

Usability, Interoperability and Biometrics Quality

- ***Introduction***
- ***Quality of the source***
- ***Quality of the acquisition***
- ***Quality of the template extraction***
- ***Conclusion***

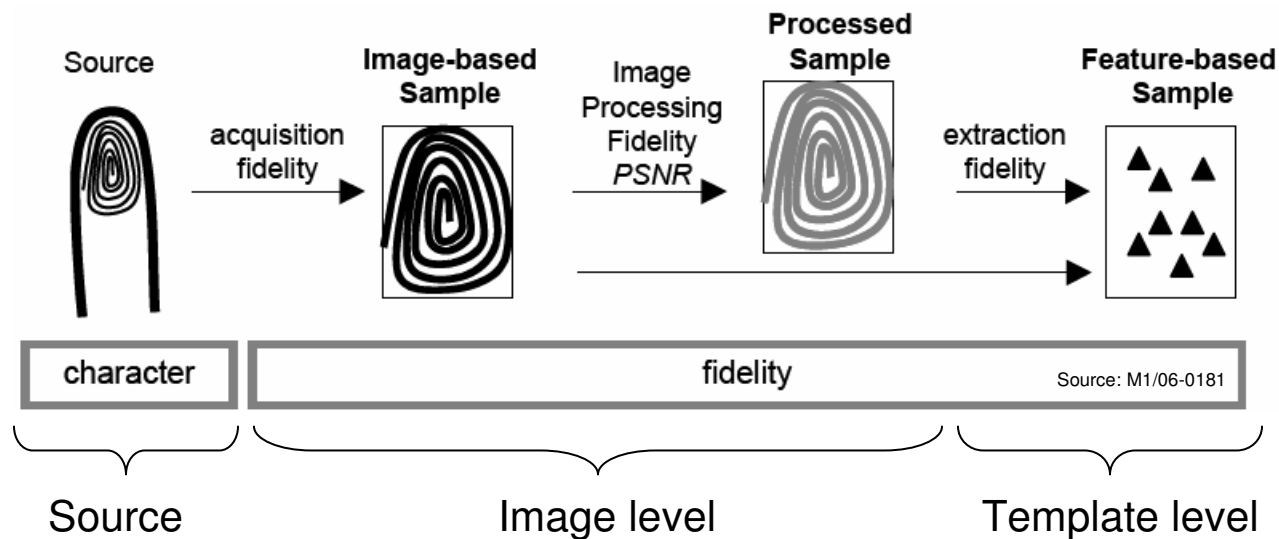


Use of quality measure

- *Quality measure is used for many tasks in a biometric system*
 - *Auto-capture:*
 - *trigger acquisition process to capture optimal quality data*
 - *Accept enrolment:*
 - *Reject bad quality data _asks for recapture*
 - *Update enrolment data:*
 - *Replace reference data with higher quality*
 - *Characterize a database / a population.*
 - *Useful to predict performances*
 - *Monitor a system _statistics*
 - *Detect problems in procedures, materials, training, ...*
 - *Conditional processing*
 - *ex: adapt process/algorithm to cope with bad quality data.*
 - *Etc ...*
- *Quality measures are meant to provide information or trigger action*
 - *Must be interpretable*
 - *“Relative Quality” / “Absolute quality”*
- *“Absolute” quality measures are particularly useful when/where*
 - *Several technology suppliers are involved (interoperability)*
 - *Image data is not available or difficult to access*



Different Factors Influencing Biometrics Quality



- $Q_{Total} = Q_{Source} \cdot Q_{Acquisition} \cdot Q_{Extraction}$

- *Simplistic formula, but shows that:*

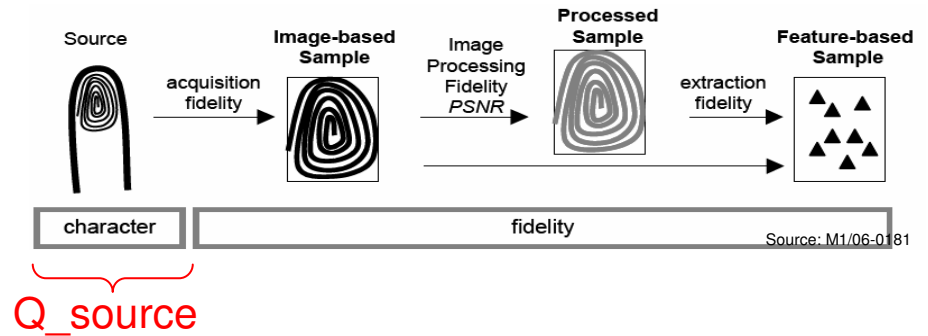
- $Q_{Total} < Q_{Source}$;
- $Q_{Total} < Q_{Acquisition}$;
- $Q_{Total} < Q_{Extraction}$

⇒ *Each component is critical to get good quality image or template*

⇒ *Each component has to compensate for the other's weaknesses*



Different Factors Influencing Biometrics Quality



Q_Source:

Population characteristics:

- scars, beards, lenses, occlusions, ...
- Can not be changed !

Procedures

- Instructions
 - “open your eyes”, use creams, remove glasses, use uniform background, ...
- Training of operators
- Some level of procedures are necessary, but often not user friendly ...

The Serenity Prayer:

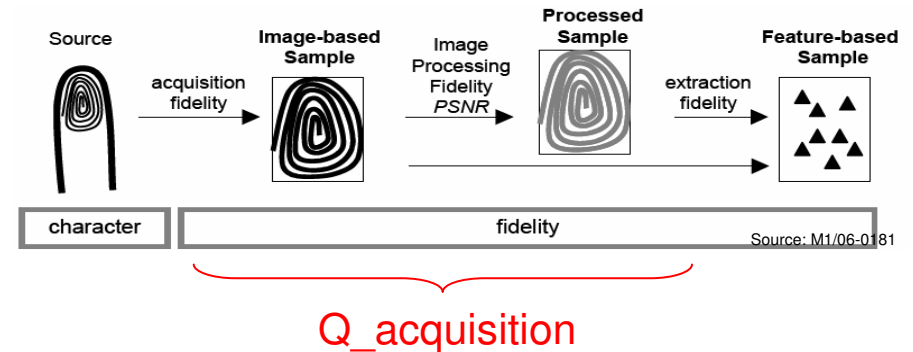
« God grant me the serenity
to accept the things I cannot change;
courage to change the things I can;
and wisdom to know the difference .»

How can a universal quality measure help ?

- Trigger specific action within a procedure
- Monitoring effect of actions



Different Factors Influencing Biometrics Quality



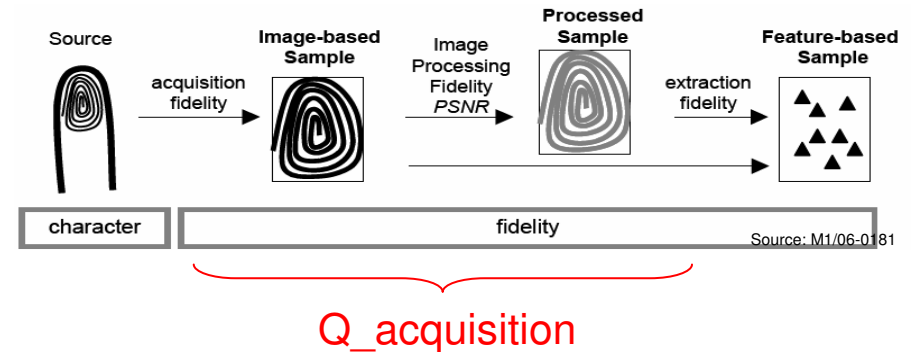
For a given source,

$$Q_Acquisition = Q_Sensor . Q_Capture Process$$

- *Q_Sensor*
 - *Fidelity of the sensor is necessary*
 - *Can the sensor reliably and accurately capture the information available ?*
 - *Field of View, Blur, resolution, distortion, SNR, ...*
 - ⇒ *“IQS”-like certifications are necessary*
 - *Also need to measure and quantify:*
 - *Fidelity | source:*
 - *The sensor need to be able to acquire “bad quality” sources*
 - *Scars, dry fingers, reflections, glasses, ...*
 - *Fidelity | environment*
 - *Depending on the application, the sensor must be robust to environment (lighting, T°, humidity ...)*



Different Factors Influencing Biometrics Quality



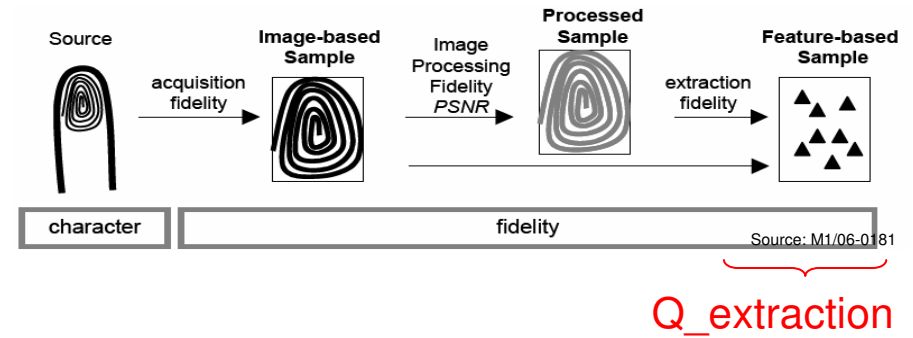
For a given source,

$$Q_Acquisition = Q_Sensor . Q_Capture_Process$$

- $Q_Capture_Process$
 - Acquisition loop
 - Capture the best possible image during a capture session
=> Real time “quality” measure can help triggering the acquisition
 - Ergonomics / Feedback (usability):
 - Acquisition must be easy and universal
 - Language and culture barrier.
 - Feed back must be real time and intuitive.
 - Feed back must also imply corrective behavior that would improve the quality
 - Necessitates more than “good/bad” or “better/worst”
 - Example: [UK Iris](#) (over 120K users, over 500K border crossing)
- => Not sure that a quality measure can really help here

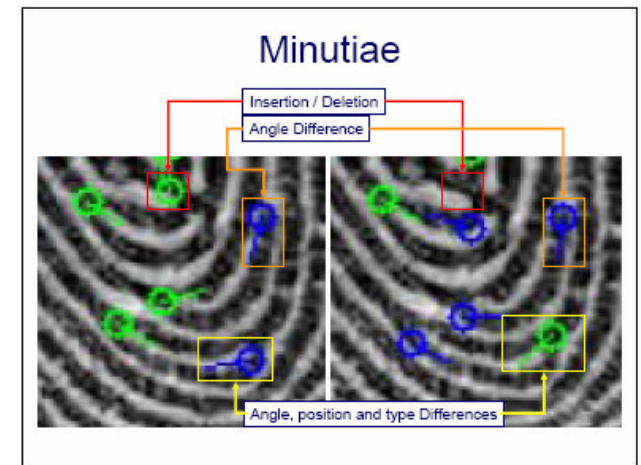


Different Factors Influencing Biometrics Quality



For a given image,
Q_extraction is affected by

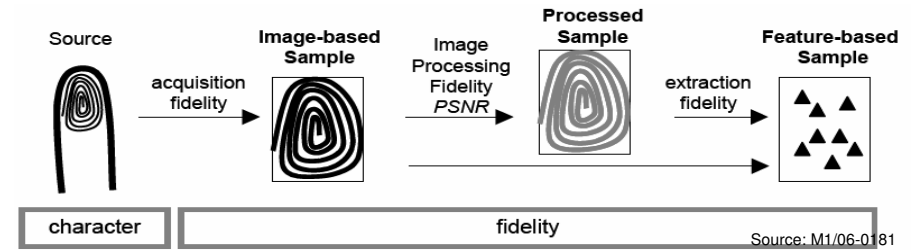
- **Quality of feature extractor**
 - Minutiae extraction is done for automated search by AFIS
 - Extraction depends on quality of feature extractor
 - **Compliance with standards**
 - Rules for minutiae placement are defined in standards
 - **But: standards do not completely address today**
 - Confidence issues
 - How certain are we there's a minutiae there
 - Precision issues
 - What is the tolerance in position and angle
 - Today each feature extractor / matcher makes its own assessments
- ⇒ Features extractors and matchers are somehow inter-dependent today
- This impacts negatively interoperability (cf Minex)



Only for fingerprint today (No template standard exists today for face and iris)

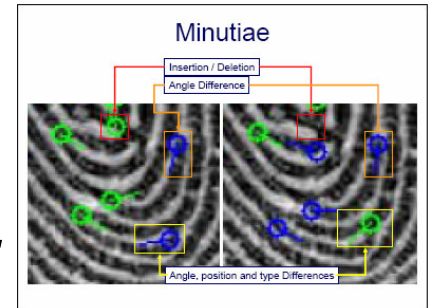


Different Factors Influencing Biometrics Quality



Confidence issue:

- Some matchers are designed to cope with many false minutiae
- Some are designed to really trust each minutia in the record
 - =>Some feature extractors will “take more risks” and keep more minutiae
 - =>Because different matcher have different needs, it is not desirable to impose rules on “level of risk”



Calibrated local quality measure can help mitigate that:

- Goal: assign to each minutiae an interpretable quality score
- Such a calibrated local quality can be used by Matchers to a posteriori prune the templates according to their robustness to false minutiae
- For example: $Minutiae_qual = P(\text{True_minutiae})$
 - Need for an annotated dataset (ground truth minutiae) is made available
 - A publicly available calibration tool will facilitate (and accelerate) interoperability



Conclusion

- **Sensor Quality :**
 - *“Fidelity” certification (IQS, WSQ) are necessary for image interoperability*
 - *Similar framework for face and iris would help*
 - *“Acquisition loop” and “Usability” are also critical to sensor quality*
- **Image Quality**
 - *NFIQ approach very useful , necessary for interoperability*
 - *But need to taking into account finger placement*
 - *Real time universal measure nice to have but not necessary*
 - *Similar open source measure for face and iris would help*
- **Minutia Quality**
 - *Definition of quality at minutiae level is necessary to increase interoperability*
 - *Need to enable minutiae pruning according to matching algorithm*

