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Information technology — Use of biometrics in video surveillance systems

**Part 1:
System design and specification**

Technologies de l'information — Utilisation de la biométrie dans les systèmes de vidéosurveillance

Partie 1: Conception et spécification

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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.

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 a patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and <http://patents.iec.ch>. 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 <http://patents.iec.ch>).~~

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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*.

This second edition cancels and replaces the first edition (ISO/IEC 30137-1:2019), of which it constitutes a minor revision. The changes are as follows:

- in the interest of using inclusive language, the terms "black list" and "white list" have been updated to "block list" and "allow list", respectively;
- minor editorial corrections have been made throughout the text, including corrections to cross-referencing within the document itself.

A list of all parts in the ISO/IEC 30137 series can be found on the ISO ~~website~~ and IEC websites.

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.

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Introduction

Considerable improvements in the performance of automatic facial recognition (AFR) technologies have resulted in applications such as automated border control using the facial images encoded in e-passports and implemented in systems whereby the identity of a co-operative traveller is verified in an environment designed for the collection of uniformly illuminated and optimally posed images. The success of these first generation AFR systems has encouraged suppliers to consider other applications where the environment for collection of images may be far from optimal. The inferior performance in such ~~less controlled~~ identification applications ~~may with less control can~~ necessitate a greater involvement by trained personnel.

The ISO/IEC 30137 series provides guidance on the use of biometric technologies in video surveillance systems (~~VSSVSSs~~), a framework for performance testing and reporting of such systems, and procedures for establishing ground truth and annotating video data for testing purposes.

This document provides the architecture, use cases and system design. The use cases include real-time alerting to the presence of individuals of interest, law enforcement applications such as reviewing post-event video footage from one or more cameras against pre-populated watchlists, commercial uses such as the identification of individuals who are to be given preferential service, and faces added to (enrolled in) a watchlist following observation of behaviours in the video material.

Other scenarios include measurement of crowd densities and determining numbers of individuals traversing a given point. While these are not the focus of this document, they are closely related and information on these ~~scenarios~~ is therefore included in ~~Annex A~~ Annex A.

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Information technology — Use of biometrics in video surveillance systems

Part 1 System design and specification

1 Scope

The ISO/IEC 30137 series is applicable to the use of biometrics in VSSs (also known as Closed Circuit Television or CCTV systems) for a number of scenarios, including real-time operation against watchlists and in post-event analysis of video data. In most cases, the biometric mode of choice will be face recognition, but this document also provides guidance for other modalities, such as gait recognition.

This document:

- defines the key terms for use in the specification of biometric technologies in a VSS, including metrics for defining performance;
- provides guidance on the selection of camera types, placement of cameras, image specification, etc. for the operation of a biometric recognition capability in conjunction with a VSS;
- provides guidance on the composition of the gallery (or watchlist) against which facial images from the VSS are compared, including the selection of appropriate images of sufficient quality, and the size of the gallery in relation to performance requirements;
- makes recommendations on data formats for facial images and other relevant information (including metadata) obtained from video footage, used in watchlist images, or from observations made by human operators;
- establishes general principles for supporting the operator of the VSS, including user interfaces and processes to ensure efficient and effective operation, and highlights the need to have suitably trained personnel;
- highlights the need for robust governance processes to provide assurance that the implemented security, privacy and personal data protection measures specific to the use of biometric technologies with a VSS (e.g. internationally recognizable signage) are fit for purpose, and that societal considerations are reflected in the deployed system.

This document also provides information on related recognition and detection tasks in a VSS such as:

- estimation of crowd densities;
- ~~determining~~ determination of patterns of movement of individuals;
- identification of individuals appearing in more than one camera;
- use of other biometric modalities such as gait or iris;
- use of specialized software to infer attributes of individuals, e.g. estimation of gender and age;

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— interfaces to ~~other~~another related functionality, e.g. video analytics to measure queue lengths or to ~~alert~~provide alerts for abandoned baggage.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain ~~terminological~~terminology 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>

— ~~Target subject~~IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Terms related ~~terms~~to the target subject

3.1.1 operator

individual(s) responsible for day-to-day operation of the system

Note_1_to_entry: This may include adjustment of the video surveillance cameras, selecting data suitable for use by the biometric application, and acting on the output of the biometric comparison process.

3.1.2 presentation attack

presentation of an artefact or of human characteristics to a biometric capture subsystem in a fashion that could interfere with the intended policy of the biometric system

3.1.3 target subject(s)

individual(s) of interest

Note_1_to_entry: A target subject will normally be someone already enrolled in a *watchlist* (3.1.4). However, this is not always the case; in some scenarios they are a target because they are to be enrolled in a watchlist.

3.1.4 watchlist

list of individuals of interest (3.1.3) (and their associated reference images) for detection by the video surveillance application

Note_1_to_entry: The watchlist may be of individuals for whom an added service level is to be offered (e.g. VIPs or premium customers). This is sometimes referred to as a “allow list”.

Note_2_to_entry: The watchlist may be a list of “wanted” individuals, e.g. individuals who should be denied access to premises or services. This is sometimes referred to as a “block list”.

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Note 3 to entry: A system may have multiple watchlists of different groups of *target subjects* (3.1.3), and with different performance goals.

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Note 4 to entry: In the case of target subject *back-tracking* (3.3.1)(3.3.1) the watchlist will normally contain only one target subject (3.1.3) (or in the case of a group of individuals of interest, a few target subjects).

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3.2 VSS Terms related terms to VSS

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3.2.1 codec

computer program capable of encoding or decoding a digital data stream or signal

3.2.2 compression ratio

measure of the compressed file size to that of the uncompressed file size

3.2.3 dropped frames

frames (3.2.4) from the video camera(s) that are not processed or are not available for facial detection and the creation of templates

Note 1 to entry: Normally measured in terms of either the number of frames per second dropped, or the percentage of the frames per second dropped.

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3.2.4 frame

single image shown as part of a sequence of images in a video stream

3.2.5 frame rate

frequency (rate) at which an imaging device produces unique consecutive images called frames (3.2.4)(3.2.4)

Note 1 to entry: Frame rate is normally expressed in frames per second (fps).

3.2.6 frame size

pixel dimensions of the frame (3.2.4) described in terms of horizontal and vertical pixels, and which may also be additionally described in terms of total megapixels

3.2.7 post-processing

steps performed after the biometric comparison process

EXAMPLE Triaging decisions based on fusion of quality and score metrics.

3.2.8 pre-processing

steps performed prior to the biometric comparison process

EXAMPLE Image quality enhancement, subject detection and feature extraction.

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3.2.9 resolution

measure of the amount of detail that can be stored in an image

Note_1-to_entry:- Resolution is normally measured in pixels per millimetre.

3.2.10 subject tracking

process of aggregating multiple biometric samples for a single individual, possibly from multiple cameras, to avoid producing separate detection alerts for the same *target subject* (3.1.3)(3.1.3)

3.2.11 video management system

VMS
component of a *video surveillance system* (3.2.12)(3.2.12) that collects video from cameras and other sources, records that video to a storage device and provides an interface to both view the live video and to randomly access recorded video according to time

3.2.12 video surveillance system

VSS
system consisting of camera equipment, monitoring and associated equipment for transmission and controlling purposes, which may be necessary for the surveillance of a protected area

3.3 Biometric system Terms related terms to biometric systems

3.3.1 back-tracking

act of finding the given image(s) of a face/individual by searching all video feeds where the individual could have been seen

Note_1-to_entry:- ~~Back-tracking may or may not~~ It is possible, but not necessary, to use facial biometrics for back-tracking.

3.3.2 face detection

determination of the presence of faces within a video *frame* (3.2.4)(3.2.4) and production of the location of each face in the frame

Note_1-to_entry:- Face detection is the first step in the face recognition process.

3.3.3 post-event analysis

non-~~real-time~~real-time analysis of data previously captured by video surveillance cameras

EXAMPLE To identify possible suspects following an incident or event.

3.3.4 real-time analysis

~~on-line~~online processing of video surveillance data as it is captured

EXAMPLE To identify individuals held on a *watchlist* (3.1.4) so that immediate action can be taken.

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3.3.5

Wiegand

de-facto wiring standard commonly used to connect a card swipe mechanism to the rest of an electronic entry system

3.3.6

zone of recognition

3-dimensional space within the field of view of the camera and in which the imaging conditions for robust biometric recognition are met

Note_1-to-entry: In general, the zone of recognition is smaller than the field of view of the camera, e.g. not all faces in the field of view may be in focus and not every face in the field of view is imaged with the necessary inter-eye distance (IED).

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3.4 Environment Terms related to the environment/scenario-related terms

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3.4.1

attractor

visual or acoustic cue within the environment which encourages individuals to look in a particular direction (i.e. towards the camera in a facial recognition application) in an attempt to improve recognition performance

3.4.2

choke point

point of congestion or obstruction through which individuals pass

3.4.3

lux

measure of illumination intensity

3.5 Symbols and abbreviated terms

AFIS Automated Fingerprint Identification System automated fingerprint identification system

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AFR automated facial recognition Automated Facial Recognition

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APCER attack presentation classification error rate

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APNRR attack presentation non-response rate

B&W black-and-white

CCTV Closed Circuit Television closed circuit television (system); another term for video surveillance (system)

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EXIF exchangeable image file

FPS Frames frames per Second second

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LFR Live Facial Recognition, real time automated facial recognition using video surveillance cameras

GUI Graphical User Interface graphical user interface

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HDR High Dynamic Range high dynamic range

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HMM Hidden Markov models

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IED ~~Inter Eye Distance~~, inter-eye distance: the distance (usually measured in pixels) between the centres of the eyes

IP ~~Internet Protocol~~, internet protocol

LFR live facial recognition; real-time automated facial recognition using video surveillance cameras

MTF ~~Modulation Transfer Function~~, modulation transfer function

NIST National Institute of Standards and Technology

NPCER normal presentation classification error rate

NPNRR normal presentation non-response rate

OSDP ~~Open Supervised Device Protocol~~, open supervised device protocol

PAD presentation attack detection

PTZ Pan, Tilt, pan, tilt and Zoom, zoom: a type of video surveillance camera that can be remotely adjusted (manually by the operator or automatically by using dedicated software).

SFR ~~Spatial Frequency Responses~~, spatial frequency response

SLI standard lighting intensity

SNR signal to noise ratio

SOP standard operational procedure

VMS ~~Video Management System~~, video management system

VSS ~~Video Surveillance System~~, video surveillance system

4 Comparison of terms used in biometric systems with those used in video surveillance

The video surveillance and biometrics communities both have well established vocabularies to describe the various components of a system, but the same term may sometimes be interpreted differently. While the terms listed above apply in Clause 3 to this document, Table 1 below highlights some of those terms and expressions where care needs to be taken when communicating with members of the video surveillance community.

Table 1.— Comparison of terms used in biometric systems with those used in video surveillance

Term	Definition within the context of automated biometric processing	Definition within the conventional use of human-led VSS, e.g. within the scope of IEC 62676 series
Crowd monitoring	For example, counting of individuals in a volume, or over a time interval	The observation of a group to determine collective behaviour or as part of a process to detect anomalous activity
Detection and localization	Biometric detection: the process of finding instances of a particular biometric mode, while correctly rejecting all instances of imagery not representing that biometric mode	Target detection: the process of finding targets of interest, such as humans or cars, in a video feed
Observation	Tracking: the process of spatially locating a particular biometric subject as it moves	Target observation: the process of following a particular target in a video feed

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