Recognition Performance
in the Case of Juvenile Fingerprints

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Motivation

- Children yet to be excluded when it comes to verification against templates older than 1 or 2 years:

  - ➢ Children <12 currently not fingerprinted for neither EU passport nor Visa Information System

  - ➢ Parliament and EDPS not convinced about feasibility and accuracy performance

  - ➢ Identification and verification to be guaranteed over time, given the validity of an enrolment for about 5 years

- Biometric verification can be expected

  - ➢ to impede child trafficking

  - ➢ to reduce abuse of children for fraud

  - ➢ to help identifying missed children

Current Situation

- Matchers do not directly take into account the growing of the ridge pattern

- Resolution of scanners and assumptions about dimension of ridge structure is another obstacle

- Children fingerprinting exists only for documentation purposes but is hardly applicable to AFIS

→ Dedicated feasibility study more than overdue !

Source: Anthony's Mobile Fingerprinting

More detailed view on images

6 years

12 years

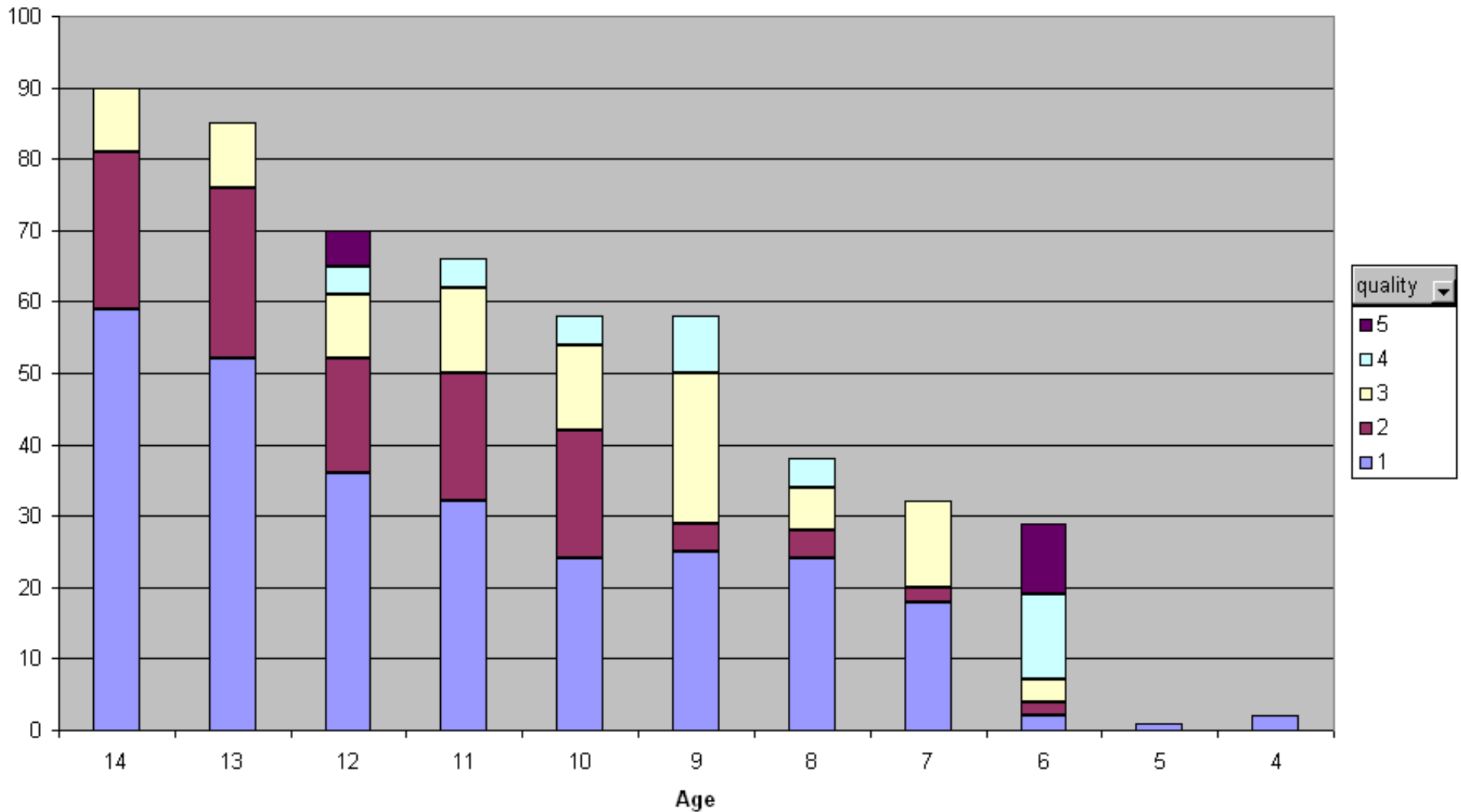- Ridge distance of 6 years old only half of adults: from ~10 pixels down to ~5 pixels [@500dpi]
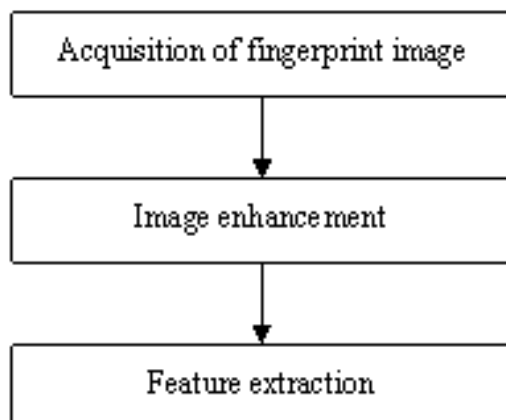
- Likelihood of low contrast regions increase

- Quality metrics (like NFIQ) not trained for juvenile fingerprints

NFIQ: Examples from BIODEV*

*BIODEV = European study on operational aspects of
visa application including biometric enrolment

Why normal matchers fail

Time = T_0 Time = T_1, $T_1 >> T_0$

Enrolment
(of reference)

| Acquisition of fingerprint image |

↓

| Image enhancement |

↓

| Feature extraction |

Identification/
Verification

| Acquisition of fingerprint image |

↓

| Image enhancement |

↓

| Feature extraction |

↓

| Comparison with reference(s) |

↓

Match?   yes →

no
↓
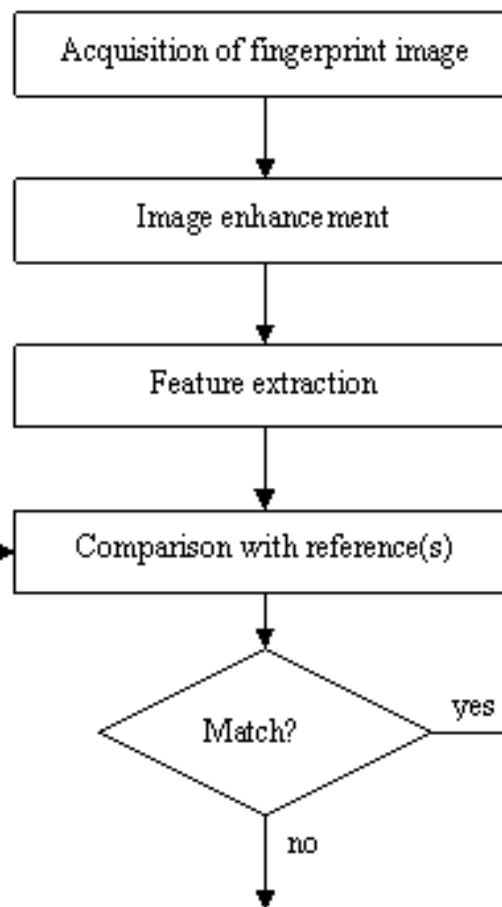
Difficulties in getting "still" images

Contrast problems

Wrong assumption about ridge distance

Local features displacement beyond accepted level of "distortion"

Acquisition

- Can be extremely difficult to enrol young children because of inadequate scanning device and overall setup

- Need for manual help by an operator is disputable

- Time to enrol can be acceptable for first enrolment but can be inacceptable for verification

- Enrolment should become more tolerant against movements

- Touchless sensors ("on the fly") could become the ultimate choice

Image: Ultimate Woodlands

- ➢ Imprint distance between ridge lines can be down to 0.1 mm (= 2 pixel @ 500 dpi) for adults!

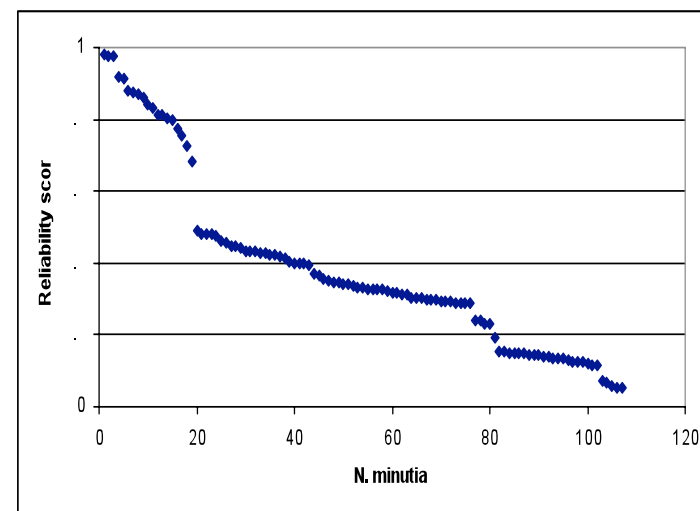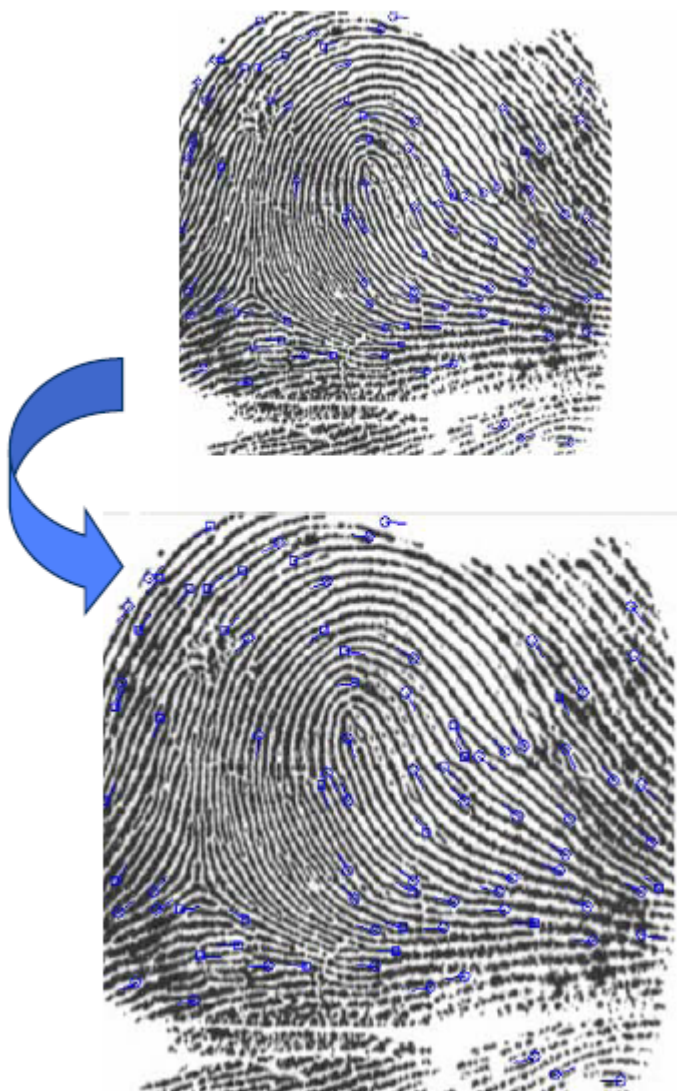- ➢ Proper acquisition process can partially avoid this
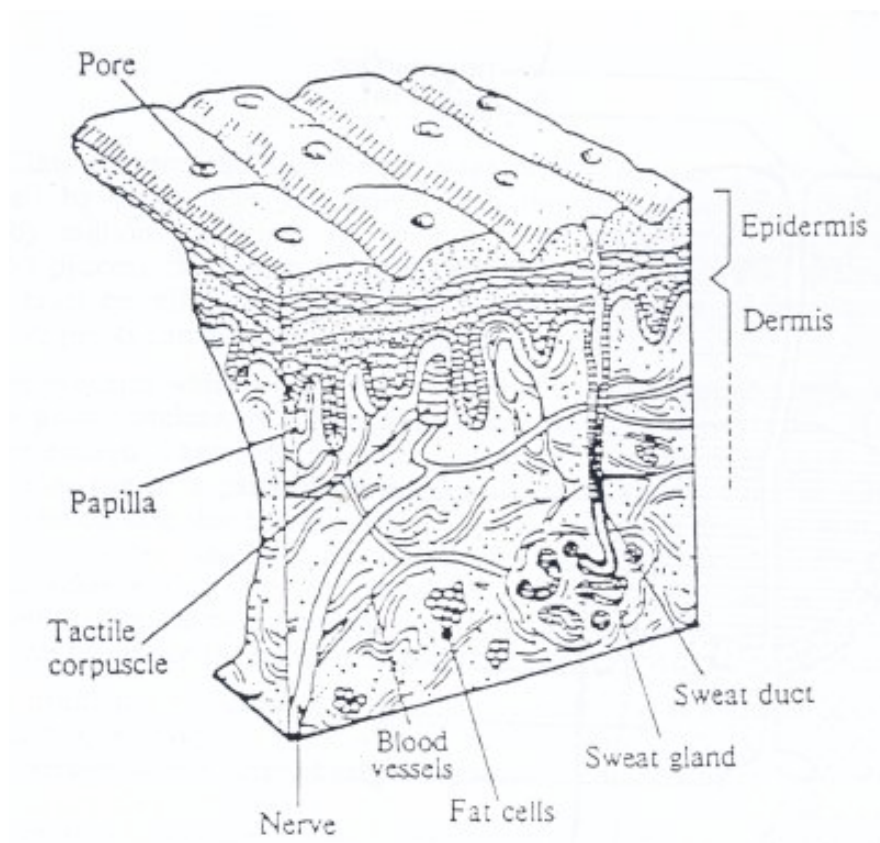
Image processing

Raw Image

Pre-Processed

NIST *mindtct* finds

- ✓ 107 minutiae
- ✓ 15 minutiae have reliability score > 0.8

Example: Age = 6, NFIQ = 4

- Matching should establish a similarity score between a template and a (kind-of) "zoomed" image

- Not yet clear whether "zooming" is linear or subject to significant distortion

- Feature extraction is usually not the same for different zooming levels of an image

- Not only minutiae positions are considered

Further facts

- 500 dpi images of very young children can be excellent
  → *Elaboration on relevant conditions necessary*

- Some vendors have already introduced ridge distance adoption and experimented with assumed ageing
  → *Feedback to vendors on measured growing effect*

- Yet no statistics available on recognition performance against aged templates in case of juveniles
  → *Need for a test database with significant time period between enrolments of individual juvenile test subjects*

Roadmap for the study

✓ Find best practice how to acquire images of sufficient quality

✓ Approximate ridge distance growing curve and use this for enhanced feature extraction

✓ Use test database to measure local feature displacement and degree of deviation from pure affine transformation

✓ Cooperate with vendors for introducing "juvenile feature"

✓ Use test database to measure performance of enhanced matchers

✓ Derive overall feasibility conclusion

Conclusions

➢ Automated verification and identification of children fingerprints <u>likely to be feasible in practice</u> at acceptable performance level

➢ Feasibility question will be tackled in several tasks:

- Physiological effects

- Enrolment best practices

- Algorithmic enhancements

- Performance test on large data sets

➢ Preliminary results might become available by end of 2010

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