TECHNICAL REPORT

ISO/IEC TR 20322

First edition
2023-03

Information technology — Cross-jurisdictional and societal aspects of implementation of biometric technologies — Biometrics and elderly people

Technologies de l'information — Aspects sociétaux et transjuridictionnels de la mise en œuvre des technologies biométriques — Biométrie et personnes âgées

Contents

Page

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.

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 or www.iec.ch/members_experts/refdocs).

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) or the IEC list of patent declarations received (see https://patents.iec.ch).

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

For an explanation of 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 www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

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

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 and www.iec.ch/national-committees.

Introduction

This document provides support for the further development of ISO/IEC International Standards on biometrics in the context of cross-jurisdictional and societal applications of biometrics, in relation to usage with elderly persons.

The contents of this document are descriptive and do not provide recommended practices and guidelines.

Examples of the benefits to be gained using this document are:

— operational support in using biometrics applied to the context of elderly people;

— enhanced acceptance by subjects of systems (elderly people and relatives) using biometric technology;

— improved public perception and understanding of these systems;

— smoother introduction and operation of these systems.

The primary stakeholders are identified as:

— users – those who use the results of the biometric data;

— developers - those who develop technical standards;

— subjects – those who provide the biometric sample;

— writers of system specifications, system architects and IT designers;

— public policy makers - those who make policies affecting the use of biometrics.

Information technology — Cross-jurisdictional and societal aspects of implementation of biometric technologies — Biometrics and elderly people

1　Scope

This document builds upon the information provided in ISO/IEC TR 24714-1, ISO/IEC TR 29194 and ISO/IEC 29138-1 in order to highlight in a more detailed way the medical, physical and cognitive aspects that are specific for the use of biometrics by elderly persons.

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 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— 　ISO Online browsing platform: available at https://www.iso.org/obp

— 　IEC Electropedia: available at https://www.electropedia.org/

3.1
elderly person
every human being over the age of 65 years

Note 1 to entry: For an explanation of why 65 years has been chosen as the age defining an elderly person, see Clause 6.

4　Abbreviated terms

DG　　　　　Directorates-General of the European Commission

EU　　　　　European Union

JRC　　　　　Joint Research Centre of the European Commission

UN　　　　　United Nations

5　Fundamental concepts

ISO/IEC TR 29194:2015, Clause 2 states:

"*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".

ISO/IEC 29138-1:2018, Clause 1 states:

"*This document identifies a collection of user accessibility needs that diverse users have of ICT systems to make these systems accessible to them. Each user accessibility need might be required of a system by an individual. Different users can have different sets of user accessibility needs in different contexts*".

The issues raised in these two documents are particularly evident in the biometric context because age-related psychophysical complications often combine with a degradation of the biometric characteristics of the individuals.

The consequences are that elderly people often experience serious difficulties in using a biometric system.

6   Elderly people in terms of age

Although it cannot be considered as a general rule, and the UN-agreed age for referring to the elderly population is 60+ years, many countries have accepted the chronological age of 65 years as a definition of an 'elderly' or older person.

This document follows the latter convention and uses the definition provided in 3.1 when referring to "elderly people".

7   Critical points associated to the use of specific biometric modalities by elderly people

7.1   General considerations

The following subclauses provide a brief description of some typical characteristics of elderly people that can have a potential consequence on specific biometric technologies. They also consider certain pathologies which are frequently experienced by elderly people.

NOTE   Although the focus of this document is on elderly people, some pathologies can also occur at an earlier age.

The biometric technologies analyzed in this document are those which are most prevalent in their use. If the use of a further biometric technology becomes particularly widespread in the future, such technology will be considered in subsequent revisions of this document.

7.2   Fingerprint recognition

7.2.1   Typical characteristics of an elderly person which can have consequences on fingerprint recognition: skin conditions

In elderly people, water loss from the stratum corneum, the outermost layer of the epidermis, can make skin dry (xerosis).[1] This can result in an inconsistent contact of the finger ridges with the scanner's platen surface, which can cause broken ridges and several white pixels replacing ridge structure.[2]

Furthermore, the differentiation between ridges and valleys reduces as ridges wear out with age. As a result, for a contact scanner, it can become difficult to capture a good quality fingerprint.

NOTE   With the implementation of contactless fingerprint scanning technologies, this issue is lessened, and could potentially be eliminated in the future.

Consequently, it can be pertinent to evaluate whether fingerprint recognition is the appropriate biometric to use for elderly people (particularly those aged over 70) in certain situations.

EXAMPLE   The US VISIT Entry/Exit systems exempts persons over the age of 79 from releasing fingerprints during the phase of verifying the credential to access to the USA at an entry point.

If contact fingerprint sensor technology is used, some scanner manufacturers provide elderly people with appropriate moisturizing solutions to be applied prior to fingerprint capture.

An advantage of using sub-dermal or touchless fingerprint sensors is that they are less affected by changes to the surface of the skin.

7.2.2 Typical pathologies experienced by elderly people which can have consequences on fingerprint recognition

7.2.2.1 Arthritis and arthrosis

An elderly person's ability to use a fingerprint device can be severely limited by arthritis, arthrosis or a loss of motor performance. Consequently, the quality of images captured by fingerprint sensors can be affected in the population of elderly people.

NOTE   It is not advisable to treat unintentional poor fingerprint presentations due to age-degraded motor functions as a presentation attack to the fingerprint system.

A solution for overcoming such issues is to re-capture the fingerprint until image quality is sufficient for system processing or, again, use touchless fingerprint sensors.

7.2.2.2 Neuromuscular diseases

Neuromuscular disease is a very broad term that encompasses many diseases and affections that impair the functioning of the muscles, either directly (pathologies of the muscles), or indirectly (pathologies of nerves or neuromuscular junctions).

Neuromuscular diseases increase with age, and can influence the use of fingerprint scanners by elderly people.

7.2.2.3 Eye diseases

Reduced visual acuity among the elderly is a very important healthcare problem. According to Reference [3], approximately one person in three has some form of vision-reducing eye disease by the age of 65.

As described in ISO/IEC TR 29194, a series of countermeasures can mitigate reduced visual acuity of people using fingerprint sensors:

— the scanner area of the fingerprint sensor can 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 can allow accurate positioning of the finger, while not limiting the size of the scanner area;

— an internally illuminated scanner area can help people with impaired vision. If this feature applies, the light only turns on when the reader is awaiting input or starts flashing slowly when the reader is awaiting input.

Another option is the use of multi-sensory alerts (lights and sound; lights, sound and vibration, etc.) to inform the subject.

7.2.3   Data concerning the use of fingerprint recognition by elderly people

The JRC has started a study on the physiological development of the fingertip ridge structure over time and its impact on automated fingerprint recognition.[4]

For those in the elderly category, experiments have shown evidence of a significant age effect (variation of accuracy of fingerprint recognition systems due to the age of the subject).

In particular, the findings highlight that:

—   for elderly people in the range 65-90, fingerprint quality decreases linearly with age (according to the estimation made in the study, this linear decrease starts at around 40-45 years of age);

—   for elderly people, as for adults in general, the fingerprint size and ridge-width remains basically invariable.

However, the skin gradually loses its elasticity and, as highlighted in 7.2.1, becomes drier.[5] These changes can result in a decrease of the quality of the fingerprint when contact scanners are used.

7.3   Face recognition

7.3.1   Typical characteristics of elderly people which can have consequences on face recognition

7.3.1.1   General

The appearance of the face and neck typically changes with age. Loss of muscle tone and thinning skin can give the face a flaccid or drooping appearance. In some people, sagging jowls can create the look of a double chin.

As highlighted in 7.2.2.3, elderly people can experience a significant decrease of visual acuity, requiring the use of corrective eyewear for daily tasks. This can be specifically important to know for operators who require the subjects to take their glasses off. In such cases, additional assistance to the subject rendered by the operator can be appropriate.

7.3.1.2   Stroke

Stroke risk increases with age[6] and is the result of sudden cut off of blood supply to a part of the brain.

A frequent effect of a stroke is facial palsy because of damage to the facial nerve inside the brain.

Several changes can occur in the face of a subject who experiences a stroke and the lower part of one side of the face is often affected (e.g. the corner of the mouth can be weak, resulting in drooling).[7]

In the case of biometric systems usage based on face recognition, a re-enrolment represents a possible procedure for people having experienced a stroke.

7.3.2   Typical pathologies experienced by elderly people which can have consequences on fingerprint recognition: neuromuscular problems

Elderly people can experience problems in maintaining a stable position in front of a biometric sensor due to different neuromuscular problems.

7.3.3   Data concerning the use of face recognition by elderly people

Research into age-related face recognition has recently gained prominence due to a growing demand of robust face recognition systems across age.

Studies on the use of elderly people's face recognition are strictly correlated to the availability of face aging databases and in some cases, they proceed in parallel with the research area of individuals' age estimation.

The most popular databases are currently FG-NET,[8] released in 2004 in an attempt to support research activities related to facial aging, and MORPH.[9]

MORPH is the largest publicly available longitudinal face database and it is actively used in several countries. The MORPH data corpus embraces thousands of facial images of individuals across time, collected in real-world conditions (not a controlled collection).

7.4   Iris recognition

7.4.1   Typical characteristics or pathologies of an elderly person which can have consequences on iris recognition

7.4.1.1   Pupil size and structure

Due to alterations of the autonomic nervous system, elderly people can have a reduced pupil diameter.[10]

Evidence of changes to the form of the pupil also correlates to age-related changes, presumably due to structural alterations.[13]

Although existing literature suggests that pupil dilation is considered one of the causes of an unsuccessful iris recognition process,[11][12] there is no particular evidence that a reduced pupil diameter has an impact.

Reference [14] highlights different covariates which can impact pupil diameter.

7.4.1.2   Cataract

The term cataract refers to any opacity of various degree of the crystalline lens, which is normally almost completely transparent.[15]

Cataract surgery is used to treat the clouding of the normally clear lens of the eye and is a procedure to remove the lens of the eye and, in most cases, replace it with an artificial lens.

The question of biometric system policy requiring re-enrolment of an iris after cataract surgery remains a controversial issue.

According to Reference [16], cataract surgeries change iris textures; iris recognition systems are sensitive to such changes.

On the other hand, Reference [17] considers images of patients' irises acquired before and two weeks after cataract surgery and does not find evidence of visible changes: the automatic matching of these images produced correct identification in all cases.

In another recent study[18] more than 85 % of patients acquired before and after cataract surgery were able to be successfully identified.

More recent studies[19] highlight that pupil dilation using eye drops and cataract surgical intervention procedures deform the iris patterns to affect the matching performance of iris recognition significantly. It is therefore imperative to incorporate measures to address these covariates in iris recognition.

7.4.1.3   Glaucoma

This condition develops when there is too much fluid pressure inside the eye. It occurs when the normal flow of the watery fluid between the cornea and the lens of the eye is blocked.

A study[20] based on the Hamming distance calculated for each eye, comparing patients before and after treatment for eye disease highlights that the large majority of eyes were resilient to change despite having developed significant pathology as glaucoma.

The study assesses that even eyes that underwent iridotomies and were treated pharmacologically were successfully identified.

7.4.2 Data concerning the use of iris recognition by elderly people

Several studies have been conducted on the ageing effect of the iris template but there are few involving the age effect on iris recognition.

It a common opinion among experts that the studies on iris recognition require a longitudinal approach similar to that adopted for face recognition, where 2–60-year time lapse has been considered.[21]

Existing literature suggests that one of the factors for template aging is related to variation of the pupil dilation-constriction parameters, which is more prevalent in elderly people.

A suggestion provided in Reference [21] in order to analyse this effect, is to collect iris images of different individuals at 4–10 years apart, focusing particularly on people aged over 50 years.

Reference [21] highlights that other factors such as sensor ageing, interoperability or image quality can have an influence comparable to the human growth.

8 Critical points which affect multiple modalities

Generally, it is believed that elderly people (in contrast to people with a disability, for example) usually do not have one single problem with one specific technology or application, but rather have a combination of problems.

Whilst it is easy to use face recognition for a person with a broken hand, it is usually not recommended or possible for elderly people to use another biometric feature.

This also raises problems with regard to multi-biometric applications. These are considered more secure and less prone to attacks than single biometric applications. But for elderly people, additional problems occur or the problems accumulate so that, in the end, an elderly person cannot use the biometric system.

Nevertheless, lower security multimodality systems can also be used by requiring that only one modality be successfully verified.

Such systems can potentially be more accessible to elderly people as they provide a choice of which biometric characteristic to present.

9 Practical issues involved in the implementation of biometric systems used by elderly people

9.1 Cognitive challenges

Ageing is associated with a decline in cognitive health, often described as the ability to think, learn and remember.[22] The most common cognitive health issue facing the elderly is dementia, which describes a group of symptoms that negatively impact memory.

A specific disease that causes progressive impairment in the brain and effects memory and cognitive function is known as Alzheimer's disease.

As the World Health Organization has highlighted (09/2019), around 50 million people have dementia and nearly 10 million new cases are diagnosed every year.[22]