OSAC 2024-N-0004
Standard Guide for Capturing Iris Images for Use with Iris Recognition Systems

Facial & Iris Identification Subcommittee
Digital/Multimedia Scientific Area Committee (SAC)
Organization of Scientific Area Committees (OSAC) for Forensic Science

OSAC Proposed Standard

DRAFT OSAC 2024-N-0004 Standard Guide for Capturing Iris Images for Use with Iris Recognition Systems

Prepared by
Facial & Iris Identification Subcommittee
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1. Scope

1.1 This guide is intended for use by practitioners who are choosing, setting up, and operating equipment designed to capture iris images for use with automated Iris Recognition Systems, such as Federal Bureau of Investigation's (FBI) Next Generation Identification (NGI) Iris Service. The guide also provides an overview of how to achieve the specifications defined in the relevant standards as listed below.

1.2 This document provides guidance for proper collection and management of iris images captured in well controlled environments, (e.g., booking stations), and semi-controlled environments (e.g., field capture).

1.3 This document provides equipment guidance for capturing iris images in the near-infrared (near-ir) region of the electromagnetic spectrum from approximately 700 nm to 900 nm. It does not address visible light spectrum (from 380 to 700 nanometers) images or video captured via conventional cameras.

1.4 This standard does not purport to address safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 Biometric Standards:

2.1.1 ANSI/NIST-ITL-1-2011 Update 2015: Data Format for the Interchange of Fingerprint, Facial and Other Biometric Information

2.1.2 ISO/IEC 29794-6:2015 - Information Technology - Biometric sample quality - Part 6: Iris image data

2.1.3 NIST Interagency Report 8013: IREX V Guidance for Iris Image Collection

2.1.4 NIST Special Publication 500-280 – Mobile ID Device Best Practice Recommendation Version 1.0 (Section 8)

2.1.5 NIST TN-2018: Standards Relevant for Iris Camera Acquisitions

3. Terminology

3.1 Definitions:

3.2 Canthus, *n*: plural canthi. The corner at each side of the eye where the upper and lower eyelids join.

3.2.1 Discussion: The medial (sometimes called inner) canthus is adjacent to the nose; the lateral (sometimes called outer) canthus is adjacent to the temple.

3.3 Iris texture, *n*: the totality of features that can be captured in an image of an iris; these features can be used for identification.

3.4 Near-infrared wavelength spectrum, *n*: in the context of this document, 700 to 900 nanometers; the range of wavelength recommended in ISO standards for use in iris recognition cameras.

3.5 Specular reflection, *n*: reflections of a scene off the outer and inner surfaces of the eye.

3.5.1 Discussion: Specular reflections create false features on the iris that negatively impact recognition accuracy. They typically show what is in front of the subject and result from improper ambient lighting.

3.6 Visible light spectrum, *n*: in the context of this document, 300 to 700 nanometers; the range of wavelengths used in conventional photography.

4. Significance and Use

4.1 Image quality is a critical factor in the performance of iris recognition systems and the performance of iris image examiners.

4.2 Many iris images are submitted to a database in an ANSI-NIST ITL-1100 Electronic Biometric Transmission Specification (EBTS) file. The images extracted from the cameras may have to be processed through a middleware to be formatted correctly prior to adding to the EBTS file. The image must not be lossy compressed at any stage of the process and should be saved in a lossless compression format.

4.3 For the purpose of this discussion, image quality factors may be characterized into the following categories:

4.3.1 Subject characteristics: characteristics that affect the visibility of the iris texture; these include eyelid opening and eyelash length, subject capability to present an on axis, well aligned image.

4.3.2 Ambient environment: factors that can affect the iris camera or the subject; these include brightness of visible light which can affect the subject's pupil dilation and the presence of extraneous near-ir light sources, such as sunlight, that can generate specular reflections that will be seen in the near-ir images collected by the iris camera.

4.3.3 Iris camera: camera characteristics including depth of focus, field of view, single eye vs. dual eye, operator interface.

4.3.4 Operator skill: the best camera can take poor images of a good subject when not used according to best practice for the camera.

5. Scenarios

5.1 Controlled acquisition

5.1.1 This scenario is when all constraints can be controlled including image capture equipment, the capture environment and the pose and positioning of the subject. An example scenario is the well controlled booking process at a criminal justice facility.

5.2 Semi-controlled acquisition

5.2.1 This scenario refers to when some, but not all, constraints can be controlled. An example is law enforcement mobile capture. In these situations, ambient conditions may not be well controlled, the level of subject cooperation may be diminished, and other conditions may create additional stress on the operator.

5.3 See Figures X and Y for examples of good and poor iris image captures in both controlled and semi-controlled environments and mitigation strategies.

5.4 Automated image quality assessment may be built into cameras. It is strongly recommended that image quality is assessed at the time of capture to provide immediate feedback to the camera operator.

ANNEX

(Mandatory Information)

A1. TABLES

1A1.1 Important environmental factors when capturing iris images)

No.	Item	Description	Comments
1	Ambient Illumination	Ambient lighting with illumination of typical office space levels shall be utilized.	Areas with direct or indirect sunlight should be avoided. Bright incandescent lighting should be avoided. Dark rooms should be avoided unless the iris capture device provides its own source of visible illumination.
2	Camera position	As recommended by the camera manufacturer.	Ensure the operator's fingers are not obscuring any part of the camera lens or illumination array.

1A1.2 Important factors regarding subject pose

No.	Item	Description	Comments
1	Subject position	The subject should remain still with the eye gaze directed towards the camera axis with the head position square to the camera sensor.	Eye gaze angle is a specific image quality metric.
2	Glasses	The subject shall remove glasses prior to image capture for enrollment scenarios.	Glasses may obstruct portions of the eye due to specular highlights, scratches or dirt on the surface of the lens.
3	Contact lenses	Contact lenses obscuring the iris texture (e.g. patterned cosmetic lenses) shall be removed prior to image capture.	Iris images shall not be captured if the subject cannot remove patterned cosmetic contact lenses.

			Clear contact lenses not obscuring the iris texture need not be removed.
5	Distance	The minimum distance between the iris capture device's lens and the subject's eye is typically 100 millimeters.	This distance is acceptable as non-intrusive and avoids excessive geometric distortion.
6	Occlusion	Minimize anything (hair, fake eyelashes) that would obstruct the iris texture.	The subject may use their fingers to open the eyes wider if the iris is obscured.

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No.	Item	Description	Comments
1	Camera type	Cameras capable of capturing images in the near-ir wavelength shall be used. Conventional visible full-spectrum image capture should not be used. The camera shall meet "ISO/IEC 29794-6:2015 Information technology — Biometric sample quality - Part 6: Iris image data."	Iris images are captured in non-visible wavelengths, making them different from images taken using a conventional camera. These images also have markedly different data storage and transmission requirements.
2	Color space	Monochrome near-iror near-ir channel of a color sensor: Near-infrared wavelength bandwidth (approximately 700 to 900 nm.) shall be used.	Illumination shall be compliant with illumination standard IEC 608251-1 and safety specification ISO 62471- 1 "Exempt" category (i.e., eye safe in all circumstances).
3	Capture	Devices used for capture of iris images should capture both left and right images simultaneously or quasi-simultaneously (within a few milliseconds).	This reduces the possibility of mislabeling the individual images (right or left) while also allowing more accurate estimation of the roll angle and potentially higher accuracy and comparison speed.

			If not mounted, the iris camera should include an orientation sensor prohibiting the iris capture process if the device is upside down.
4	Failure to Acquire (FTA)	For fully cooperative subjects, the FTA rate should be below a level which is acceptable for a specific scenario.	Failure to acquire occurs when the device is unable to acquire an image required in a specific scenario within a specified time out period.
5	Compressio n	Iris images from a device must be uncompressed or losslessly compressed.	
6	Image Format	The device must supply images in a standard format suitable for use by matching and encoding systems. (e.g., bmp, png)	The image format should be compatible with middleware of the applicable system.
7	Image Quality Metrics	Image quality and consistency have a direct impact on matching capability.	The camera should encourage operator behavior that will generate images that are ISO/IEC 29794-6:2015 compliant. Examples of compliant and non-compliant images are seen in Fig. Y of this document.

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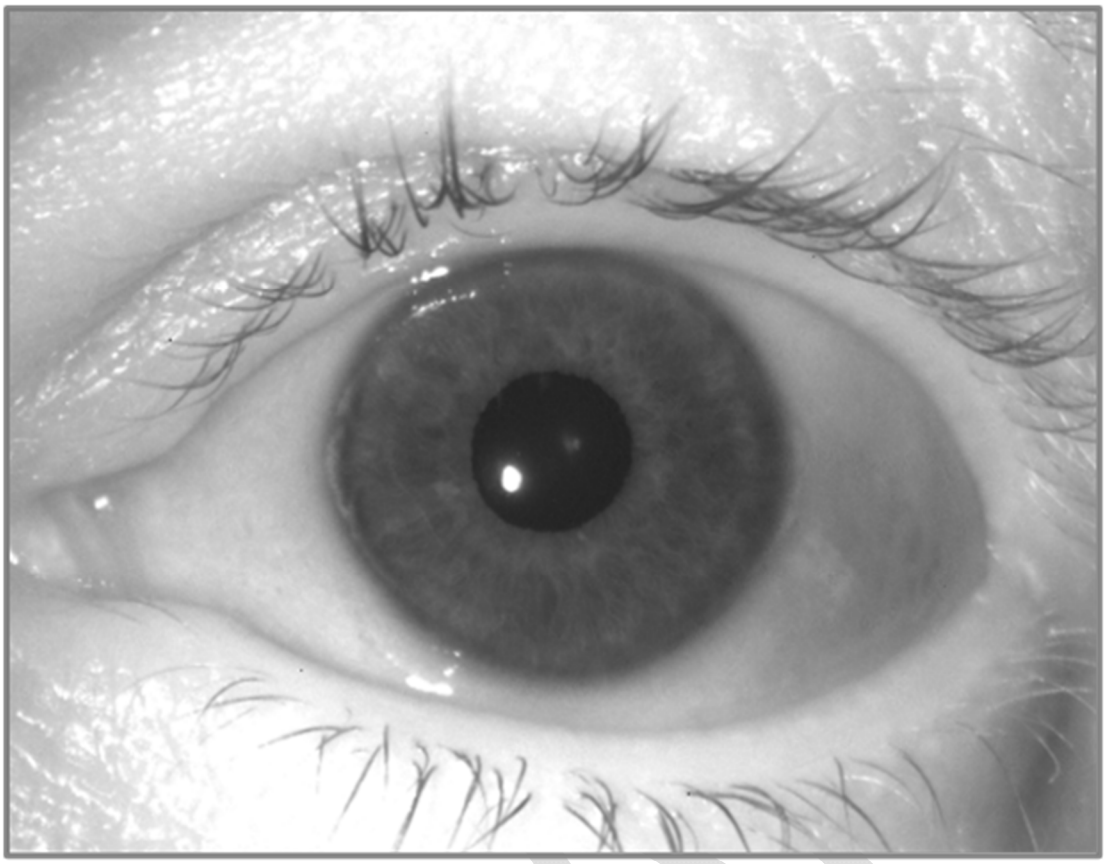

FIG. X Example of a Good Quality Iris Image

https://www.nist.gov/document/irexvslides20140612pptx

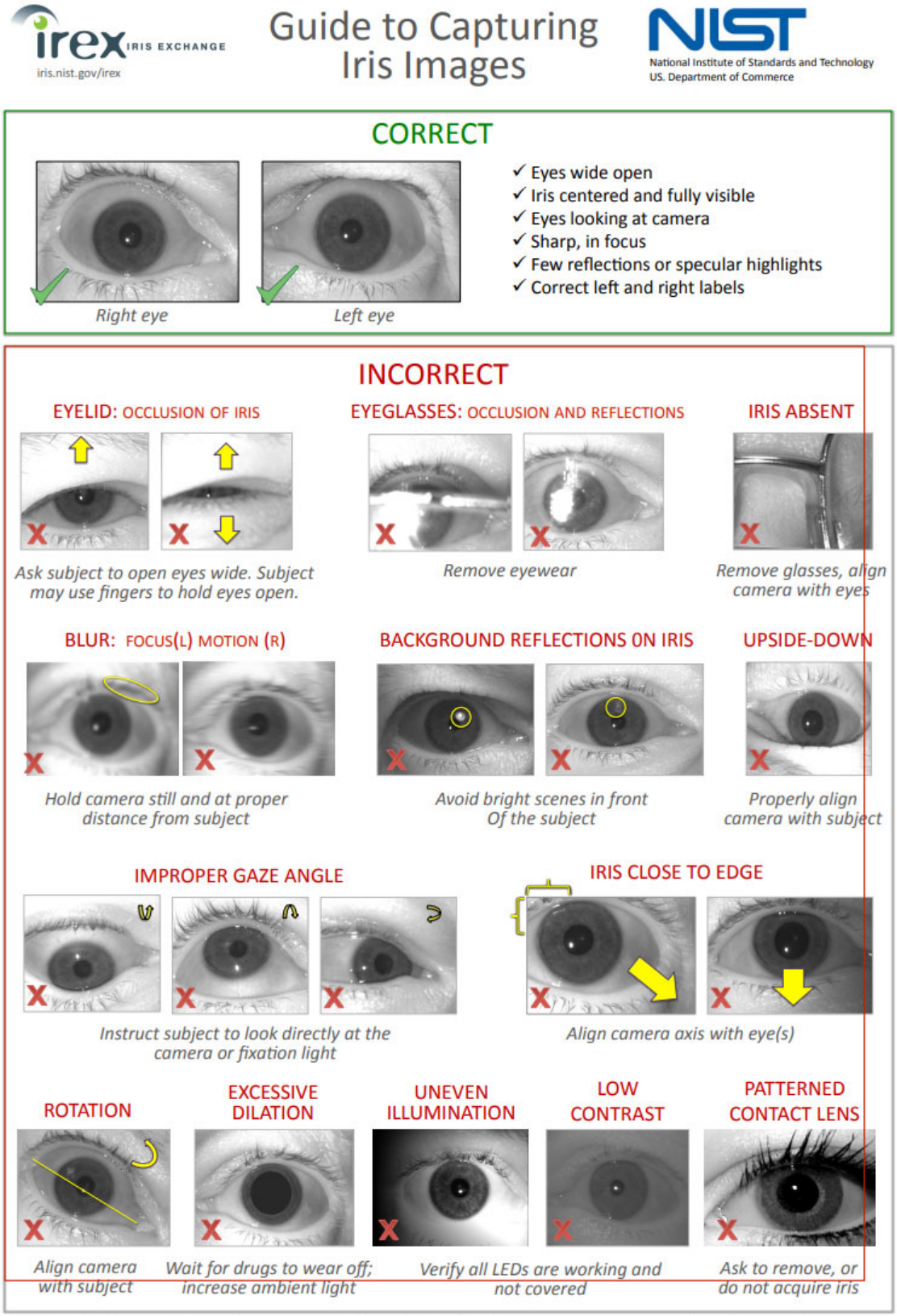
irex IRIS EXCHANGE
iris.nist.gov/irex
Guide to Capturing Iris Images
NIST
National Institute of Standards and Technology
US. Department of Commerce
CORRECT
✓ Eyes wide open
✓ Iris centered and fully visible
✓ Eyes looking at camera
✓ Sharp, in focus
✓ Few reflections or specular highlights
✓ Correct left and right labels
Right eye
Left eye
INCORRECT
EYELID: OCCLUSION OF IRIS
Ask subject to open eyes wide. Subject may use fingers to hold eyes open.
EYEGLASSES: OCCLUSION AND REFLECTIONS
Remove eyewear
IRIS ABSENT
Remove glasses, align camera with eyes
BLUR: FOCUS(L) MOTION (R)
Hold camera still and at proper distance from subject
BACKGROUND REFLECTIONS ON IRIS
Avoid bright scenes in front Of the subject
UPSIDE-DOWN
Properly align camera with subject
IMPROPER GAZE ANGLE
Instruct subject to look directly at the camera or fixation light
IRIS CLOSE TO EDGE
Align camera axis with eye(s)
ROTATION
Align camera with subject
EXCESSIVE DILATION
Wait for drugs to wear off; increase ambient light
UNEVEN ILLUMINATION
Verify all LEDs are working and not covered
LOW CONTRAST
PATTERNED CONTACT LENS
Ask to remove, or do not acquire iris
Poster developed by NIST in furtherance of its statutory responsibilities under the Federal Information Security Management Act (FISMA) of 2002, Public Law 107-347. The IREX Program (iris.nist.gov/irex) advances high performance iris recognition through standards development and testing.

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FIG. Y Examples of Good and Poor Image Captures
https://www.nist.gov/system/files/d