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Information technology — Biometric sample quality —

Part 1: Framework

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

Partie 1: Cadre

Reference number
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

This second edition cancels and replaces the first edition (ISO/IEC 29794-1:2009), which has been technically revised to revise Clause 8 and Table 2, which describes the structure of quality record.

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*

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

— *Part 6: Iris image data*

ISO/IEC 29794 series is prepared to accommodate new, additional parts that address other modalities specified by ISO/IEC 19794, with part numbers and titles aligning appropriately. However, as Part 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 the ISO/IEC 19794 series will reference this part of ISO/IEC 29794 normatively, and their respective data fields will be updated as required.

This corrected version of ISO/IEC 29794:2016 incorporates the following corrections.

1. "as given in Formula (C.1)" has been deleted from C.2 a).

2. Table 2, row: 5-byte Quality Block, column: Governing Section + Description + Notes:

QAID values of 0 to 32767

is changed to

QAID values of 1 to 32767

3. A.2, table, row: 5, column: Block 1 Byte 4+5 (QAID)

0

is changed to

10

Introduction

Quality metrics are useful for several applications in the field of biometrics. While ISO/IEC 19784-1 specifies a structure and gives guidelines for quality score categorization, ISO/IEC 29794 defines and specifies methodologies for objective, quantitative quality score expression, interpretation, and interchange. This International Standard is intended to add value to a broad spectrum of applications in a manner that encourages competition, innovation, interoperability and performance improvements, and avoids bias towards particular applications, modalities, or techniques.

This International Standard presents several biometric sample quality scoring tools, the use of which is generally optional but can be determined as 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 7.1 and 7.2 will be incorporated into data interchange formats. If a CBEFF header is present, then CBEFF_BDB_quality may 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.

This edition introduces encoding of a vector of quality metrics.

Information technology — Biometric sample quality —

Part 1: Framework

1 Scope

This part of ISO/IEC 29794, for any or all biometric sample types as necessary, establishes the following:

— terms and definitions that are useful in the specification and use of quality metrics;

— purpose and interpretation of biometric quality scores;

— encoding of quality data fields in biometric data interchange formats;

— methods for developing biometric sample datasets for the purpose of quality score normalisation;

— format for exchange of quality algorithm results;

— methods for aggregation of quality scores.

The following are outside the scope of this part of ISO/IEC 29794:

— specification of minimum requirements for sample, module, or system quality scores;

— performance assessment of quality algorithms;

— standardization of quality algorithms.

2 Conformance

A biometric sample quality record shall conform to this part of ISO/IEC 29794 if its structure and data values conform to the formatting requirements of Clause 7. Conformance to normative requirements of 7.1 and 7.2 fulfils Level 1 and Level 2 conformance as specified in ISO/IEC 19794-1:2011, Annex A. Conformance to normative requirements of 7.3 is Level 3 conformance as specified in ISO/IEC 19794-1:2011, Annex A.

3 Normative references

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

ISO/IEC 19794–1:2011, *Information technology — Biometric data interchange formats — Part 1: Framework*

ISO/IEC 19785–1, *Information technology — Common Biometric Exchange Formats Framework — Part 1: Data element specification*

ISO/IEC 2382–37, *Information technology — Vocabulary — Part 37: Biometrics*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37, ISO/IEC 19794-1 and the following apply.

4.1
acquisition fidelity
fidelity (4.6) of a sample attributed to the acquisition process

4.2
character
contributor to *quality* (4.11) of a sample attributable to inherent properties of the *source* (4.17)

4.3
environment
physical surroundings and conditions where biometric capture occurs, including operational factors such as *operator* (4.9) skill and enrolee cooperation level

4.4
extraction fidelity
component of the *fidelity* (4.6) of a sample attributed to the biometric feature extraction process

4.5
extrinsic
when used to describe a *quality score* (4.12), requiring reference to an external *source* (4.17), such as a standard, register, or technical specifications for full *interpretation* (4.8) and normalisation

4.6
fidelity
expression of how accurately a biometric sample represents its *source* (4.17) biometric characteristic

Note 1 to entry: The fidelity of a sample comprises components attributable to one or more of the processing steps: acquisition, extraction, signal processing.

4.7
intrinsic
when used to describe a *quality score* (4.12), conveying fully *interpreted* (4.8), normalised data without the requirement for additional *extrinsic* (4.5)information for *quality score normalisation* (4.13)

4.8
interpretation
process of analysing a *quality score* (4.12) along with other data in order to give that score contextual, relative meaning

4.9
operator
individual who processes a capture subject in a biometric system, performing or supervising capture and recapture

4.10
performance
assessment of false match rate, false non-match rate, failure to enrol rate and failure to acquire rate of a biometric system

4.11
quality
degree to which a biometric sample fulfils specified requirements for a targeted application

Note 1 to entry: Specified quality requirements may address aspects of quality such as focus, resolution, etc. Implicit quality requirements address the likelihood of achieving a correct comparison result.

4.12
quality score
quantitative expression of *quality* (4.11)

4.13
quality score normalisation
rescaling of *quality scores* (4.12) to improve consistency in scale and *interpretation* (4.8)

4.14
quality score normalisation dataset
QSND
dataset of biometric samples annotated with *quality scores* (4.12) for use in *quality score normalisation* (4.13)

Note 1 to entry: Target quality scores may be assigned on the basis of *performance* (4.10) outcomes using the sample in question, or may be based on quality factors recorded in acquisition of the dataset.

4.15
quality score percentile rank
QSPR
percentile rank of the *quality score* (4.12) of a biometric sample, derived from its own utility score and those of other samples in an identified control dataset

Note 1 to entry: See *QSND* (4.14).

4.16
raw quality score
quality score (4.12) that has not been *interpreted* (4.8), either by the creator or recipient of the score, and alone may not intrinsically provide contextual information

4.17
source
physical body part or function represented by a biometric sample

4.18
utility
observed *performance* (4.10) of a biometric sample or set of samples in one or more biometric systems

Note 1 to entry: The *character* (4.2) of the sample *source* (4.17) and the *fidelity* (4.6) of the processed samples contribute to, or similarly detract from, the utility of the sample.

Note 2 to entry: Utility may combine performance measures such as false match rate, false non-match rate, failure to enrol rate, and failure to acquire rate.

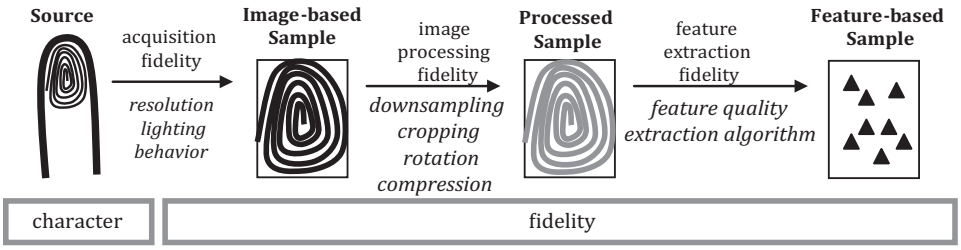
5 Abbreviated terms

BDB	biometric data block
BDIR	biometric data interchange record
BIR	biometric information record
CBEFF	common biometric exchange formats framework (ISO/IEC 19785)
FERET	facial recognition technology database
FNMR	false non-match rate
QAID	quality algorithm identifier
QSND	quality score normalisation dataset
QSPR	quality score percentile rank
QVID	quality algorithm vendor identifier
XML	eXtensible Markup Language

6 Biometric sample quality criteria

6.1 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 part of ISO/IEC 29794 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

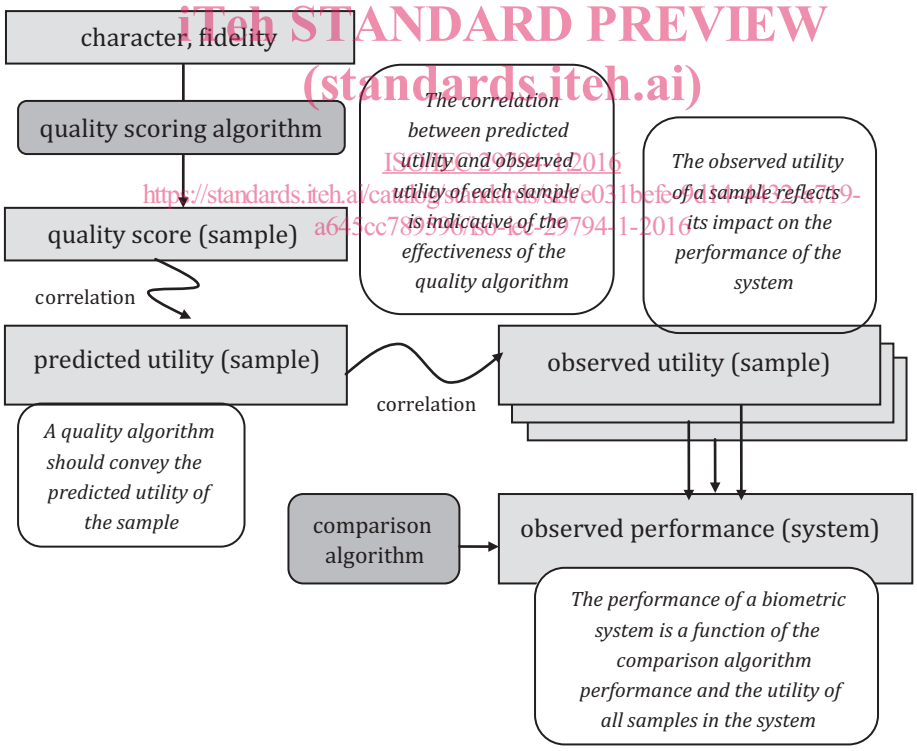


Figure 2 — Relationship between quality and system performance

6.2 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 the following.

a) ***Character*** of a sample. An expression of quality based on the inherent properties 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.

b) ***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.

c) ***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 false match rate, false non-match rate, 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, grey scale/colour bit depth, or number of features. Though such factors can 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.

Table 1 — Illustration of relationship between fidelity, utility, and character

		Fidelity	
		Low	High
Character	Low	Low fidelity and low character results in low utility. Recapture might improve utility. However, if possible, use of other biometric characteristics is recommended.	High fidelity and low character results in low utility. Recapture will not improve utility. Use of other biometric characteristics is recommended.
	High	Samples with high character and low fidelity typically will not demonstrate high utility. Utility can be improved upon recapture or image enhancement techniques.	Samples with high character and high fidelity indicate capture of useful sample. High utility is expected.

6.3 Usefulness of quality data

6.3.1 Real-time quality assessment

Real-time quality data can be used by an operator, automated system, or a user to help improve the average quality of biometric samples submitted upon enrolment. This feedback might indicate the character, fidelity, utility, and improvability of a sample. In this way, operational efficiency and overall system performance can be improved by assisting an operator, or augmenting an automated quality control system, in decisions to accept the sample, reject the sample, reattempt a capture, or declare a failure to acquire or failure to enrol. Quality data can be retained for later use in, for example, determining whether an enrolment sample should be replaced when the next sample is captured.