INTERNATIONAL STANDARD

ISO/IEC 19794-9

Second edition
2011-10-01

Information technology — Biometric data interchange formats —

Part 9: Vascular image data

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

Partie 9: Données d'images vasculaires

Reference number
ISO/IEC 19794-9:2011(E)

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Published in Switzerland

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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. 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 national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 19794-9 was prepared by Technical Committee ISO/TC JTC1, *Information technology*, Subcommittee SC 37, *Biometrics*.

This second edition cancels and replaces the first edition (ISO/IEC 19794-9:2007), Clause 8 and Annex A of which have been technically revised.

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

— *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*

— *Part 13: Voice Data*

— *Part 14: DNA data*

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 standard for the exchange of human vascular biometric image information. It defines specific 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.

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 a comparison subsystem.

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.

2 Conformance

A biometric data record conforms to this part of ISO/IEC 19794 if it satisfies all of the normative requirements related to:

a) its data structure, data values, and the relationships between its data elements, as specified throughout Clause 9 for the Vascular Image Record Format of this part of ISO/IEC 19794, and

b) the relationship between its data values and the input biometric data from which the biometric data record was generated, as specified throughout Clause 9 for the Vascular Image Record Format of this part of ISO/IEC 19794.

A system that produces biometric data records is conformant to this part of ISO/IEC 19794 if all biometric data records that it outputs conform to this part of ISO/IEC 19794 (as defined above), as claimed in the Implementation Conformance Statement associated with that system. A system does not need to be capable of producing biometric data records that cover all possible aspects of this part of ISO/IEC 19794, but only those that are claimed to be supported by the system in the Implementation Conformance Statement (ICS).

A system that uses biometric data records is conformant to this part of ISO/IEC 19794 if it can read, and use for the purpose intended by that system, all biometric data records that conform to this part of ISO/IEC 19794 (as defined above), as claimed in the Implementation Conformance Statement associated with that system. A system does not need to be capable of using biometric data records that cover all possible aspects of this part of ISO/IEC 19794, but only those that are claimed to be supported by the system in an ICS.

3 Normative reference

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 10918-1, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines*

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

ISO/IEC 14495-1, *Information technology — Lossless and near-lossless compression of continuous-tone still images: Baseline*

ISO/IEC 19794-1:2011, *Information technology — Biometric data interchange formats — Part 1: Framework*

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
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.

4.2
dorsal
back side of a finger or a hand

4.3
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

4.4
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

4.5
ventral
palm side of a finger or a hand

5 Abbreviated terms

nm	nanometre
ppcm	pixels per centimetre
VIR	vascular biometric image record
RGB	red, green, blue color model

6 Data conventions

6.1 Byte and bit ordering

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

7.2 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.

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 1200 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 the observed biometric

characteristic. Two or more wavelengths of illumination light source may be specified in the case that multiple different light sources are used for background masking.

7.4 Pixel aspect ratio

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, green, and blue (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 14495-1 or the JPEG2000 compression algorithm specified in ISO/IEC 15444-1.

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 10918-1 or the JPEG2000 compression algorithm specified in ISO/IEC 15444-1. 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 15444-1.

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 clause 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 clause 7.9.1.

7.8.2 Palm

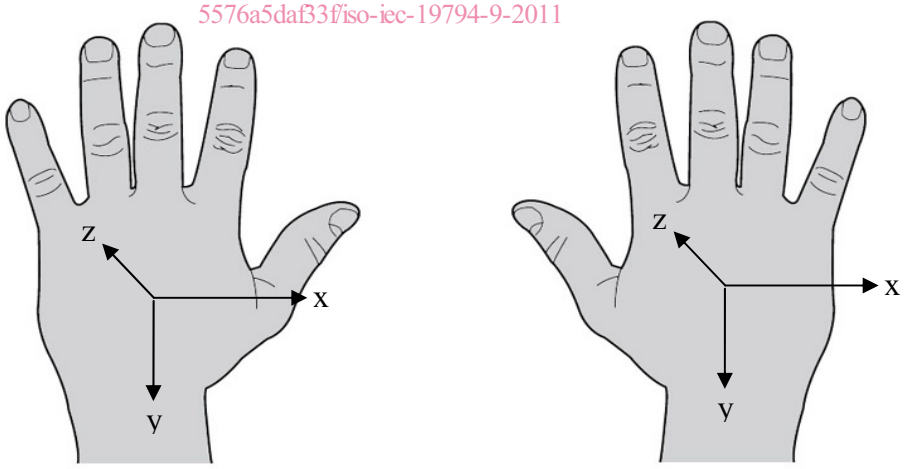
The palm area shall not be bent and each finger boundary shall be exposed to the camera. Fingers shall be straight. An example of the standard pose of a palm is shown in Figure 2. In the standard pose, the camera's direction is parallel to the z-axis of the palm coordinate system defined in clause 7.9.2.

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.



Left hand Right hand

Figure 1 — Standard pose and object coordinate system of the back of the hand vascular biometrics. The Euclidean direction is right-handed.