
**Information Technology — Biometrics
— Guide on designing accessible and
inclusive biometric systems**

*Technologies de l'information — Biométrie — Guide sur la conception
des systèmes biométriques accessibles et inclusifs*

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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.

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 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/IEC JTC 1, *Information Technology*, Subcommittee SC 37, *Biometrics*.

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Introduction

This Technical Report provides support for the further development of ISO/IEC biometrics international standards in the context of cross-jurisdictional and societal applications of biometrics, including standardization of both existing and future technologies.

ISO/IEC/TR 24714-1:2008 lays down the principle that inclusive designs of biometric systems are ones that as many subjects within the target population as is reasonably possible can use the systems effectively and with minimum discomfort. This Technical Report offers guidance in the dialogue between writers of system specifications for biometric systems and the developers of biometric systems, in reaching a common understanding of the target population and agreement of what is reasonably possible. This Technical Report aims to aid the procurement process of biometric systems, provide a means of acceptance of inclusive design, and ultimately improve accessibility of biometric systems.

Central to a common understanding of target populations is an agreed taxonomy. This Technical Report establishes taxonomy based upon a person's inability to perform a function. This enables a writer of a system specification for a biometric system to specify those categories that must be handled by the primary biometric system and those categories that would be required to use the exception handling process. Conversely the taxonomy enables biometric system suppliers to specify which parts of the population they have accommodated for in their designs.

Agreed quantification of the target population and how accessibility and inclusivity is to be achieved enables acceptance testing to be devised.

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Information Technology — Biometrics — Guide on designing accessible and inclusive biometric systems

1 Scope

Procurements of biometric systems often stipulate requirements for the systems to be inclusive and make provision for exception handling.

This Technical Report provides guidance for biometric system design and procurement to handle the range of accessibility and usability issues. This report will build upon the generic guidance in ISO/IEC/TR 24714-1, *Information technology — Biometrics — Jurisdictional and societal considerations for commercial applications – Part 1: General guidance*.

The biometric modalities addressed in this technical report include those described in the ISO/IEC 19794, (All parts), *Information Technology — Biometric data interchange formats*:

- Finger
- Face
- Iris
- Signature
- Vascular
- Hand-geometry
- Voice

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2 Accessible and inclusive design taxonomy

The taxonomy used by this Technical Report reflects that described in ISO/IEC/TR 29138-1. This Technical Report provides examples of good practice for particular biometric modalities against the taxonomy, resulting in guidelines for inclusive design for the widest range of the population. The Technical Report can also help in selecting suitable biometric modality solutions when designing solutions with a particular population from the taxonomy descriptions.

There is a basic principle of designing biometric systems in a way that they can be used effectively and with minimum discomfort by the whole target population. There is also the need of reaching a common understanding of the target population and an agreement of what is reasonably possible. This brings the requirement of designing biometric systems following the best possible guidance to create systems that are accessible. Accessibility problems of biometrics systems are not limited to disabled people. Other groups may be affected due to occupational constraints, medical procedures and religious/cultural issues.

A person may not be aware of any issues of them using a biometric system until at the point of use.

Biometric systems are not familiar to all, and even then may not be regularly used. Therefore inclusive design must be based upon a lack of familiarity.

Considering all these scenarios, the following taxonomy can be considered. Each of the categories and subcategories in this taxonomy will be detailed in subsequent clauses of this Technical Report.

- (Inability to) Perceive visual information
 - People who are unable to perceive any visual information.

- People who have difficulty in perceiving visual information.
- (Inability to) Perceive auditory information
 - People who are unable to perceive any auditory information.
 - People who have difficulty in perceiving auditory information.
- (Inability to) Perform motor actions
 - People who are unable to walk unaided.
 - People who are unable to stand.
 - People who are unable to pitch, or yaw, or rotate head, or keep stationary.
 - People who are unable to raise and/or rotate arms/hands.
- (Inability to) Present physiological attribute
 - Unable to present the specified hand(s).
 - Unable to present specified finger(s) and/or palm(s).
 - Unable to present the specified eye(s) as attribute or as landmark.
 - People who are unable to present physical attribute within the specified field of the sensor.
 - Unable to present specified auditory input.
- (Inability to) Apply instructions due to mental impairment
 - People with cognitive or learning difficulties.
 - Where interaction and/or responses from system are counter intuition or familiarity.
- (Inability to) Follow guidance due to cultural discrepancies
 - People with language differences.

A description of each sub-category is provided in the form of examples, rather than any medical condition. Associated with each category are references that contain guidance to improve particular accessibility. In addition specific guidance for biometric systems is offered if this is not contained in other reference documents.

Depending on the disability, the use of certain biometric modalities can be inappropriate and alternatives should be in place.

3 Generic problems and recommendations

3.1 Generic problems

- Difficulty in positioning to see information or device if not in line of sight.

3.2 Recommendations

- In authentication schemes that use tokens (where the user has to claim its identity in advance), these tokens should store information about the impairment of the user, for dynamic adaptation of the system to that impairment.

3.3 Sources for addition guidance on accessibility

For the design and development of a biometric system able to be used by people with disabilities, a huge amount of standards and technical reports should also be addressed. ISO/IEC/TR 29138-2 provides an inventory of all those related standards (international and regional) that could be applicable, being some of them independent on the disability, while others focussed on a certain kind of disability.

4 (Inability to) Perceive visual information

4.1 Examples of Problems

4.1.1 People who are unable to perceive any visual information

- Cannot access information presented (only) via graphics.
- Cannot find device(s).
- Cannot tell status of visual indicators (e.g. LEDs, on screen indicators), or gain visual feedback.
- Cannot determine number, size, location of controls on touch screens or flat membrane keypads, or difficulty in locating without activating.
- Cannot align line of sight to markers.

4.1.2 People who have difficulty in perceiving visual information

- Difficulty in discriminating foreground information from background information.
- Difficulty in discriminating colours.
- Problems with glare from screens.
- Difficulty in seeing temporary presented information.
- Difficulty with insufficient ambient light.

4.2 Modality independent guidance

Clauses in ISO/TR 22411 that apply to this case are 8.2.1, 8.2.2, 8.2.5, 8.3.1, 8.3.3, 8.4.4, 8.5.1, 8.5.2, 8.5.3, 8.6, 8.7.1, 8.7.3, 8.11.1, 8.11.3, 8.12.2, 8.12.3.1, 8.12.3.2, 8.12.3.3, 8.12.6, 8.17.2, 9.2.1, and 9.2.1.3.

In addition, the following recommendations should be followed.

- Feedback to the user should not be provided only by means of visual signalling. Other feedback alternatives, such as auditory or tactile should be considered as complementary to the visual feedback.

NOTE While using colour can be a plausible solution, caution should be exercised on the choice of colours to accommodate people with colour vision deficiency.

- In authentication schemes (where the user has to claim its identity in advance) use tokens that also have information stored about the impairment of the user, and adapt dynamically the system to that impairment.
- Visually the capture device should stand out if it is attached to a terminal. The capture device should be highlighted by making it a different colour to the surrounding area, or using alternative illumination.

4.3 Additional modality specific recommendations

4.3.1 Finger

- The reader should not be flush against the rest of the terminal. This will make it more noticeable from both a visual and a tactile point of view. The device as a whole should be raised from the terminal, with the scanner area itself slightly recessed into the raised surrounding casing.
- Where multiple scans are taken in sequence, ideally the subject should be able to simply press and hold the finger in place (i.e. removing the necessity to lift and replace the finger repeatedly). If repeated removal and replacement of the finger(s) is required, then there should be a ridge around the scanner area to aid location.
- The scanner area should be recessed into the surrounding raised casing, thereby guiding the finger into the correct location.
- A tactile marking (consisting of, for example, a circular area with a different texture) in the very centre of the scanner area would allow accurate positioning of the finger, while not limiting the size of the scanner area.
- The scanner area should be lit internally. The light should only turn on when the reader is awaiting input or the light should start flashing slowly when the reader is awaiting input.

NOTE It may be of interest to read the lessons learned stated in the following two links: <http://www.gao.gov/assets/300/299126.pdf> and https://www.dhs.gov/xlibrary/assets/usvisit/usvisit_biometric_standards.pdf

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4.3.2 Face

- The light should only turn on when the camera is awaiting input.
- For capture devices requiring precise location of the subject, audio feedback can be provided to allow interacting with the systems without the need of visual feedback (e.g. telling the user where to move for a proper alignment for best face presentation).

4.3.3 Iris

- For capture devices requiring precise location of the subject, audio feedback can be provided to allow interacting with the systems without the need of visual feedback (e.g. telling the user where to move for a proper alignment or to open more the eyelids for a better acquisition).

4.3.4 Signature

- The signing tablet should not be flush against the rest of the terminal. This will make it more noticeable from both a visual and a tactile point of view. The device as a whole should be raised from the terminal, with the signing area itself slightly recessed into the raised surrounding casing.
- When a tactile screen is used for capturing the signature, there should be high contrast in the light (or colour) intensity between the area where the signature should be placed and the rest of the screen.
- When a tactile screen is used for capturing the signature and the area to capture the signature does not occupy the whole screen, an audio feedback should be provided when the signing device (i.e. stylus or finger) is outside the acquisition limits.

4.3.5 Vascular and Hand Geometry

- The reader should not be flush against the rest of the terminal. This will make it more noticeable from both a visual and a tactile point of view. The device as a whole should be raised from the terminal, with the scanner area itself slightly recessed into the raised surrounding casing.

- Where multiple scans are taken in sequence, ideally the subject should be able to simply hold the hand in place (i.e. removing the necessity to lift and replace the finger repeatedly). If repeated removal and replacement of the hand(s) is required, then there should be a ridge around the scanner area to aid location.
- The scanner area should be recessed into the surrounding raised casing, thereby guiding the finger or hand into the correct location.
- Ideally, a tactile marking (consisting of, for example, a circular area with a different texture) in the very centre of the scanner area would allow accurate positioning of the finger or hand, while at the same time not limiting the size of the scanner area.

4.3.6 Voice

- The level of directionality of the microphone should be low enough to allow acquiring the sound from the biometric capture subject even if the subject is unable to face the sensor properly due to visual impairment..

5 (Inability to) Perceive auditory information

5.1 Examples of Problems

5.1.1 People who are unable to perceive any auditory information

- Cannot hear information presented through speech.
- Cannot hear information presented through tones.
- Cannot operate devices via voice activation only.
- Difficulty in repeatability of voice inflections for voice recognition.
- Require guide or personal assistant.

5.1.2 People who have difficulty in perceiving auditory information

- Difficulties with certain frequencies.
- Difficulties with background noise interfering with auditory information.
- Speech is too fast.
- Difficulty in hearing audio information only once.
- Difficulty in discriminating sounds.

5.2 Modality independent recommendations

Clauses in ISO/TR 22411 that apply to this case are 8.2.3, 8.2.4, 8.7.1, 8.9, 8.10, 8.12.6, 8.20.1, and 8.20.2.

In addition, the following recommendations should be followed.

- The system should not use auditory as the sole mechanism for communicating information.
- The system should provide visual or vibration feedback to show when the acquisition has taken place, and about the result of the whole process.
- Lighting signalling should be turned on when the sensor is awaiting input.