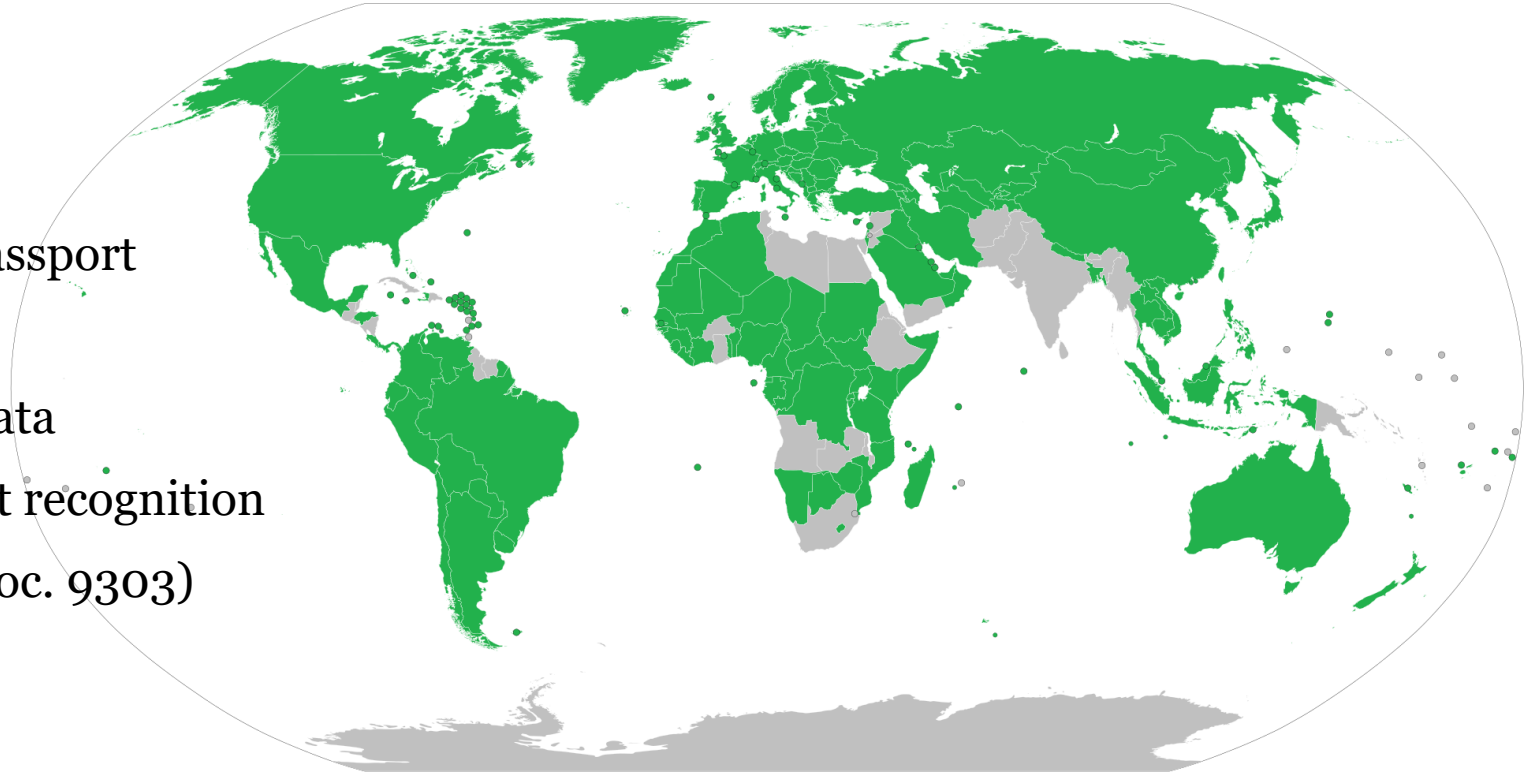
- Biometric passports



Biometrics irl

- Biometric passports

- Combined paper and electronic passport
- Contactless smart card
- PKI for authentication of stored data
- Standards for face, iris, fingerprint recognition
- ICAO – Int. Civil Aviation Org. (Doc. 9303)



Map of countries with biometric passports as of juli 2023
https://en.wikipedia.org/wiki/Biometric_passport

Biometrics irl

- CCTV – closed circiut television

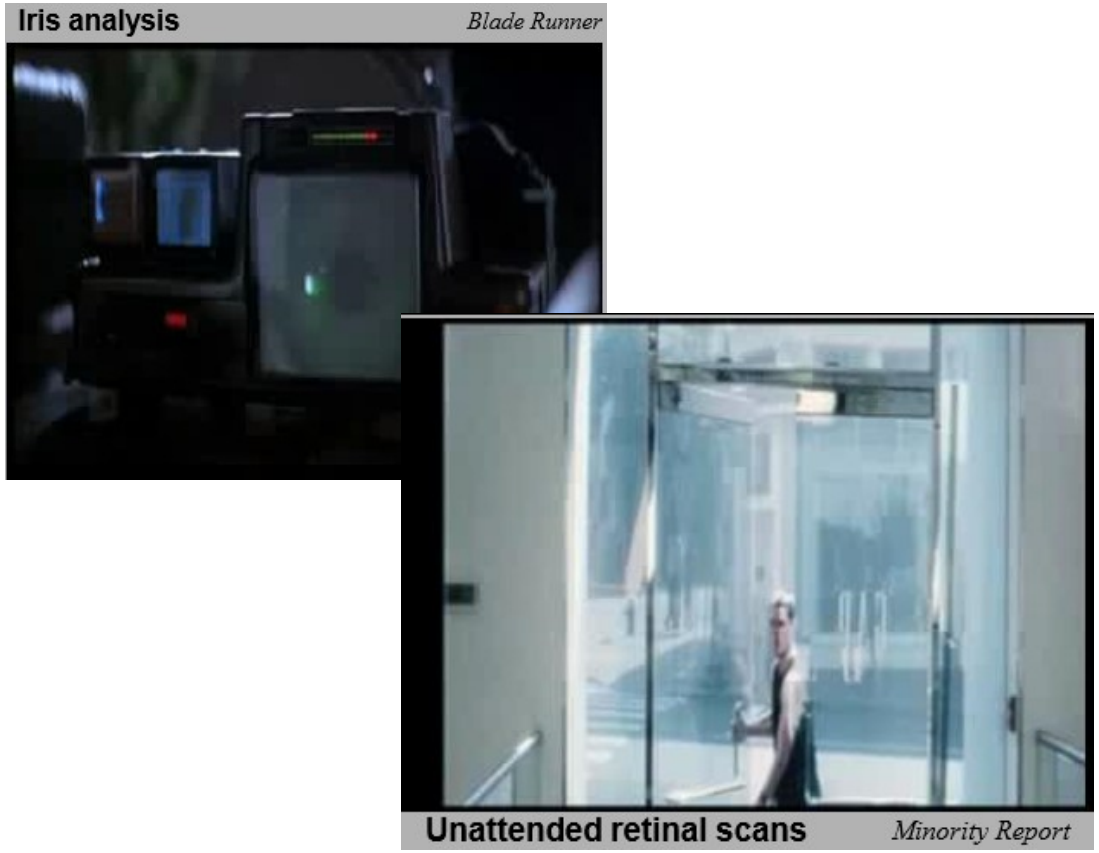
Attacks on biometrics

- **Fingerprints copies by**
- Gelatin or tape and even Wine gum
  https://youtu.be/Fxdhb65iciM
- high res photos
  https://www.bbc.com/news/technology-30623611
- **But**
- Modern security devices check for liveness,

Attacks on biometrics

- **Biometric passport hacks**
- Early years (2005 – 2008)
  Several successful attacks on chip
  https://en.wikipedia.org/wiki/Biometric_passport

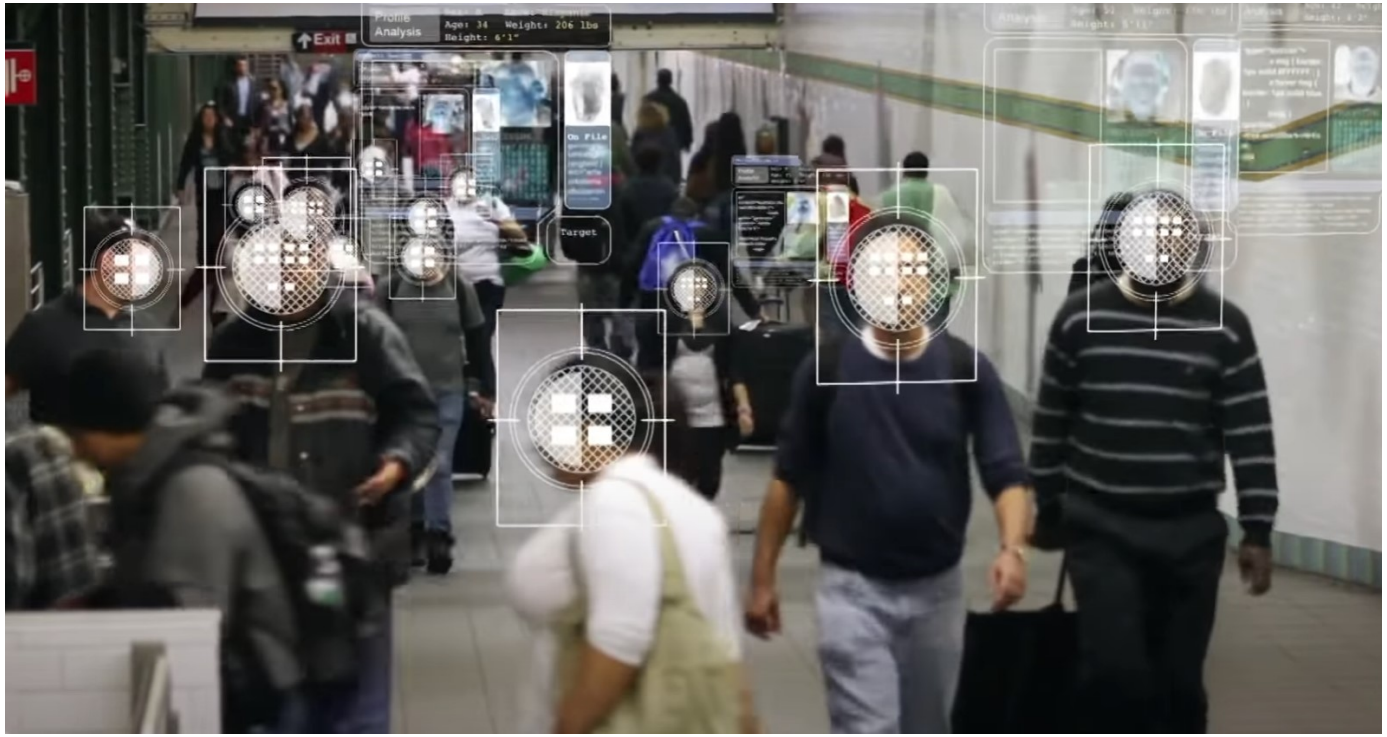
Biometrics – future or present?



- Camera technology

- Blade Runner 1982
  -Iris Scan
- Minority Report 2002
  - Retinal Scan
- …

Biometrics – future or present?



- Camera technology
- Iris/retina scan
- Behavior analysis
- Thermoanalytics scan

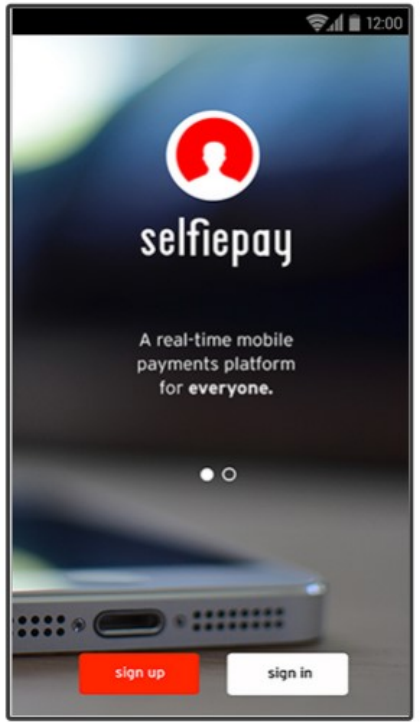
Biometrics – future or present?

- Ear scan

- Outer ear scan
  Capacitative screen
- Inner ear
  Sound/ultrasound echo

Biometrics – future or present?

- Pay with fingerprint, facial, PayPal, Samsung Pay,Apple pay, Google Pay, …
- Visa card biometrics at ATM
- MasterCard selfie pay
- US Colleges and universities move to biometric in access control



Recap: something you are

- Vary each time you measure them
- Scheme must allow variation
- Can deny access to legitimate users
- Can allow access to illegitimate users
- Can be copied
- Can be obtained by others quite easily
- Cannot be changed if compromised
- Cannot be handed over in duress

Final thoughts

- Biometrics are not secret
- Biometrics are (ideally) unique to each individual
- Increasing number of successful attacks against biometric identification -> rethink before replacing password

➢ Recommendation: Biometric should be used for 2FA (the 2nd factor)
Or
In combination with password

Link collection:

- Biometrics passport - Wikipedia
- Mobile Accessories | FLIR Systems Thermal camera for mobil devices
- Hacker fakes German minister's fingerprints using photos of her hands | Technology | The Guardian
- Asia Times | Israeli spyware: WhatsApp hack raises global fears | Article
- The Xerox character-substitution bug is worse than first thought | Computerworld
- Ryska hackare tar över Chrome och Firefox med trojan – TechWorld
- Hacking an ATM, as easy as using Windows XP
- Password Cracking - Computerphile – YouTube old but still viable
- FireEye confirmsss that APT14 Group hacked TeamViewer
- WiGLE: Wireless Network Mapping One of many sites that tracks Wifi and Bluetooth networks (legally and not invasive)

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