Skin diseases in fingerprints

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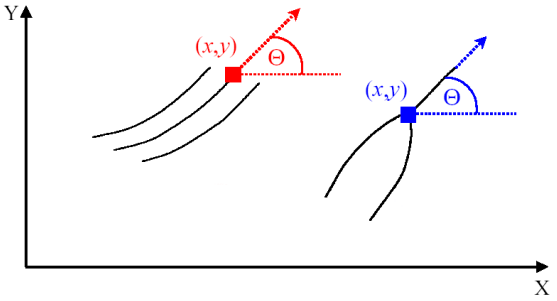
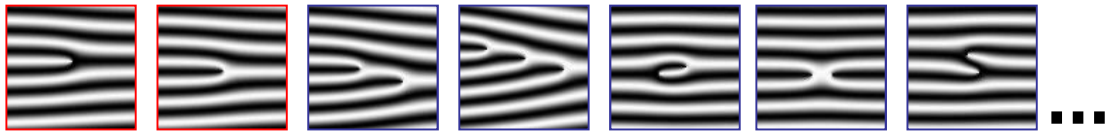
April 2017

Fingerprints – technology principles

- Fingerprint technologies

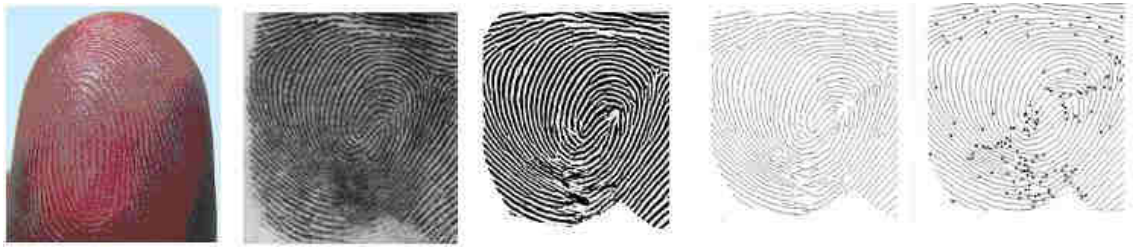


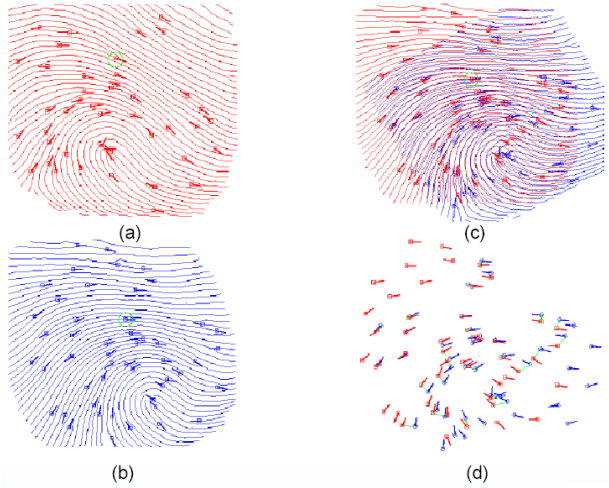
- Minutiae



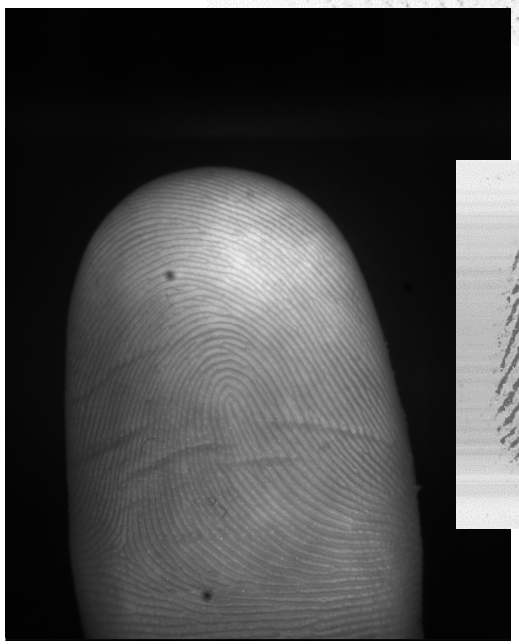
Stored *n* quadruples $\{x_i, y_i, t_i, \theta_i\}$, $i=1..n$

- Recognition process





Fingerprints – high quality samples



Finger(print) fakes – spoofing I.

Suprema SFM 3020
(fake – rubber stamp)

Synthetic fingerprints (SFinGe)

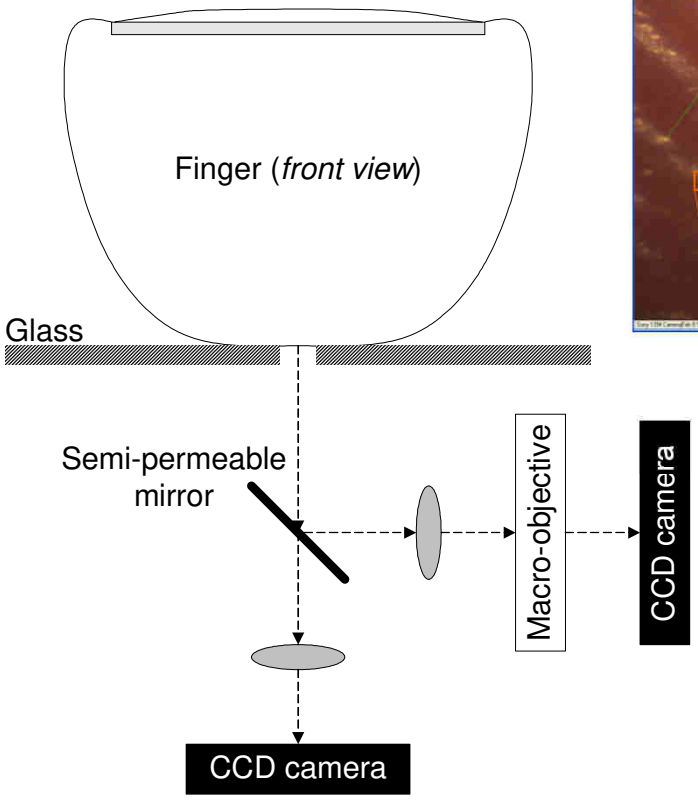
Artificial fingers

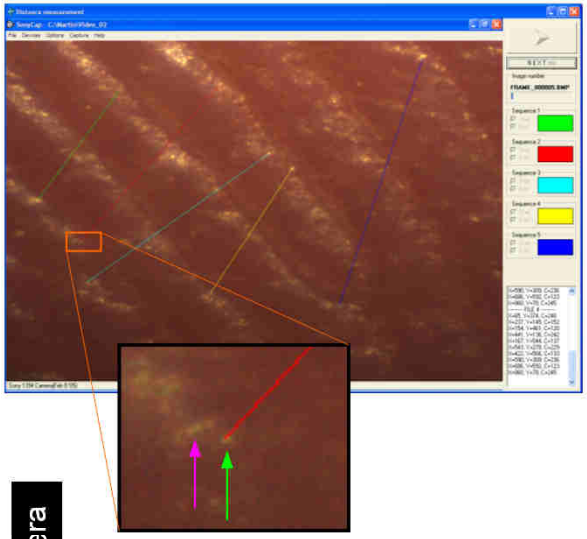
Fake fingerprints of various materials

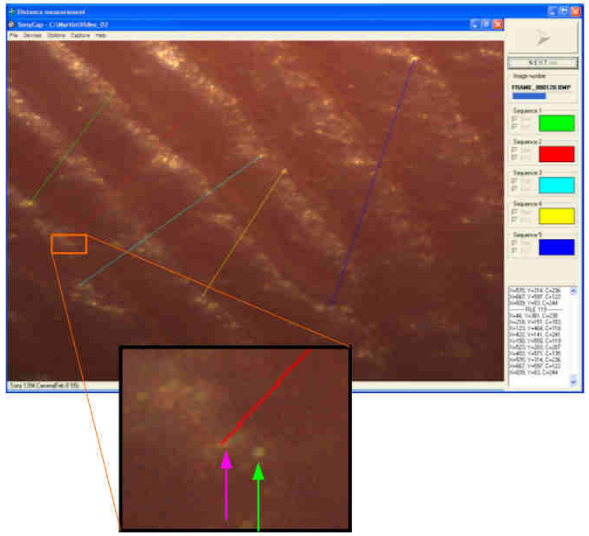
Finger(print) fakes – spoofing II.

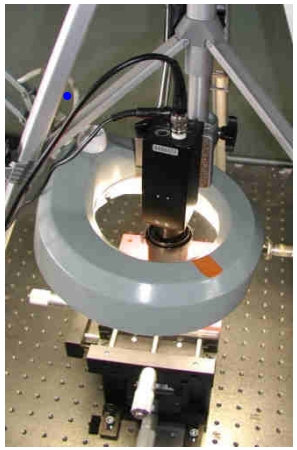
Liveness detection = anti-spoofing I.

- **We have some international and national patents and utility models in this area**



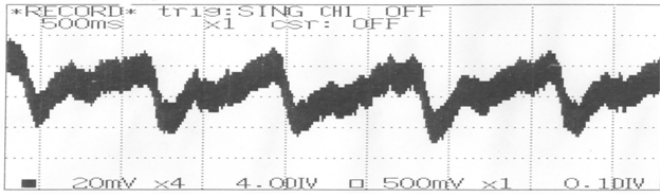




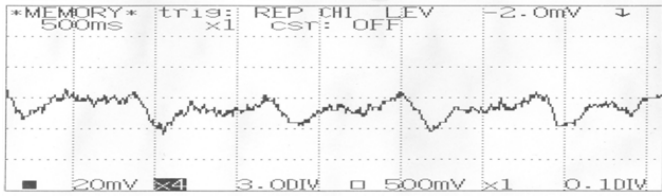


Liveness detection = anti-spoofing II.

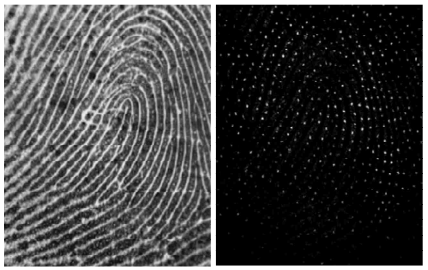
- Sweat detection



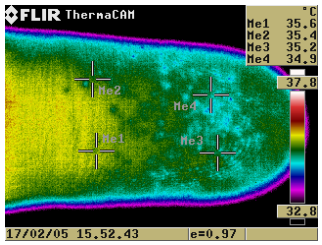
- **Heart activity detection**



- Ultrasound principle / tomography

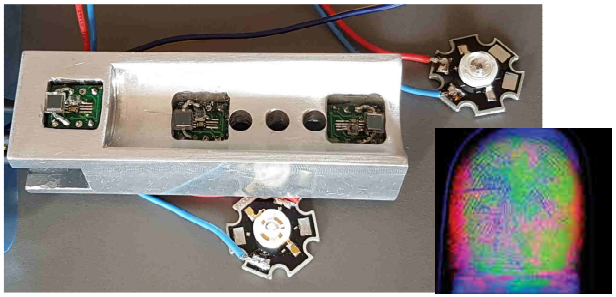


- **Temperature** (stimulus)

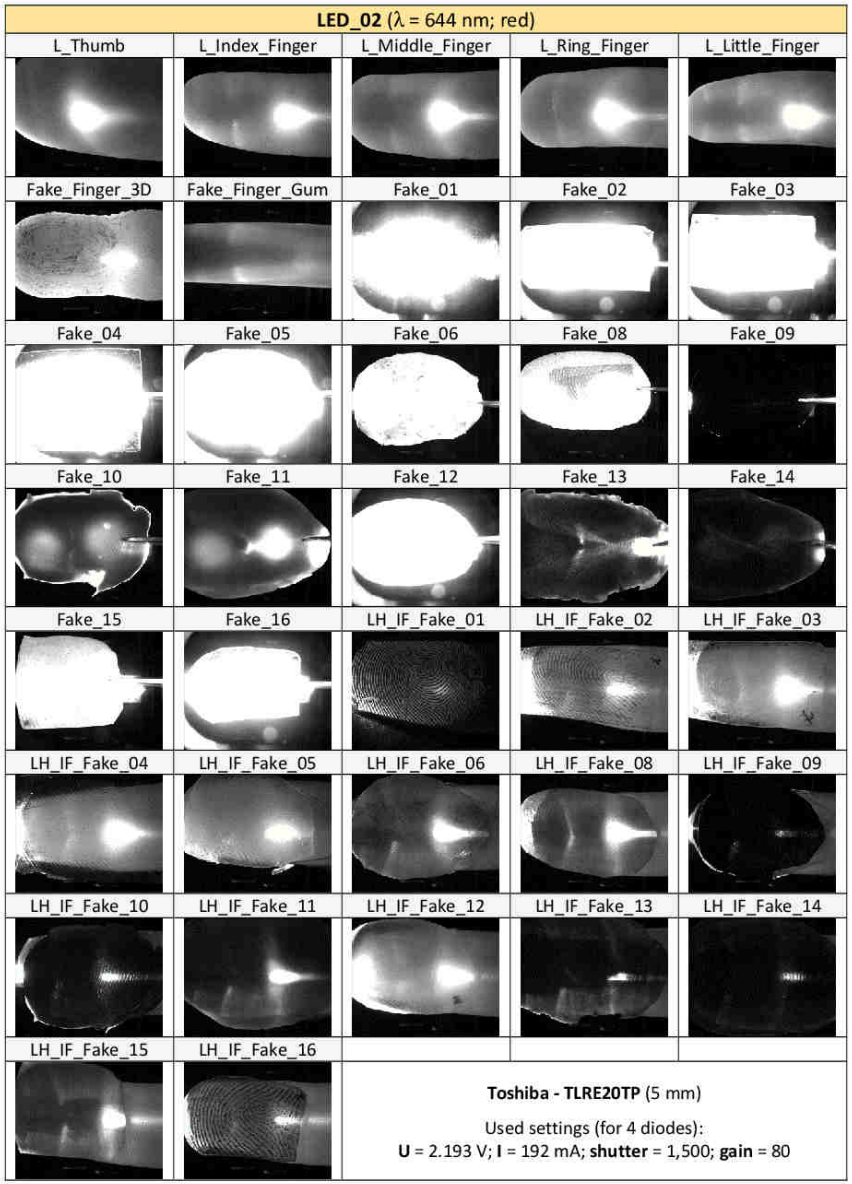


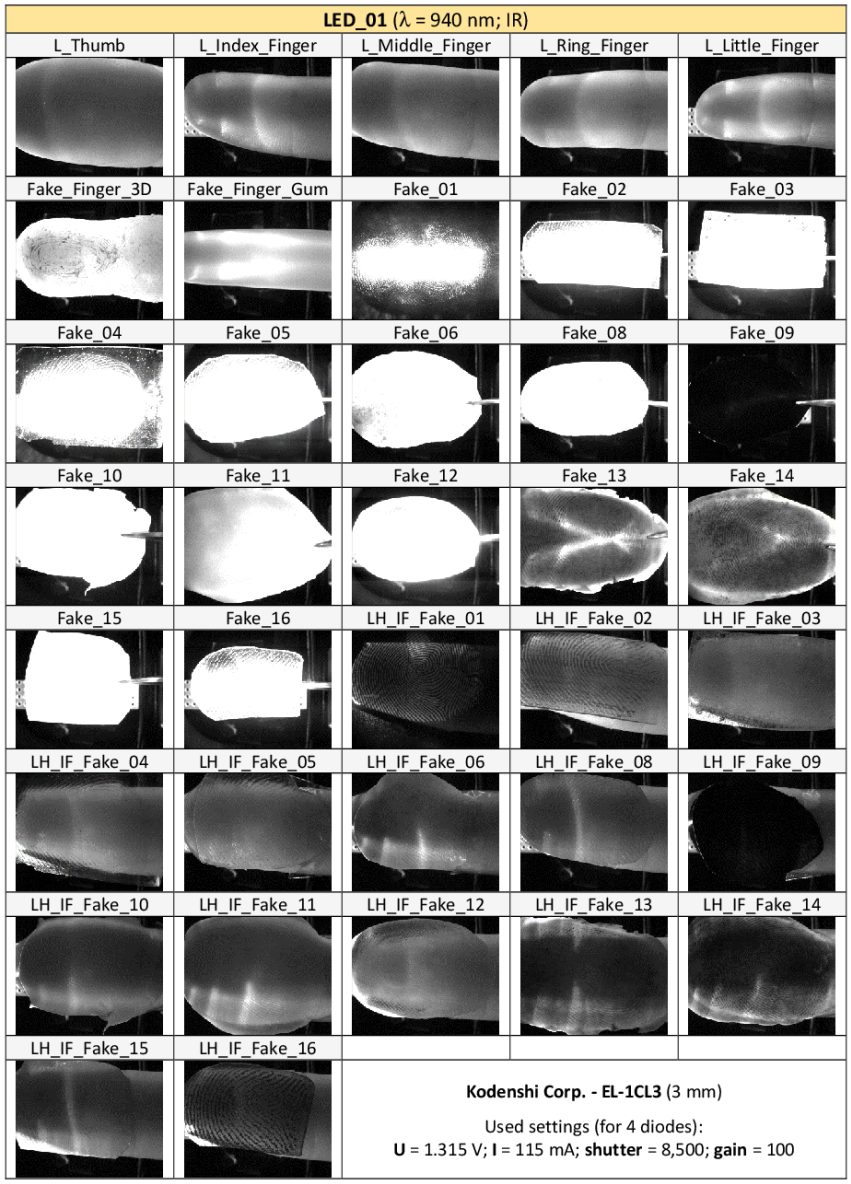
- **Skin elasticity / Skin color**

- **Multispectral properties** (acquirement of DB + patent)

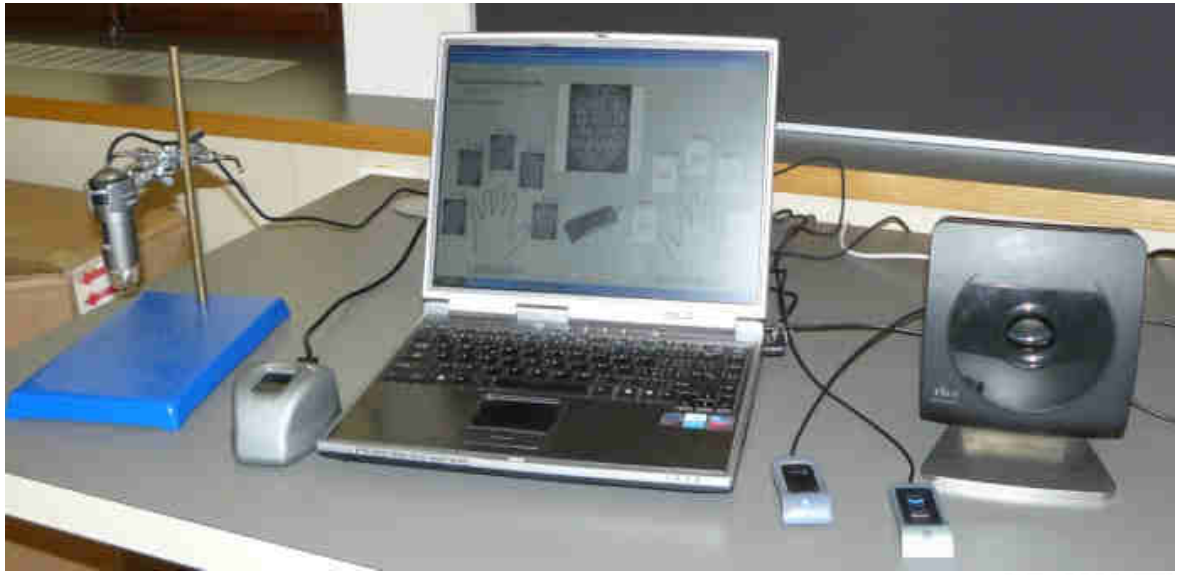


Liveness detection = anti-spoofing III.





Influence of **skin diseases** on fingerprints I.



Over 2,400 FPs

a) CRD

b) CRD

c) E500

d) EII

e) MSO

f) DIN

Psoriasis – a partial seizure.

a) MSO

b) MSO

c) E500

d) EII

e) CRD

f) DIN

Fingertip eczema – a light form.

a) CRD

b) CRD

c) E500

d) EII

e) MSO

f) DIN

Dyshidrosis.

a) CRD

b) CRD

c) E500

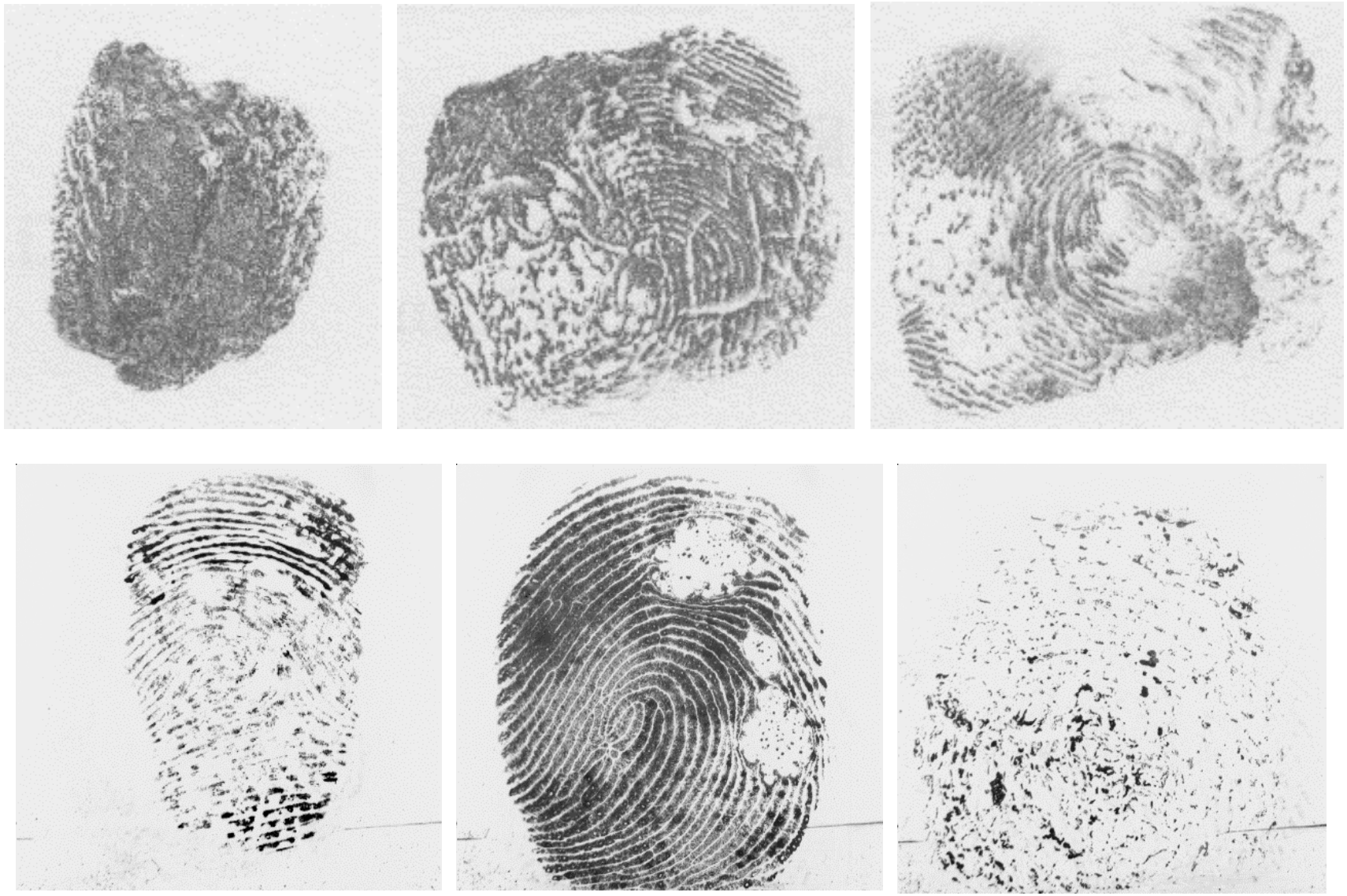
d) EII

e) MSO

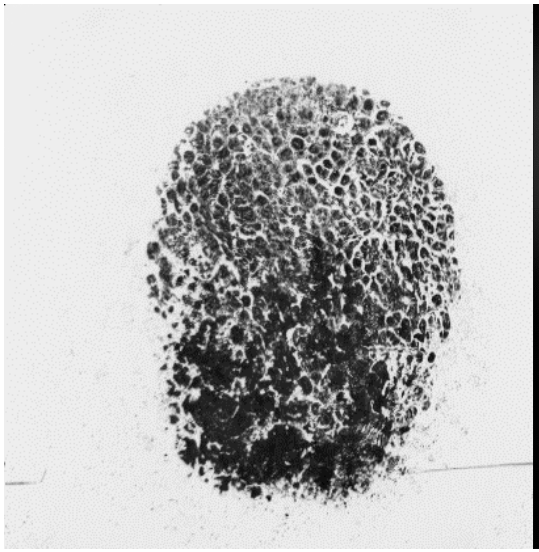
f) DIN

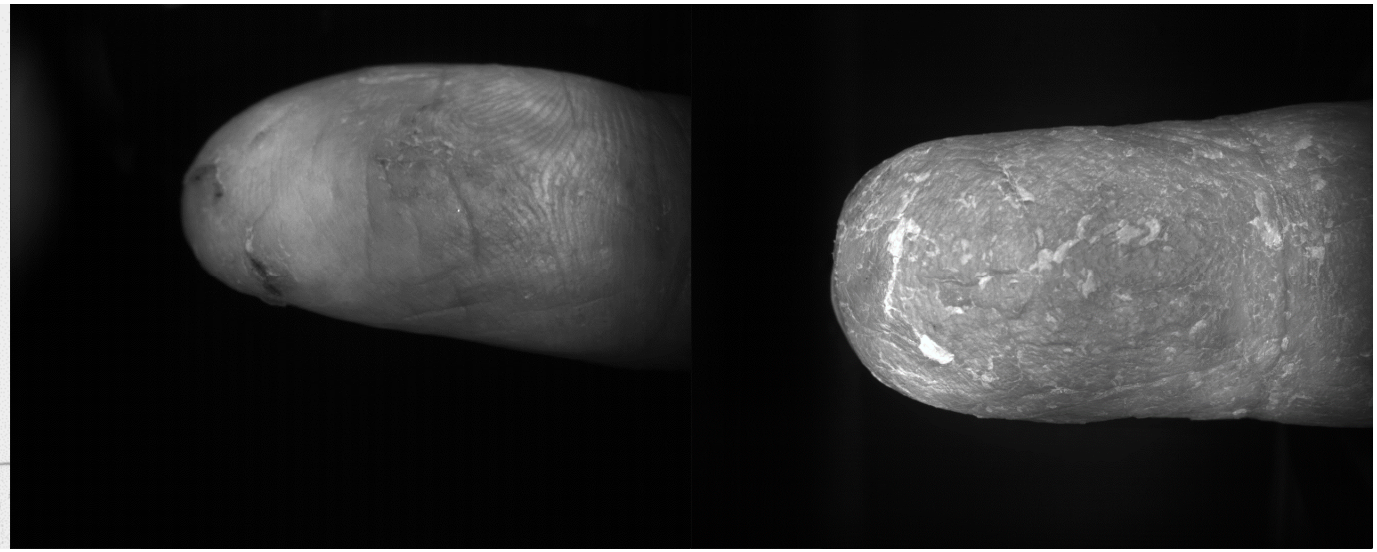
Verruca vulgaris.

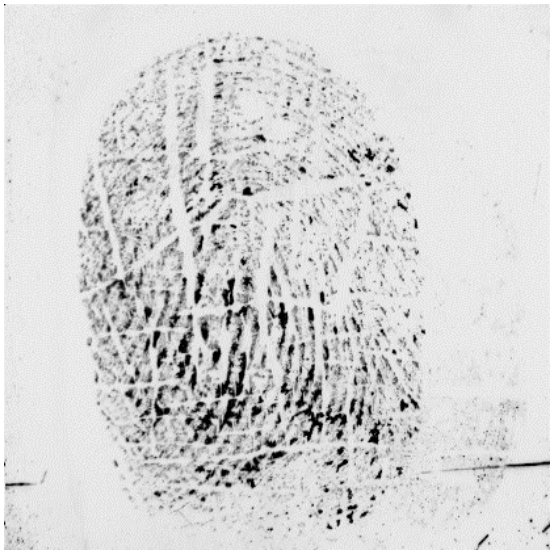
Influence of **skin diseases** on fingerprints II.



Influence of **skin diseases** on fingerprints III.

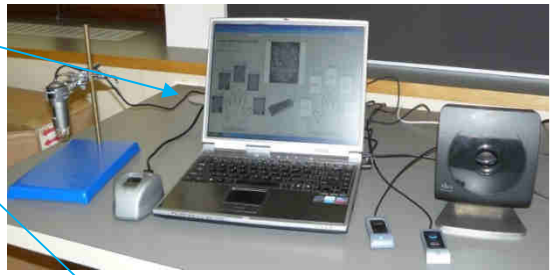


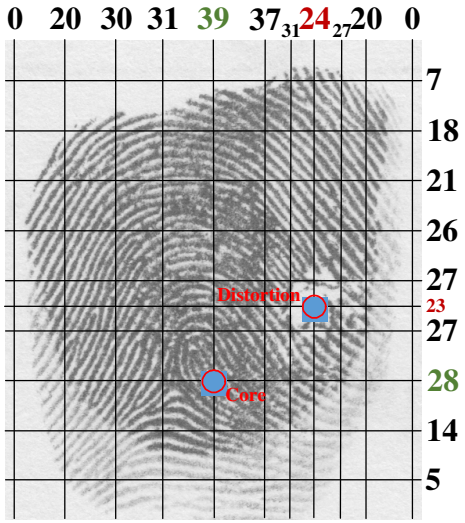


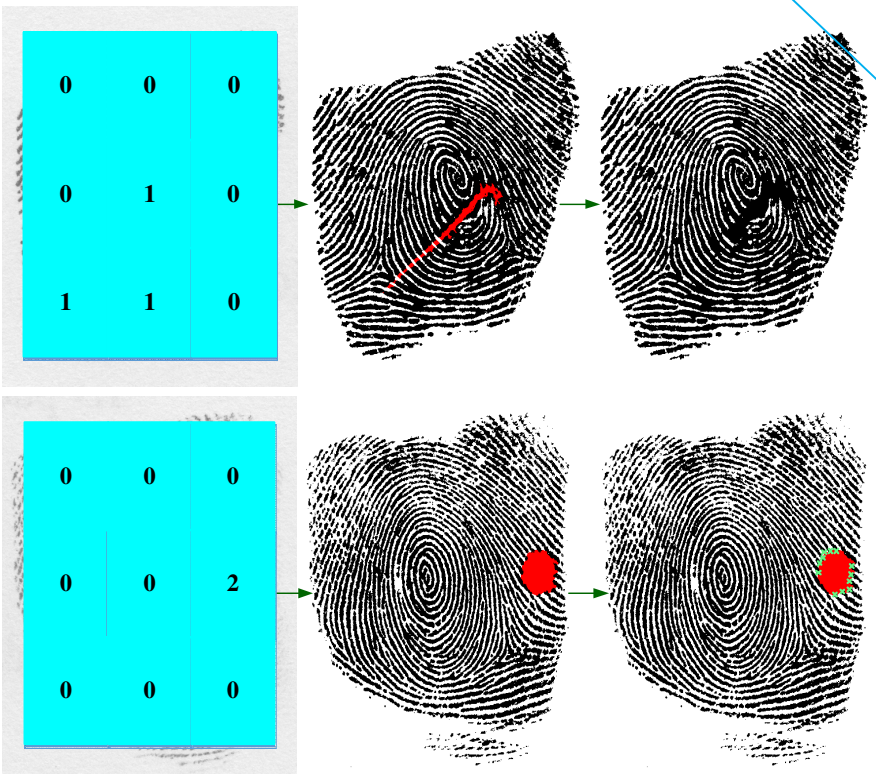


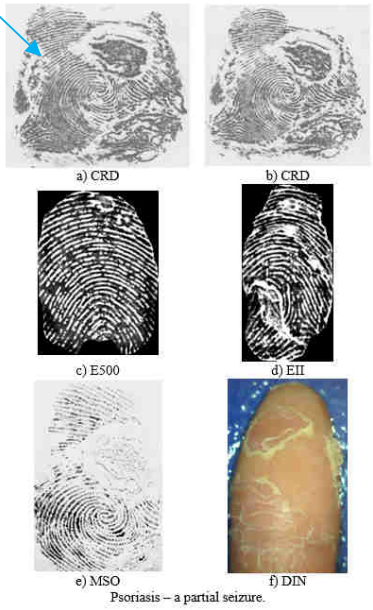
Influence of **skin diseases** on fingerprints IV.

- **Histopathologic changes**
- **Change of skin color**
- **Histopathologic changes and color change**
- **We have internationally unique DB**
- **Algorithms for detection and recovery**









Psoriasis – a partial seizure.

- Liquids used in daily life
  - Strong influence

Reference

Shower gel

Dish gel

  - Little influence

Reference

Hand-cream

Detergent

- Troubles in getting damaged fingerprints
- Very specific fingerprints

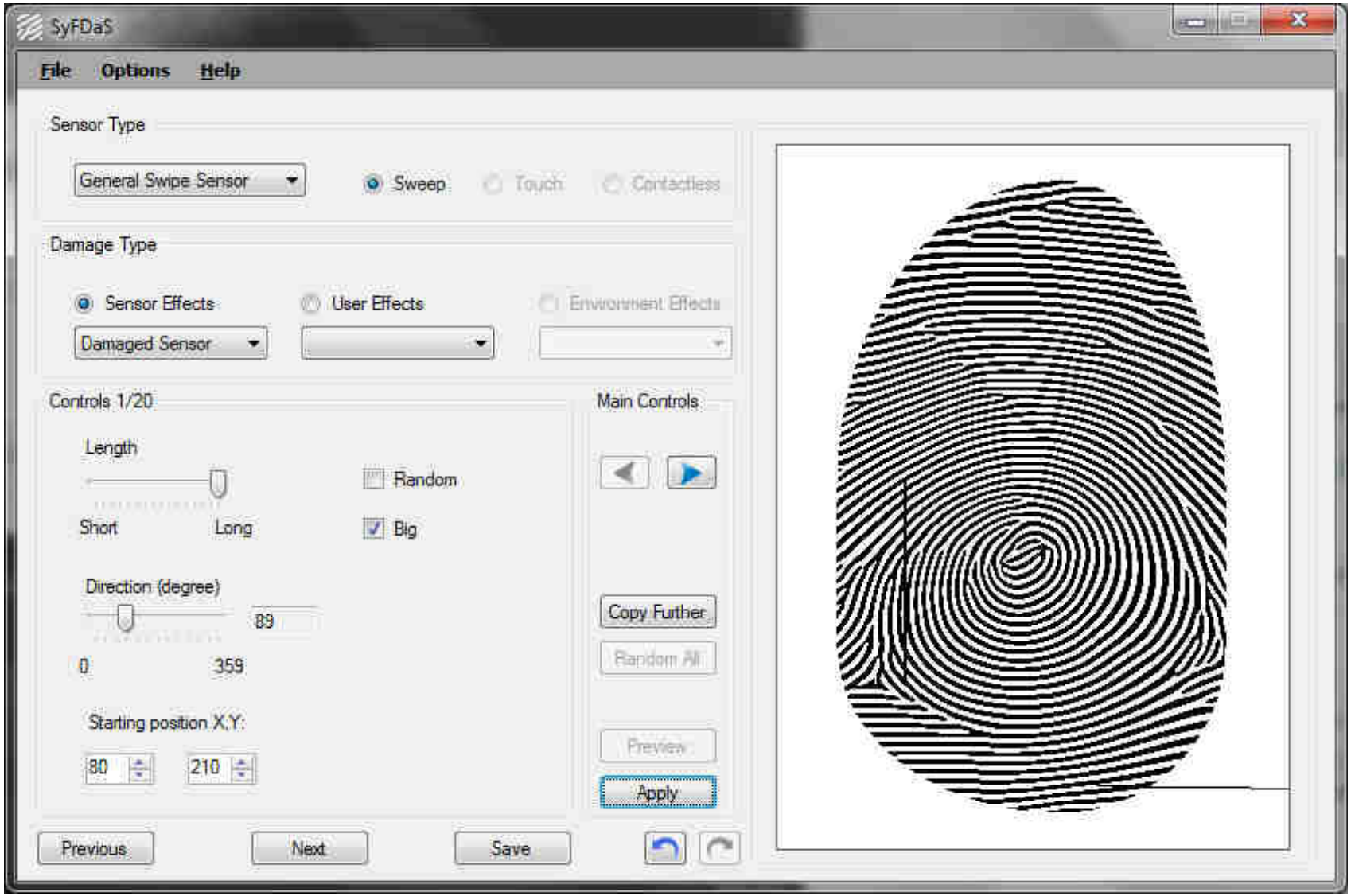
- This is an inverse biometric task

- Could be generated from random minutiae points or from template!

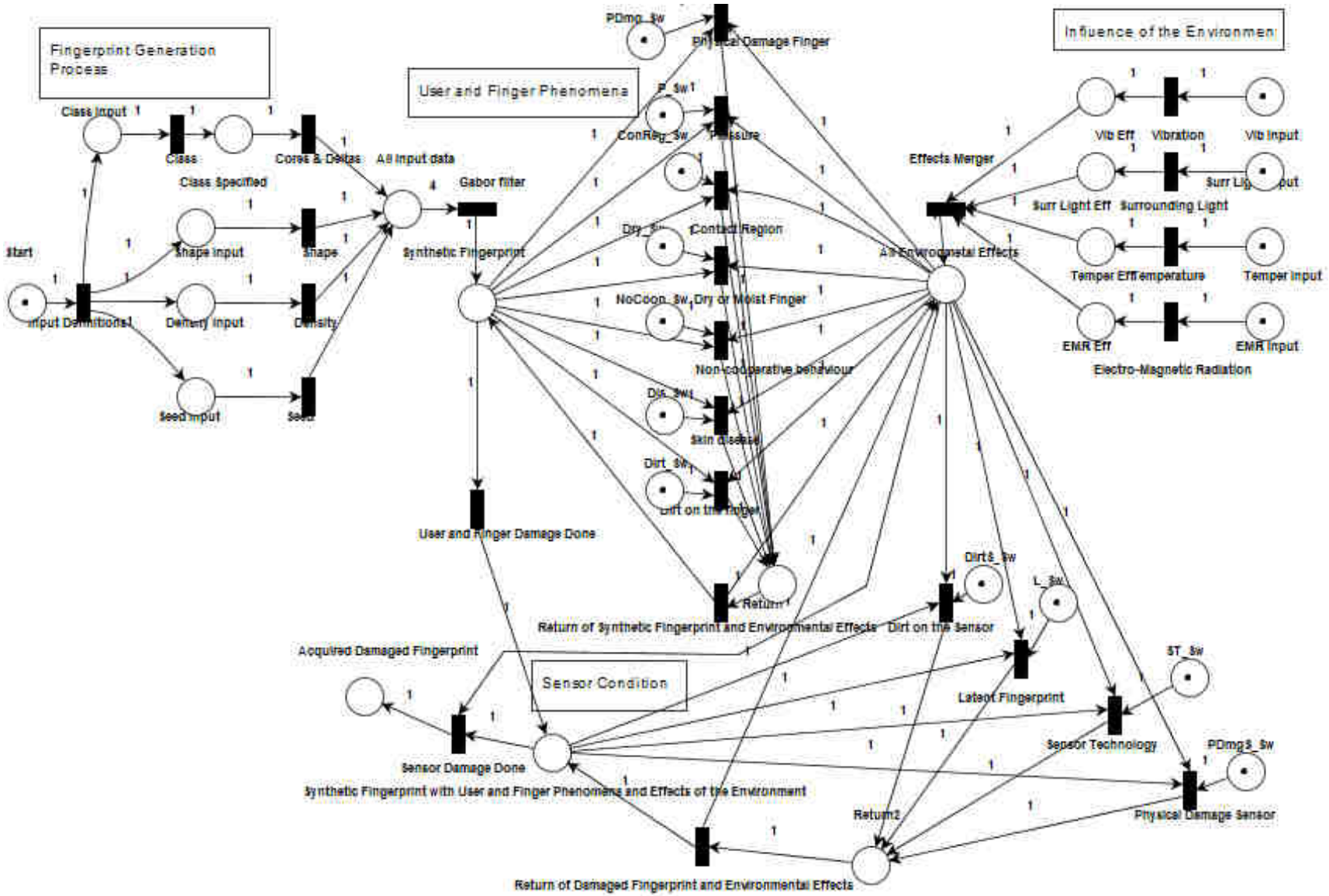
Synthetic fingerprints – generation II.

- Application **SFinGe**
  - biolab.csr.unibo.it/sfinge.html
  - Generates very real fingerprints
- Application **Anguli**
  - http://dsl.cds.iisc.ac.in/projects/Anguli/
  - Similar principle to SFinGe
  - Quick generation of large-scale DBs
- **Our own application**
  - Generation using minutiae points
  - Damage/disease is a library
  - Many various damages/diseases

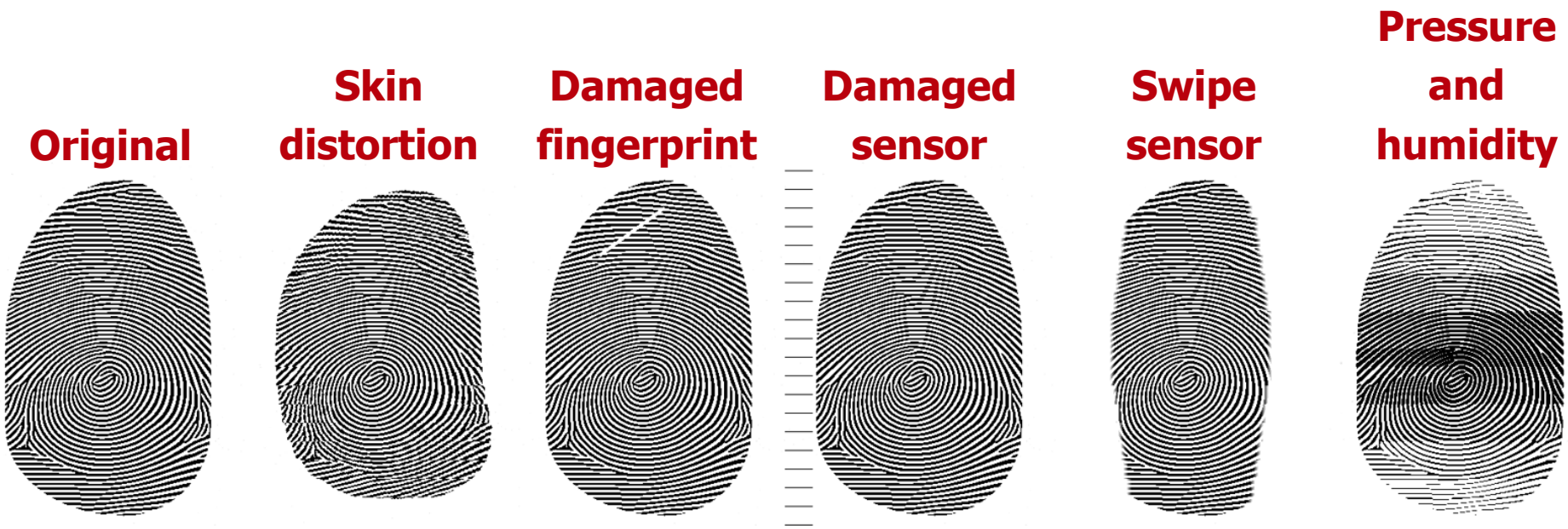
Synthetic fingerprints – generation III.



Synthetic fingerprints – generation IV.

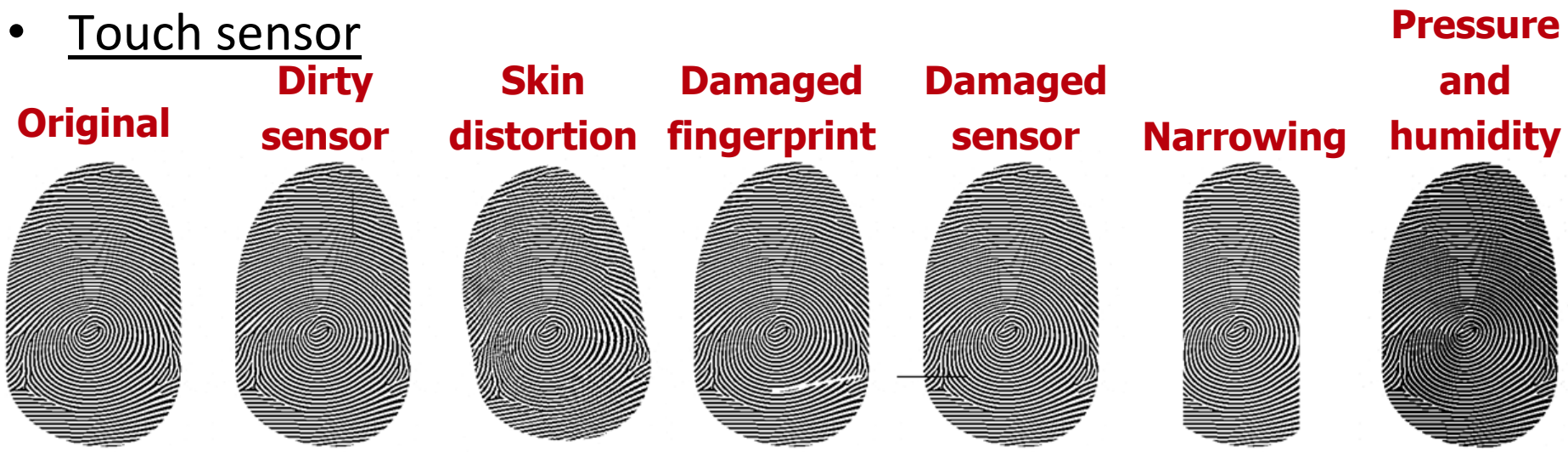


- Various fingerprint damages implemented yet

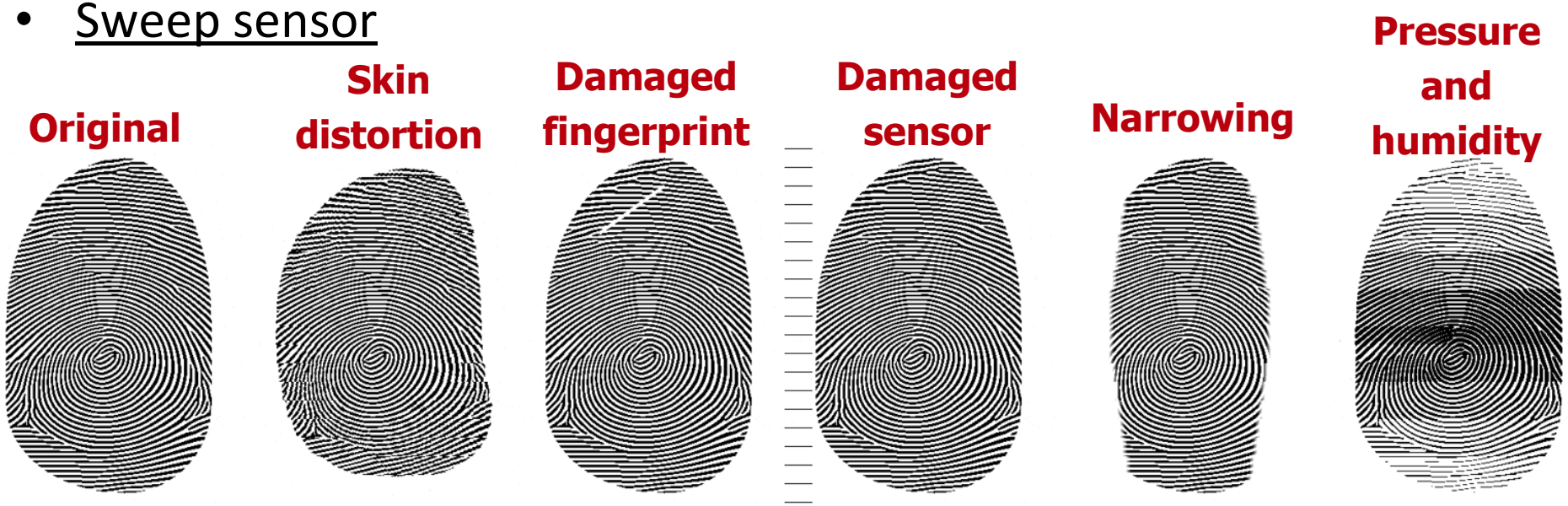


Synthetic fingerprints – generation VI.

- Touch sensor



- Sweep sensor



Fingerprints – an overview of our algorithm

DB of synthetic fingerprints

Generator of a synthetic fingerprint

Damage simulation

Disease simulation

Fingerprints DB without damage

Fingerprints DB with annotated diseases

Fingerprints DB with annotated damages

Fake fingerprints DB

Quality detection (NFIQ, Innovatrics, own algorithms)

OK

Processing (segmentation, thresholding...)

Detection and extraction of features (e.g. minutiae)

Biometric template preparation

Biometric template

Low quality

Enough regions as input for professing

Detection and extraction of (non)damaged regions

Non-damaged regions

Decision about processing and regions output

Not enough regions

Non-usable fingerprint

Damaged regions

Artefacts recognition

Damage

Disease

Unknown damage

Damage type

Disease type

Manual processing (annotation)

Thank you for your attention

Thanks to: IGA FIT-S-17-4014 „*Secure and reliable computer systems*“