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Hand Data Interchange Format, Standardization

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Synonyms

Encoding of Hand Geometry Information; Hand Silhouette Data.

Def nition

Standard that def nes a common format to code information related to hand geometry based biometrics. This format is def ned to allow interoperability among different vendors worldwide, and has been developed by the international community taking part in ISO/IEC JTC1/SC37 standardization subcommittee.

Main Body Text

Introduction

Subcommittee SC37 from ISO/IEC JTC1 deals with the standardization of biometrics. Among SC37 Working Group 3 is devoted to def ne Interchange Data Formats for biometric modalities, among other duties. For that purpose, a multipart standard is under development, and it is referred by the number ISO/IEC 19794. Part 10 of the multipart standard covers hand geometry biometrics, and is denoted ISO/IEC 19794-10. The full title is "Information technology - Biometric data interchange formats - Part 10: Hand geometry silhouette data"[1].

This International Standard provides a data interchange format, based on a CBEFF data block [2], for applications requiring an interoperable hand geometry record. The information consists of a variety of mandatory and optional items, including data capture parameters, standardized hand position, and vendor specif c information. This information is intended for interchange among organizations that rely on automated devices and systems for identif cation or verif cation purposes based on the information from hand geometry.

It is important to note that although this part of ISO/IEC 19794 mandates a particular data format, it does not mandate a particular algorithm. For example, a user may be enrolled on a system from one vendor, and verif ed on a system from another.

Also, an important issue is that this format stores hand silhouette data rather than colour or greyscale image data. To increase the f exibility of the data format, provisions have been made to store views of the left and right hands, in addition to multiple views of each hand.

Specif c implementations of this part of ISO/IEC 19794 that could be constrained by storage space or transmission capability (such as smart card applications) may wish to limit the number of views stored for each hand. Such limitations are outside the scope of this part of ISO/IEC 19794, but authors of the International Standard advise that reduced choices can prejudice interoperability.

Silhouette Acquisition Requirements

The capture device as well as the capture process is out of the scope of the standard. As already mentioned, this is not an image-based standard, but one related to the coding of the shape of the hand. Therefore no matter the camera used for acquiring the sample (black and white, colour, resolutions, etc.), or which algorithm has been used for pre-processing such image, the primary input for this document is such pre-processed image, showing the silhouette of the hand captured. This silhouette can be either the one referring to the top-view of the hand, or its side-view. Figure 1 shows the standardized orientation of both types of view.
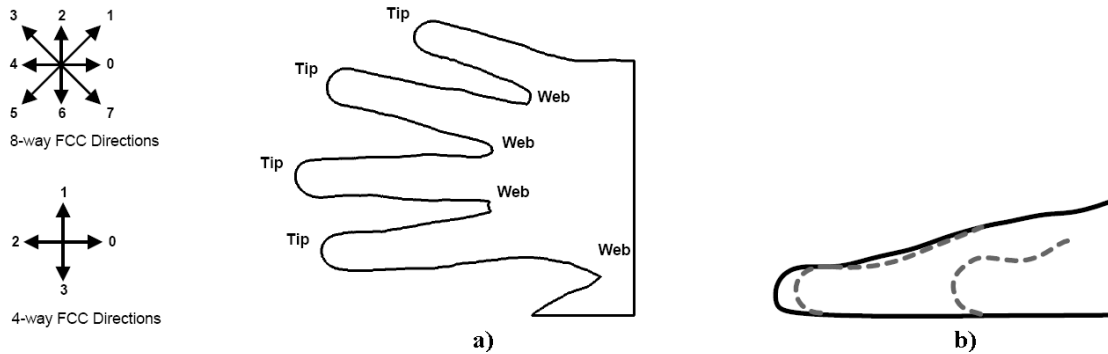

Fig. 1. Standard hand orientation images: a) top-view, b) side-view. Images taken from [1]

The hand silhouette will be represented in this standard as a sequence of points showing the direction to the next point in the silhouette (what is called a Freeman Chain Code or FCC). In order to code the FCC in an interoperable way, a set of requirements have to be def ned:

- A basic requirement is that aspect ratio shall be 1:1, with an error less than $\pm 2\%$
- The starting point shall be in the rightmost column of the silhouette in Figure [1], at the uppermost row occupied by the silhouette in that column (i.e. the upper right corner of the silhouette). Successive points shall trace the outline in a counter-clockwise direction.
- The silhouette shall be a closed shape (i.e., it shall have no gaps in the outline, and the f nal outline point shall be common to the starting point).
- The starting point shall occur exactly twice in the silhouette, as the f rst and last points only (the silhouette will not cross through the starting point at any other time)
- The right column shall be vertical (i.e., the penultimate point shall occur directly below the starting point, and no points occur to the right of the starting point)

Quite important is the orientation of the camera when capturing the image. Figure 2, shows the coordinate system when dealing with the camera point of view. This is really signif cant for some data to be stated in the record to be coded.

Record Format

After def ning the set of requirements for image acquisition, the Standard def nes the way such information has to be coded and stored within a CBEFF-compliant wrapper. The structure to be followed is:

- A f xed-length (15-byte) general record header containing information about the overall record, with the following f elds:
  – Format identif er (4 bytes with the hexadecimal value 0x484E4400) and version number (coded in another 4 bytes);
  – Record length (in bytes) including all hand views within this record (coded in 4 bytes);
  – Number of hand views (HGVRs) (1 byte);
  – 2 bytes reserved for future use.
- One or more variable-length Hand Geometry View Records (HGVRs), each containing a single hand silhouette, consisting of:
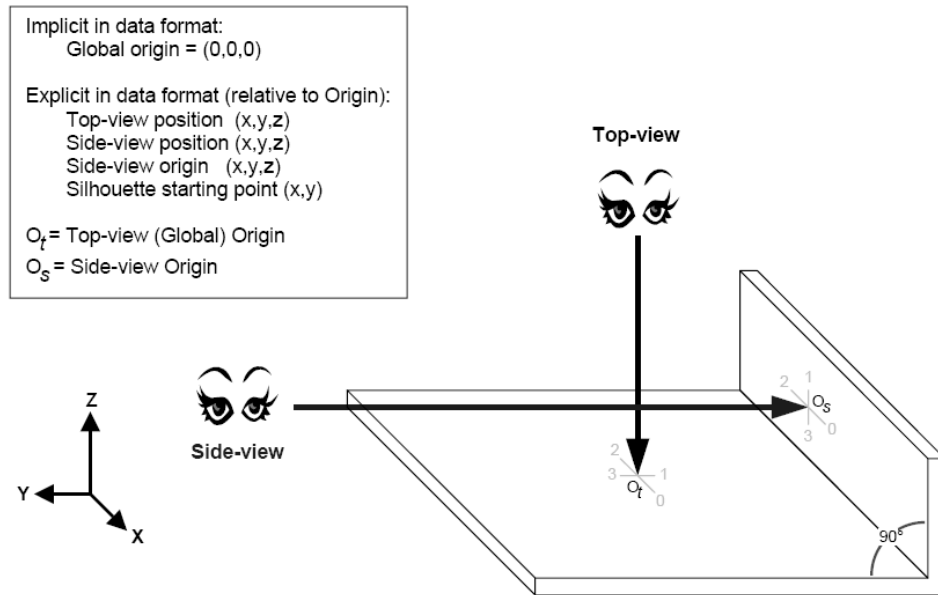
Fig. 2. Coordinate System linking top and side views, referred to the 4-FCC directions. Image taken from [1]

- A f xed-length (25-byte) hand view header containing the following information:
  - · Length of the HGVR (in 2 bytes);
  - · HGVR index (in 1 byte);
  - · Hand identif er (1 byte), which indicates the f ngers that the system attempt to acquire within the silhouette, and the view of the hand (top view of the palm, top view of the back of the hand, side view from the thumb side, or side view from the little f nger side;
  - · Hand Integrity (1 byte), which shows the identif ed problems in the sample acquired (e.g. f nger missing, misplacement, etc.);
  - · Data resolution in pixels per centimetre (1 byte);
  - · Geometric distortion of the system, as a signed value incrementing 0.1% (1 byte);
  - · Silhouette quality (3 bytes), being 0 the lowest quality and 100 the highest possible quality, always coded in the lower byte, while the higher 2 bytes are reserved for future use;
  - · Camera position relative to the global origin (1 byte for X position, 1 byte for Y position, and 1 byte for Z position);
  - · Target position relative to the global origin (1 byte for X position, 1 byte for Y position, and 1 byte for Z position);
  - · Silhouette starting point relative to the view origin (1 byte for X position and 1 byte for Y position);
  - · Data compression algorithm (1 byte), which currently refers to only 2 coding methods, such as 8-way FCC and 4-way FCC;
  - · Hand scanning technology (1 byte), giving information whether the image was acquired using an optical camera, a linear scanning array, or no information is specif ed;
  - · Extended data length (2 bytes);
  - · 3 bytes reserved for future use.
- Silhouette data, encoded using a Freeman Chain Code (FCC), either using 8-way FCC, or 4-way FCC (depending on what is declared in the "Data compression algorithm" f eld at the HGVR header;
- Extended data (optional), for any application-specif c or proprietary data used by the system vendor.

For further details refer to the current version of this International Standard [1]. Current version also provides a record sample, as well as an informative annex related to the best practices in this biometric modality, including hand placement and platen and optical design.

Other Related Standards

There is other standard related to this technology, born under ANSI/INCITS scope. This is ANSI/INCITS 396-2005: "Information Technology - Hand Geometry Interchange Format". This standard is extremely similar to ISO/IEC 19794-10, where the major technical differences are:

- Within the General Header:
    - ANSI/INCITS 396 includes a CBEFF Product Identif er;
    - ANSI/INCITS 396 version number is a binary byte, while in 19794-10 is a 4-byte string.
- Regarding the View Header:
    - ANSI/INCITS 396 has a creation date that was dropped by ISO 19794-10;
    - 19794-10 adds a view index that associates multiple views of the same hand (such as a top-view and side-view taken at the same time);
    - 19794-10 adds a Hand Integrity f eld that indicates which f ngers are ok and which are missing/mangled;
    - 19794-10 adds a starting-point location linking the absolute position of the silhouette to the camera's optical axis;
    - 19794-10 supports 4-way or 8-way FCCs, where ANSI/INCITS 396 only supports 8-way.

Due to the fact that the International Standard ISO/IEC 19794-10 is already available, ANSI is considering withdrawing ANSI/INCITS 396-2005 in a near future.

Summary

To provide interoperability in storing and transmitting hand-geometry-related biometric information, one international standard has been developed. Beyond this International Standard, other standards deal with conformance and quality control, as well as interfaces or performance evaluation and reporting (see relevant entries in this Encyclopaedia for further information).

Related Entries

Biometric Data Interchange Format, Common Biometric Exchange Framework Formats, Hand Geometry, Hand-geometry Device, International Standardization of Biometrics.

References

1. ISO/IEC: 19794-10:2007 - information technology - biometric data interchange formats - part 10: Hand geometry silhouette data (2007)
2. ISO/IEC: 19785-1:2005 - information technology common biometric exchange formats framework part 1: Data element specif cation (2005)

Def nitional Entries

Camera Point of View

Effective location and orientation of a camera that would result in the observed hand silhouette.

Freeman Chain Code - FCC

Compact method for representing the contours of an object, f rst made popular by Herbert Freeman.

Hand Geometry View Record - HGVR

Block of data that contains a hand silhouette captured from one camera point of view during one hand placement.