INTERNATIONAL STANDARD

ISO/IEC 20027

First edition
2018-07

Information technology — Guidelines for slap tenprint fingerprintture

Titre manque

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

Reference number
ISO/IEC 20027:2018(E)

© ISO/IEC 2018

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO/IEC 2018 – All rights reserved

Contents

Page

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

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.

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).

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

This first edition cancels and replaces ISO/IEC TS 20027:2015, which has been technically revised.

The main changes compared to the previous edition are as follows:

— Clauses 2 and 3 have been added according to the ISO/IEC Directives, Part 2;

— in 5.2, a new example of ways to give feedback has been added.

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.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

 © ISO/IEC 2018 – All rights reserved

Introduction

The slap tenprint capture process captures multiple slap images which contain all ten fingerprints.

Slap fingerprints, or “simultaneous plain impressions”, are simply multiple flat fingerprints captured at the same time.

A single slap image contains four fingerprints from one hand, so two slap images contain eight fingerprints.

A third slap image is captured containing the two thumbprints, so three slap images contain all ten fingerprints.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

Information technology — Guidelines for slap tenprint fingerprintture

1 Scope

This document provides guidelines to follow during the acquisition process of slap tenprints in order to obtain fingerprints of the best quality possible within acceptable time constraints.

Non-cooperative users are out of the scope of this document.

When using ten-fingerprint sensors, it is fundamental to know how to use them and how to proceed with the acquisition. This document describes how to capture fingerprints correctly by specifying best practices for slap tenprint captures.

It gives recommendations on the following topics:

1) hardware of the fingerprint sensor and its deployment;
2) user guidance;
3) enrolment process including a sample workflow;
4) application software for developers and system integrators;
5) processing, compression and coding of the acquired fingerprint images;
6) operational issues and data logging;
7) evaluation of a solution and its components.

Although this document primarily focuses on reaching optimal data quality for enrolment purposes, the recommendations given here are applicable for other purposes. All processes which rely on good quality tenprint slaps can take advantage of the best practices.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37 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

© ISO/IEC 2018 – All rights reserved

4 Sensor hardware requirement

Image quality should comply with the quality specifications from ISO/IEC 19794-4. EBTS V 8.002:2008[6], Annex F corresponds to ISO/IEC 19794-4:2011, B.1, and BSI TR-03121[5] corresponds to ISO/IEC 19794-4:2011, B.2.

This document considers recommendations based on the experience of the use of fingerprint optical sensors based on the principle of frustrated total internal reflection. The recommendations are to be considered properly when considering the use of a new technology, as specificities of the technology may induce specific recommendation that will be included in a future version of this document.

The sensor device should provide methods for re-calibration in the field by qualified service staff if the device technically supports it.

The need for calibration or re-calibration depends on the sensor technology and calibration might not be necessary for all devices.

The compliance of a sensor device to the applicable quality standard should be verified at any time in the operational environment.

5 Acquisition software

5.1 Acquisition process

For the acquisition process, the highest quality images should be used. The acquisition of these images should be done automatically. If the automatic acquisition process does not provide images of sufficient quality, an alternative manual process may be activated. For example, after 3 captures of insufficient quality, manual capture may be proposed to the operator.

The sequence of images having the highest quality should be used; if a timeout has occurred then these may be below the desired quality levels. The best images may not be the last acquired.

Some devices support surface heating and may assist in better quality images where fingers are especially dry.

An example of an acquisition process design can be found in Annex A and Annex B. An example of a quality metric process design can be found in Annex C.

5.2 User feedback

The presence of a user interface is strongly advised to provide user feedback.

Feedback can be given, for example, by:

— a screen attached in close proximity to the sensor;

— illuminated pictograms on the sensor;

— LEDs assigned to pictograms directly on the sensor.

— Sound coming from the sensor or from the PC to which the sensor is connected.

The following information should be given to the user:

— assistance to finger positioning with images and/or video on the screen and/or audio instructions (for instance to instruct the user to move their fingers to the left/right/top/bottom);

— visual and/or audio notification when a successful acquisition has been completed;

— a quality indicator for each acquisition; this indicator should follow the NIST fingerprint image quality (NFIQ) measurement;

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

— if possible, the reason for a bad quality acquisition (e.g. wrong positioning of the hand).

Additional information (e.g. a poster or a video) can be used to illustrate to users how to use the system. This information can be displayed close to the sensor and additionally in the waiting zone.

Operators should be trained to give guidance to the users.

5.3 Acquisition check

The software linked to the sensor should account for the following during the acquisition process in order to perform a better acquisition:

— Any feedback provided by the sensor software (background correction, quality evaluation, end of acquisition, etc.).

— A timeout for capturing the best available image in case the specified quality threshold is not reached.

— The inability of the subject to provide a full set of fingerprints. Acceptable images for certain fingers may not have been captured, which could be due to:

  — missing fingers;

  — inability for the subject to interact with the sensor correctly;

  — temporary or permanent issues with the subject's fingerprints.

— The image quality of the captured images. This is to enable the system to finish the acquisition process after the preset quality level or a timeout has been reached.

— The subject's fingers have been removed from the sensor at the end of the acquisition process.

— Check two consecutively captured slaps and captured thumbs are not identical. A duplicate check should also be performed to ensure that all expected fingers have been captured once and once only.

  NOTE Due to computational time constraints this recommendation can also be enforced by the operator instead of the software.

— Residual traces have not been acquired.

— The fingerprint images are as originally acquired. Optionally, segmented images can be produced.

— Hand inversion between left and right slap has not occurred. This check can be based on the different physical characteristics of the shapes of both hands.

5.4 Image processing

5.4.1 Resolution

Fingerprints should only be taken at 500 ppi or 1 000 ppi. Ideally scanning and transmission resolution should be identical. However, if an image is captured at 1 000 ppi and is to be transmitted at 500 ppi, then the guidance for down-sampling contained in the document NIST Special Publication 500-289 Compression Guidance for 1 000 ppi Friction Ridge Imagery[1] should be followed in order to produce a 500 ppi image with the minimal effect on the image contents and quality.

5.4.2 Segmentation

Depending on the call to capture one, two, three or four fingerprints, this number of individual fingerprints should be extracted from the input image and provided as single fingerprints generated by a segmentation process which takes into account fingers reported to be missed.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

For this segmentation process, the following criteria should be fulfilled:

— ability to accept rotated fingerprints having the same direction at an angle up to 45°;

— rotated fingerprints having the same direction should be corrected to be vertical;

— segment the first part over the finger (first phalanx);

— segmentation should be performed on uncompressed data;

— recording of any missing, damaged or amputated fingers.

Recommended size for fingerprint images is given in ISO/IEC 19794-4:2011, D.1.

NOTE Size limitation is done in order to prevent performance issues.

5.4.3 Compression

Wavelet Scalar Quantization (WSQ) compression should be used for 500 ppi images, and JPEG 2000 compression for 1 000 ppi images.

Fingerprint images should be compressed according to the recommendations in ISO/IEC 19794-4:2011, 8.3.17.

The implementation of the WSQ algorithm used should be certified by a registered authority and referenced as such (for example, the US Federal Bureau of Investigation and the respective certificate number can both be coded in the WSQ header).

Multiple lossy compressions should be avoided as they degrade image quality.

6 Logging and evaluation of data

6.1 Logging data

The purpose of the logging data is not to track people but to give guidance to the staff in charge of the enrolment and to maintain a constant quality of the acquisition process.

The following data, or parts of it, should be logged:

— transaction ID;

— timestamp of acquisition;

— duration of biometric acquisition process;

— number of captured images;

— number of successful captures;

— quality scores for all captured fingerprints;

— overall quality score of captured slap or tenprints sets (if present);

— information about vendor, software, hardware and versions;

— information about the origin (e.g. Agency Identifier);

— information about errors (e.g. about uniqueness check, segmentation, etc.);

— size of acquired data;

— testing flags (if applicable);

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

 © ISO/IEC 2018 – All rights reserved

— demographic data on the subject (gender, age);

— record of any missing, damaged or amputated fingers.

NOTE It might be appropriate to have a regular logging workflow and an evaluation mode logging workflow with more comprehensive logging data. The latter one could be used for regular or incident-based checks of the whole process.

When used in a verification or identification scenario, it is recommended to also log results of the verification and identification process.

6.2 Useful statistical evaluations

Conducting regular (e.g. every month, every three months, every year) evaluations on the acquired logging data is recommended.

As a minimum, the following basic set of evaluations should be conducted:

— quality scores distribution;

— error code distribution;

— average enrolment duration;

— distribution of enrolment duration;

— distribution of gender and age, especially in relation to quality scores.

When used in a verification or identification scenario, it is recommended to also evaluate the accumulated results of the verification or identification attempts.

7 Operational process

7.1 General user guidance

The presence of a user interface is advised to support better acquisition.

Tenprint devices may be enabled with a feature that can detect incorrect position. Such devices can report this error to the software to either improve workflow speed or assure workflow consistency.

For persons with conditions or disabilities affecting the fingers, it may not be possible to have the subject directly place the finger on the platen. A backup procedure may be necessary, such as using a small platen device and manually placing the platen against the finger directly (instead of having the person place the finger on a device).

The following placement recommendations should be applied:

— The user should set down the fingers flat on the sensor and their tips but not set down only the tips [Figure 1 a)] or the sides of the fingers [Figure 1 b)].

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

a) Flat finger position on sensor **b) Hand orientation position on sensor**

Figure 1 — Finger positions on sensor

— The user should position the fingers straight, parallel to the edges of the sensor [Figure 2 a)] and avoid any rotation unless a rotation is the only way to place all fingers on the acquisition surface of the sensor [Figure 2 b)].

a) Prefer parallel fingers in relation to the edges **b) Avoid rotated fingers in relation to the edges**

Figure 2 — Finger positions

— The user should position the thumb(s) straight, parallel to the edges of the sensor [Figure 3 a)] and avoid any rotation [Figure 3 b)]. It is advantageous for segmentation algorithms to have the two thumbs presented parallel to the edges of the sensor and without rotation.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

 © ISO/IEC 2018 – All rights reserved

a) Correct thumb position

b) Wrong thumb position

Figure 3 — Thumb positions

— The user should put down all the fingers simultaneously on the sensor (do not roll them on the sensor or do not put down one finger after the other on the sensor).

— The user should not spread the fingers too much [Figure 4 a)] or cross the fingers [Figure 4 b)].

a) Spread fingers

b) Crossed fingers

Figure 4 — Spreading and crossing fingers

— The user should centre the hand or the thumb(s) on the sensor acquisition surface.

— The user should not position the fingers on the borders of the sensor acquisition surface, in order to avoid cutting or missing part of the slap (Figure 5).

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

a) Mind the top border of the sensor

b) Mind the low border of the sensor

Figure 5 — Minding sensor borders

— The user should position the fingers on the sensor such that as much as possible of the fingerprint area of the digital phalanx is present in the scanning area. If the user has placed the hand on the sensor wrongly, it should be ensured that the hand is removed before putting it down again on the sensor, as moving the hand directly on the sensor can cause skin distortions.

7.2 Acquisition process recommendations

Visual or oral instructions should be provided to the user to understand how to position the fingers on the sensor correctly. It is recommended to instruct the user to look at these instructions carefully, listen to the advice given by the operator in a supervised context and to follow the instructions of the sensor (LED, beeps, etc.) after each step of the process.

NOTE 1 Samples of pictograms, icons and symbols are specified in ISO/IEC 24779-4[8].

NOTE 2 A study conducted by the USA's National Institute of Standards and Technology (NIST) shows that best results are obtained by combining audio and video rather than by using written instructions only[2].

— The user should move in front of the sensor and place the indicated finger(s) on the prism surface following finger placement recommendation in 7.1.

— The user should wipe the fingers if they are wet [Figure 6 a)] or moisten them if they are too dry [Figure 6 c)].

a) Poor quality finger due to wetness

b) Good quality finger

c) Poor quality finger due to dryness

Figure 6 — Example of finger with good and poor quality

Different sensor technologies adapt differently to wet or dry fingers. User guidance should consider such technology information, too.

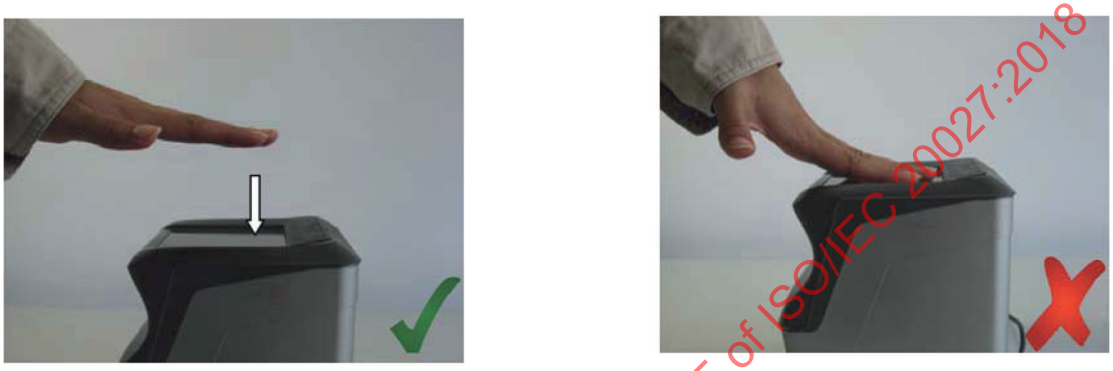
STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

Especially with an automatic system, the user should be notified when the acquisition procedure begins. Visual and/or audible feedback may be given depending on the scanner. Furthermore, step-by-step guidance should be given on the slap or the thumbprint(s) to be actually presented.

— The required hand (for a right/left slap) or thumb(s) (for individual or simultaneous thumbprint) should be directed vertically towards the sensor. The direction of the hand movement should be perpendicular to the sensor acquisition surface [Figure 7 a)].

Directing the hand obliquely toward the sensor and pressing on it in an oblique way causes distortion [Figure 7 b)].



a) Vertical movement of the hand **b) Oblique pressure on the sensor**

Figure 7 — Hand movement and pressure on sensor

— The hand or thumb(s) should be placed correctly on the sensor (Figure 8). The live feedback should be used (if any provided) to handle this operation at best.

a) Fingers **b) Thumbs**

Figure 8 — Correct placement of fingers and thumbs

— Sufficient pressure should be applied on the sensor for the acquisition (in order to cover enough surface of the finger) but no over-pressure (otherwise fingerprint structures get lost in the image). The user can be encouraged to use the other hand to apply pressure on the hand to be enrolled if necessary. The user should then take care that the finger(s) of the other hand do not touch the sensor surface.

— Leave the hand or the thumb(s) on the sensor until asked to release by the sensor or the operator. In case the fingers of a user are very dry, he should be encouraged to moisturize them. In some cases,

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

the scanning process may take a significant amount of time, so the user should be notified on not releasing the hand or finger(s) until requested.

— The hand or the thumb(s) should not be moved during the acquisition. Once the acquisition is done, the user should be notified. Then, the next slap or the next thumbprint(s) to be acquired according to the implemented workflow should be indicated.

— The user should remove the hand or the thumb(s) completely from the sensor before recapturing, moving to the next capture step or ending the process.

8 Operational issues

8.1 Placement recommendations

The placement of the device is a critical issue for a correct acquisition[3].

The following is recommended:

— Give access to the sensor so that the user is able to position oneself with great ease in order to place the hands and thumbs on it.

— Place the sensor in its best working way in accordance with the manufacturer recommendations[3].

— Specify the height range of people to be captured. Perform own tests on the best placement. Ideal height for acquisition is elbow height.

— Ensure that any strong light sources do not directly illuminate into the sensor prism. This includes all direct lights. However, ensure appropriate environmental illumination allowing user and operator a good view of the sensor.

— As light can change, the operator should be aware of this change in luminosity and react accordingly.

— Set the room temperature to avoid a large temperature difference between sensor surface and finger(s). Failure to do this could cause halo effects due to condensation in the captured images. Some sensors are able to work under far larger temperature constraints, e.g. because they have heated prisms. Furthermore, for other than indoor uses the chosen sensors should be able to operate under other (usually rougher) environmental constraints.

NOTE 1 Consideration and evaluation methodology of environmental influence or biometric system can be found in ISO/IEC 29197[9].

NOTE 2 This document is primarily intended for enrolment applications, but may partly also be applicable to field-level verification procedures or similar.

— Make sure that the sensor is correctly fixed and stable in order to prevent any movement during the acquisition of the prints.

NOTE 3 In order to address accessibility concerns (e.g. people in wheelchairs), temporarily detachable devices can be useful.

8.2 Calibration recommendations

In case of sensor with calibration function, the following is recommended:

— Clean the acquisition surface of the sensor before its initialization in accordance with the manufacturer recommendations for best results with products recommended by the manufacturer. Failure to do this can result in ghost images.

— Carry out the sensor calibration if applicable (refer to the instructions given by the sensor manufacturer). During this calibration process, no object should be on the sensor, and the surface should be clean.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

 © ISO/IEC 2018 – All rights reserved

Check if the sensor needs to be covered with a lid during calibration. Information as to whether this is necessary is provided by the sensor manufacturer.

8.3 Cleaning recommendations

The following is recommended:

— Clean the acquisition surface of the sensor in accordance with the manufacturer recommendations for hygienic reasons and proper sensor use. Use the products recommended by the manufacturer and the recommended frequency of cleaning (as in 8.2, cleaning may be recommended before the initialization of the sensor).

— The sensor capturing software should be able to deal with minor pollution. For every application/transaction, especially high throughput ones, the sensor should be cleaned every time.

— The operator should be properly trained to clean the sensor and ensure they have the correct cleaning materials.

8.4 Operator recommendations

In the case of enrolment, the acquisition quality is even more important than in the case of verification. Therefore, training operators involved in the acquisition process is crucial. Operators should be trained in order to make them effective in helping users during the enrolment and verifying that this enrolment is done correctly. Operator training should be repeated frequently to maintain the operators' capabilities and to provide new information to them.

The following is recommended:

— Provide dry soft tissue if necessary in order to wipe the fingers if they are wet or sweaty.

— Provide humidifying pads if necessary in order to moisten the fingers if they are too dry. The need for drying or humidifying fingers mostly depends on the environmental conditions and on the sensor characteristics. Disinfecting towels can be provided to address hygienic issues.

Operators should ensure that the person acquiring fingerprints does not use any finger dummies, fakes or something similar. Therefore, a direct view of the sensor is necessary. It is recommended that the person shows the fingers to the operator before starting the acquisition process. Feedback and sharing of user experience between operators may be done also regularly or through the trainings in order to share and spread among operators specific recommendation for their system.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

© ISO/IEC 2018 – All rights reserved

Annex A
(informative)

Example of an acquisition process

This annex explains how an acquisition of ten slap fingers is made in a general way, as shown in Figure A.1.

First, one capture of the hand is performed. Then, the quality of each captured fingerprint is checked. If the quality of all fingers is above the threshold of the application, the acquisition is successful. Otherwise, the acquisition is performed again (with a maximum of three attempts in this example).

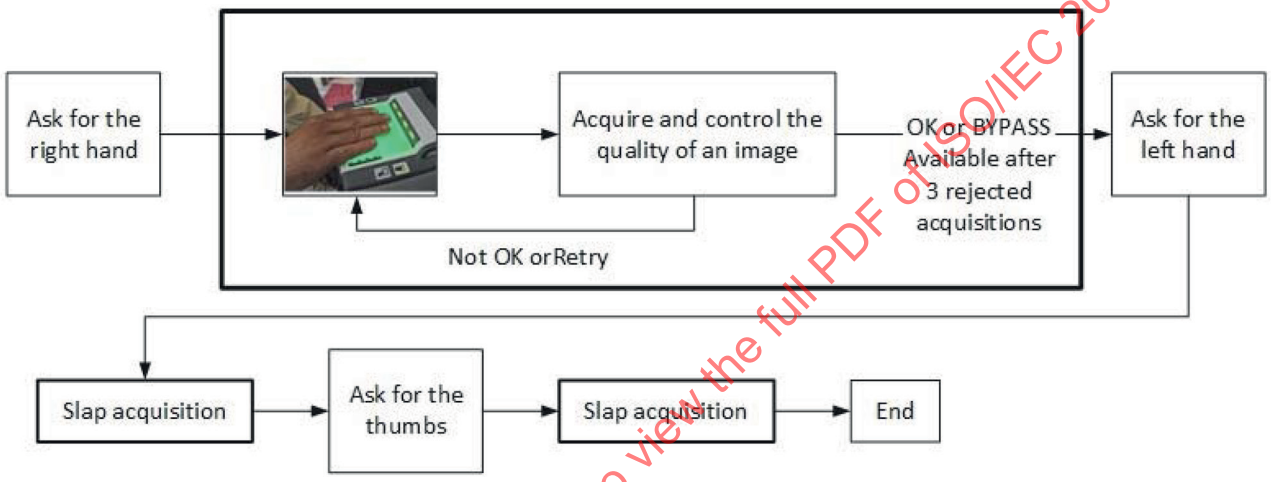


Figure A.1 — Overview of a ten-slap enrolment

The process begins with the acquisition of fingerprints of the right hand. In the standard process, a multi-finger acquisition is applied. Therefore, multiple fingerprints are captured at once. The quality of all fingerprints of this hand is checked. If this quality is not sufficient, then the right hand is captured again.

If available, actionable feedback should be provided to assist the user in acquisition of the image.

If the required quality cannot be achieved for all fingerprints within the three attempted captures, there are two alternatives:

— attempting another capture (the operator decides how many captures are wanted before stopping the process);

— the system keeps the image with the best average quality and continues with the next slap.

After the acquisition of fingerprints from the right hand, the fingerprints from the left hand and finally those of the thumbprints are captured.

In addition to the set of ten fingerprints, this process also delivers complete slap images including the angles between fingers.

NOTE The need for complete slap images depends on the application.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

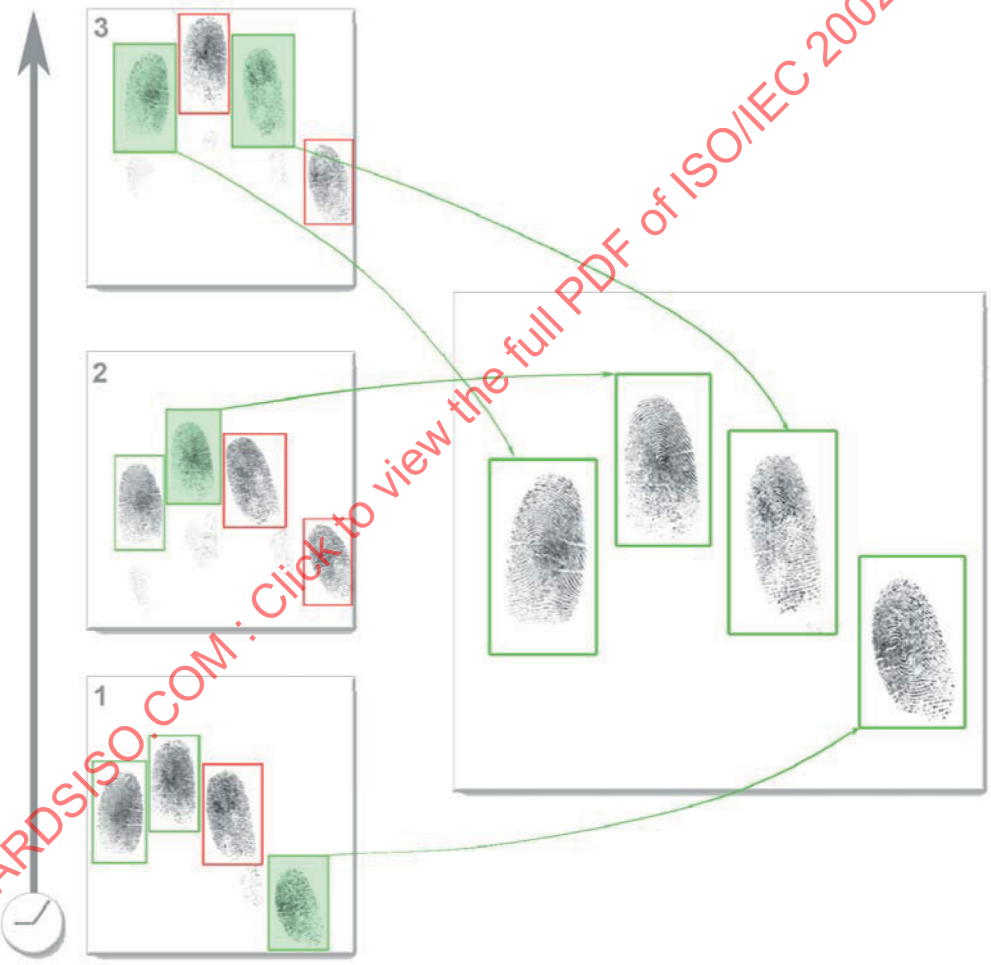
© ISO/IEC 2018 – All rights reserved

Annex B
(informative)

Example of an acquisition process based on composite records

This annex gives an example of an acquisition process based on a composite record (See Figure B.1 and Figure B.2).

Composite records shall be considered with care as it may not be permitted for some applications.



STANDARDSISO.COM : Click to view the full PDF of ISO/IEC 20027:2018

Figure B.1 — Concept of composite records

Multiple captures (three times in this example) are performed. Different decision criteria, based upon operational and system requirements, can be used to determine which image is chosen to be used for the composite record.

If the acquisition of specific fingers is too difficult in multi-finger capture, the process should switch to single-finger capture for those.

© ISO/IEC 2018 – All rights reserved