
**Information technology — Biometric data
interchange formats —**

**Part 9:
Vascular image data**

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

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Partie 9: Données d'images vasculaires
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ISO/IEC 19794-9:2007

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Conformance	1
3 Normative references	1
4 Terms and definitions.....	2
5 Abbreviated terms	3
6 Data conventions	3
6.1 Byte and bit ordering	3
6.2 Scan sequence	3
7 Image capture requirements.....	4
7.1 Spatial resolution	4
7.2 Gray scale depth	4
7.3 Illumination	4
7.4 Pixel aspect ratio	4
7.5 Normalization of projection	4
7.6 Image storage format	4
7.7 Imaging area	5
7.8 Standard pose	5
7.9 Object coordinate system	7
8 Vascular image format specification	7
8.1 Vascular image data block	7
8.2 Vascular image record header	7
8.3 Vascular image header	9
Annex A (informative) A sample image data packet.....	16

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

ISO/IEC 19794-9 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

ISO/IEC 19794 consists of the following parts, under the general title *Information technology — Biometric data interchange formats*:

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- Part 1: Framework
- Part 2: Finger minutiae data
- Part 3: Finger pattern spectral data
- Part 4: Finger image data
- Part 5: Face image data
- Part 6: Iris image data
- Part 7: Signature/sign time series data
- Part 8: Finger pattern skeletal data
- Part 9: Vascular image data
- Part 10: Hand geometry silhouette data
- Part 11: Signature/sign processed dynamic data

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Introduction

Vascular biometric technologies have existed for many years. Additionally, new technologies employing vascular images obtained from various parts of the human body are emerging or under continuous improvement as a result of new, state-of-the-art imaging devices. Some of them are being widely adopted as reliable biometric modalities.

Currently, however, little vascular biometric image information is being exchanged between the equipment and devices from different vendors. This is due in part to the lack of standardized formats for information exchange that would ensure interoperability among the various vendors.

The purpose of this part of ISO/IEC 19794 is to define a proposed standard for the exchange of human vascular biometric image information. It defines a specific definition of attributes, a data record format for storing and transmitting vascular biometric images and certain attributes, a sample record, and conformance criteria.

This part of ISO/IEC 19794 is intended for applications requiring the exchange of raw or processed vascular biometric images. It is intended for applications not limited by the amount of storage required. It is a compromise or a trade-off between the resources required for data storage or transmission and the potential for improved data quality/accuracy. Basically, it is to enable various algorithms to identify or verify the vascular biometric image data transferred from other image sources. Currently available vascular biometric technologies that may utilize this part of ISO/IEC 19794 for image exchange are technologies that use the back of the hand, palm and finger. (standards.iteh.ai)

The use of captured source images can provide interoperability among and between vendors relying on various different recognition or verification algorithms. Accordingly, data from the captured vascular biometric image offers the developer more freedom in choosing or combining matching algorithm technology.

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Information technology — Biometric data interchange formats —

Part 9: Vascular image data

1 Scope

This part of ISO/IEC 19794 specifies an image interchange format for biometric person identification or verification technologies that utilize human vascular biometric images and may be used for the exchange and comparison of vascular image data. It specifies a data record interchange format for storing, recording, and transmitting vascular biometric information from one or more areas of the human body. It defines the contents, format and units of measurement for the image exchange. The format consists of mandatory and optional items, including scanning parameters, compressed or uncompressed image specifications and vendor-specific information. Information compiled and formatted in accordance with this part of ISO/IEC 19794 can be recorded on machine-readable media or may be transmitted by data communication facilities.

Vascular biometric image data that comply with this part of ISO/IEC 19794 are intended to be embedded in a CBEFF-compliant structure in the CBEFF Biometric Data Block (BDB) as specified in ISO/IEC 19785-1.

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2 Conformance

Applications claiming conformance with this part of ISO/IEC 19794 shall be capable of encoding and decoding vascular biometric image data and the associated parameter data used in the transmitting and/or receiving of vascular biometric images as defined by this part of ISO/IEC 19794. Minimum conformance shall require the ability to transmit (exchange) and extract interoperable vascular biometric information

Since the size of the human body areas used by vascular biometric technologies varies dramatically among the different technologies, the recommended image quality criteria described in this part of ISO/IEC 19794 should be associated with specific technologies. Therefore, it would be unreasonable to specify the minimum requirement of the spatial resolution of an image in a single standard format. Accordingly, the minimum requirement of the spatial resolution is not defined in this part of ISO/IEC 19794.

3 Normative references

The following referenced documents are indispensable for the application 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 19794-1, *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 10918 (all parts), *Information technology — Digital compression and coding of continuous-tone still images*

ISO/IEC 15444 (all parts), *Information technology — JPEG 2000 image coding system*

ISO/IEC 14495 (all parts), *Information technology — Lossless and near-lossless compression of continuous-tone still images*

4 Terms and definitions

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

4.1

capture

acquire vascular biometric image data from an individual

4.2

centroid

centre of gravity

NOTE In this part of ISO/IEC 19794, it is used to define a unique location within a silhouette image that can be assumed as the origin of a coordinate system.

4.3

gray scale

continuous-tone image that has one component, which is luminance

4.4

pixel

picture element

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NOTE A digital image is a matrix with pixels organized in row-column format. A digital image with M by N components of gray scale or color values consists of $M \times N$ pixels.

4.5

raw

image file format in which the image is stored in the same format in which it is stored in video memory, typically one byte (for monochrome images) per picture element or three bytes (for color images) per picture element

NOTE This format does not contain any information related to the image and/or imaging parameters.

4.6

scan resolution

spatial resolution

number of pixels per unit distance

NOTE Horizontal scan resolution can be different from vertical scan resolution.

4.7

vascular biometric image

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

4.8

vascular image header record

information contained in the header data structure of the vascular image data format as specified in this part of ISO/IEC 19794

4.9**ventral**

palm side of a finger or a hand

4.10**dorsal**

back side of a finger or a hand

4.11**transaction**

command, message or input record that explicitly or implicitly calls for a processing action

NOTE Information contained in a transaction is applicable to a single subject.

5 Abbreviated terms

nm nanometre

ppcm pixels per centimetre

ROI region of interest

VIR vascular biometric image record (designates all data records which this part of ISO/IEC 19794 specifies)

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6 Data conventions (standards.iteh.ai)**6.1 Byte and bit ordering**

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The quantities in all records and vascular biometric image elements (pixel data), if represented as multibyte quantities, are represented in big-endian format. That is, the more significant bytes of any multibyte quantity are stored at lower addresses in memory than are the less significant bytes. The order for transmission shall also be the most significant byte first and the least significant byte last. Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last. All numeric values are unsigned integer quantities of fixed-length.

6.2 Scan sequence

A raw vascular image data conforming to this part of ISO/IEC 19794 is a two dimensional bit-mapped data that scans an object from the upper left corner to the lower right corner within a region of interest of a human body. This standard defines the scan direction of an imaging sensor as being along the positive x and y-axis which is defined in 7.9 for each vascular biometric technology, assuming the target human body (finger, back of the hand, or palm, etc.) is positioned in standard pose. The standard pose is defined in 7.8. If an image is scanned in a standard pose, the x and y-axis of the object coordinate system is in parallel with the x and y-axis of the image coordinate system. The x-direction of the image coordinate system is defined as the scan line from left to right and the y-direction as being from the top to the bottom of the image. Additionally, in a standard pose, the object z-axis is assumed to be in a direction parallel with the z-axis of the imaging device.

The scan sequence shall be raster scan order; that is, image pixels are acquired along the x-axis from top to bottom in the y-direction. In order to map the object coordinate system to the image coordinate system without further translation, each vascular biometric image data may define the x and y-axis origin which is not the pixel location of the upper-left corner of the image. If the origin is not specifically defined, it shall be the pixel location of the upper-left corner of the image.

7 Image capture requirements

7.1 Spatial resolution

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 may require more spatial resolution than a palm vein device due to the size difference of biometric features. Therefore, this standard does not specify the requirement of minimum spatial resolution. However, the spatial resolution of the captured image shall be represented in terms of pixels per centimetre.

7.2 Gray scale 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.

7.3 Illumination

For the capture of vascular biometric images, the skin is typically illuminated using near-infrared 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 standard specifies that the image is either based on transparency or reflectance of target features. Two or more wavelengths of illumination light source may be specified in the case that multiple different light sources are used for background masking.

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7.4 Pixel aspect ratio <https://standards.iteh.ai/catalog/standards/sist/16ad6756-7dc5-4be4-8223-009d6aa9a488/iso-iec-19794-9-2007>

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

7.5 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.

7.6 Image storage format

The captured vascular image shall be transmitted and stored in one of several possible formats described in the following paragraphs.

7.6.1 Raw format

The image is represented by a rectangular array of pixels with specified numbers of columns and rows. Each pixel has at least 8 bits of information. There is no image header, and each pixel in a monochrome image is represented by one or more bytes. Color images are represented as three samples per pixel, each comprised of one or more bytes, representing red, blue, and green (RGB) intensities, in that order. The image is organized in row-major order, with the lowest address corresponding to the upper left corner of the image. If the pixel intensity value is represented by more than one byte, the bytes shall be stored in big-endian order.

7.6.2 Lossless compression format

If lossless compression is used the image data shall be compressed in accordance with the JPEG-LS lossless compression algorithm specified in ISO/IEC 14495 or the JPEG2000 compression algorithm specified in ISO/IEC 15444.

7.6.3 Lossy compression format

If lossy compression is used the image shall be compressed in accordance with the JPEG compression algorithm specified in ISO/IEC 10918 or the JPEG2000 compression algorithm specified in ISO/IEC 15444. If one of these compression algorithms is used, a compression factor of 4:1 or less is recommended.

7.6.4 Multichannel image format

Images may be acquired utilizing more than three colors or channels utilizing multichannel cameras. In this case, pixel values may not be directly related to specific colors, rather they may be related to certain physical characteristics. Images captured with more than three sensing channels shall be stored in accordance with the JPEG2000 compression algorithm as specified in ISO/IEC 15444.

7.7 Imaging 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 part of ISO/IEC 19794 reserves fields for future development of technologies that may utilize different parts of human body.

7.8 Standard pose

This part of ISO/IEC 19794 defines the standard poses to capture 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 7.9.

7.8.1 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 1. In the standard pose, the camera's direction is parallel to the z-axis of the back of the hand coordinate system defined in 7.9.1.

7.8.2 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 2. In the standard pose, the camera's direction is parallel to the z-axis of the palm coordinate system defined in 7.9.2.

7.8.3 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 3.

7.8.4 Standard poses for future modalities

The format shall reserve standard pose definitions of future technologies that may utilize different part of the human body.