

Biometric Databases and Evaluation

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Outline

1. What is biometrics ?
2. Needs for multimodal biometrics
3. Existing databases
4. Design issues of a multimodal biometric database
5. BIOMET : multimodal person authentication database
6. Coordination, standardization and evaluation
7. Conclusions and perspectives

1. What is BIOMETRICS ?

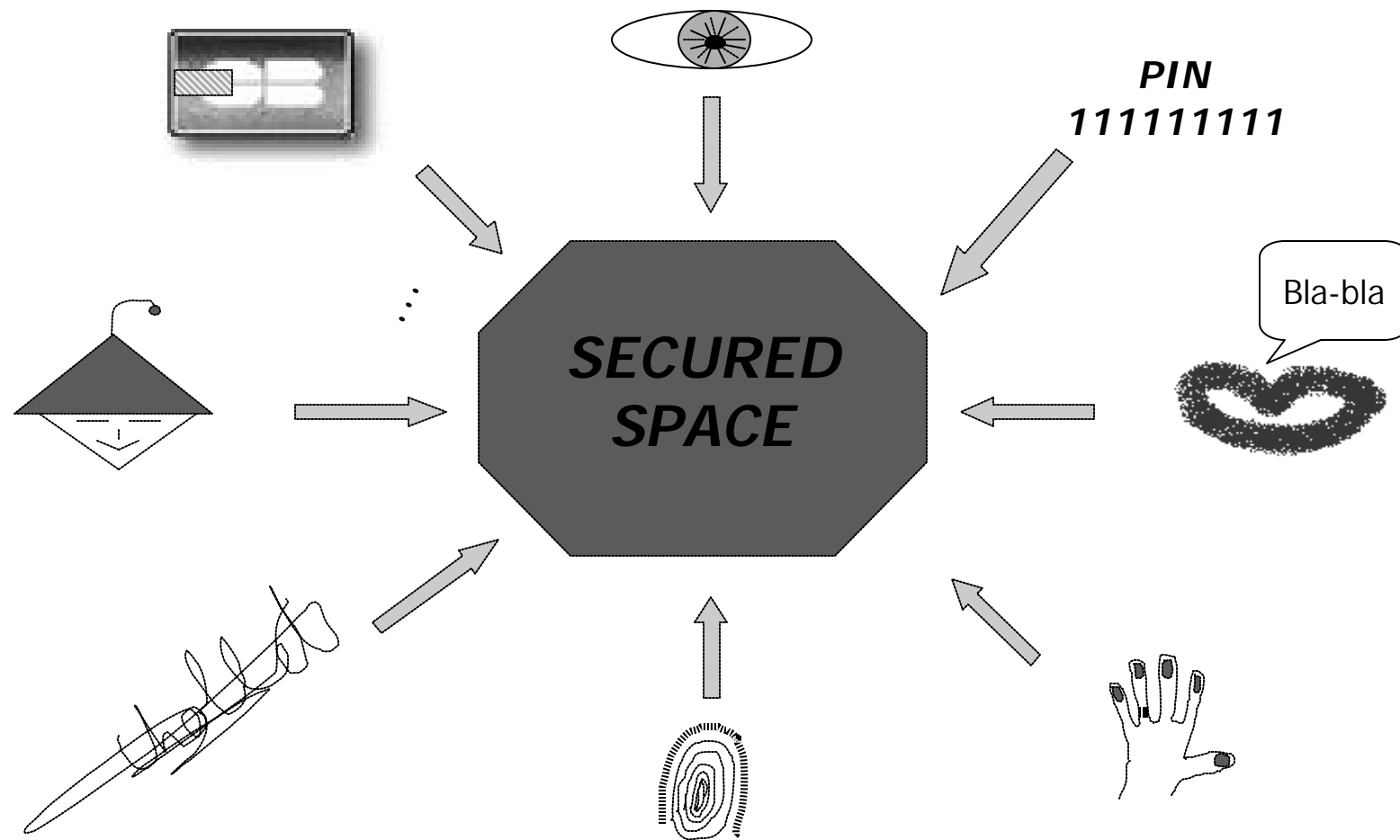
This term has several meanings :

- ◆ statistical and mathematical methods applicable to data analysis problems in the biological sciences
- ◆ Biometrics are automated methods of recognizing a person based on physiological or behavioral characteristic.

The second meaning is of concern here.

It is a hot topic for security and prevention of identity theft

1.1 Modalities for Person Authentication



1.1 Modalities for Person Authentication cntd.

- ◆ A device you own (key, smart card,...)

- A code you remember (password, ...)

- ◆ Could be lost or stolen

- ◆ Biometric-data:

- ▶ Physiological characteristics:

- ◆ Face, iris, fingerprint, hand shape, vein...

- ▶ Behavioral characteristics:

- ◆ Speech, signature, keystroke,...

- ◆ more common: for ex. speech is the preferred modality over the telephone
(but 'voice' is much more variable than fingerprints)

2. Needs for Multimodal Biometrics

- ◆ Mono-modal systems exist with variable performance
- ◆ Verification of identity should not be an additional burden to the user
- ◆ Biometric person authentication of people is based on their “biological data”
 - ▶ are more reliable (imposture more difficult)
 - ▶ More practical than using PIN codes, cards,...
- ◆ Why biometric person authentication is not deployed on a large scale ?
 - ▶ algorithmic performances are not robust
 - ▶ implementation cost
 - ▶ acceptance by the users (human factor)
- ◆ Answer: fusion of monomodal systems for person authentication
 - ▶ better performance
 - ▶ people can choose their preferred authentication system
 - ▶ adaptability for specific applications
(mouse +fingerprint, video surveillance + face, telephone +speech....)

3. Existing multimodal databases and evaluation schemes

Existing Database - modality – evaluation - reference system :

(not an exhaustive listing)

- ▶ NIST - audio
 - ◆ publicly available - yearly evaluations (since 95)
- ▶ FVC - fingerprint -
 - ◆ biannual evaluations (2000, 2002, 2004)
- ▶ XM2VTS – face and speech -
 - ◆ publicly available
- ▶ MCYT- fingerprint and signature -

◆ BIOMET multimodal person authentication database

4. Design issues for multimodal biometric databases

Technical and practical issues:

- ◆ Intra- and inter-person variability
- ◆ Temporal variability
- ◆ Environmental conditions
- ◆ Capture devices variability
- ◆ Sensor-Software compatibilities
- ◆ Intentional imposture (liveness detection)

Legal issues:

- ◆ Insure the non disclosure of the real identity of the subject (quite difficult for face and signature)
- ◆ Assuming there is little correlation between the modalities, it is possible to create "chimerical" clients that is reference templates for each modality of such client come from different real persons.

5. BIOMET Database

- ◆ An extension of the M2VTS and DAVID projects (audio-video data) to include such modalities as signature, fingerprint, and hand shape
- ◆ BIOMET-I database creation was initiated by French GET
 - ◆ GET is the owner of the database
 - ◆ Still in the validation phase (annotation, common protocols)
 - ◆ Most probable distribution mode: ELDA
- ◆ BIOMET -II (new acquisition campaign-Swiss NF funding)
 - ◆ Duplication of the acquisition BIOMET-GET acquisition platform
 - ◆ Problems with evolving sensors
 - ◆ Data acquisition not yet effective
- ◆ BIOMET-III (future campaign in INT-EVRY)

5. ...

- ◆ Advantage of multi-site acquisition platform:
 - ◆ combination of the data
 - ◆ sharing of the reference systems ...
 - ◆ bigger size of the combined databases (100+ 100 + 100 +)
 - ◆ more variability
 - ◆ sharing of the development efforts and experience

5.1 BIOMET-I: general database description

- ◆ 5 different modalities :
 - ◆ audio
 - ◆ video (face)
 - ◆ hand geometry
 - ◆ signature
 - ◆ fingerprints
- ◆ 3 sessions (3 and 5 months spacing)
- ◆ 130, 106 and 91 persons in each session
(temporal variability for 91 subjects)
- ◆ balanced female-male data
 - ▶ age of subjects : 20 – 65 years
 - ▶ 10 % students (mean age 20)

5.2 BIOMET : Audio-video data

3 different cameras used (one conventional and 2 more research based systems)

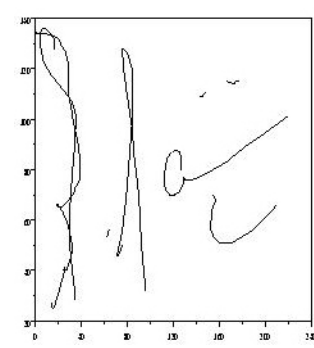
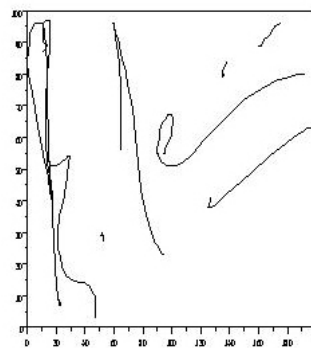
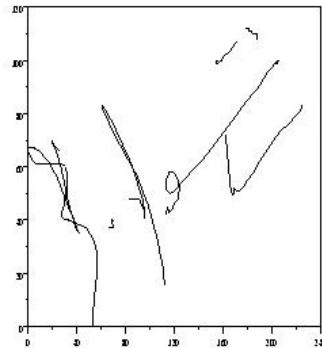
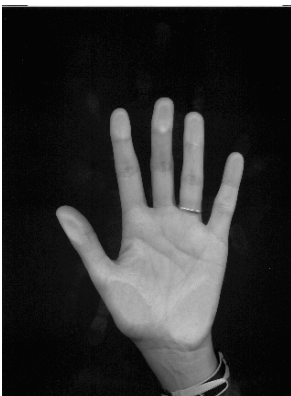
- ◆ commercially available digital camera (SONY DVR-TR20-E)
 - ▶ audio data with build in micro during the frontal face acquisition (French digits + phonetically balances sentences)
 - ▶ video shots (1.5 min mean duration) : frontal, turn to left and right (slightly), down, up, left and right profile
- ◆ IR camera (to diminish the influence of lightening conditions)
 - ▶ home-made camera with frontal images (1 image/s)



- ◆ Face images acquired with a 3D acquisition system
 - ▶ (research prototype)

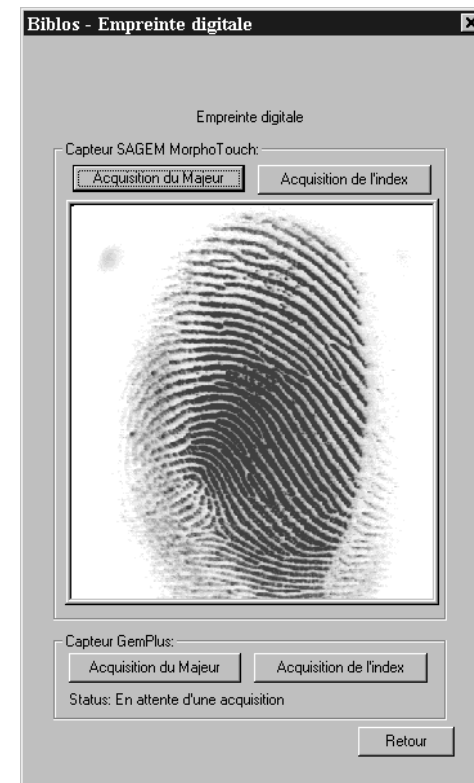
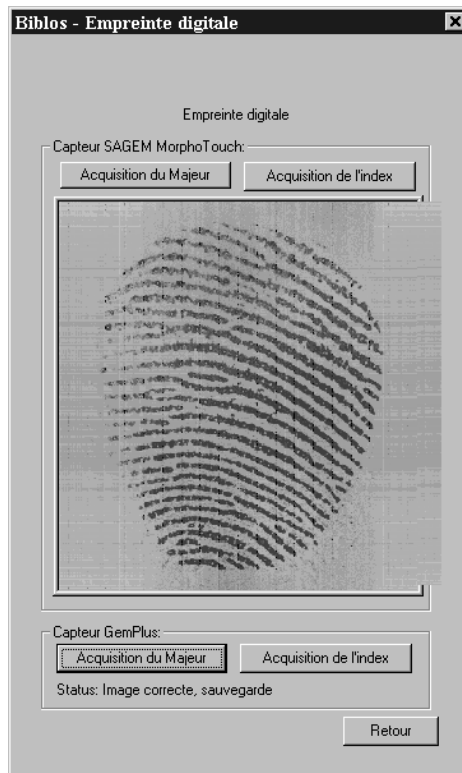
5.3 BIOMET : Hand images and signature

- ◆ Hand images acquired with a scanner (2 dim images, with visible palm prints)
 - ▶ images of the left hand taken only (5 images acquired during the 3 sessions)
- ◆ Signature data
 - ▶ on-line capture (x,y, pressure, azimuth, altitude of the pen)
 - ▶ of-line capture (ink pen)
 - ▶ problem: impostor signatures simulated by other persons: 15 genuine and 17 impostor signatures (5 different impostors, no professional imitators)
 - ▶ example: genuine signature and two imitations



5.4 BIOMET : Fingerprints

- ◆ 2 sensors : capacitive (left image) and optical (right image)
- ◆ 6 middle and 6 index fingerprints (during the 3 sessions)



6. Coordination, Standardization and Evaluation

- ◆ European Biometric Forum
- ◆ Open source software of reference systems
 - ▶ ELISA
- ◆ Distribution of multimodal biometric databases
- ◆ Elaboration of evaluation protocols
- ◆ Availability of scores for fusion purposes
- ◆ Organization of worldwide evaluation campaigns
- ◆ Contributions to norms and standards

7. Conclusions and Perspectives

- ◆ BIOMET-GET database is in its validation phase (annotation, common protocol design)
- ◆ FUTURE:
 - ▶ reference systems
 - ▶ research workshops
 - ▶ evaluation campaigns
 - ▶ additional data sets on different sites (Uni Fribourg, INT-Evry)
 - ◆ new sensors
 - ◆ new modalities (iris)
 - ◆ we could make it a moving acquisition platform