INTERNATIONAL STANDARD

ISO/IEC 39794-6

First edition
2021-03

Information technology — Extensible biometric data interchange formats —

Part 6: Iris image data

Technologies de l'information — Formats d'échange de données biométriques extensibles —

Partie 6: Données d'image de l'iris

iTeh Standards
(https://standards.iteh.ai)
Document Preview

ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-49b5-8fdb-dacb3aa94c7d/iso-iec-39794-6-2021

Reference number
ISO/IEC 39794-6:2021(E)

© ISO/IEC 2021

iTeh Standards
(https://standards.iteh.ai)
Document Preview

ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-49b5-8fdb-dacb3aa94c7d/iso-iec-39794-6-2021

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

 © ISO/IEC 2021 – All rights reserved

Contents

Page

Foreword ..... **iv**

Introduction ..... **v**

1 Scope **1**

2 Normative references **2**

3 Terms and definitions **2**

4 Symbols and abbreviated terms **3**

5 Conformance **4**

6 Iris image content specification **4**
6.1 General 4
6.2 Uncropped iris image 5
6.3 VGA iris image 6
6.4 Cropped iris image 6
6.5 Cropped and masked iris image 7
6.5.1 General 7
6.5.2 Masking of the sclera 7
6.5.3 Masking of the eyelids 7
6.5.4 Mask transition blurring 8

7 Abstract data elements **9**
7.1 Purpose and overall structure 9
7.2 Version block 11
7.3 Representation block 11
7.3.1 General 11
7.3.2 Eye label 11
7.3.3 Iris image kind 11
7.3.4 Bit depth 11
7.3.5 Image data format 12
7.3.6 Horizontal orientation 13
7.3.7 Vertical orientation 13
7.3.8 Compression history 13
7.3.9 Capture date/time block 14
7.3.10 Iris image data 14
7.3.11 Range 14
7.3.12 Capture device block 14
7.3.13 Quality blocks 15
7.3.14 Roll angle block 15
7.3.15 Localization block 16
7.3.16 PAD data block 17

8 Encoding **17**
8.1 Tagged binary encoding 17
8.2 XML encoding 17

9 Registered BDB format identifiers **17**

Annex A (normative) **Formal specifications** **19**

Annex B (informative) **Encoding examples** **26**

Annex C (normative) **Conformance testing methodology** **27**

Annex D (informative) **Iris image capture** **33**

Bibliography **37**

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/...

© ISO/IEC 2021 – All rights reserved

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.

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) or the IEC list of patent declarations received (see patents.iec.ch).

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

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.

iTeh Standards
(https://standards.iteh.ai)
Document Preview

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

A list of all parts in the ISO/IEC 39794 series can be found on the ISO website.

ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ee3e2-2d53-49b5-8fdb-dacb3aa94e7d/iso-iec-39794-6-2021

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.

 © ISO/IEC 2021 – All rights reserved

Introduction

The purpose of this document is to define an International Standard for the exchange of iris image extensible information. This document contains a specific definition of iris image record attribute data elements, record's tagged binary and XML encoding extensible formats for storing and transmitting the iris image and certain attribute data elements, and conformance criteria.

Currently, the exchange of iris information between equipment from different vendors can be achieved using images of the eye. While some applications can successfully operate with full size uncompressed rectilinear images, there are others for which this is expensive in terms of storage and bandwidth. This document therefore also defines compact representations.

Biometric data interchange formats enable the interoperability of different biometric systems. The first generation of biometric data interchange formats was published between 2005 and 2007 in the first edition of the ISO/IEC 19794 series. From 2011 onwards, the second generation of biometric data interchange formats has been published in the second edition of the established parts and the first edition of some new parts of ISO/IEC 19794. In the second generation of biometric data interchange formats, new useful data elements such as those related to biometric sample quality have been added, the header data structures have been harmonized across all parts of the ISO/IEC 19794 series, and an XML encoding has been added in addition to the binary encoding.

In anticipation of the future need for additional data elements and in order to avoid future compatibility issues, ISO/IEC JTC 1/SC 37 has developed the ISO/IEC 39794 series as a third generation of biometric data interchange formats, defining extensible biometric data interchange formats capable of including future extensions in a defined way. Extensible specifications in ASN.1 (Abstract Syntax Notation One) and the Distinguished Encoding Rules of ASN.1 form the basis for encoding biometric data in binary tag-length-value formats. XML schema definitions form the basis for encoding biometric data in XML (Extensible Markup Language).

Annex A specifies the ASN.1 schema and XML schema of the formal structure description to which tagged binary encoded and XML encoded iris image extensible records are to conform (respectively).

Annex B provides sample iris image extensible record encodings. Annex C includes normative assertions for testing conformance of iris image extensible records. Finally, Annex D gives recommendations on iris image capture.

iTeh Standards
(https://standards.iteh.ai)
Document Preview

© ISO/IEC 2021 – All rights reserved

iTeh Standards
(https://standards.iteh.ai)
Document Preview

ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-49b5-8fdb-dacb3aa94c7d/iso-iec-39794-6-2021

Information technology — Extensible biometric data interchange formats —

Part 6: Iris image data

1 Scope

This document specifies:

— generic extensible data interchange formats for the representation of iris image data: a tagged binary data format based on an extensible specification in ASN.1 and a textual data format based on an XML schema definition that are both capable of holding the same information,

— examples of data record contents,

— application specific requirements, recommendations, and best practices in data acquisition, and

— conformance test assertions and conformance test procedures applicable to this document.

The iris image information is stored as:

— an array of intensity values optionally compressed with ISO/IEC 15948 or ISO/IEC 15444-1, or

— an array of intensity values optionally compressed with ISO/IEC 15948 or ISO/IEC 15444-1 that can be cropped around the iris, with the iris at the centre, and which can incorporate region-of-interest masking of non-iris regions.

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-49b5-81db-dacb3aa94c7d/iso-iec-39794-6-2021

This document also specifies elements of conformance testing methodology, test assertions, and test procedures, as applicable to this document.

It establishes:

— test assertions pertaining to the structure of the iris image data format, as specified in Clauses 6, 7, 8 and 9 of this document,

— test assertions pertaining to internal consistency by checking the types of values that may be contained within each field, and

— semantic test assertions.

The conformance testing methodology specified in this document does not establish:

— tests of other characteristics of biometric products or other types of testing of biometric products (e.g. acceptance, performance, robustness, security), or

— tests of conformance of systems that do not produce data records conforming to the requirements of this document.

This document does not establish:

— requirements on the optical specifications of cameras, or

— requirements on photometric properties of iris images, or

— requirements on enrolment processes, workflow and use of iris equipment.

© ISO/IEC 2021 – All rights reserved

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 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Part 1*

ISO/IEC 8825-1, *Information technology — ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER) — Part 1*

ISO/IEC 15444-1, *Information technology — JPEG 2000 image coding system — Part 1: Core coding system*

ISO/IEC 15948, *Information technology — Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification*

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

W3C Recommendation, *XML Schema Part 1: Structures Second Edition*, 28 October 2004, http://www.w3.org/TR/xmlschema-1/

W3C Recommendation, *XML Schema Part 2: Datatypes Second Edition*, 28 October 2004, http://www.w3.org/TR/xmlschema-2/

iTeh Standards
(https://standards.iteh.ai)
Document Preview

3 Terms and definitions

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

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

https://standards.iteh.ai/catalog/standards/iso/e04ce3c2-2d53-49b5-8fdb-dacb3aa94c7d/iso-iec-39794-6-2021

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

— IEC Electropedia: available at http://www.electropedia.org/

3.1
defocus
image impairment due to the position of the *iris* (3.4) along the optical axis of the camera away from the plane or surface of best focus, generally resulting in reduced sharpness (blur) and reduced contrast

3.2
depth of field
distance range relative to the entrance aperture of a capture device over which the *iris* (3.4) image has greater than a specified quality with respect to focus

3.3
greyscale
continuous-tone image that has one component, which is pixel intensity

3.4
iris
coloured annular structure in the front portion of the eye comprised of muscular and connective tissue and pigmented layers, that defines the *pupil* (3.9) and controls its size

3.5
iris centre
centre of a circle modelling the boundary between *iris* (3.4) and *sclera* (3.12)

 © ISO/IEC 2021 – All rights reserved

3.6
iris radius
radius of a circle modelling the boundary between *iris* (3.4) and *sclera* (3.12)

3.7
margin
distance in an image from the iris-sclera border, when modelled as a circle, to the closest image border, expressed in pixels

Note 1 to entry: Throughout this document, margins are defined in terms of the *iris radius*, *R* (3.6). When written as an ordered pair, the order is (horizontal, vertical).

EXAMPLE (0,6*R*, 0,2*R*) indicates that for an iris radius of *R*, there shall be margins of image data 0,6·*R* to the right and left of the *iris* (3.4) and 0,2·*R* above and below the iris.

3.8
Modulation Transfer Function
MTF
ratio of the image modulation to the object modulation as a function of *spatial frequency* (3.14)

3.9
pupil
optical opening in the centre of the eye that serves as a variable light aperture and defines the inner boundary of the *iris* (3.4)

3.10
pupil centre
average of coordinates of all the pixels lying on the boundary of the *pupil* (3.9) and the *iris* (3.4)

iTeh Standards
(https://standards.iteh.ai)
Document Preview

3.11
round
mathematical function applied to a number *x* such that round(*x*) is the integer that is closest in value to *x*

3.12
sclera
generally white wall of the eye peripheral to the *iris* (3.4)

ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/sist/[illegible]-8fdb-dacb3aa94c7d/iso-iec-39794-6-2021

3.13
segmentation
process of determining, within an image containing an *iris* (3.4), the boundaries between areas containing visible iris tissue and those that do not

Note 1 to entry: This process is preceded by localization of the iris, and typically followed by cropping or masking regions that are not iris tissue.

3.14
spatial frequency
measure of the spatial period of a sinusoidal intensity pattern in space, in units of cycles/degree or of cycles/mm at a given target range

3.15
spatial sampling rate
number of picture elements (pixels) per unit distance in the object plane or per unit angle in the imaging system

4 Symbols and abbreviated terms

For the purposes of this document, the abbreviations given in ISO/IEC 39794-1 and the following apply.

© ISO/IEC 2021 – All rights reserved

JPEG2000	Joint Photographic Experts Group enhanced compression standard for images, as defined in ISO/IEC 15444
PGM	Netpbm greyscale image format
PPM	Netpbm colour image format
PNG	Portable Network Graphics lossless compression standard for images, as defined in ISO/IEC 15948
VGA	Video Graphics Array image format, having width 640 pixels and height 480 pixels

5 Conformance

A BDB conforms to this document if it satisfies all of the requirements related to:

a) its data structure, data values and the relationships between its data elements as specified throughout Clauses 6, 7, 8 and Annex A of this document, and

b) the relationship between its data values and the input biometric data from which the biometric data record was generated as specified throughout Clauses 6, 7, 8 and Annex A of this document.

A system that produces biometric data records is conformant to this document if all biometric data records that it outputs conform to this document (as defined in points a) to b) above) as claimed in the ICS associated with that system. A system does not need to be capable of producing biometric data records that cover all possible aspects of this document, but only those that are claimed to be supported by the system in the ICS. The test for output record conformance shall be conducted in accordance with the normative content of Annex C.

iTeh Standards
(https://standards.iteh.ai)

A system that uses biometric data records is conformant to this document if it can read, and use for the purpose intended by that system, all biometric data records that conform to this document (as defined in points a) to b) above) as claimed in the ICS associated with that system. A system does not need to be capable of using biometric data records that cover all possible aspects of this document, but only those that are claimed to be supported by the system in an ICS.

ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-49b5-8fdb-dacb3aa94c7d/iso-iec-39794-6-2021

A binary BDB conforms to this document if it satisfies the format requirements with respect to its structure, with respect to relations among its fields, and with respect to relations between its fields and the underlying input that are specified within A.1.

An XML document conforms to this document if it satisfies the format requirements with respect to its structure, with respect to relations among its fields, and with respect to relations between its fields and the underlying input that are specified within A.2.

6 Iris image content specification

6.1 General

This clause establishes requirements on the semantic content of the images that are allowed by this document. These requirements relate to the geometric structure, pre-processing, compression protocol, format and dimensions of the image data. (Guidance on iris image capture is given in Annex D.) Image data may be uncompressed or compressed. If uncompressed, then it shall be encoded using PGM or PPM image format[3]. All uncompressed raw images shall have an 8 bit pixel depth. Images with a pixel depth other than 8 bits shall be encoded using PNG or JPEG2000.

The remaining subclauses of Clause 6 group these requirements according to the type of image. As shown in Table 1, four image types are defined according to a hierarchy inherited from an

 © ISO/IEC 2021 – All rights reserved

unconstrained abstract basic iris image. The associated abstract values are provided in subclause 7.3.3. The requirements of Clause 7 establish the encoding specifications for the image.

NOTE The specifications of image types, compression protocols, formats and cropping dimensions in this first edition of this document have been determined by the NIST Interoperable Iris Exchange (IREX-1) study[6] (2009), which was commissioned for this purpose.

Table 1 — Hierarchy of iris image types

FORMAT NAME	Iris Centring	Margins (*R*: iris radius)		Width and height pixels	Data size kB	Compression mode	Data encoding method
		Horizontal	Vertical				
IMAGE_TYPE_UNCROPPED	no	≥ 0,6*R*	≥ 0,2*R*	unspecified	variable	none	PGM or PPM
					variable	lossless	PNG or JPEG2000
					variable	lossy	JPEG2000
IMAGE_TYPE_VGA	no	≥ 0,6*R*	≥ 0,2*R*	*W* = 640 *H* = 480	307,2	none	PGM or PPM
					typically 70-140	lossless	PNG or JPEG2000
					variable	lossy	JPEG2000
IMAGE_TYPE_CROPPED	yes	=0,6*R*	=0,2*R*	unspecified	variable	none	n/a
					typically 40-70	lossless	PNG or JPEG2000
					typically 8-24 (compact)	lossy (see NOTE 4)	JPEG2000
IMAGE_TYPE_CROPPED_AND_MASKED	yes	=0,6*R*	=0,2*R*	unspecified	variable	none	n/a
					typically 20-50	lossless	PNG or JPEG2000
					typically 2-6 (compact)	lossy	JPEG2000

NOTE 1 The application of lossy compression to IMAGE_TYPE_UNCROPPED images is not recommended for images with spatial sampling rate below 10 pixels/mm.

NOTE 2 Typical data sizes for IMAGE_TYPE_CROPPED and IMAGE_TYPE_CROPPED_AND_MASKED assume an iris of approximately 120 pixels radius. Other sizes are listed as variable to reflect variations in spatial sampling rate and in iris size.

NOTE 3 The use of cropping, masking, or lossy compression can degrade iris recognition accuracy.

NOTE 4 For applications of 1:1 comparison, the compressed IMAGE_TYPE_CROPPED data size can be as low as 3,5 kB.

iTeh Standards (https://standards.iteh.ai) Document Preview
ISO/IEC 39794-6:2021 https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-49b5-8fdb-...aa9ec7d/iso-iec-39794-6-2021

6.2 Uncropped iris image

An uncropped iris image shall contain a raster scan image of a single eye. An example is shown in Figure 1. For an iris radius of *R*, there shall be margins of image data at least 0,2*R* above and below the iris, and at least 0,6*R* to the right and left of the iris. These margins of image data shall be acquired from

© ISO/IEC 2021 – All rights reserved

the actual object being imaged, not synthesized values. It is not assumed that the iris is centred within the image.

If uncropped image data is compressed, then ideally it should be compressed losslessly. PNG shall not be used in its interlaced mode. If JPEG2000 is used, image data shall be stored in JPEG2000 format.

The uncropped iris image type shall be identified in the iris record by assigning the abstract value *uncropped* to the iris image type element in subclause 7.3.3, as defined in Table 3.

6.3 VGA iris image

A VGA iris image is a special case of the uncropped iris image; the image width shall be 640 pixels and the image height shall be 480 pixels. An example is shown in Figure 1. Additional constraints of margins and container are inherited from the uncropped image type in subclause 6.2.

If images are compressed, then images shall be compressed in accordance with either PNG or JPEG2000 for lossless compression, or JPEG2000 for lossy compression.

The VGA iris image type shall be identified in the iris record by assigning the abstract value *vGA* to the iris image type element in 7.3.3, as defined in Table 3.

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ISO/IEC 39794-6:2021
https://standards.iteh.ai/catalog/standards/iso/e04ce3e2-2d53-4965-81db-dacb3aa94c7d/iso-iec-39794-6-2021

Figure 1 — Example of uncropped iris image or VGA iris image

6.4 Cropped iris image

A cropped version of a rectilinear iris image may be instantiated. This supports moderately compact storage. It requires a coarse localization of the iris.

The cropped rectilinear image shall contain an iris centred relative to the geometric centre of the raster representation. An example is shown in Figure 2.

The crop region shall be sized such that a margin 0,6*R* pixels wide is included on both the right and left sides of the iris, where *R* is an estimate of the iris radius. Margins above and below the iris shall include 0,2*R* pixels. Margin pixels shall represent actual sensor readings, not substitute values.

Parts of the iris estimated to have been cropped during capture (i.e. absent in the input image) shall be replaced with pixels of value 0. Note that records with partially or fully missing iris data should not ordinarily be generated; instead, the defect should be detected and another capture attempted.

© ISO/IEC 2021 – All rights reserved