TECHNICAL SPECIFICATION

ISO/IEC TS 20027

First edition
2015-09-15

Biometrics interoperability profiles — Best practices for slap tenprint captures

Profils biométriques interopérables — Recommandations pour les captures de 10 doigts à plat

Reference number
ISO/IEC TS 20027:2015(E)

© ISO/IEC 2015

COPYRIGHT PROTECTED DOCUMENT

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 ISO documents 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 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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

It has been adopted from the European Technical Specification, CEN/TS 16428:2012, *Biometrics Interoperability profiles — Best Practices for slap tenprint captures*.

Biometrics interoperability profiles — Best practices for slap tenprint captures

1　Scope

The main goal of this Technical Specification is to give guidelines to follow during the acquisition process of slap tenprints in order to obtain fingerprints with the best quality possible within acceptable time constraints.

Non-cooperative users are out of the scope of this Technical Specification.

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

It gives guidance on the following topics:

1)　recommendations on the hardware of the fingerprint sensor and its deployment;

2)　recommendations on user guidance;

3)　recommendations on the enrolment process including a sample workflow;

4)　recommendations for developers and system integrators on application software;

5)　recommendations on processing, compression and coding of the acquired fingerprint images;

6)　recommendations on operational issues and data logging;

7)　recommendations on the evaluation of a solution and its components.

Although this Technical Specification 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 reported here.

2　Sensor hardware requirement

Image quality should comply with the quality specifications from ISO/IEC 19794-4 [1]. 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.3.

NOTE 1　This Technical Specification considers optical sensors based on the principle of total internal reflection. However, this does not mean that other technologies cannot be used for tenprint enrolment purposes. As soon as sufficient experiences are available and recommendations can be given on emerging technologies, they 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.

It is recommended that the compliance of a sensor device to the applicable quality standard can be verified at any time in the operational environment.

NOTE 2　The need for calibration or re-calibration depends on the sensor technology and calibration might not be necessary for all devices.

3   Acquisition software

3.1   Acquisition process

For the acquisition process, the highest quality images should be used. The acquisition of these images should be done automatically. 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.

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

3.2   User feedback

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

Feedback can be given, for example, by

— a screen attached in close neighbourhood to the sensor,

— illuminated pictograms on the sensor,

— LEDs assigned to pictograms directly on the sensor.

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 its 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, which indicator should be simple [e.g. a two-state logic (not good/good) or similar];

— 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.

3.3   Acquisition check

The software linked to the sensor should take account of 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.

— All 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 could 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.

3.4   Image processing

3.4.1   Segmentation

Independently of physical resolution of the sensor and the image acquired, the resolution of the fingerprint image should be at least 197 ppcm (500 ppi) and, therefore, can differ from the scan resolution.

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.

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

— Ability to accept rotated fingerprints having the same direction in 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.

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.

3.4.2   Compression

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

NOTE 1   The compression ratio should not be too high, a maximum compression ratio of 15 is recommended.

NOTE 2   The WSQ compression is mainly used for fingerprint compression; it has been optimized to be compatible with minutiae calculation.

The implementation of the used WSQ algorithm should be certified by the FBI and should be referenced by the respective certificate number (coded in the WSQ header).

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

4   Logging and evaluation of data

4.1   General

Logging and evaluation data might be subject to national legal constraints and should be handled accordingly.

4.2 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);

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

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.

4.3 Useful statistical evaluations

Conducting regular (e.g. every month, every three month, 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.

5 Operational process

5.1 General user guidance

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

The following placement recommendations should be applied.

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

a) Tips of the fingers
b) Sides of the fingers

Figure 1 — Finger positions on sensor

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

— The user should position the thumb(s) straight, parallel to the edges of the sensor (see Figure 3) and avoid any rotation.

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 fingers too much [see Figure 4 a)] or cross his/her fingers [see 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 his/her fingers on the borders of the sensor acquisition surface, in order to avoid cutting or missing part of the slap (see Figure 5).

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 fingers is placed on 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 could cause distortions.

5.2 Acquisition process recommendations

Visual 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 currently developed in ISO/IEC 24779-4.[7]

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) with great ease on the prism surface.

— The user should wipe his/her fingers if they are wet [see Figure 6 a) and b)] or moisten them if they are too dry [Figure 6) c)].

a) Example of a wet finger

b) Example of a correct-quality finger

c) Example of a too-dry finger

Figure 6 — Quality of fingers

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

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 [see Figure 7 a)].

Directing the hand obliquely toward the sensor and pressing on it in an oblique way causes distortion [see 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 (see Figure 8) The live feedback should be used (if any provided) to handle this operation at best. The term "correctly" refers to recommendations described in Clause 4.

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 his 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 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 his/her hand or the thumb(s) completely from the sensor before recapturing, moving to the next capture step or ending the process.

6 Operational issues

6.1 Placement recommendations

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

The following is recommended.

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

— Place the sensor in its best working way in accordance with 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 on the sensor.

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

— The room temperature should be set 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   A complex operational scenario has been developed in ISO/IEC 29197.[8]

   NOTE 2   This Technical Specification 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.

6.2 Calibration recommendations

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.

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

6.3   Cleaning recommendations

The following is recommended.

— Clean the acquisition surface of the sensor in accordance with manufacturer recommendations for hygienic reasons, with products recommended by manufacturer. Good capturing software should be able to deal with minor pollution, as it is not realistic that for every user the sensor can be cleaned in high throughput applications.

6.4   Operator recommendations

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 or cold. 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.

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 operator's capabilities and to provide new information to them.

Operators shall ensure that the person acquiring fingerprints does not use any finger dummies, fakes or something similar. Therefore, a direct view to the sensor is necessary. It is recommended that the person shows his fingers to the operator before starting the acquisition process.

Annex A
(informative)

Example of acquisition process

This annex explains how an acquisition of ten slap fingers is made in a general way.

See Figure A.1.

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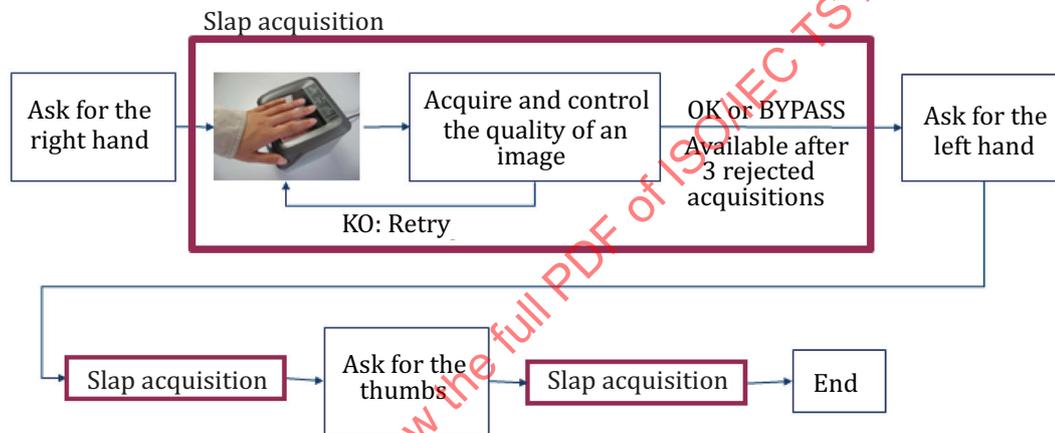

Figure A.1 — Overview of a ten-slap enrolment

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. The process should prefer the slap with the best overall quality.

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

— attempting another capture (operator will decide how many captures he wants 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 slap of the right hand, the fingerprints from the slap of 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.

Annex B
(informative)

Example of an acquisition process based on composite records

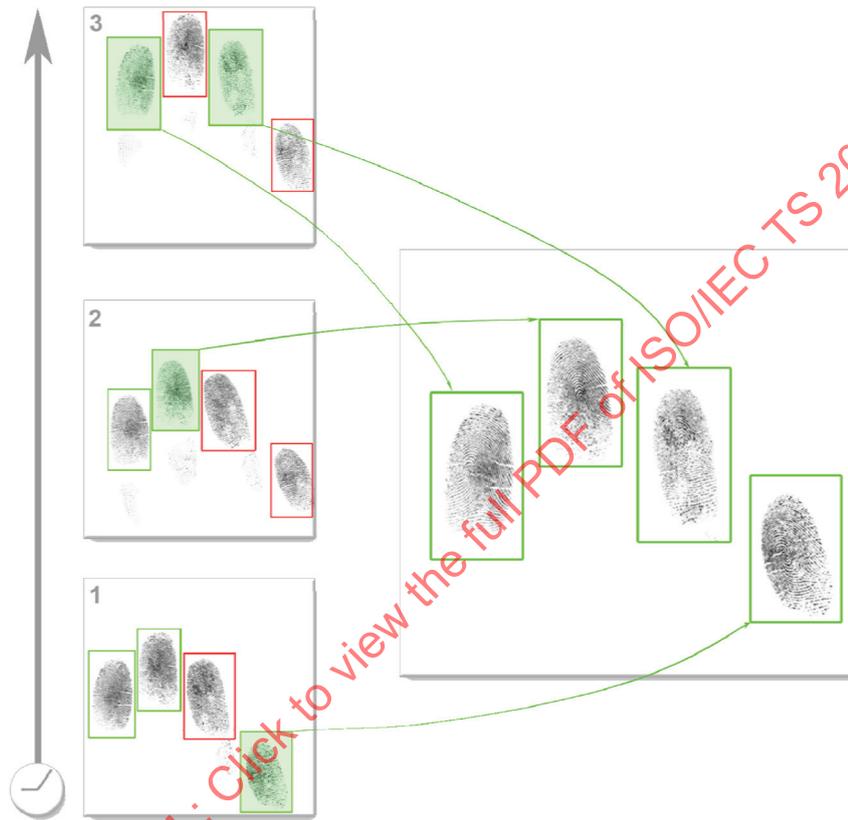See Figure B.1 and Figure B.2.

Figure B.1 — Concept of composite records

This annex explains how to build composite records based on cross matching.

NOTE   This process only applies to tenprint sets without corresponding control slaps of images.

Multiple captures (three times in this example) are performed. For every single finger out of the set, the three fingerprints are matched against each other and the one that matches best against the other two is chosen 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.

If the acquired fingerprints have poor quality at least one repetition of the appropriate process should be enforced before accepting lower quality fingerprints.
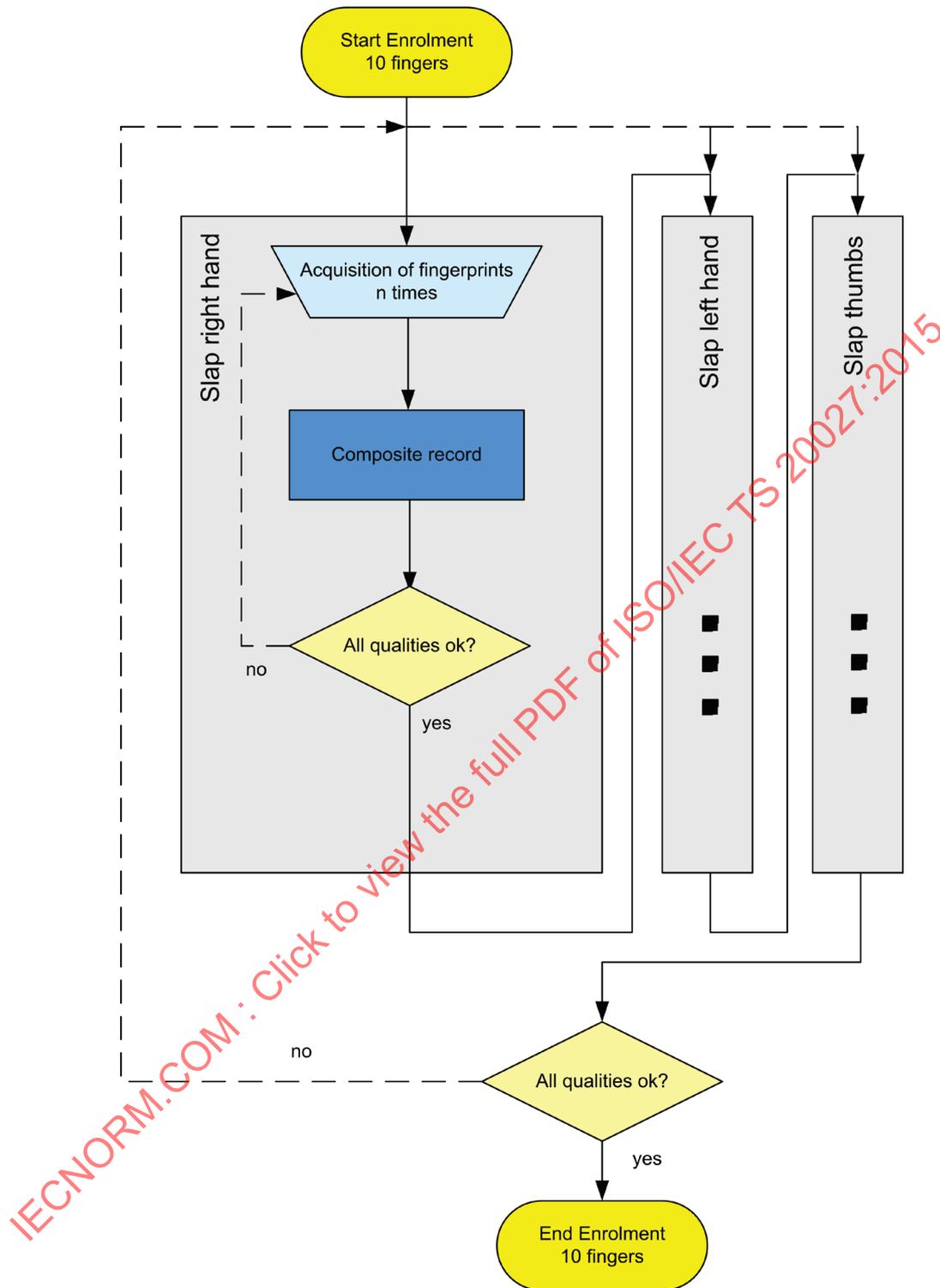
Figure B.2 — Overview of the enrolment of ten fingers

Composite records based on cross matching

— The process begins with the acquisition of fingerprints of the right hand. In the standard process multi finger acquisition is applied. Therefore, multiple fingerprints are captured at once while the sequence of fingerprint acquisition is repeated three times.