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Information technology — Biometric sample quality —

Part 1: Framework

Technologies de l'information — Qualité d'échantillon biométrique —

Partie 1: Cadre

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 29794-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

ISO/IEC 29794 consists of the following parts, under the general title *Information technology — Biometric sample quality*:

— *Part 1: Framework*

— *Part 4: Finger image data* [Technical Report]

— *Part 5: Face image data* [Technical Report]

Future parts of ISO/IEC 29794 will address other modalities specified by ISO/IEC 19794, with part numbers and titles aligned appropriately. However, as ISO/IEC 29794-1 is intended for use by all modalities, a modality does not necessarily need a modality-specific part in order to make use of quality scores.

It is anticipated that a future version of each part of ISO/IEC 19794 will normatively reference ISO/IEC 29794-1, and their respective data fields will be updated as required.

Introduction

Quality metrics are useful for several applications in the field of biometrics. ISO/IEC 19784-1 specifies a structure and gives guidelines for quality score categorization, and ISO/IEC 29794 defines and specifies methodologies for objective, quantitative quality score expression, interpretation, and interchange. This part of ISO/IEC 29794 is intended to add value to a broad spectrum of applications in a manner that

a) encourages competition, innovation, interoperability and performance improvements; and

b) avoids bias towards particular applications, modalities, or techniques.

This part of ISO/IEC 29794 presents several biometric sample quality scoring tools, the use of which is generally optional but can be determined to be mandatory by particular application profiles or specific implementations.

A number of applications can benefit from the use of biometric sample quality data; an example is the use of real-time quality feedback upon enrolment to improve the operational efficiency and performance of a biometric system. The association of quality data with biometric samples is an important component of quality metric standardization. Quality fields as specified in 8.1 will be incorporated into data interchange formats. If a CBEFF header is present, then CBEFF_BDB_quality can additionally be used to express quality data. Useful analyses can be performed using quality data along with other data in order to improve the performance of a biometric system. For example, correlating quality data to other system metrics can be used to diagnose problems and highlight potential areas of performance improvement.

Information technology — Biometric sample quality —

Part 1:
Framework

1 Scope

For any or all biometric sample types as necessary, this part of ISO/IEC 29794

1. establishes terms and definitions that are useful in the specification, and use of quality metrics;
2. recommends the purpose and interpretation of biometric quality scores;
3. defines the format and placement of quality data fields in biometric data interchange formats;
4. suggests methods for developing biometric sample datasets for the purpose of quality score normalization; and
5. suggests a format for exchange of quality algorithm results.

Outside the scope are the following:

1. the specification of minimum requirements for sample, module, or system quality scores;
2. performance assessment of quality algorithms; and
3. standardization of quality algorithms.

2 Conformance

A block of quality data is in conformity with this part of ISO/IEC 29794 if it conforms to the normative requirements of Clause 8.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

19794-1:2006, *Information technology — Biometric data interchange formats — Part 1: Framework*

19785-2:2006, *Information technology — Common Biometric Exchange Formats Framework — Part 2: Procedures for the operation of the Biometric Registration Authority*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
acquisition fidelity
fidelity of a sample attributed to the acquisition process

4.2
biometric failure to enrol
failure of the biometric system to store a usable biometric reference due to deficiencies in the biometric data during an enrolment application

NOTE 1 Deficiencies in the biometric data can result from failure to capture an adequate or usable biometric sample, failure to extract adequate or usable biometric features from the sample, or failure to generate an adequate or usable biometric reference from the biometric features.

NOTE 2 See SC 37 N SD2 for most recent definition.

4.3
biometric failure to enrol rate
proportion of biometric enrolment sessions that resulted in a biometric failure to enrol for other than non-biometric reasons

NOTE 1 Basing the denominator on the number of biometric enrolment sessions can result in a higher value than basing it on the number of biometric capture subjects.

NOTE 2 The proportion denominator is the number of biometric enrolment sessions, excluding those sessions that failed to complete for non-biometric reasons.

NOTE 3 See SC 37 N SD2 for most recent definition.

4.4
character
contributor to quality of a sample attributable to inherent features of the source

4.5
environment
physical surroundings and conditions where biometric capture occurs, including operational factors such as operator skill and enrolee cooperation level

4.6
extraction fidelity
component of the fidelity of a sample attributed to the biometric feature extraction process

4.7
extrinsic
〈quality score〉 requiring reference to an external source, such as a standard, register, or technical specifications, for full interpretation and normalization

4.8
fidelity
expression of how accurately a biometric sample represents its source biometric characteristic

NOTE The fidelity of a sample comprises components attributable to one or more of the processing steps: acquisition, extraction, signal processing.

4.9
intrinsic
⟨quality score⟩ conveying fully interpreted, normalized data without the requirement for additional extrinsic information for quality score normalization

4.10
interpretation
process of analyzing a quality score along with other data in order to give that score contextual, relative meaning

4.11
failure to acquire rate
proportion of the biometric application attempts that resulted in failure to acquire an adequate or usable biometric sample, for other than non-biometric reasons

NOTE 1 The proportion denominator is the number of biometric enrolment attempts, excluding those attempts that failed to complete for non-biometric reasons.

NOTE 2 See SC 37 N SD2 for most recent definition.

4.12
false match rate
FMR
proportion of the completed biometric non-match trials that result in a false match

NOTE 1 The value computed for the false match rate will depend on thresholds, and other parameters of the comparison process, and the protocol defining the biometric non-match trials. In particular, treatment of comparisons between

— identical twins,

— completely different biometric characteristics of different individuals, such as face topography and Galton ridges, and

— different but related biometric characteristics from the same individual, such as left and right hand topography,

will need proper consideration. See ISO 19795-1.

NOTE 2 “Completed” refers to the computational processes required to make a comparison decision, i.e. failures to decide are excluded.

NOTE 3 See SC 37 N SD 2 for most recent definition.

4.13
false non-match rate
FNMR
proportion of the completed biometric match trials that result in a false non-match

NOTE 1 The value computed for the false non-match rate will depend on thresholds and other parameters of the comparison process, and the protocol defining the biometric match trials.

NOTE 2 “Completed” refers to the computational processes required to make a comparison decision, i.e. failures to decide are excluded.

NOTE 3 See SC 37 N SD2 for most recent definition.

4.14
operator
individual who processes a user in a biometric system, performing or supervising capture and recapture

4.15
performance
assessment of the FMR, FNMR, failure to enrol rate and failure to acquire rate of a biometric system

4.16
quality
degree to which a biometric sample fulfils specified requirements for a targeted application

NOTE Specified quality requirements can address aspects of quality such as focus, resolution, etc. Implicit quality requirements address the likelihood of achieving a correct matching result.

4.17
quality score
quantitative expression of quality

4.18
quality score normalization
rescaling of quality scores to improve consistency in scale and interpretation

4.19
quality score normalization dataset
QSND
dataset of biometric samples annotated with quality scores for use in quality score normalization

NOTE Target quality scores can be assigned on the basis of performance outcomes using the sample in question, or can be based on quality factors recorded in acquisition of the dataset.

4.20
quality score percentile rank
QSPR
percentile rank of the quality score of a biometric sample, derived from its own utility score and those of other samples in an identified control dataset

cf. quality score normalization dataset

4.21
raw quality score
quality score that has not been interpreted, either by the creator or recipient of the score, and alone can not intrinsically provide contextual information

4.22
sample
image, signal, or pattern based interpretation of a physical human feature used for identification or verification using biometric techniques

4.23
source
physical body part or function represented by a biometric sample

4.24
utility
observed performance of a biometric sample or set of samples in one or more biometric systems

NOTE 1 The character of the sample source and the fidelity of the processed samples contribute to – or similarly detract from – the utility of the sample.

NOTE 2 Utility can combine performance measures such as FMR, FNMR, failure to enrol rate, and failure to acquire rate.

5 Acronyms and abbreviated terms

BDB biometric data block

BIR biometric information record

CBEFF common biometric exchange formats framework (ISO/IEC 19785)

FERET facial recognition technology database

FMR false match rate

FNMR false non-match rate

QAID quality algorithm identification

QSND quality score normalization dataset

QSPR quality score percentile rank

XML extensible markup language

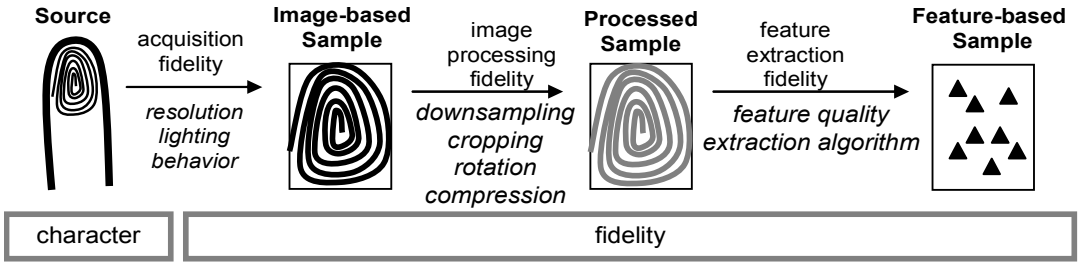
6 General biometric system

A general biometric system is described in Standing Document 11, ISO/IEC JTC 1/SC 37 Part 1 Overview Standards Harmonization Document (SC 37 N-SD11).

7 Biometric sample quality criteria

7.1 Reference model

In biometrics, the term “quality” is used to describe several different aspects of a biometric sample that contribute to the overall performance of a biometric system. For the purposes of standardization, this document defines terms, definitions, and a reference model for distinguishing between these different aspects of quality, illustrated in Figure 1. Figure 2 illustrates the relationship between character, fidelity, quality, utility, and system performance.



Quality = Function [character, fidelity components]
Utility reflects the impact of the quality of a single sample on system performance

Figure 1 — Quality reference model illustration

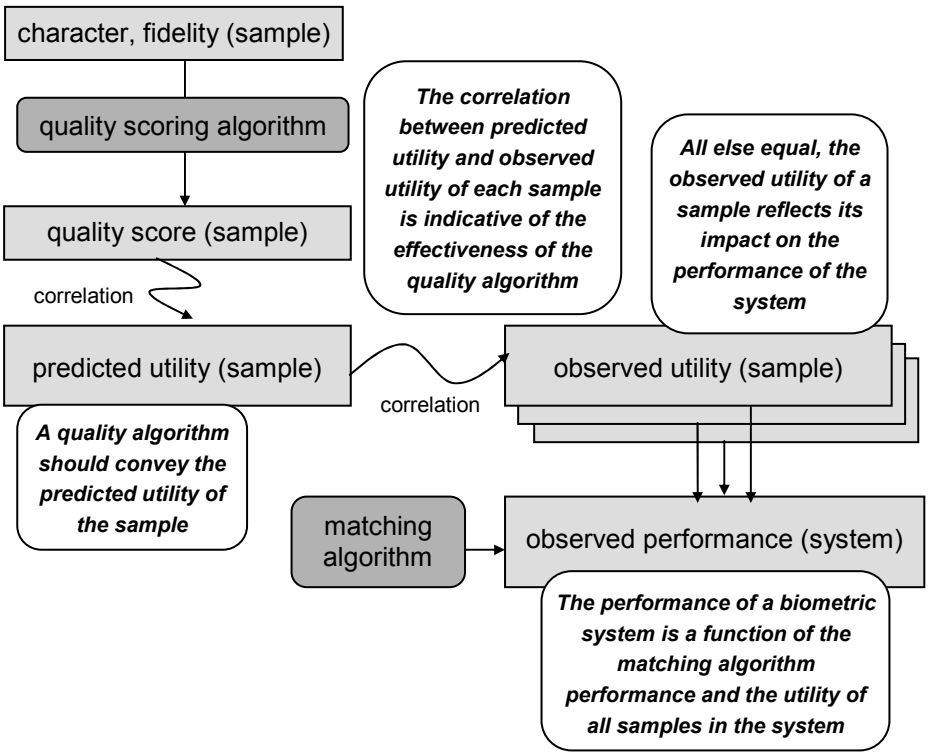


Figure 2 — Relationship between quality and system performance

7.2 Quality components: character, fidelity, utility

The term “quality” as it is currently used in the field of biometrics has several connotations, depending on context. Three prevalent uses are to subjectively reflect:

1. the ***character*** of a sample. An expression of quality based on the inherent features of the source from which the biometric sample is derived. For example, a scarred fingerprint has poor character, and blepharoptosis (droopy eyelid) causes poor iris character;

2. the ***fidelity*** of a sample to the source from which it is derived. An expression of quality based on fidelity reflects the degree of its similarity to its source. Sample fidelity is comprised of fidelity components contributed by different processes;

3. the ***utility*** of a sample within a biometric system. An expression of quality based on utility reflects the predicted positive or negative contribution of an individual sample to the overall performance of a biometric system. Utility-based quality is dependent on both the character and fidelity of a sample. Utility –based quality is intended to be more predictive of system performance, e.g. in terms of FMR, FNMR, failure to enrol rate, and failure to acquire rate, than measures of quality based on character or fidelity alone. (See Table 1)

The term “quality” should not be solely attributable to the acquisition settings of the sample, such as image resolution, dimensions in pixels, grayscale/color bit depth, or number of features. Though such factors may affect sample utility and could contribute to the overall quality score.

Note that the character and utility of an acquired sample depend on the features to be considered by the comparator. For instance, the same finger image may be of low character and utility with respect to minutiae recognition (because of too few minutiae), but of high character and utility with respect to spectral pattern recognition.