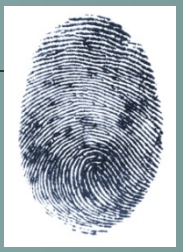
Understanding Biometrics



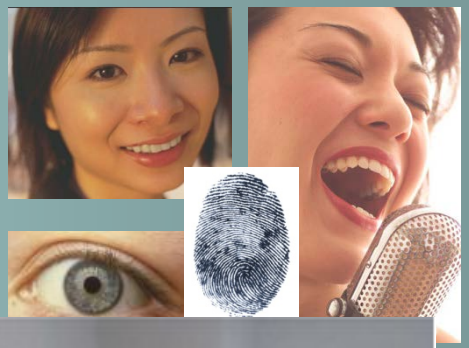
12. Trends and Emerging Technologies

Dr. Terence Sim

Existing biometrics

- Physiological
  - Fingerprint/vein
  - Face
  - Iris
  - Retina
  - Hand geometry
  - Palmprint/vein
  - DNA
  - Dental
- Behavioral
  - Voice
  - Gait
  - Keystroke dynamics
  - Signature

Advances in existing biometrics



- Iris at a distance: > 3m
  - Chinese Academy of Sciences, China
  - Biometrics Research Engineering Centre, South Korea

Advances in existing biometrics

- Fingerprint (anti-)spoofing
  - “Liveness” detection
  - Microscopic pores instead of minutiae
- Iris (anti-)spoofing
  - “Liveness” detection
  - Fake iris detection
- Cancelable biometrics

Cancelable Biometrics

- Store distorted biometric, never original

During Enrollment

Distortion done in sensor itself.

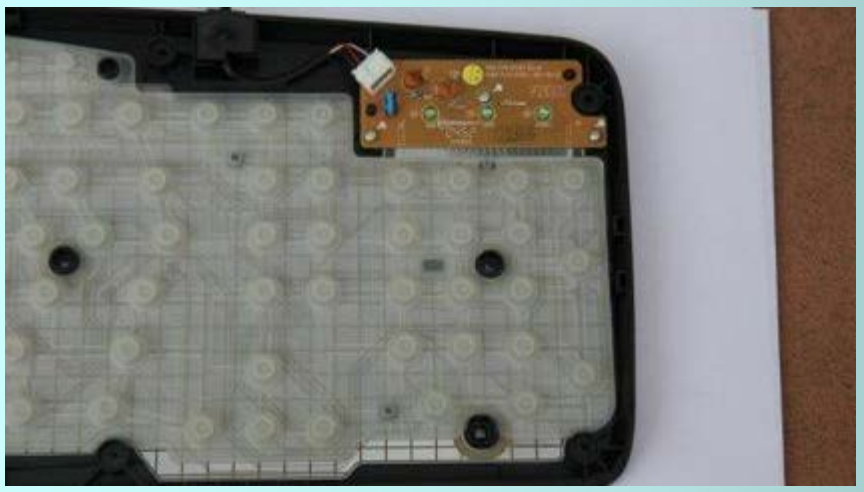
During Identification

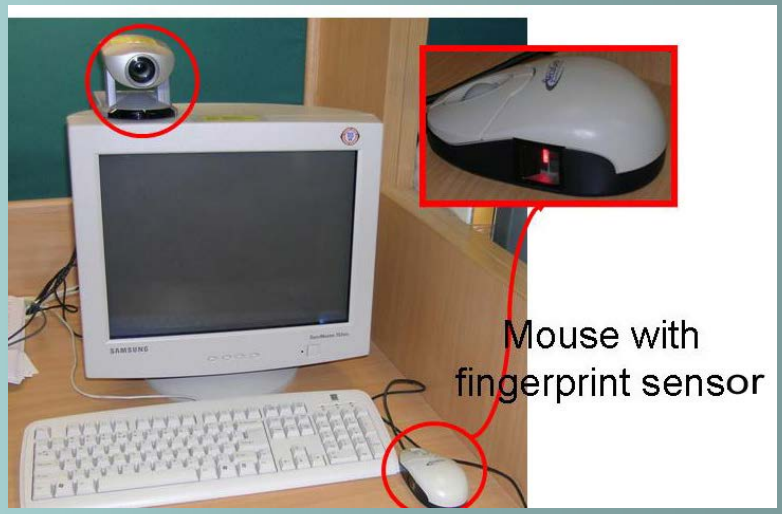
Use a different distortion if biometrics stolen.

http://www.research.ibm.com/ecvg/biom/cancel.html

Keystroke dynamics

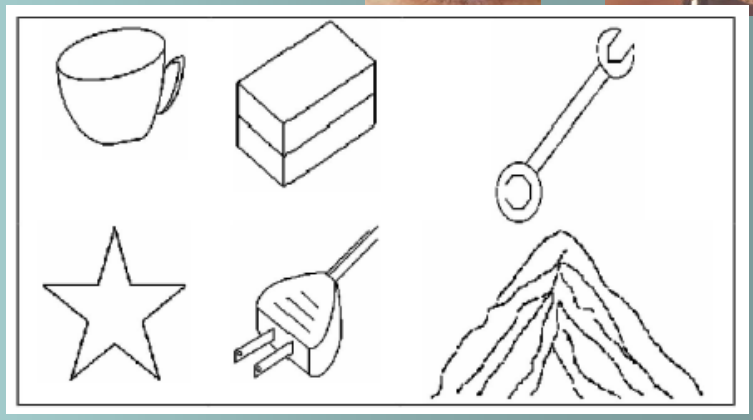
- For Continuous Authentication
  - @NUS
  - Typing patterns
  - Free-text, fixed text
  - Pressure sensitive keyboard

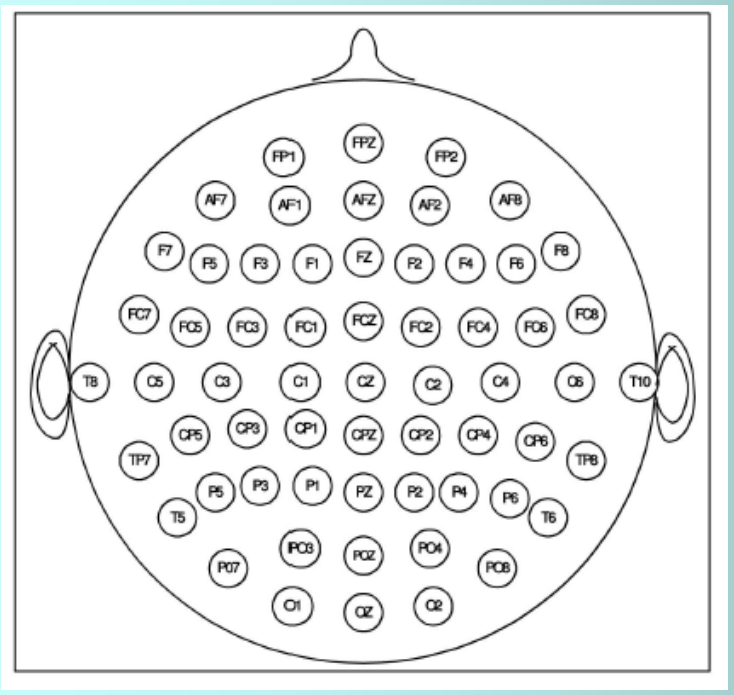




New biometrics

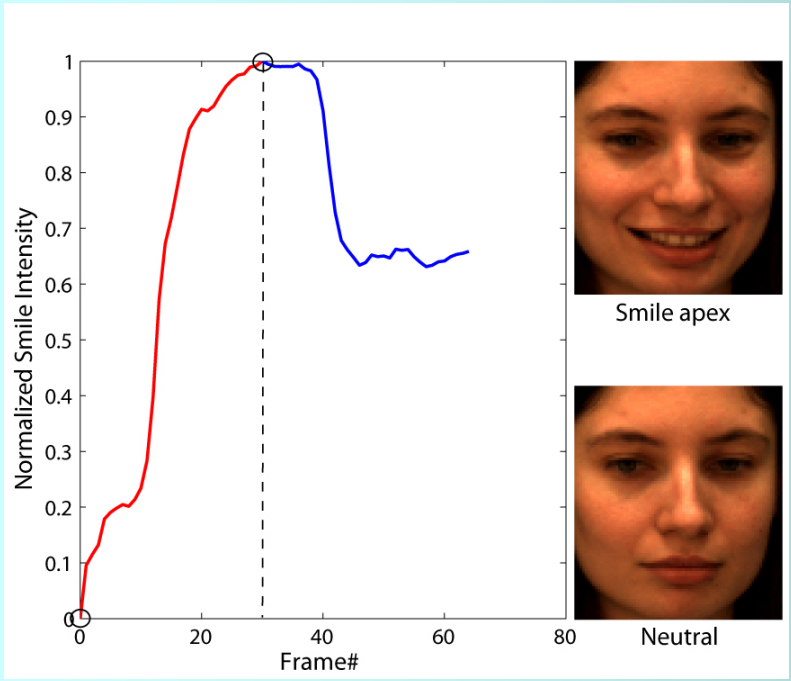
- EEG
  - Univ. of Sussex
  - Ionian Univ.





New biometrics

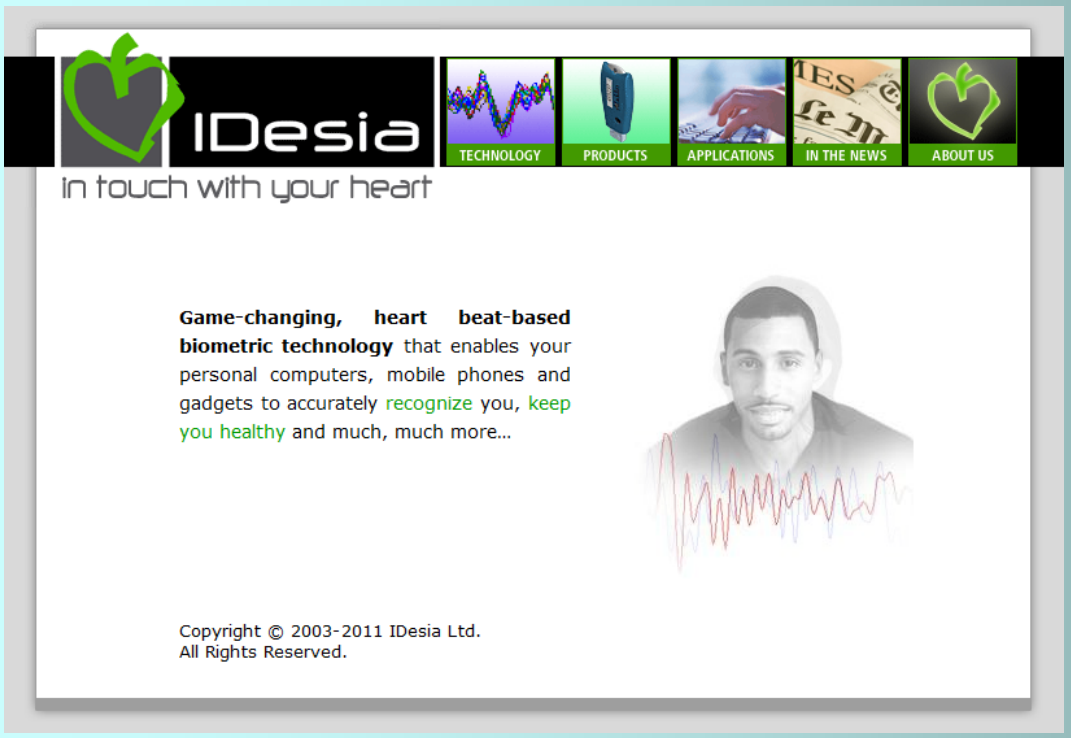
- Facial dynamics
  - @NUS



ICPR 2008, CAIP 2009, CVPR 2010

New biometrics

- Heart signal



New biometrics

Oculomotor Plant Biometrics

Most popular biometric identification methods such as fingerprint verification or iris recognition are based on physiological properties of the human body.

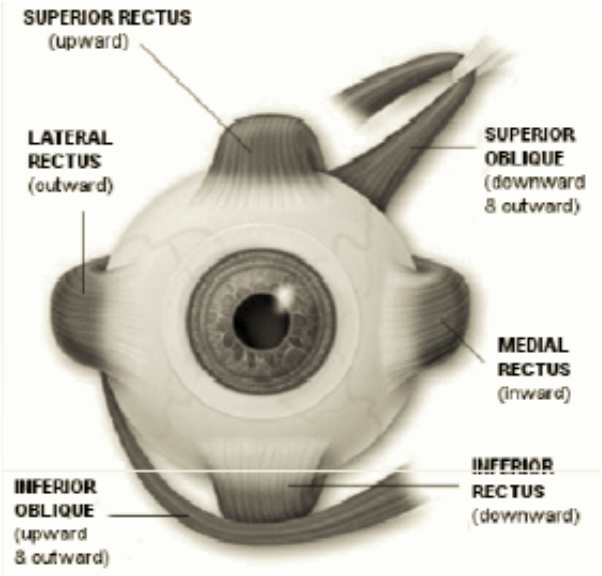
However, physiological properties are vulnerable to forging and may be used to identify an unconscious or even a dead person.

Eye Movements combine both physiological (muscle) and behavioral (brain) aspects.

Eye movement based identification uses information mostly produced by the brain, and so far impossible to imitate.

Eye Movements:

1. Saccades
2. Fixations
3. Smooth Pursuits
4. Optokinetic reflex
5. Vestibule-ocular reflex
6. Vergence



Eye Movement Classification Algorithms: Velocity Threshold (I-VT), Hidden Markov Model (I-HMM), Kalman Filter (I-KF), Minimum Spanning Tree (I-MST), Dispersion Threshold (I-DT).

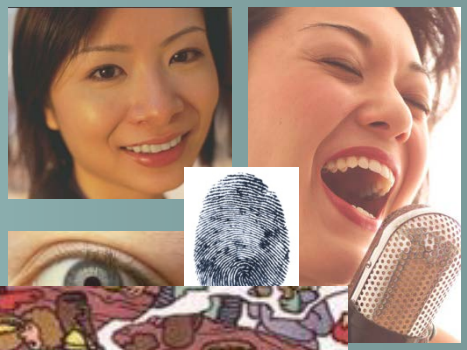
Privacy Preserving Technology

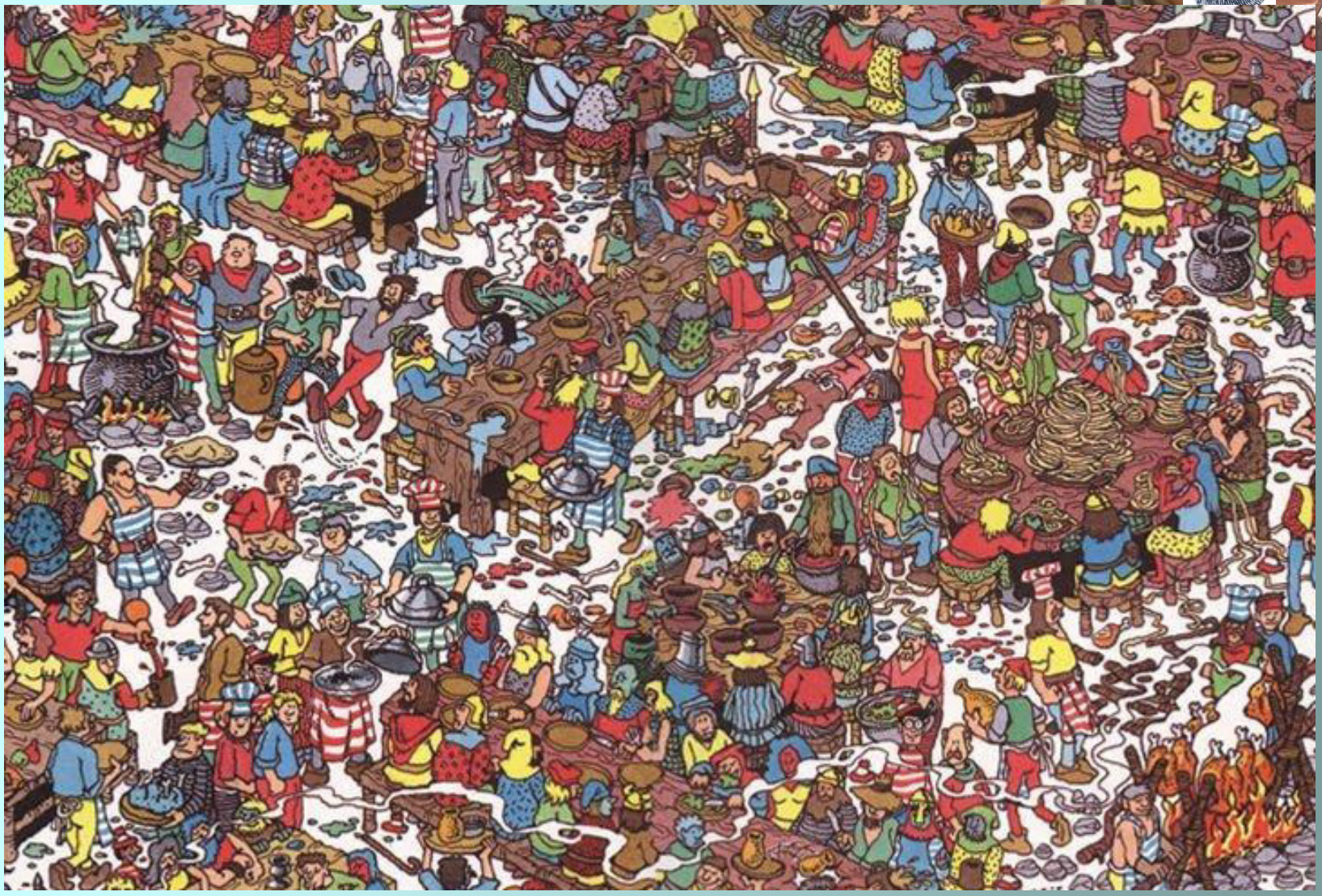
- Research into using technology to preserve privacy yet allow authentication
  - Face anonymization or de-identification
  - K-anonymity
  - Zero-knowledge proof

Zero-knowledge Proof

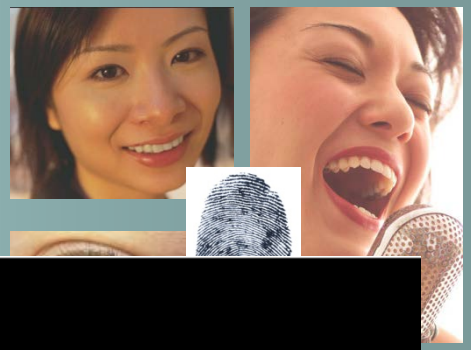
- Where’s Waldo (Wally)?

Waldo





Waldo



Zero-knowledge Proof

- I have proved to you that I know where Waldo is.

- But you are none the wiser!

Example from Moni Naor, Yael Naor, Omer Reingold, “Applied Kid Cryptography”, 1999.

Summary

- Biometrics research is widespread
  - Advancing performance of existing biometrics
  - Devising new biometrics

- Multimodal biometrics – for the super paranoid