INTERNATIONAL STANDARD

ISO/IEC 39794-9

First edition
2021-06

Information technology — Extensible biometric data interchange formats —

Part 9: Vascular image data

Reference number
ISO/IEC 39794-9:2021(E)

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Published in Switzerland

Contents

Page

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 or www.iec.ch/members_experts/refdocs).

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. In the IEC, see www.iec.ch/understanding-standards.

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.

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 and www.iec.ch/national-committees.

Introduction

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 form of second editions of the established parts and first editions of a number of 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 have been added, the header data structures have been harmonized across all parts of the ISO/IEC 19794 series, and XML encoding has been added in addition to the binary encoding.

In anticipation of the future need for additional data elements and 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 manner. 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).

This third generation of vascular image data interchange formats complements ISO/IEC 19794-9:2007 and ISO/IEC 19794-9:2011.

This document is intended for those applications requiring the exchange of raw or processed vascular images (for example, palm images) that are sometimes not necessarily limited in the amount of resources available for data storage or transmitting time. It can be used for the exchange of scanned vascular images containing detailed image pixel information.

Use of the captured or processed image allows interoperability among biometric systems relying on pattern-based or other algorithms. Thus, data from the captured hand image offers the developer more freedom in choosing or combining comparison algorithms. For example, an enrolment image can be stored on a contactless chip located on an identification document. This allows future verification of the holder of the document with systems that rely on pattern-based algorithms. Establishment of an image-based representation of vascular information will not rely on pre-established definitions of patterns or other types. It will provide implementers with the flexibility to accommodate images captured from dissimilar devices, varying image sizes, spatial sampling rates, and different grey-scale depths. Use of the vascular image will allow each vendor to implement their own algorithms to determine whether two vascular records are from the same hand.

This document supports both binary and XML encoding, to support a spectrum of user requirements. With XML, this document meets the requirements of modern IT architectures. With binary encoding, this document is also able to be used in bandwidth or storage-constrained environments.

Information technology — Extensible biometric data interchange formats —

Part 9:
Vascular image data

1 Scope

This document specifies

— generic extensible data interchange formats for the representation of vascular 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 39794-1, *Information technology — Extensible biometric data interchange formats — Part 1: Framework*

ISO/IEC 14495-1, *Information technology — Lossless and near-lossless compression of continuous-tone still images: Baseline — 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 8824-1, *Information technology – Abstract Syntax Notation One (ASN.1) – Part 1: Specification of basic notation*

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

3 Terms and definitions

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

ISO and IEC maintain terminological 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.org/

3.1
centroid
centre of gravity

Note 1 to entry: In this document, this term is used to define a unique location within a silhouette image that can be assumed as the origin of a coordinate system.

3.2
dorsal
back side of a finger or a hand

3.3
ventral
palm side of a finger or a hand

3.4
vascular biometric image
captured raw or processed image that represents physical characteristics or traits of vascular pattern used to recognize the identity or verify the claimed identity of an individual

4 Symbols and abbreviated terms

ICS	implementation conformance statement
JPEG	joint photographic experts group
MIR	midrange infrared
NIR	near infrared
nm	nanometre
PGM	portable gray map
PNG	portable network graphics
ppcm	pixels per centimetre
RGB	red, green, blue color model
VIR	vascular biometric image record

5 Conformance

A biometric data block (BDB) conforms to this document if it satisfies all of the requirements related to:

— its data structure, data values and the relationships between its data elements as specified throughout Clauses 6, 7, 8 and Annex A, and

— 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.

A system that produces biometric data records conforms to this document if all biometric data records that it outputs conform to this document (as defined above) as claimed in the implementation conformance statement (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.

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 the list 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.

Conformance test methodology shall be in accordance with Annex C.

6 Modality-specific information

6.1 Capture recommendations

6.1.1 Image area

Vascular pattern biometric technologies obtain images from different locations of the human body. The technologies currently available employ images from the finger, back of the hand, and palm side of the hand. The location used for imaging shall be specified in the format. Also, the direction (left/right) of hand and/or finger index (thumb, index, middle, ring, and little) shall be specified. This document reserves fields for future development of technologies potentially using different parts of the human body.

6.1.2 Illumination

For the capture of vascular biometric images, the skin is typically illuminated using NIR wavelengths in the range of approximately 700 to 1 200 nm. The angle from the light source to the tangent plane of the skin's surface is not defined in VIR because technologies that use a reflectance image may use diffuse illumination instead of direct illumination for the purpose of avoiding specular reflectance. Instead, this document specifies that the image is either based on transparency or reflectance of the observed biometric characteristic. Two or more wavelengths of the illumination light source may be specified in the case that multiple different light sources are used for background masking.

6.1.3 Normalization of projection

The captured image shall be an orthographic projection of the body area being imaged. If the original raw image is not orthographic to the body area, it shall be converted to an orthographically projected one. Any major geometric distortion caused by the optical system shall also be eliminated prior to creation of the VIR.

6.1.4 Occlusion by opaque artifacts

Some opaque artifacts, such as rings, tattoos, bandages, etc., can occlude vascular patterns. Using images including occlusions should be avoided.

6.2 Image coordinate system considerations

6.2.1 Standard pose

6.2.1.1 General

This document defines the standard poses for capturing raw images of target body areas. Based on these standard poses, object (target area of the human body) coordinate systems are defined as described in subclause 6.2.2.

6.2.1.2 Palm

The palm area shall not be bent and each finger boundary shall be exposed to the camera. Fingers shall be straight. An example of the standard pose of a palm is shown in Figure 1. In the standard pose, the camera's direction is parallel to the z-axis of the palm coordinate system defined in subclause 6.2.2.2.

6.2.1.3 Finger

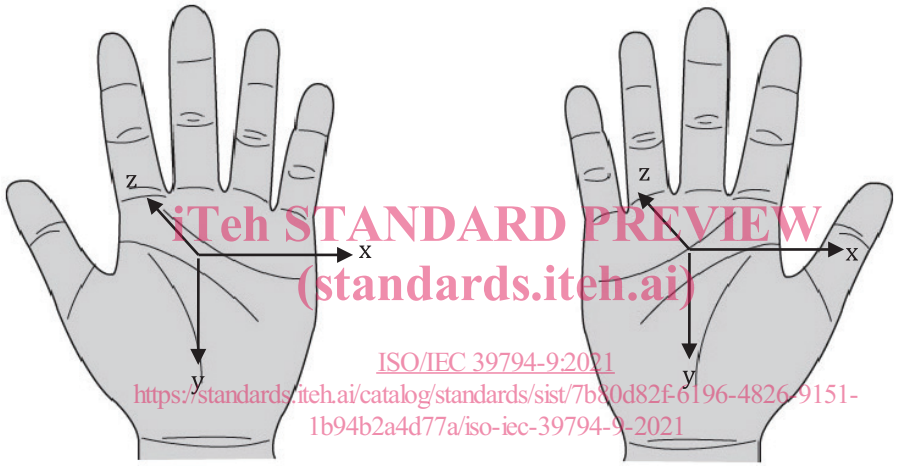
The standard pose is a straight finger. For clarity, the "frontal side" is defined as the ventral side of each finger. An example of the standard pose of a finger is shown in Figure 2.

6.2.1.4 Back of the hand

The standard pose for the back of the hand shall be to position the hand with the dorsal side toward the capture device with the tangent plane of the back of the hand in parallel with the image coordinate space to produce an orthographic image of the back of the hand. An example of the standard pose of the back of the hand is shown in Figure 3. In the standard pose, the camera's direction is parallel to the z-axis of the back of the hand coordinate system defined in subclause 6.2.2.3.

6.2.1.5 Standard poses for future modalities

This document shall reserve standard pose definitions of future technologies that can potentially utilize different parts of the human body.

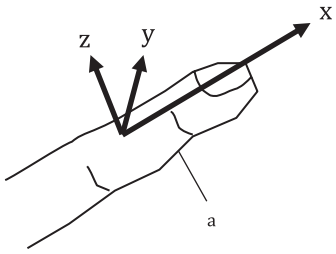


Key

x-axis	perpendicular to the y-direction on the palm plane
y-axis	along the opposite direction of the middle finger
z-axis	perpendicular to the x-axis and away from the imaging device

NOTE The Euclidean direction is right-handed.

Figure 1 — Standard pose and object coordinate system of palm vascular biometrics



Key

x-axis	direction from root to tip
y-axis	perpendicular both to the x and the z-axes
z-axis	perpendicular to the x-axis and away from the frontal side
a	Frontal side.

NOTE The Euclidiean direction is right-handed.

Figure 2 — Standard pose and object coordinate system of finger vascular biometrics

Key

x-axis	perpendicular to the y-direction along the tangent plane on the back of the hand
y-axis	along the opposite direction of the middle finger
z-axis	orthogonal to both the x-axis and the y-axis and away from the imaging device

NOTE The Euclidiean direction is right-handed.

Figure 3 — Standard pose and object coordinate system of the back of the hand vascular biometrics

6.2.2 Object coordinate system

6.2.2.1 General

The vascular image header record provides an optional field that specifies the degree of rotation of the vascular image out of the standard pose. To effectively specify the rotation angle, the object (target body) coordinate system for each vascular technology is defined in this subclause. All of the coordinate systems are right-handed Euclidian coordinate systems.

6.2.2.2 Palm

The y-axis of a palm object is along the opposite direction of the middle finger, while the x-axis is perpendicular to the y-direction on the palm plane as shown in Figure 1. The z-axis shall be determined by the right-handed Euclidean coordinate system; thus the positive direction of z-axis is away from the imaging device. The origin of the object's coordinate system is defined as the centroid of hand silhouette image.

6.2.2.3 Finger

The x-axis is defined as the direction from the root to the tip of a finger as shown in Figure 2. The z-axis is the direction perpendicular to the x-axis and away from the frontal side. The y-axis is perpendicular both to the x and the z-axes with the direction following the right-handed Euclidean coordinate system. The origin of the finger coordinate system is defined as the centroid of the finger silhouette image.

6.2.2.4 Back of hand

The y-axis of a back of the hand object is along the opposite direction of the middle finger, while the x-axis is perpendicular to the y-direction along the tangent plane on the back of the hand as shown in Figure 3. The z-axis shall be orthogonal to both the x-axis and the y-axis. The positive z-axis direction is away from the imaging device, which follows the right-handed Euclidean coordinate system. The origin of the object coordinate system is defined as the centroid of the hand silhouette image.

6.2.2.5 Coordinate systems for future modalities

This document shall reserve object coordinate system definitions for future technologies that may utilize different parts of the human body.

6.3 Image representation requirements

6.3.1 General

Image representation requirements are dependent on various factors including the application, the available amount of raw pixel information to retain or exchange, and targeted performance metrics. As a result of these factors, the images represented will have characteristics based on the aspects described below.

6.3.2 Pixel aspect ratio

The default pixel aspect ratio is 1:1. If the image is not made of square pixels, the aspect ratio shall be described.

6.3.3 Bit-depth

The image shall have a dynamic range spanning at least 128 gray scale levels, allocating at least one byte (8 bits) per intensity value and providing at least 7 bits of useful intensity information. The image may utilize two or more bytes per gray scale value instead of one.

6.3.4 Spatial sampling rate

Image capture requirements are dependent on various factors such as the type of application, the available amount of raw pixel information to be retained or exchanged, and the targeted performance. Another factor to consider as a requirement for vascular biometric imaging is that the physical size of the target body area where an application captures an image for the extraction of vascular pattern data varies substantially (unlike other biometric modalities). For example, a finger vein biometric device can require a higher spatial sampling rate than a palm vein device due to a difference in size of the observed biometric characteristic. Therefore, this document does not specify the requirement of minimum

