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Information technology — Extensible biometric data interchange formats —

Part 5: Face image data

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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.

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).

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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.

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.

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Introduction

Face images have been used for many decades to verify the identity of individuals. In recent years, digital face images have been used in many applications including human examination as well as computer-automated face recognition. Photographic formats are standardized, e.g., for passports and driver licences. There is also a need for a standard data format for digital face images to enable interoperability. A prominent case where such interoperability is essential is the electronic passport system, where face images are stored for several purposes including Automated Border Control.

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 was published in the second edition of the established parts and the first edition of some new parts of the ISO/IEC 19794 series. In the second generation of biometric data interchange formats, new useful data elements such as data elements related to biometric sample quality were added, the header data structures were harmonized across all parts of the ISO/IEC 19794 series, and XML encoding was been added in addition to the binary encoding.

In anticipation of the need for additional data elements, and in order to avoid future compatibility issues, the ISO/IEC 39794 series provides standard biometric data interchange formats capable of being extended in a defined way. Extensible specifications in ASN.1 (Abstract Syntax Notation One) and the distinguished encoding rules (DER) of ASN.1 form the basis for encoding biometric data in binary tag-length-value formats. XSDs (XML schema definitions) form the basis for encoding biometric data in XML (eXtensible Markup Language).

This third generation of face image data interchange formats complements ISO/IEC 19794-5:2005 and ISO/IEC 19794-5:2011. The first generation of biometric data interchange formats, which has been adopted, e.g., by ICAO for the biometric data stored in Machine Readable Travel Documents, is expected to be retained in the standards catalogue as long as needed.

This document is intended to provide a generic face image data format for face recognition applications requiring exchange of face image data. Typical applications are:

— automated face biometric verification (one-to-one comparison) and identification (one-to-many comparison), and

— human verification of a biometric claim by comparison of data subjects against face images, including examination of face images with sufficient detail.

In addition to the data format, this document specifies application specific profiles including scene constraints, photographic properties and digital image attributes like image spatial sampling rate, image size, etc. These application profiles are contained in Annex D.

The structure of the data format in this document is not compatible with the previous generations. However, this new revision addresses, for the first time, a mechanism to maintain future extensions in a backwards- and forwards-compatible manner. This will mean that a parser is able to read data records and understand data items that are formatted according to versions of the standard that are older, the same or newer than the parser is developed to. All newer data items will not disrupt the parsing process and can be ignored. Newer versions of this document will at least include the mandatory data items of the previous standards.

The 3D encoding types 3D point map and range image are not supported by this edition of this document.

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Information technology — Extensible biometric data interchange formats —

Part 5:
Face image data

1 Scope

This document specifies:

— generic extensible data interchange formats for the representation of face 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.

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*

ITU-T Rec. T.81 | ISO/IEC 10918-1, *Information technology — Digital compression and coding of continuous-tone still images — Part 1: Requirements and guidelines*

ISO 11664-2:2007, *Colorimetry — Part 2: CIE standard illuminants*

ISO/IEC 14496-2:2004, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ITU-T Rec. T.800 | 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*

Doc ICAO 9303: *Machine Readable Travel Documents*

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

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

3 Terms and definitions

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

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

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

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

3.1
1:1 application case
biometric verification

Note 1 to entry: Biometric verification is defined in ISO/IEC 2382-37 as a process of confirming a biometric claim through biometric comparison.

3.2
1:N application case
biometric identification

Note 1 to entry: Biometric identification is defined in ISO/IEC 2382-37 as a process of searching against a biometric enrolment database to find and return the biometric reference identifier(s) attributable to a single individual.

3.3
2D face image
two-dimensional face representation that encodes the luminance and/or colour texture of the face of a capture subject in a given lighting environment

3.4
3D face image
three-dimensional face representation that encodes a surface in a 3D space

3.5
3D vertex
representation using 3D vertices and triangles between these points for coding of a 3D surface

3.6
RGB
colour space designed to encompass most of the colours achievable on CMYK colour printers, but by using red, green and blue primary colours on a device such as a computer display

3.7
anthropometric landmark
landmark on the face used for identification and classification of humans

3.8
landmark code
<anthropometric> two-part code that uniquely defines an anthropometric landmark

3.9
camera to subject distance
CSD
distance between the eyes plane of a capture subject and the and the sensor/image plane of the camera

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3.10
Cartesian coordinate system
3D orthogonal coordinate system

3.11
chin
central forward portion of the lower jaw

3.12
CIE standard illuminant D65
commonly used standard illuminant defined by the International Commission on Illumination (CIE) that is intended to represent average daylight and has a correlated colour temperature of approximately 6500 K

Note 1 to entry: CIE standard illuminant D65 is specified in ISO 11664-2.

3.13
colour image
continuous tone image (3.16) that has more than one channel, each of which is coded with one or multiple bits

3.14
colour space
way of representing colours of pixels in an image

EXAMPLE RGB and YUV colour spaces are typically used in this document.

3.15
common biometric exchange formats framework
CBEFF
data format specifically for exchanging biometric data that provides for the encompassing of any biometric type into a standard format

3.16
continuous tone image
image whose channels have more than one bit per pixel

3.17
crop factor
ratio of the diagonal of the full frame camera (43,3 mm) to that of a selected camera's image sensor

Note 1 to entry: The determination of an appropriate focal length lens for a field of view equivalent to a full frame camera can be made by considering the crop factor.

3.18
crown
top of the head ignoring any hair

3.19
dots per inch
DPI
individual printed dots in a line or column within a span of 25,4 mm (1 inch)

3.20
exposure value
EV
number that represents a combination of a camera's shutter speed and f-number, such that all combinations that yield the same exposure have the same description value

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3.21
eye centre
centre of the line connecting the inner and the outer corner of the eye

Note 1 to entry: The eye centres are the feature points 12.1 and 12.2 as defined in ISO/IEC 14496-2:2004, Annex C.

Note 2 to entry: The inner and the outer corner of the eye are defined by ISO/IEC 14496-2-2:2004: feature points 3.12 and 3.8 for the right eye, and 3.11 and 3.7 for the left eye.

3.22
eye-to-mouth distance
EMD
distance between the face centre and the mouth midpoint

Note 1 to entry: The mouth midpoint is the feature point 2.3 as defined in ISO/IEC 14496-2:2004, Annex C.

3.23
eye visibility zone
EVZ
zone covering a rectangle having a margin to any part of the visible eyeball

Note 1 to entry: The margin is defined in D.1.4.3.3.

3.24
face centre
M
midpoint of the line connecting the two eye centres

3.25
face image kind
category of *face images* (3.27) that satisfy specific requirements

Note 1 to entry: Application specific requirements are specified in one of the application profiles in Annex D.

3.26
facial animation parameter
FAP
standard for the virtual representation, which includes visual speech intelligibility, mood and gesture by using feature points

Note 1 to entry: Visual representation as specified in ISO/IEC 14496-1 and ISO/IEC 14496-2.

3.27
face image
electronic image-based representation of the face of a capture subject

3.28
face portrait
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

3.29
face texture
2D sampling face representation that encodes one or a combination of several spectral spatial modulations received by 3D imaging systems of a face in a given lighting system having a 2D coordinate link to the face shape

3.30
feature point
reference point in a face image as used by face recognition algorithms

Note 1 to entry: Commonly referred to as a landmark, an example being the position of the eyes.

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3.31
fish eye
type of distortion where central objects of the image erroneously appear closer than those at the edge

3.32
Frankfurt Horizon
standard plane for orientation of the head defined by a line passing through the right tragion (the front of the ear) and the lowest point of the right eye socket

Note 1 to entry: The Frankfurt Horizon may be hard to define, as it is related to the ear position that may be covered by hair.

Note 2 to entry: The Frankfurt Horizon has been defined in the Frankfurt-am-Main (anthropological) Agreement of 1882.

3.33
greyscale image
continuous tone image (3.16) encoded with one luminance channel

Note 1 to entry: If the luminance channel is coded with 8 bits, the greyscale image is also referred to as a monochrome or black and white image.

3.34
horizontal deviation angle
HD
maximal allowed deviation from the horizontal of the imaginary line between the nose of a capture subject and the lens of the camera

3.35
human examination
process of human comparison of a face image with an individual or another face image through detailed examination of face characteristics and structures for the purposes of biometric verification or identification

3.36
human identification
process of human searching through a list of face images to match against an input image(s)

Note 1 to entry: Also known as one-to-many (1:N) searching.

Note 2 to entry: Identification can be performed by human (experts) as well, and human identification may consider more than biometric data.

3.37
human verification
process of confirming a specific biometric claim by human comparison of a face image with an individual or another face image

Note 1 to entry: Also known as one-to-one (1:1) comparison.

Note 2 to entry: Verification can be performed by human (experts) as well, and human verification may consider more than biometric data.

3.38
implementation under test
IUT
Implementation of a technical system currently tested

3.39
inner region
pixels of a face image carrying data of the central region of a face

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3.40
inter-eye distance
IED
length of the line connecting the eye centres of the left and right eye

3.41
issuer
organization that issues Machine Readable Travel Documents (MRTDs)

3.42
lower camel-case notation
naming convention in which compound words are joined together without spaces, where the first letter of the entire word is lowercase, but the first letter of subsequent words is uppercase

3.43
magnification distortion
image imperfection where the degree of magnification varies with the distance from the camera and the depth of the face

3.44
modus
manner in which a particular property is acquired

3.45
near infrared
section of infrared band with wavelength from 780 nm to 3000 nm

3.46
outer region
pixels of a face image outside of the inner region

3.47
photo booth
automated system for digitally capturing 2D images in either public or office environments

Note 1 to entry: A photo booth encloses the subject in a highly-controlled lighting environment and consists of a camera, lighting and peripheral devices such as printers. It has entrances on one or both sides with reflective curtains protecting against ambient light.

3.48
photo kiosk
semi-automated system for digitally capturing 2D images in an office-environment

Note 1 to entry: A photo kiosk consists of camera and lighting and usually has a separate panel placed behind the subject to provide the required background but is otherwise open.

3.49
pixel
picture element on a two-dimensional array that comprises an image

3.50
pixel per inch
PPI
individual pixels in a line or column of a digital image within a span of 25,4 mm (1 inch)

3.51
presentation attack
presentation of an artefact or human characteristic to the biometric capture subsystem in a fashion that could interfere with the intended policy of the biometric system

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3.52
presentation attack detection
PAD
automated determination of a presentation attack

3.53
radial distortion
image imperfection where the degree of magnification varies with the distance from the optical axis

3.54
red eye effect
red glow from a subject's eye caused by light from flash reflecting from blood vessels behind the retina

3.55
subject
individual who is to be displayed on the face portrait

Note 1 to entry: If the face portrait is part of a Machine Readable Travel Document (MRTD), this individual is intended to be the holder of the MRTD.

3.56
upper camel-case notation
naming convention in which compound words are joined together without spaces and the first letter of every word is uppercase

3.57
wavelength
distance between repeating units of a wave pattern

Note 1 to entry: Commonly designated by the Greek letter lambda (λ).

3.58
white light
apparently colourless light on human perception

EXAMPLE Ordinary daylight, standard lights as D50, D65, etc.

Note 1 to entry: For many purposes it is assumed that white light contains all wavelengths of the visible spectrum at equal intensity based on human perception. Strong deviations from equal intensity usually lead to deviations in the perception of colours.

4 Abbreviated terms

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

ABC	Automated Border Control
CCD	charge-coupled device
CMOS	complementary metal-oxide-semiconductor
CSD	camera to subject distance
DOVID	diffractive optically variable image device
DPI	dots per inch
EMD	eye-to-mouth distance

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