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Information technology — Biometric sample quality — Part 5: Face image data

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Foreword

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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 ISO documentsdocument 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 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This standard does not include contractual, legal or statutory requirements. Voluntary standards do not replace national laws, with which standards users are understood to comply and which take precedence. Local regulations / regional laws can apply.

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

This first edition cancels and replaces the first edition of ISO/IEC TR 29794-5:2010, which has been technically revised.

The main changes are as follows:

— the document has been completely revised to become an International Standard.;

~~The main changes in this edition are~~

~~1. replacement of all content in the technical report ISO/IEC TR 29794-5:2010,~~

~~2. updating of the technical report with informative text~~— information on the role of quality measures~~,~~ has been added;

~~3. introduction of~~ — requirements on quality software ~~as an International Standard~~have been added.

A list of all parts in the ISO/IEC 29794 series can be found on the ISO ~~website.~~ and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at ~~www.iso.org/members.html~~www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

Adoption of deep learning techniques has caused error rates associated with automated face recognition tasks to be reduced. ~~-~~However, errors still occur and are often related to imaging, human factors, the level of biometric capture subject cooperation, the comparison algorithm, and its associated threshold and decision logic. ~~This document is needed because without~~Without significant modernization of capture procedures, recognition errors will become more prevalent as volumes increase. This document is aimed at ~~reduction of~~reducing errors due to image quality~~.~~, through the use of quality assessment algorithms. Quality assessment algorithms have several roles ~~—~~(see Annex ~~-~~C~~—~~), primarily those related to sample capture. Drivers for improved capture are as follows.

— Need for improved usability — ~~As~~The general improvement of biometric systems~~, in general, have improved, it~~ has ~~become clear~~highlighted that improved usability for both biometric capture subjects and human operators can reduce errors through the improvement of capture. Without a careful consideration of both biometric capture subjects and system operators, system designers risk seeing the limitations inherent in using technology alone.

— Increasing volumes — Vast numbers of face images are being collected in many commercial, civil identity management~~,~~ and law enforcement applications. These photographs are used as reference enrolment samples, or as recognition probes that, in turn, sometimes later serve as references.

— New programs — Future large-scale programs will employ face recognition: For example, in China the railway transportation system uses face recognition for identity verification and to improve passenger check-in efficiency. The European Union uses face recognition for biometric exit confirmation. The United States currently uses face recognition for immigration exit and vessel boarding. In India, the Aadhaar program allows face recognition for authentication.

— Face-blind cameras — Historically, many face images were collected using cameras that were not face-aware. ~~This contrasts with the situation with~~In contrast, in some situations concerning fingerprint and iris biometrics ~~where~~, capture devices run in an auto-capture quality-assessment loop, with explicit awareness of the kind of image intended for collection.

— Reliance on imaging design specifications — Faces collected for ID credentials and authoritative databases are largely collected using cameras set up according to published documentary standards, most recently ISO/IEC 39794-5, regulating geometry and photography. In the best case, face images from such collections are then checked with image compliance tools. When photographs are collected by a human photographer, this can be without any automated quality assessment, relying only on the photographer to check conformance.

— Behaviour not intended by the relevant capture standard — Some recognition failures arise from biometric capture subjects effecting differences in presentation in reference and probe images. Standards define a canonical presentation to be centred and frontal with neutral expression, eyes-open and without eyewear. Facial recognition systems are expected to operate accurately across a wide range of individuals who vary in age, body size, ethnicity, language, culture, literacy and familiarity with technology. Careful human factors design is vital to the acquisition of canonical images and improved face image capture.

— Quality assessment is separated from the capture process — In many cases, a photograph is captured and later submitted to a backend server while ensuring no image tampering occurs, where it is assessed for quality. If poor quality is detected (by human or automated means), re-capture is initiated hours or days later, when possible, with another encounter and attendant expense.

Regarding image quality, Table 1 lists characteristics of face image quality relating to the biometric capture subject and characteristics relating to the capture process, demonstrating that issues due to mis-presentation (often associated with human factors design) and issues related to imaging are in many

cases separable. For example, photographs can be systematically de-focused even when the biometric capture subjects present perfectly.

Table 1 — Characterization of face image quality

	Biometric capture subject characteristics	**Capture process**
Static properties	Biological characteristics: — injuries and scars, — dermatological conditions, — etc.	Capture process and capture device properties: — image resolution, — optical distortions, — sub-optimal camera angle, — field of view, — etc.
	Other static characteristics: — ~~Thick~~thick or dark glasses, — ~~Permanent~~permanent jewellery, — ~~Makeup~~makeup and cosmetics, — etc.	Static properties of the background: — ~~[~~(textured~~]~~) wallpaper.
	-	Affordance: — ~~Properties~~properties of a data capture subsystem that intuitively imply its functionality and use to biometric capture subjects, — ~~Human~~human-centric system physical and process design.
Dynamic properties	Behaviour: — exaggerated expression, — hair across the eye, — facial hair, — etc.	Scenery: — background moving objects, — variation in lightning.
		Capture device variation: — de-focus, — camera vibration, — sub-optimal camera angle, — poor exposure, — etc.

By defining image quality measurements, this document is intended to improve the accuracy of automated face recognition systems. Quality can be tied to recognition accuracy —(see Annex B.). Improved quality can also improve human review of images. The quality measures included in this document were selected because guidance on how to control them has already been included in ISO/IEC 39794-5. The implementations of some quality measures were evaluated for performance.[62] The reference implementation defines quality measures that use external algorithms with licence conditions.[58]

This document recognizes the Open Face Image Quality (OFIQ) project[60] as the reference implementation of the requirements of the document. It is open-source.[59] Other quality algorithm implementations can conform to this document as described in clause Clause 5.

Some of the computations of this document can be effective on images captured with illumination at non-visible wavelengths.

Encoding of quality data is defined in ISO/IEC 29794-1. The methodology for performance evaluation of quality assessment algorithms is also defined in ISO/IEC 29794-1.

NOTE Use of this document can be subject to local regulations.

Information technology — Biometric sample quality — Part 5: Face image data

1 Scope

This document establishes requirements on implementations that quantify how a face image's properties conform with those of canonical face images, for example those specified in ISO/IEC 39794-5:2019 ~~Annex~~ , Clause D.1, for three use-cases:

1) collection of ~~1)~~ reference samples for ID documents~~,~~;

2) sample system enrolment; and

3) probes for instantaneous response.

This document also establishes terms and definitions for quantifying face image quality and specifies methods for quantifying the quality of face images.

This document does not establish requirements on:

— assessing the quality of pairs or sequences of images;

NOTE ~~1~~ This document establishes requirements for software that inspects exactly one image. This document does not establish requirements for software that compares two or more images (such as biometric recognition). However, the computations of this document can be applied separately to each image in a pair or sequence.

— assessing the quality of 3D captures;

— encodings of face image quality data;

— performance evaluation of face image quality assessment algorithms.

The use cases within scope of this document primarily address the assessment of images from data capture subjects who consent to processing of their biometric data, or for whom biometric capture is operationally authorized.

~~NOTE 2 Use of this document can be subject to local regulations.~~

~~3~~2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO/IEC 29794-1, *Information technology — Biometric sample quality — Part 1: Framework*

ISO/IEC ~~-~~ 39794 ~~-~~ 1:2019, *Information technology — Extensible biometric data interchange formats — Part 1: Framework*

ISO/IEC 39794-5:2019, *Information technology — Extensible biometric data interchange formats — Part 5: Face image data*

ISO/IEC 19794-1:2011*Information*2011, *Information technology — Extensible biometricBiometric data interchange formats — Part 5: Face image data1: Framework*

ISO/IEC 2382-37:2022, *Information technology — Vocabulary — Part 37: Biometrics*

43 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37, ISO/IEC 29794-1, ISO/IEC 39794-5:2019, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.orghttps://www.electropedia.org/

3.1
canonical face image
face image conformant to an external standard or specification of a reference face image

Note 1 to entry: In many applications, the canonical face image is that given in ISO/IEC 39794-5:2019 Annex, Clause D.1, which specifies a reference face image for a machine-readable travel document.

Note 2 to entry: Most of the computations of this document can be effective on images captured in automated border control gates, visa images and other server-side images, which are in scope of this document.

3.2
de-focus
aberration in which an image or part of an image is out of focus

Note 1 to entry: De-focus tends to reduce the sharpness and contrast of the image.

3.3
face detection
process of determining whether and where faces are present in an image

3.4
face image
electronic image-based representation of the face of a capture subject

Note 1 to entry: Any image captured for UC1 to UC3use-cases 1 – 3 described in Clause 5 is considered as a face image.

Note 2 to entry: ISO/IEC 39794-5 includes a definition for face portrait as the visual representation of the capture subject, which includes the full-frontal part of the head, including hair in most cases, as well as neck and possibly top of shoulders. Face portraits appear in several places on and in a machine-readable travel document (MRTD).

Note 3 to entry: Given an image that has a roll angle of 90 degrees ° or more (which is far from the presentation intended by ISO/IEC 39794-5:2019), a QAA can assign low quality component values or fail to return a record

[SOURCE: ISO/IEC 39794-5:2019, 3.27], modified — Notes to entry have been added.]