

Application of Digital Image Processing To Biometrics

Chul Jung
(2018-02-05)

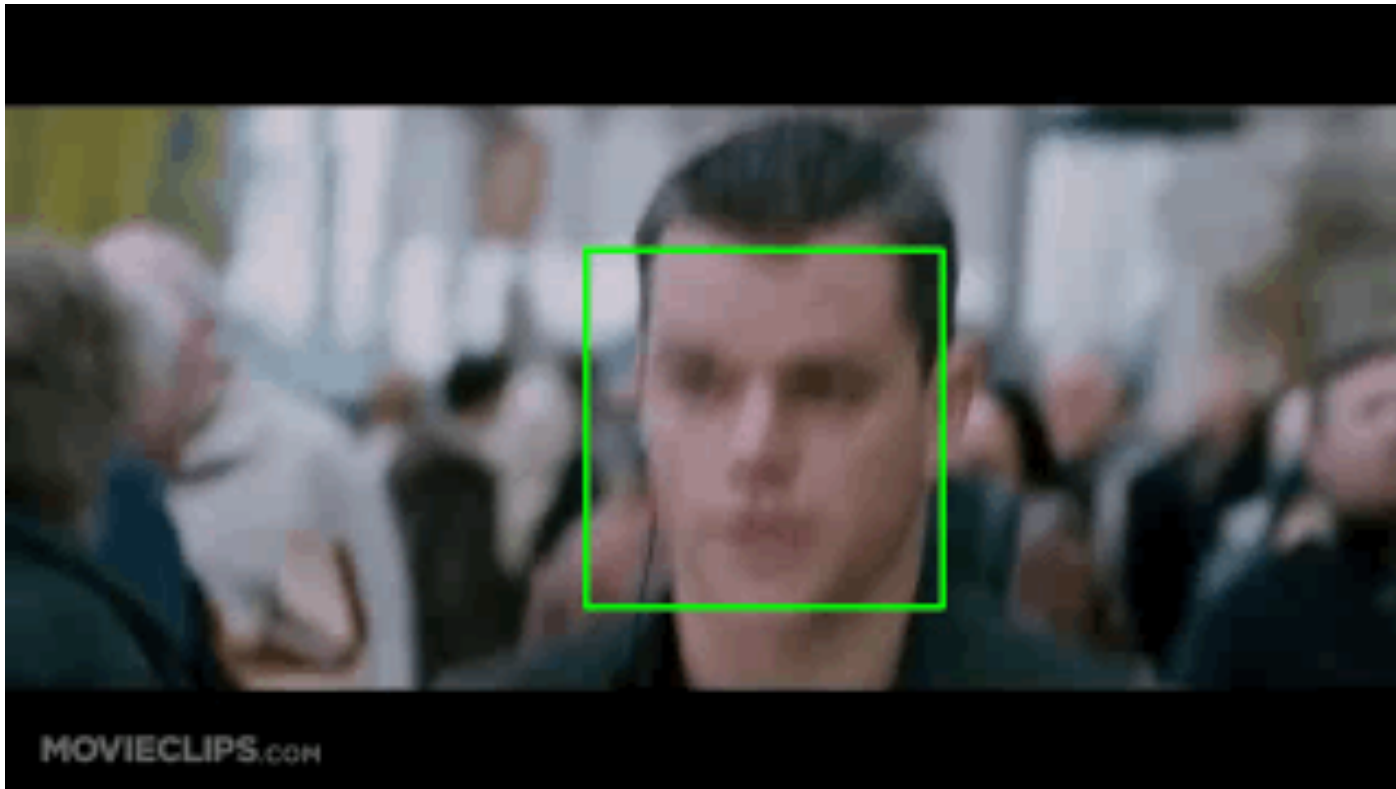
School of Computer Science
University of Guelph

Outlines

- What is Biometrics?
- The Type of Biometric
- Fingerprint
- Iris Scanner
- Face Recognition

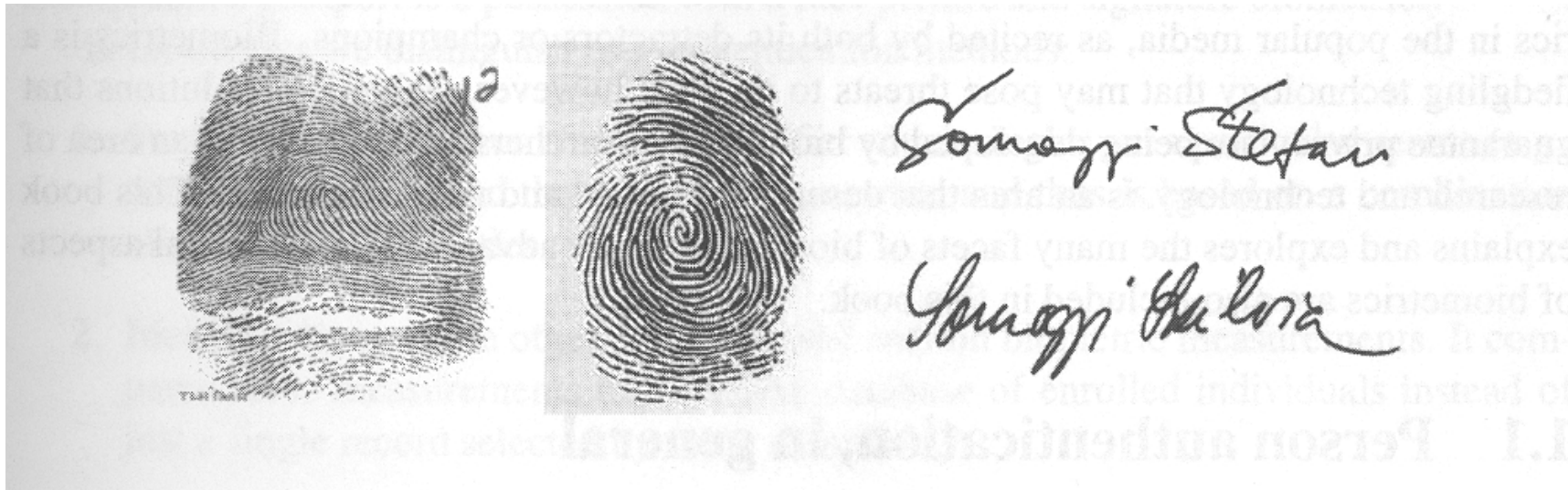
Science fiction has made it's way to science fact

How imaginative depictions of technology in a Film can become reality

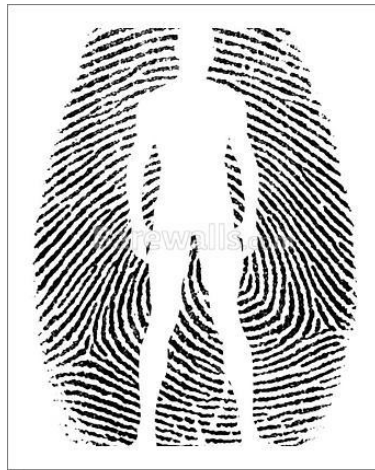


What is Biometrics?

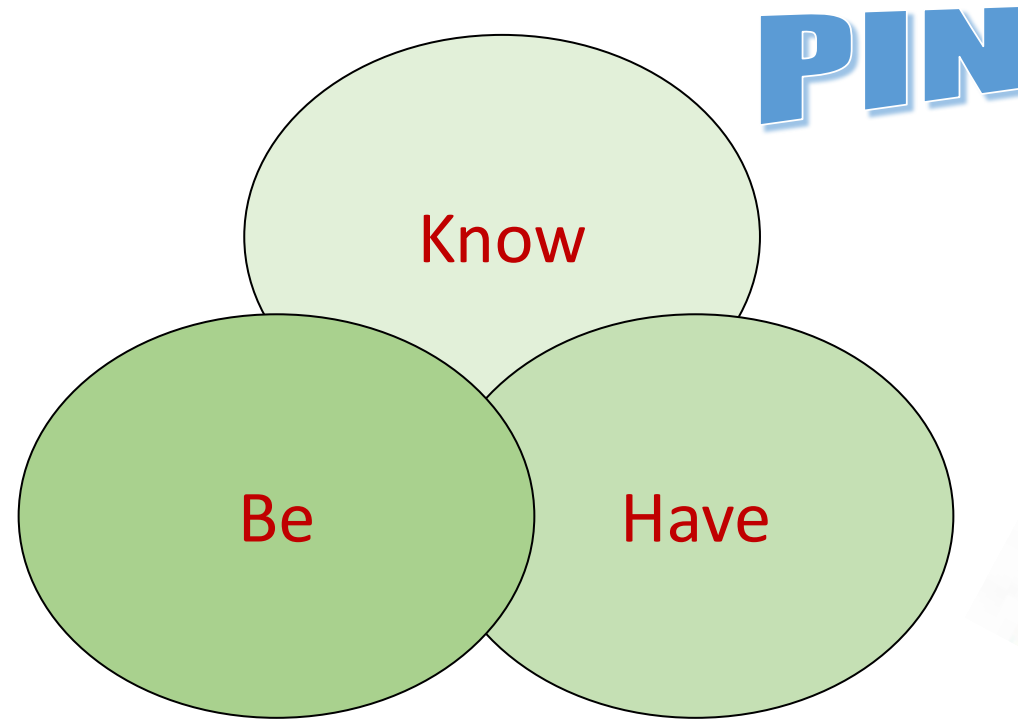
- Science of **identifying**, or **verifying** the identity of a person
- Specific **physiological** or behavioral characteristics.



Identification vs. Authentication



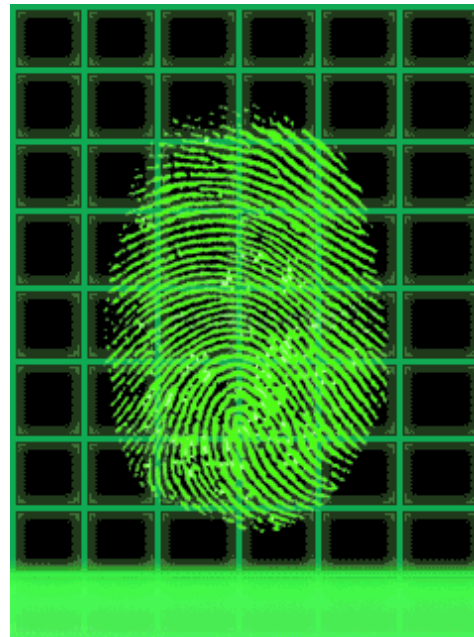
bwc42291485 Barewalls ©



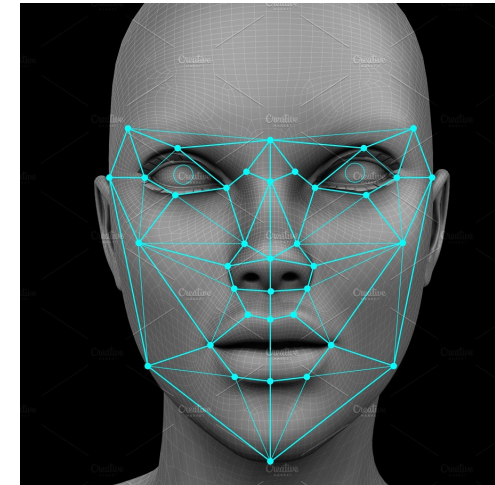
Types of Biometrics



Iris Scan



Fingerprint



Face Recognition

Types of Biometrics

Common:

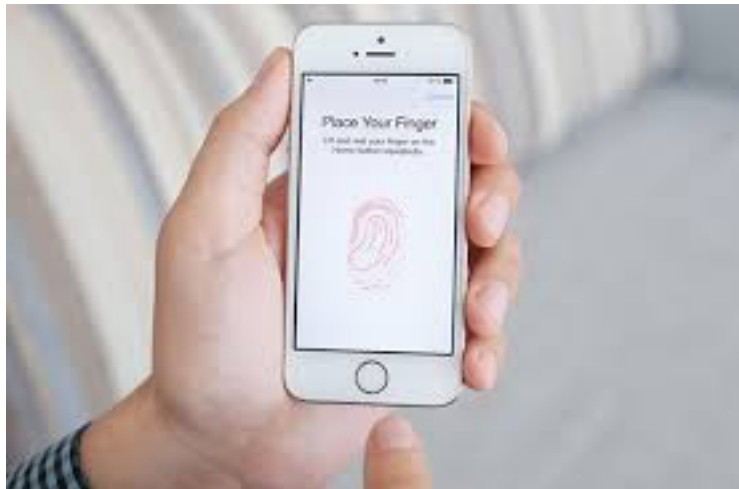
- Fingerprint Recognition
- Iris Recognition
- Face Recognition
- Hand Geometry
- Speaker Recognition
- Signature verification

Others:

- DNA
- Retina recognition
- Thermograms
- Ear recognition
- Skin reflection
- Body odor
- Lip motion
- Gait
- Keystroke

Reds: physiological / Greens: behavioral characteristics

Fingerprint



bwc46898313 Barewalls ©

Fingerprint Technology

An optical sensor.

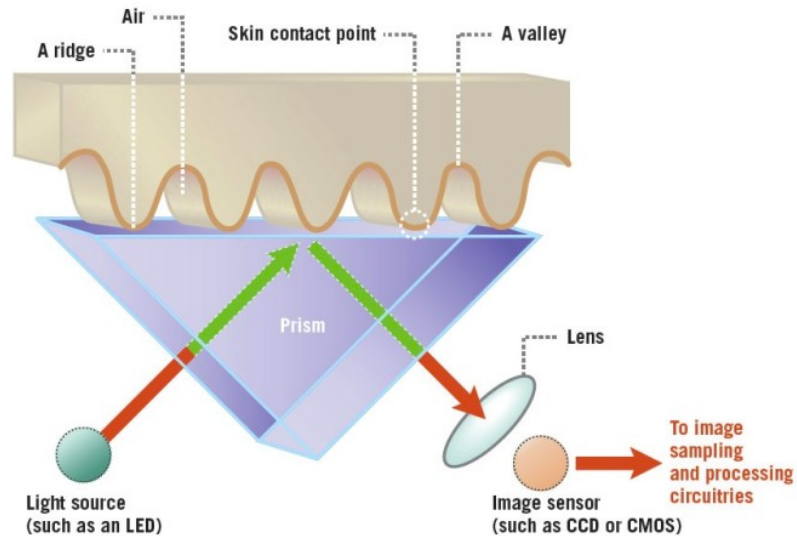
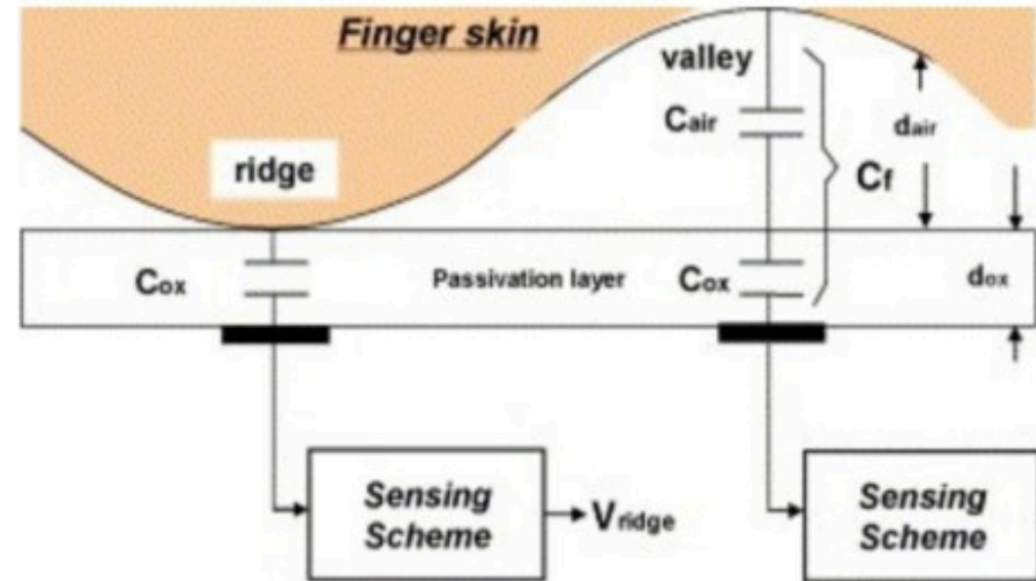


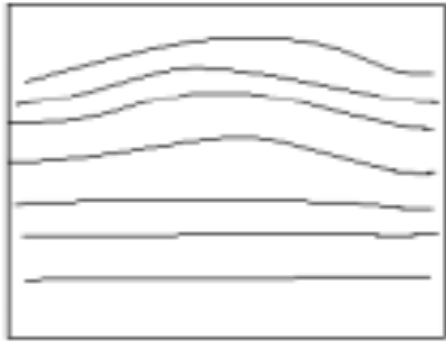
Figure 2

Capacitive sensor

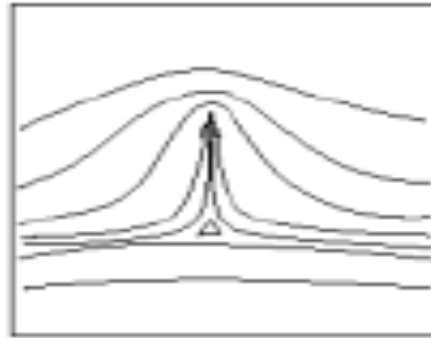


Fingerprint Patterns

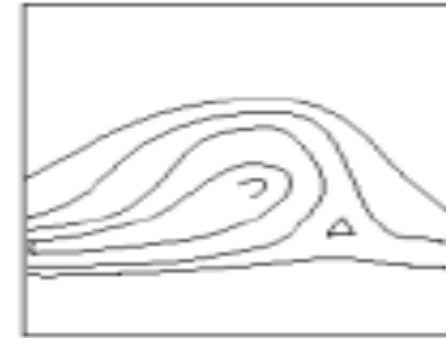
Henry system of classification



Arch



Tented Arch



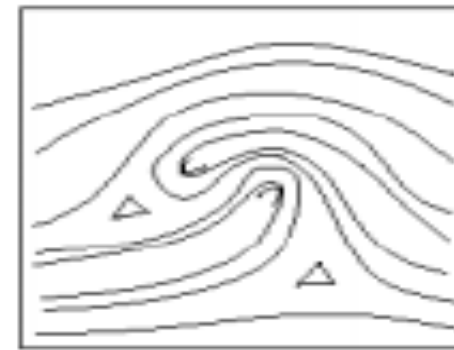
Left Loop



Right Loop



Whorl



Twin Loop

Fingerprint / Minutiae

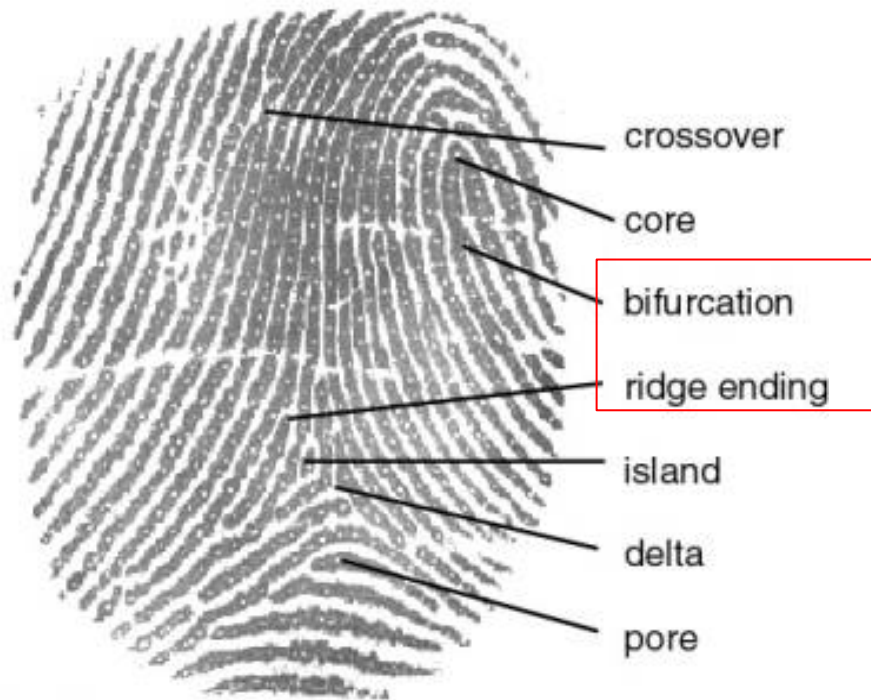


Figure 1

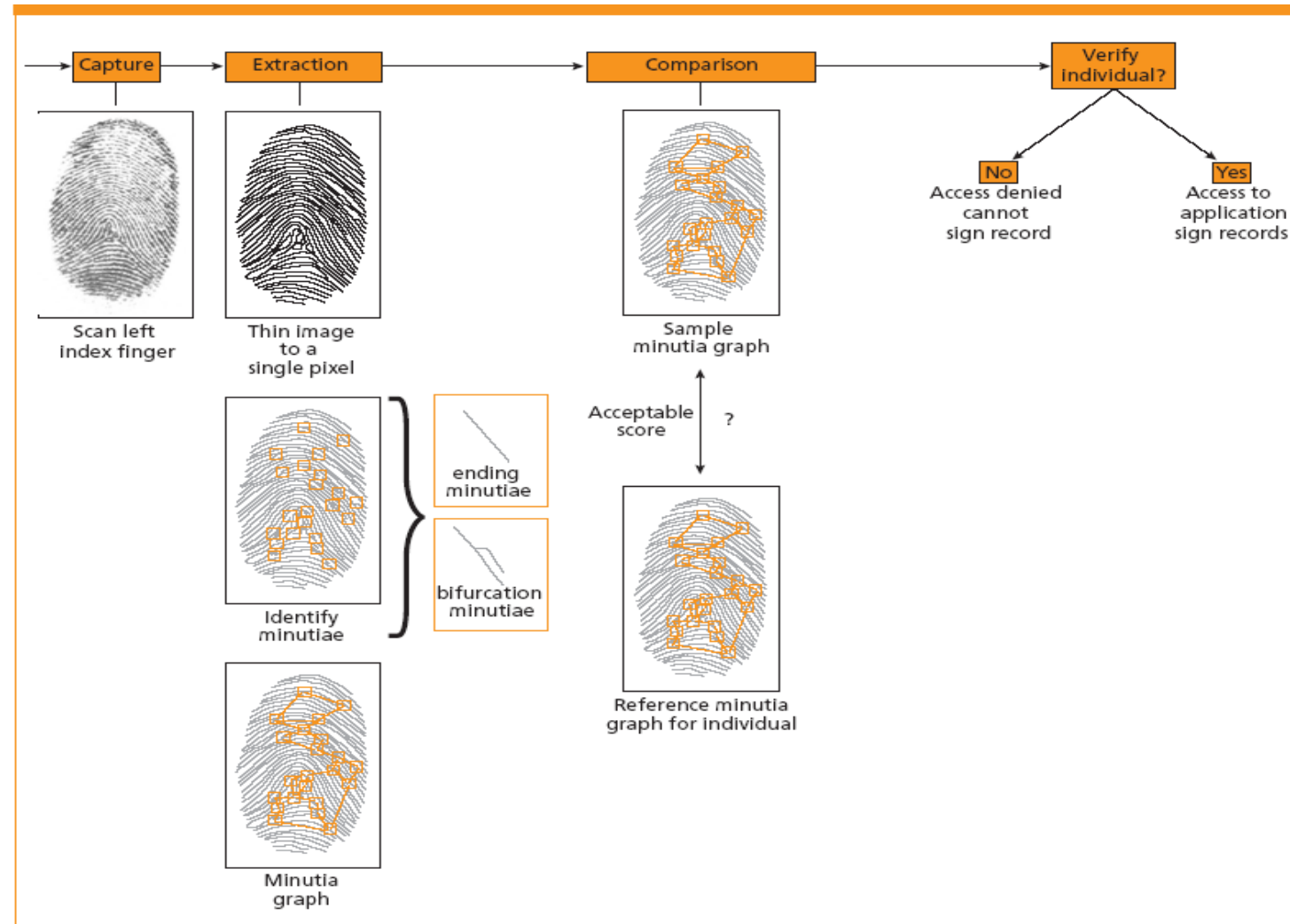


Ridge branch

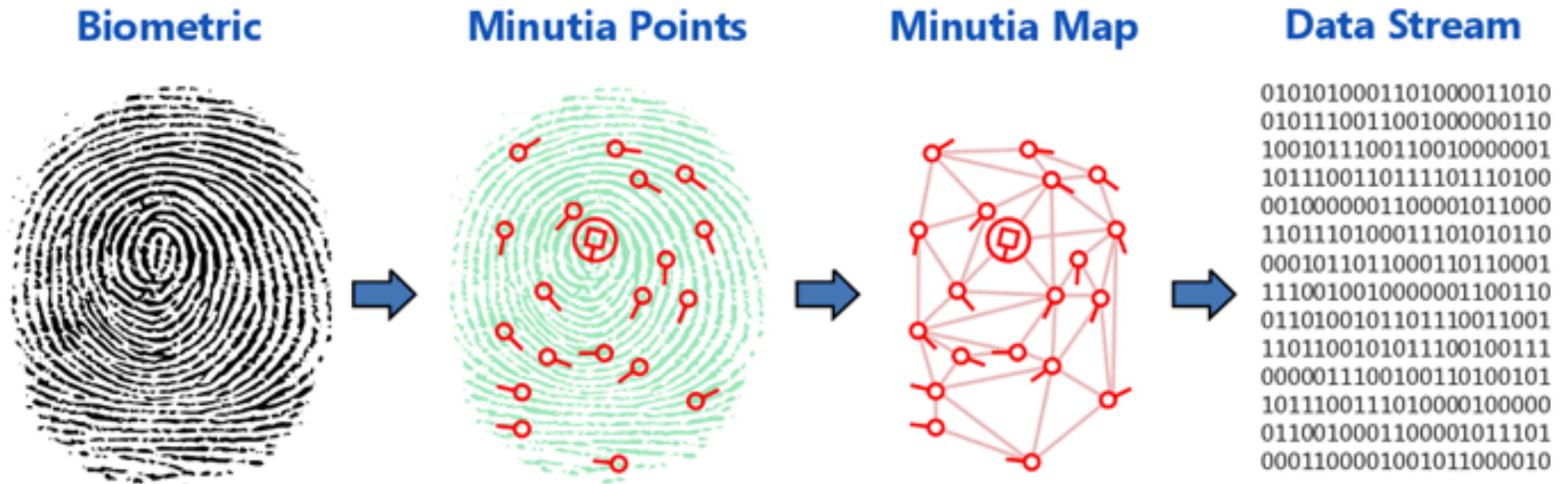


Ridge end

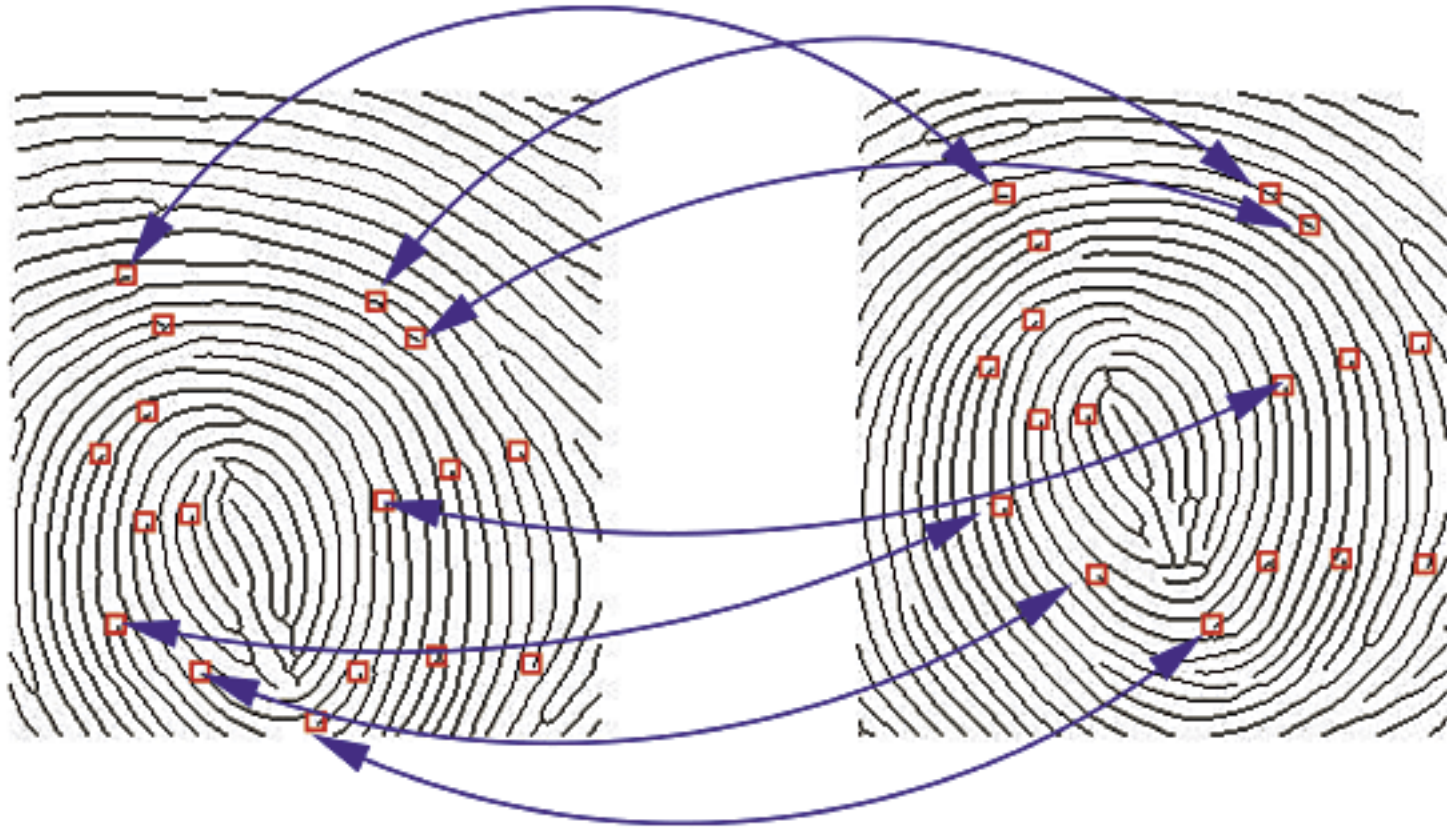
Minutiae Based Algorithm



Feature Extraction of Minutiae



Minutiae Comparison

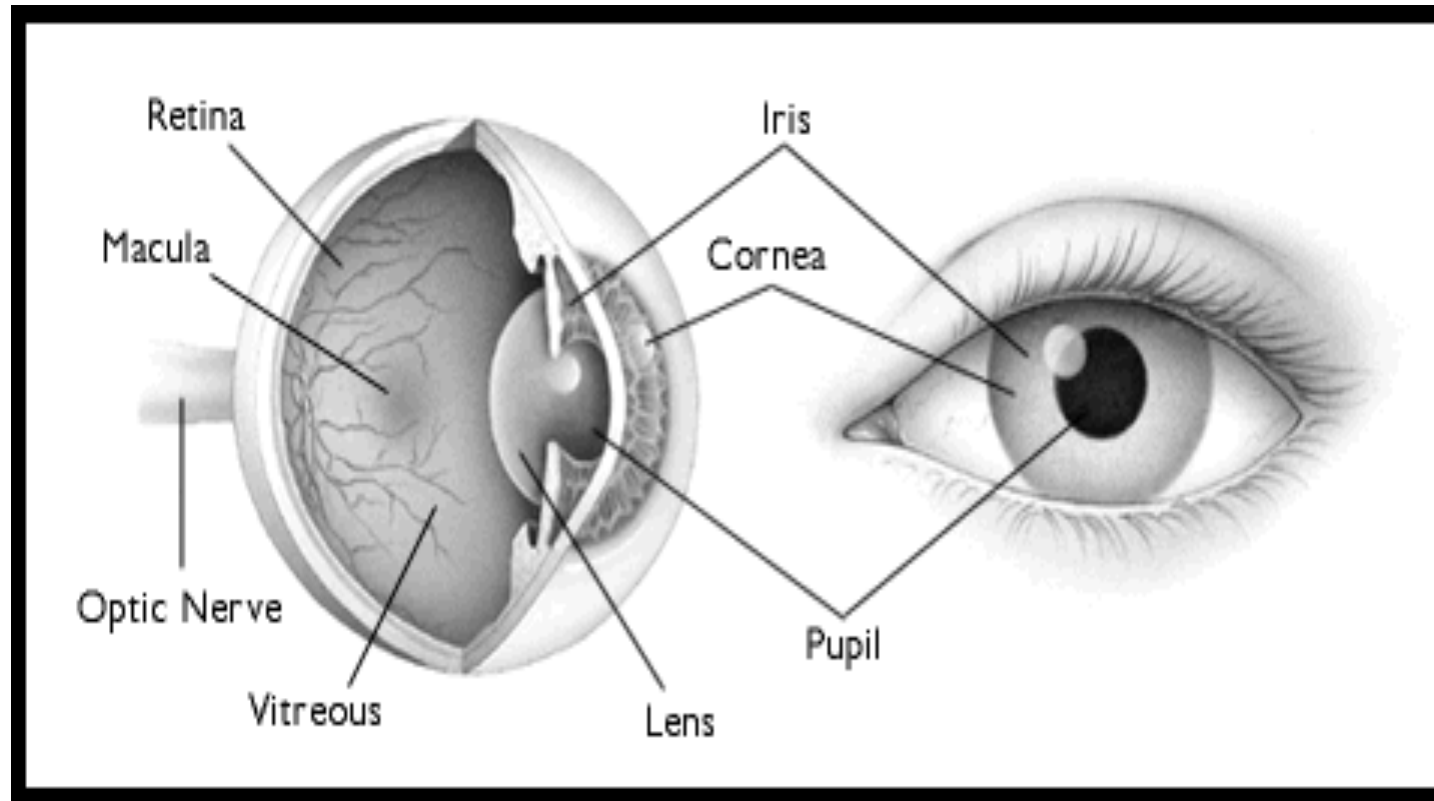


Iris scan

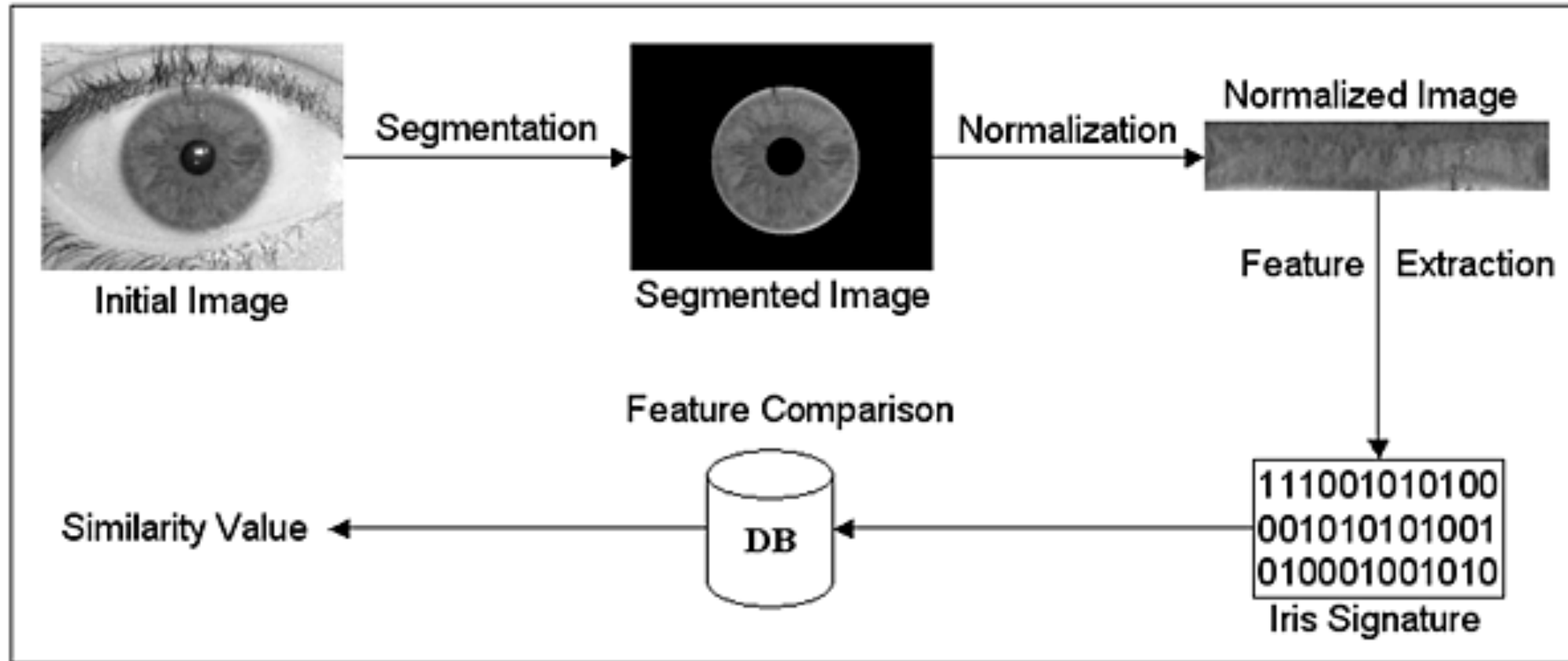


- Colored circle of eyes
- both visible and near-infrared light
- Contactless, fast
- operate at long distances

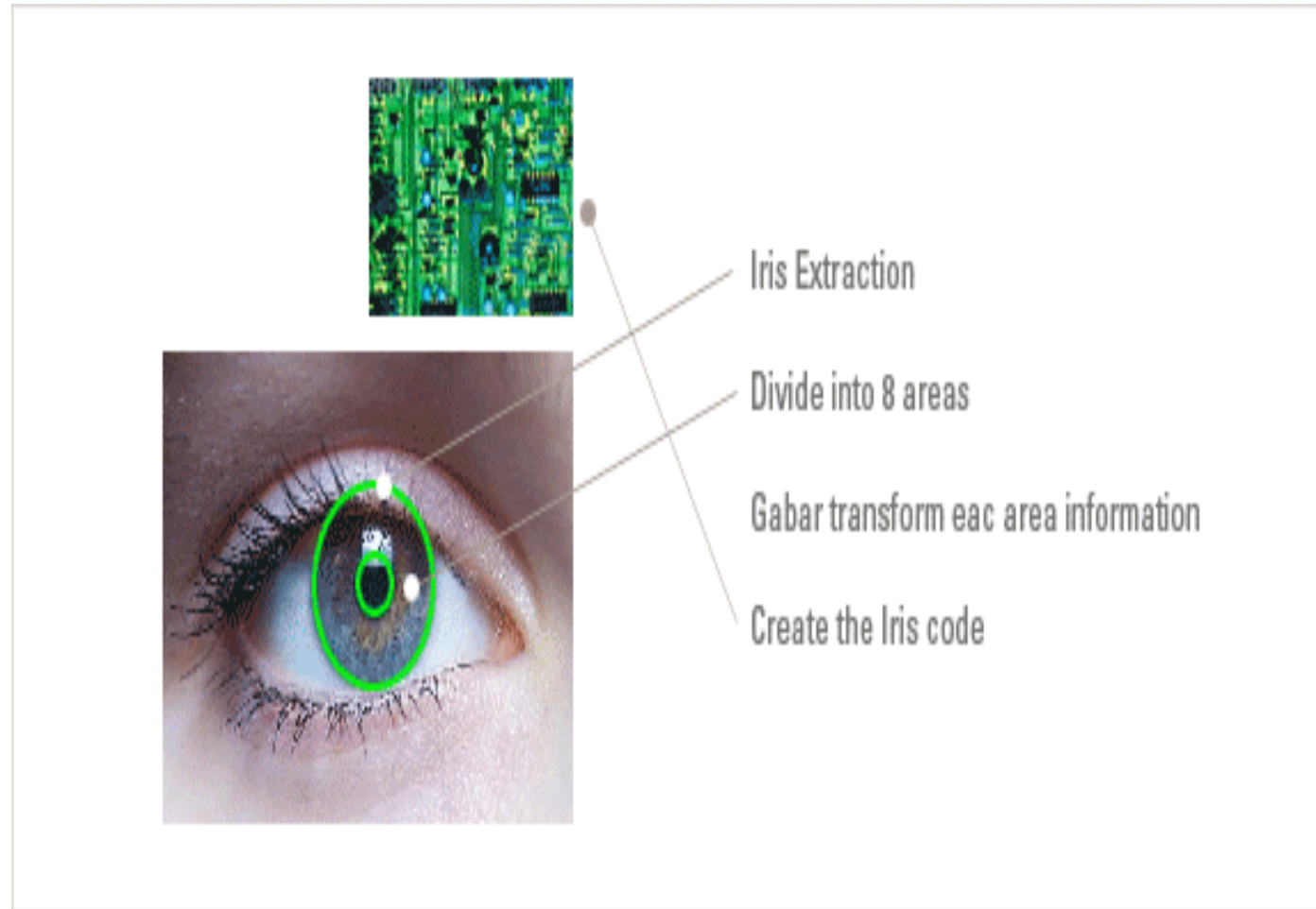
What is Iris ?



Iris Recognition Diagram

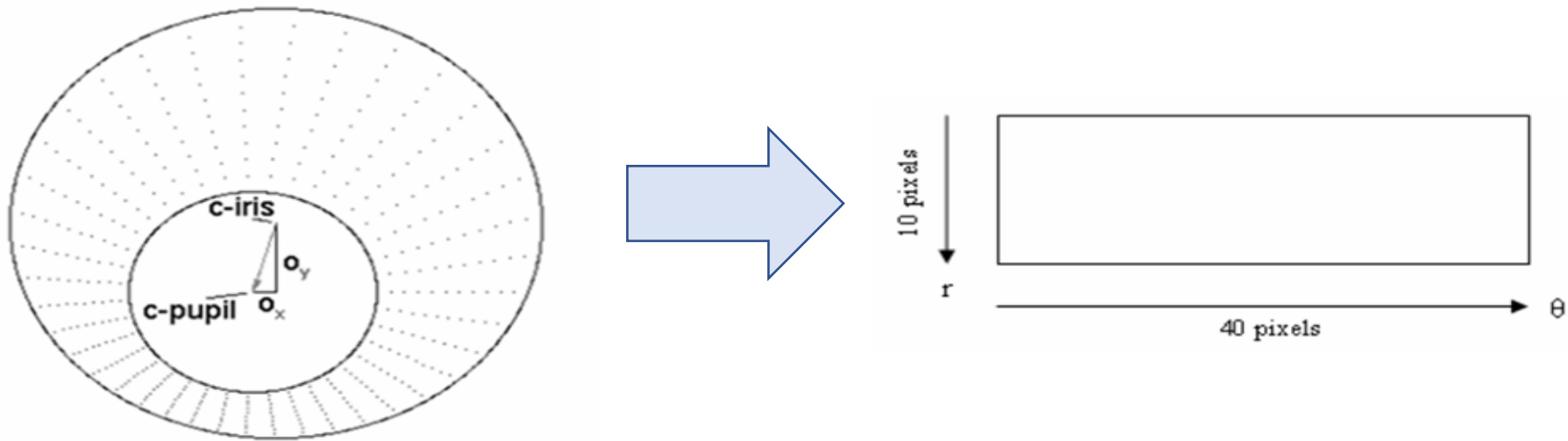


Segmentation(cont...)

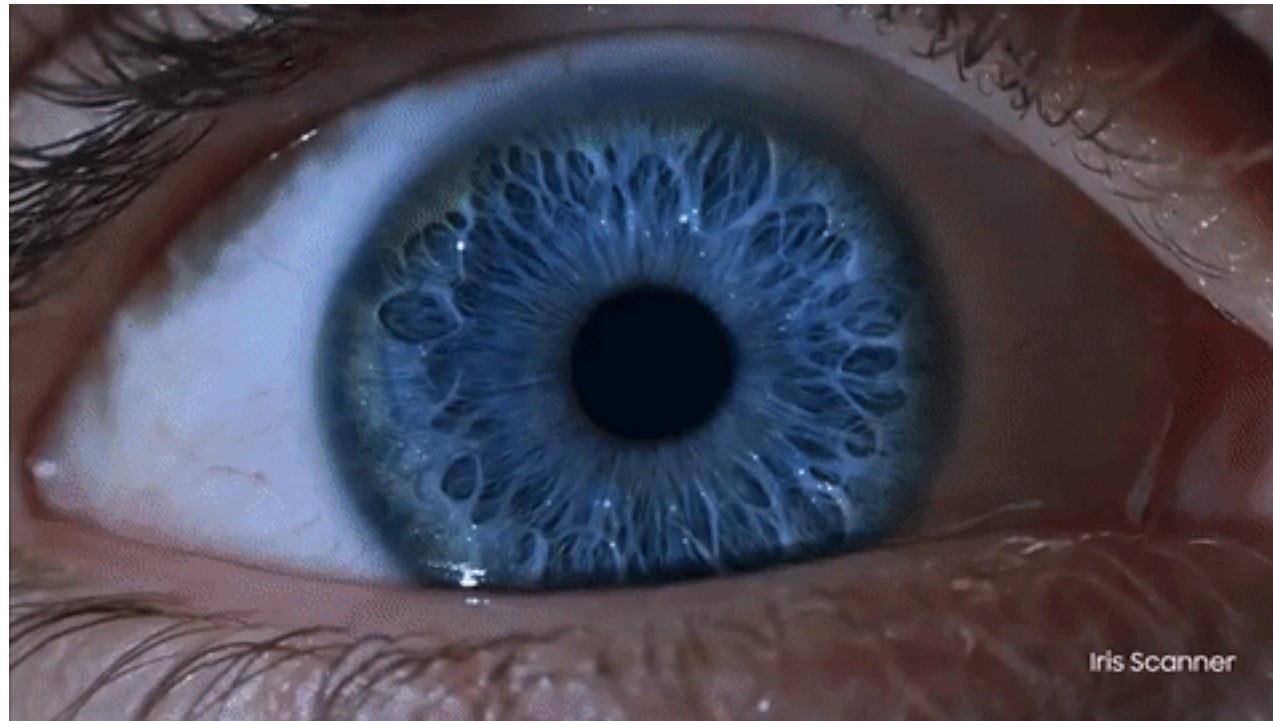


Normalization (cont...)

- Normalization produces a 2D array with horizontal dimensions of angular resolution and vertical dimensions of radial resolution.



Segmentation / Normalization



<https://giphy.com/gifs/magticom-3o6ZsSyWGqIJKX7nzO>

Face Recognition

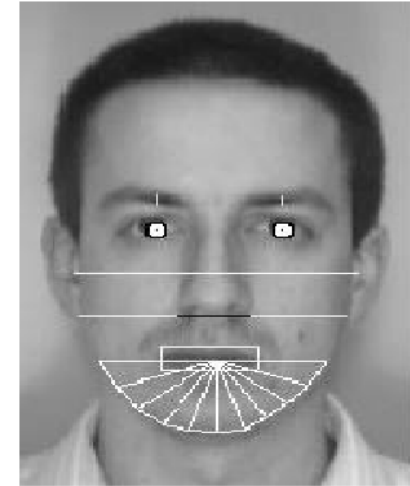
Geometric features

- Recognition possible at low resolution and at high noise levels because geometrical features such as nose width and eye separation are used
- Automated extraction of facial geometric features is very hard

Template matching

- Extract facial regions (matrix of pixels) and compare with that of known individuals
- Need templates for different face poses/views
- Very high dimensional data

Eigenface and Principal Component Analysis (PCA)

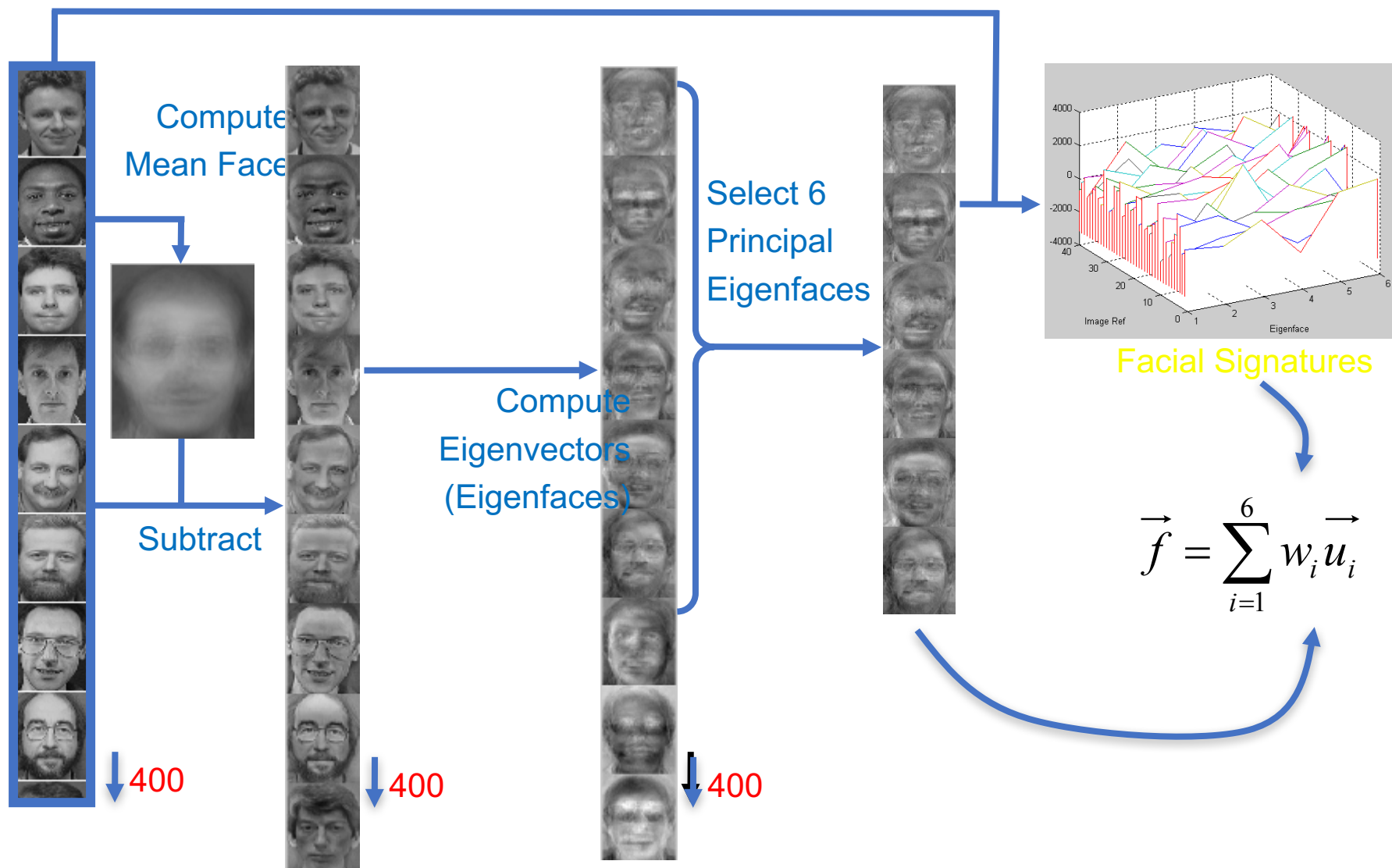


Eigenface Technology

- A set of Eigenfaces - two-dimensional face-like arrangements of light and dark areas, as shown to the right, is made by combining all the pictures and looking at what is common to groups of individuals and where they differ most



Face Recognition via PCA



Eigenfaces

- The eigenfaces $\mathbf{v}_1, \dots, \mathbf{v}_K$ span the space of faces
 - A face is converted to eigenface coordinates by

$$\mathbf{x} \rightarrow \left(\underbrace{(\mathbf{x} - \bar{\mathbf{x}}) \cdot \mathbf{v}_1}_{a_1}, \underbrace{(\mathbf{x} - \bar{\mathbf{x}}) \cdot \mathbf{v}_2}_{a_2}, \dots, \underbrace{(\mathbf{x} - \bar{\mathbf{x}}) \cdot \mathbf{v}_K}_{a_K} \right)$$

$$\mathbf{x} \approx \bar{\mathbf{x}} + a_1 \mathbf{v}_1 + a_2 \mathbf{v}_2 + \dots + a_K \mathbf{v}_K$$



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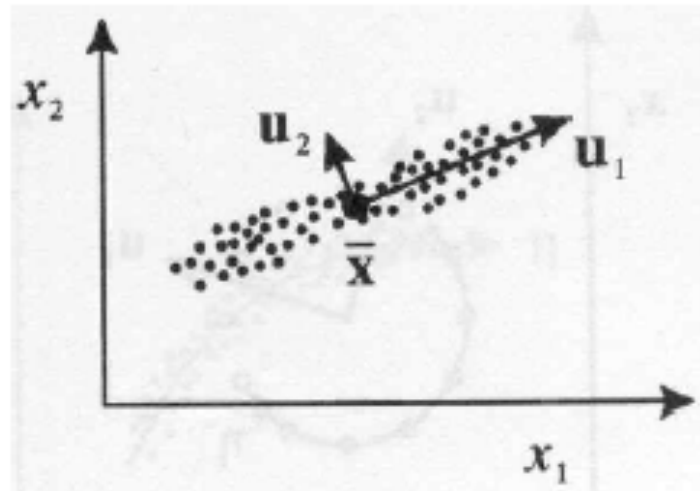
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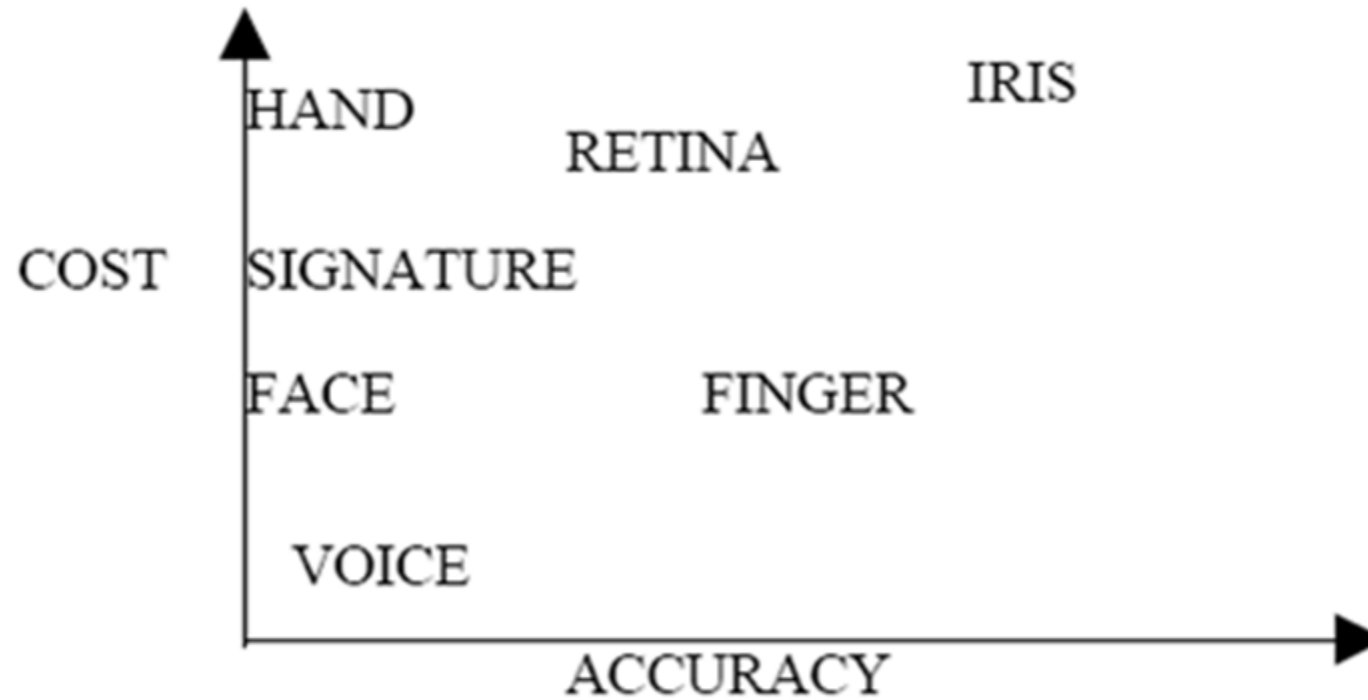


Principal Component Analysis (PCA)

- Geometric interpretation
 - PCA projects the data along the directions where the data varies the most.
 - These directions are determined by the eigenvectors of the covariance matrix corresponding to the largest eigenvalues.
 - The magnitude of the eigenvalues corresponds to the variance of the data along the eigenvector directions.



How difference?



Comparison between cost and accuracy

Any Questions?

- Thank you very much