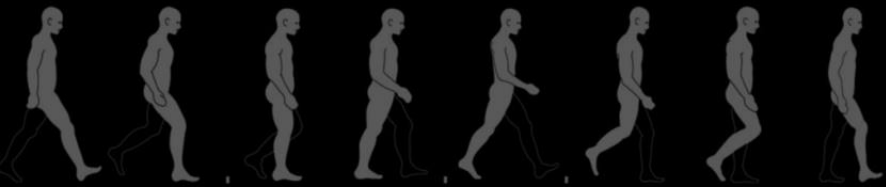# Biometric Authentication Systems

Chapter 12:

Other Biometrics

Ngo Thanh Trung

Reviewing questions

- 1- Can we recognize people at low resolution video sequence when we cannot see face, fingerprint,…

Reviewing questions

- 2- Can we walk like other person?

Reviewing questions

- 3- What information gait can tell?

Reviewing questions

- 4- When gait biometrics has advantage over other biometrics like face, fingerprint, iris?

Reviewing questions

- 5- What impacts gait recognition performance?

Reviewing questions

- 6- How can we integrate temporal information in single frame gait feature?

Reviewing questions

- 7- How long is one gait cycle approximately?

Outline

- Ear
- Hand geometry
- Keystrokes
- Retina
- Body odor
- Others

Comparison of serval biometric features

Biometric Features	Univ	Dist	Perm	Coll	Perf	Acce	Circ
DNA	H	H	H	L	H	L	L
Ear	M	M	H	M	M	H	H
Face	H	L	M	H	L	H	H
Facial Thermogram	H	H	L	H	M	H	L
Fingerprint	M	H	H	M	H	M	M
Gait	M	L	L	H	L	H	M
Hand Geometry	M	M	M	H	M	M	M
Hand Vein	M	M	M	M	M	M	L
Iris	H	H	H	M	H	L	L
Keystroke	L	L	L	M	L	M	M
Odor	H	H	H	L	L	M	L
Palmprint	M	H	H	M	H	M	M
Retina	H	H	M	L	H	L	L
Signature	L	L	L	H	L	H	H
Voice	M	L	L	M	L	H	H

1. Universality
2. Uniqueness
3. Permanence
4. Measurability
5. Performance
6. Acceptability
7. Circumvention

Ear recognition

- Ear geometry recognition uses the shape of the ear to perform identification
- Suggestions have been made that the shapes and characteristics of the human ear are widely different
- An infrared image can be used to eliminate hair
- Might be recognized at a distance
- Shape is stable despite aging
- Minimally impacted by changes in facial expression
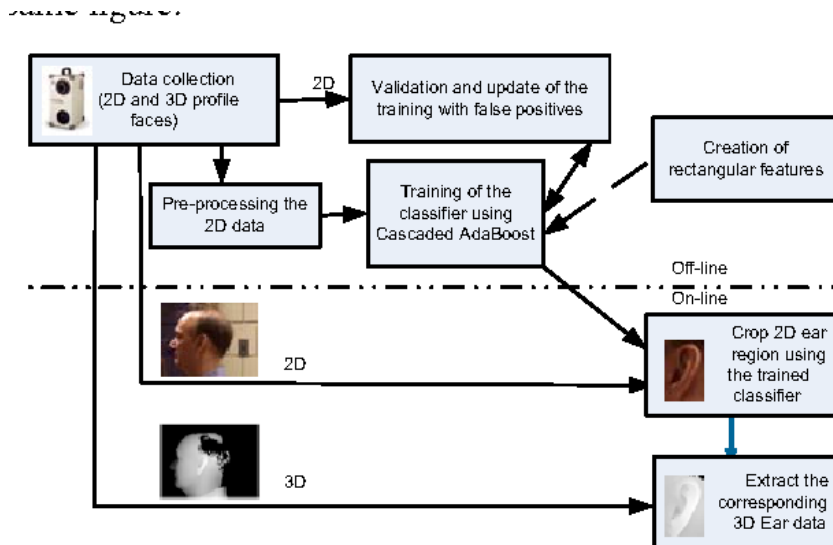- Image acquisition does not involve explicit contact with the sensor
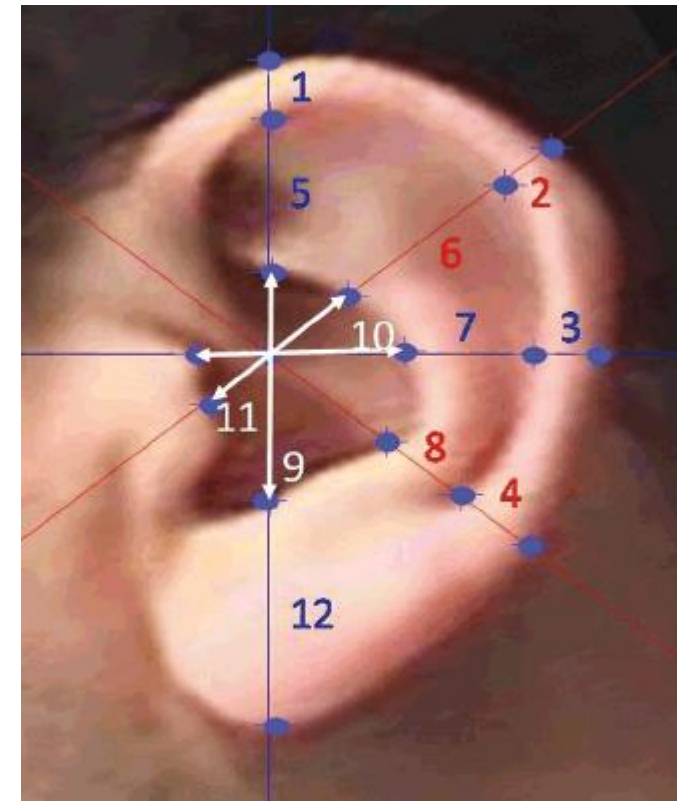
Ear information

(1) Helix Rim
(2) Lobule
(3) Antihelix
(4) Concha
(5) Tragus
(6) Antitragus
(7) Crus of Helix
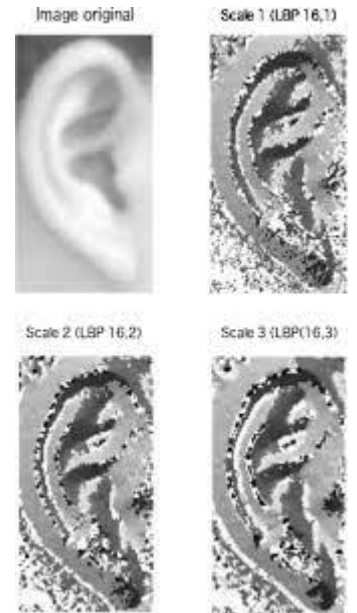(8) Triangular Fossa
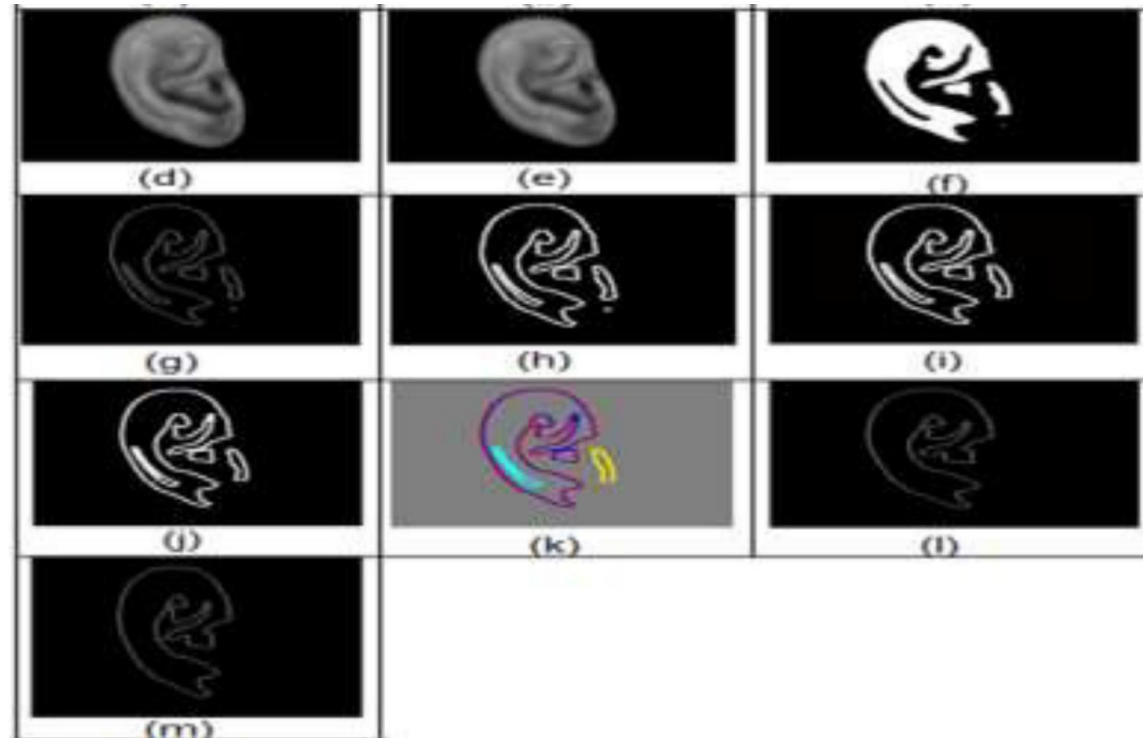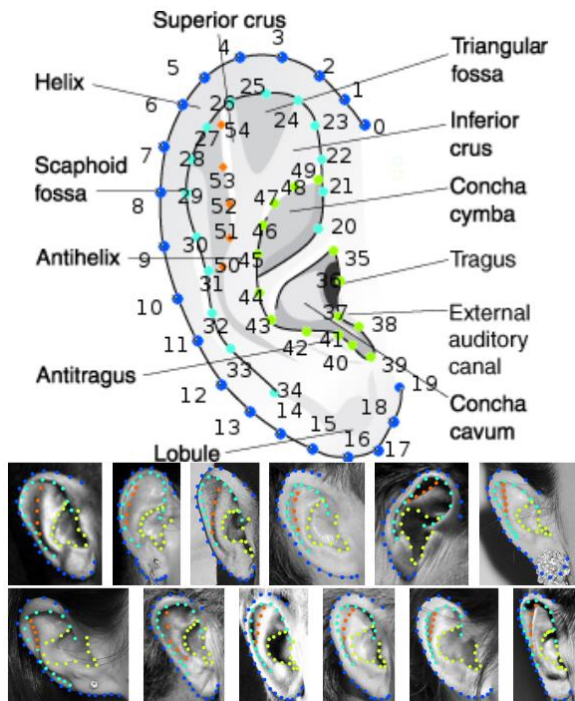(9) Incisure Intertragica

Ear Detection

- Sliding window with template matching
- Sliding window with Viola &Jones Adaboost method (face detection)
- SIFT features

Adaboost ear detection
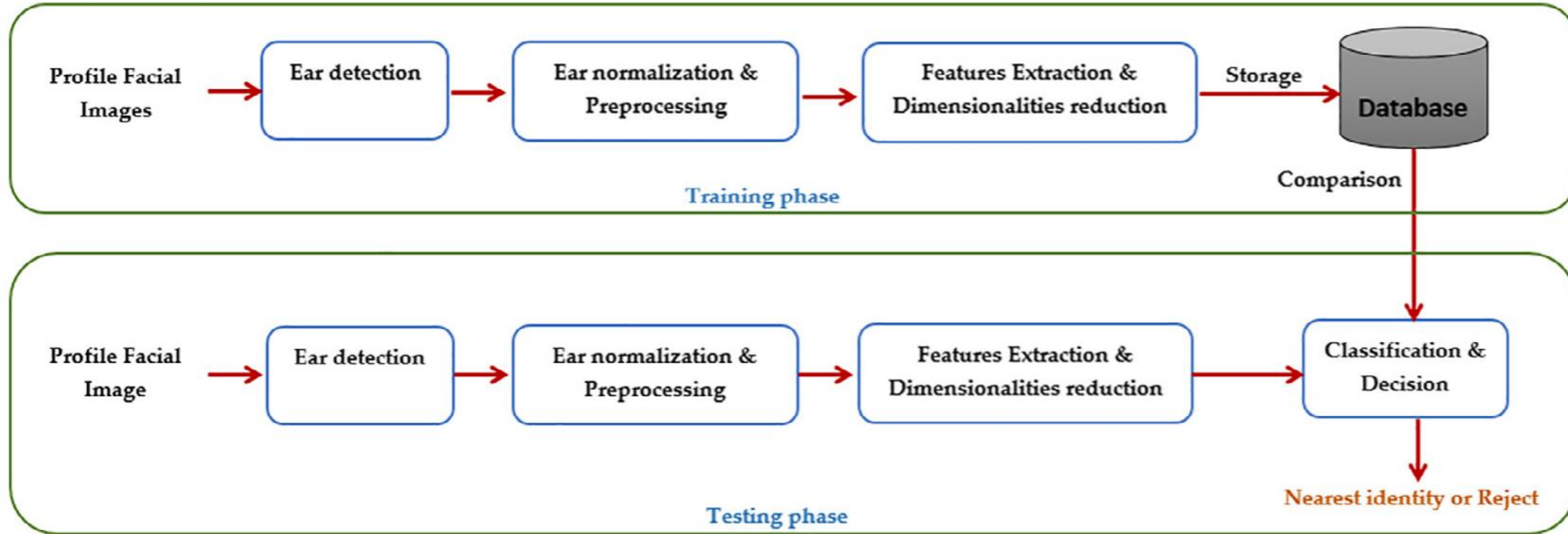
Ear feature extraction

- Landmarks
- Edge features
- LBP features

Ear recognition

Profile Facial Images → Ear detection → Ear normalization & Preprocessing → Features Extraction & Dimensionalities reduction → Storage → **Database**

Training phase

Comparison

Profile Facial Image → Ear detection → Ear normalization & Preprocessing → Features Extraction & Dimensionalities reduction → Classification & Decision → Nearest identity or Reject

Testing phase

Hand geometry recognition

- Biometric information: geometric structure of the hand
  - width of the fingers at various locations,
  - width of the palm,
  - thickness of the palm,
  - length of the fingers,
  - contour of the palm,…

- Hand geometry measurement is **non-intrusive** because it does not have any physical contact with the image acquisition device while acquiring image data

Hand capture

a) A constrained hand capture scenario. b) An unconstrained capture scenario

Hand geometry
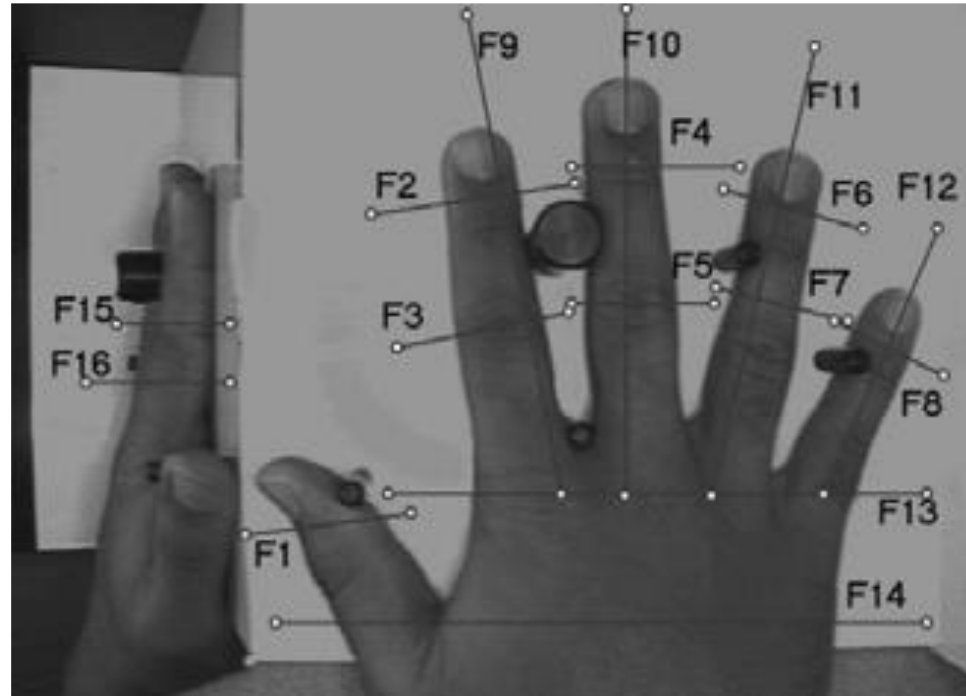
Hand Geometry recognition

- Euclidean and Manhattan distances
- Multi-class Support Vector Machines

Application of hand geometry recognition

Hand geometry systems have been successfully deployed in several applications

- including nuclear power plants,

- border control systems,

- recreational centers and

- time-and-attendance systems

Keystroke

- The rhythms with which one types at a keyboard are sufficiently distinctive to form the basis of the biometric technology known as keystroke dynamics: timing of press and release a key

- 100% software-based, requiring no sensor more sophisticated than a home computer
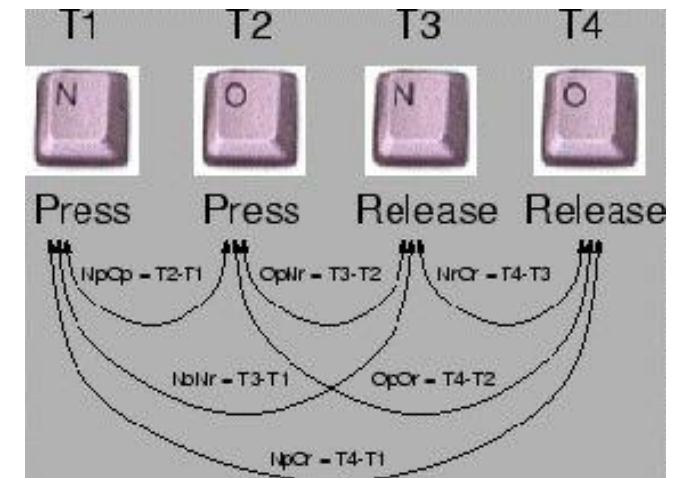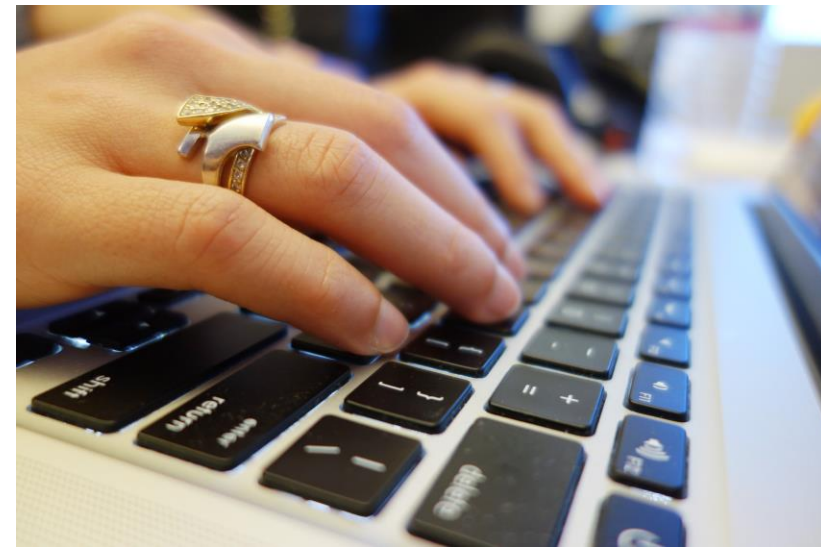
Keystrokes dynamics features

- Interval—the time between the release of one key and pressing the next;

- Dwell time—the time between pressing and releasing the same key;

- Latency—the time between pressing one key and releasing the next one;

- Flight time—time between pressing one and the next key;

- Up to up—the time between releasing the first and next key.
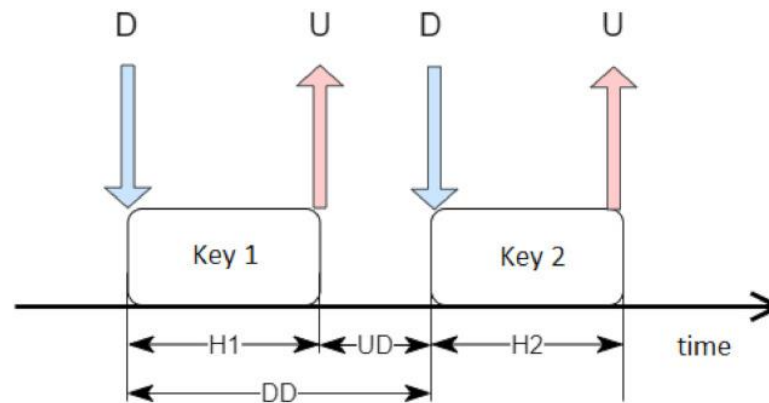
Retina recognition

- The pattern of blood vessels that emanate from the optic nerve and disperse throughout the retina depends on individuals and never changes.
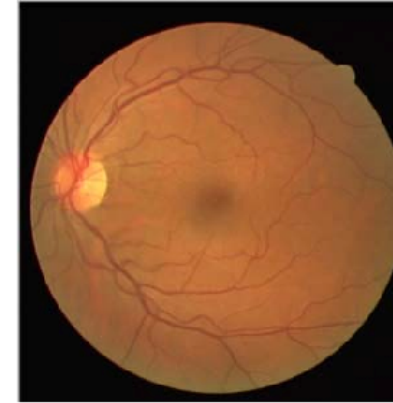
- No two retinas are the same, even in identical twins.

Retina

Lens

Pupil

Blood vessels

Fovea

Macula

Cornea

Iris

Retina: Vein Pattern
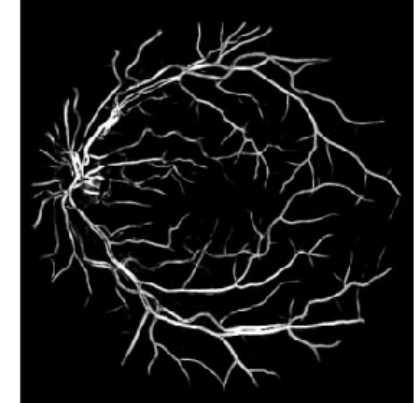
Iris Pattern
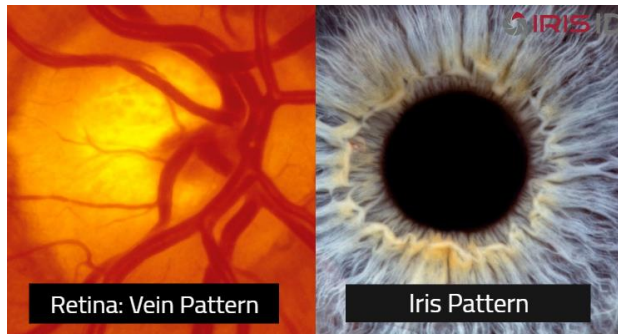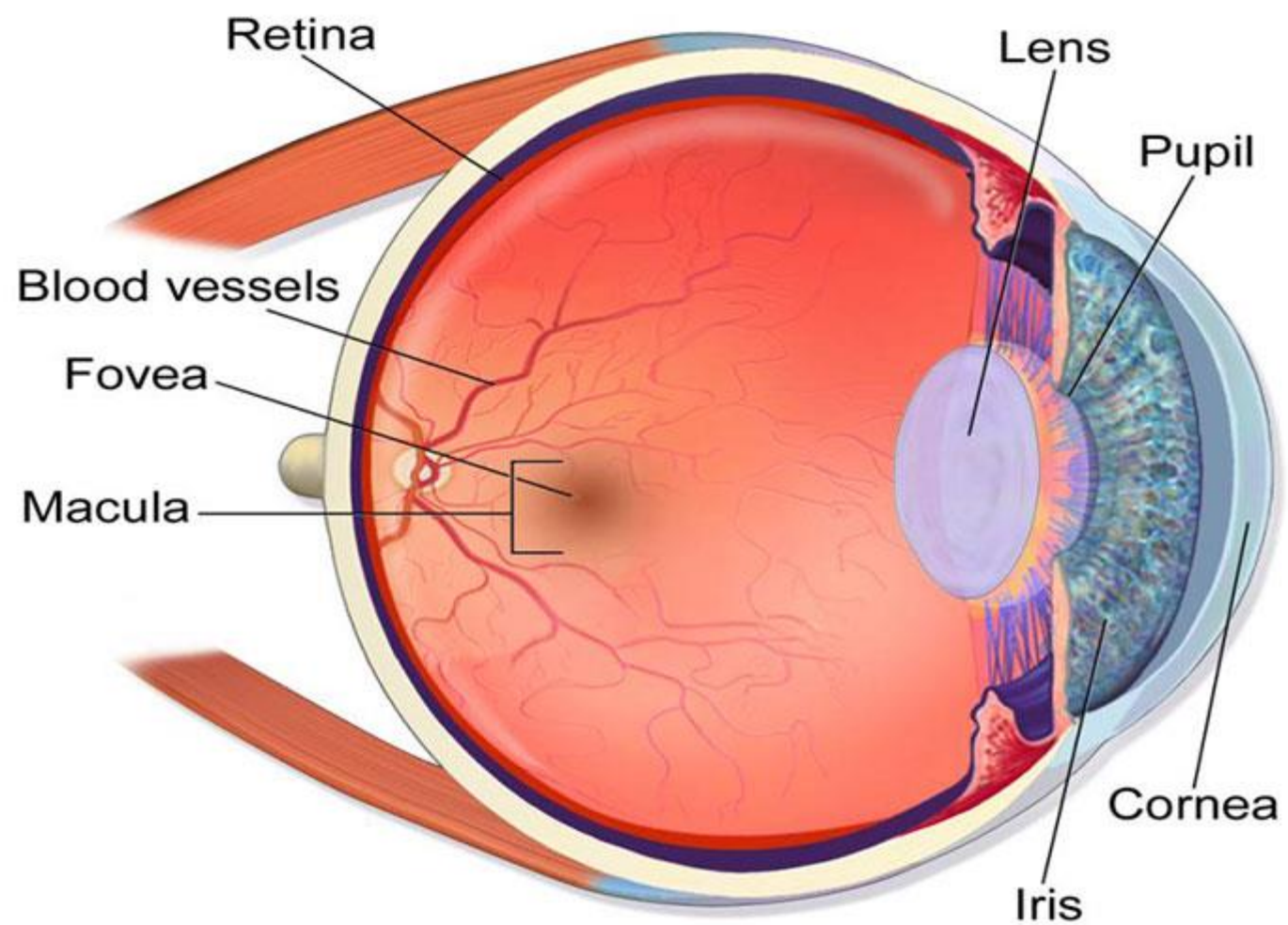
Retina capture

- Retinal Imaging
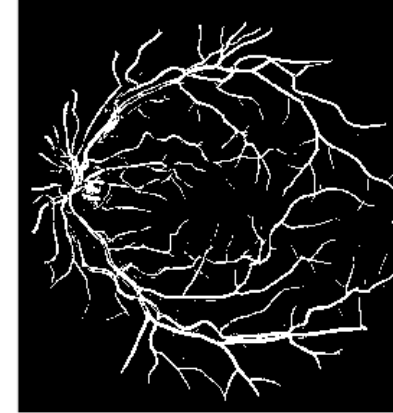
Retina feature extraction
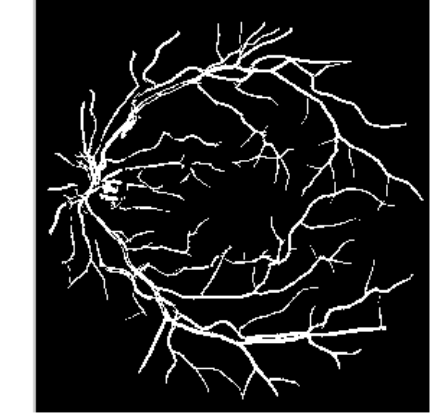
- Skeleton of retina vein
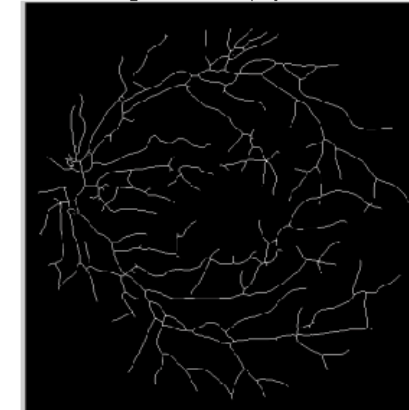

(a) The original retina image

(b) Wavelet segmentation

(c) Statistical thresholding
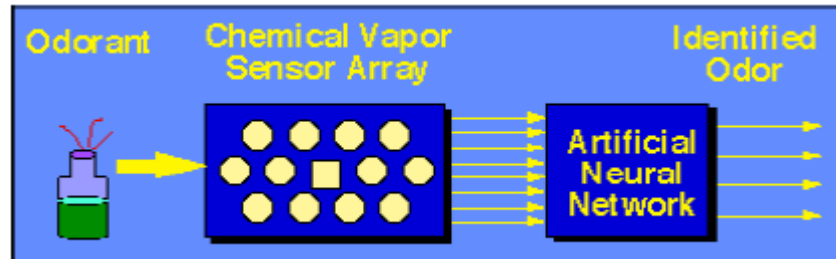
(d) Discard small pixels

(e) Skeletonization

Body odor

• It's absolutely clear that people with differing immunity genes produce different body odors

• Electronic/artificial noses: developed as a system for the automated detection and classification of odors, vapors, gases.

Artificial nose

- Artificial noses are not yet sophisticated enough to do all the job

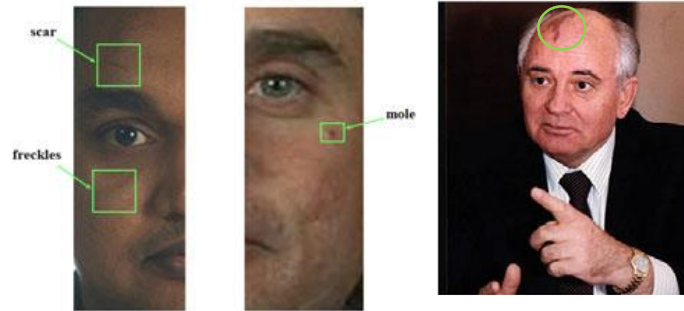**Schematic Diagram of Artificial nose**

Prometheus (Alpha Mos) , an example of electronic nose

Other biometrics modality

- Voice
- Palmprint, footprint
- Soft biometrics

Periocular

facial marks