Federal Bureau of Investigation
Science & Technology Branch
Criminal Justice Information Services Division

An Eye on Iris

International Association for Identification (IAI)
105th Annual Educational Conference
Nashville, Tennessee
August 3, 2021

Bethany L. Retton
Programs Research and Standards Unit (PRSU)
Global Law Enforcement Support Section (GLESS)

Federal Bureau of Investigation
Science & Technology Branch
Criminal Justice Information Services Division

What is an iris?

What makes an iris unique?

Can an iris be used for identification?

Is an iris pattern stable?

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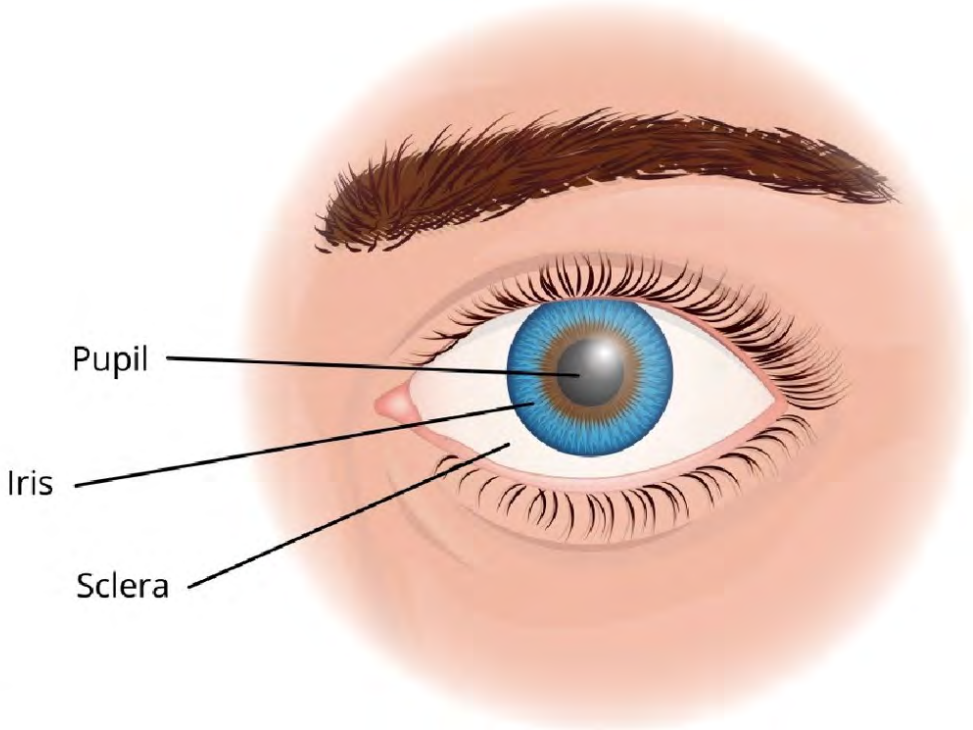
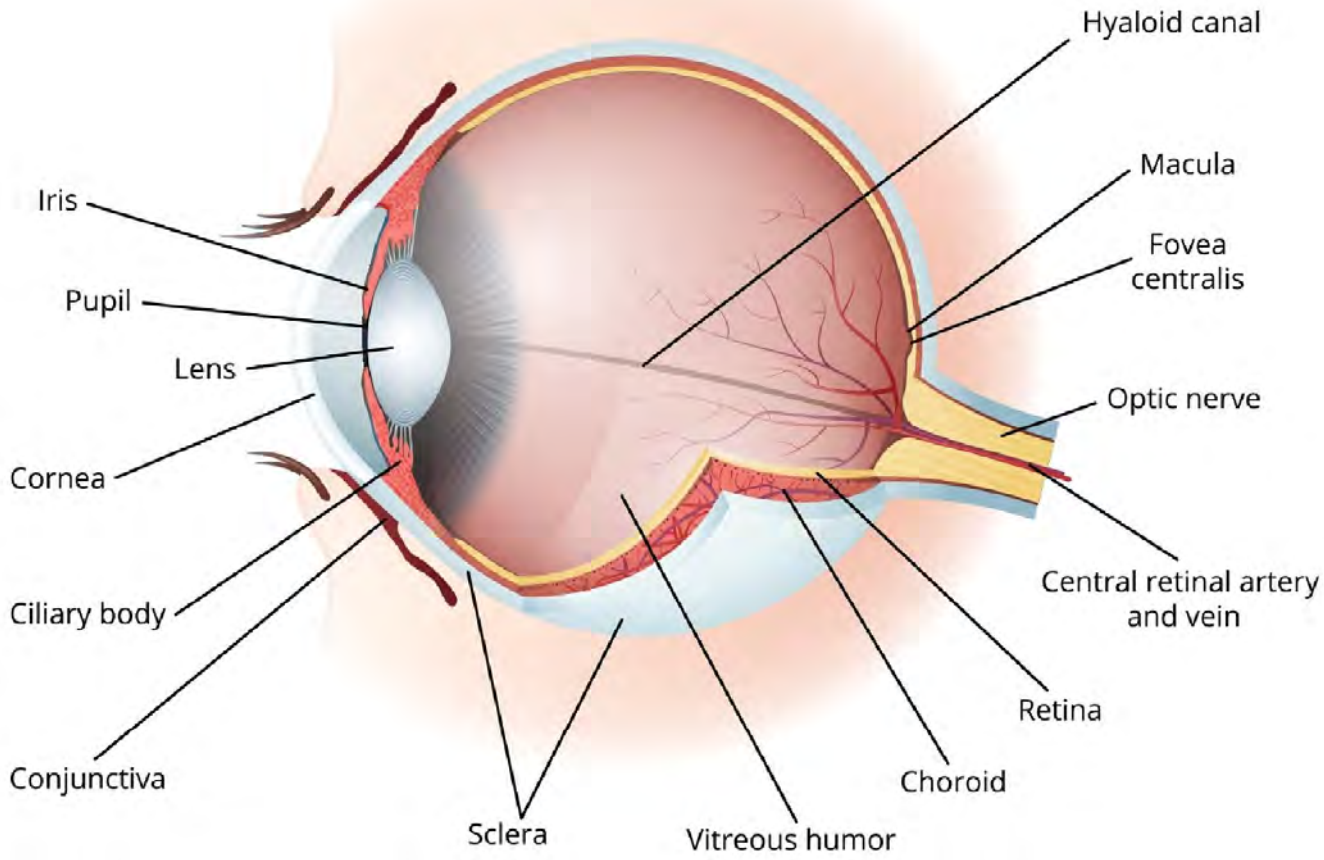
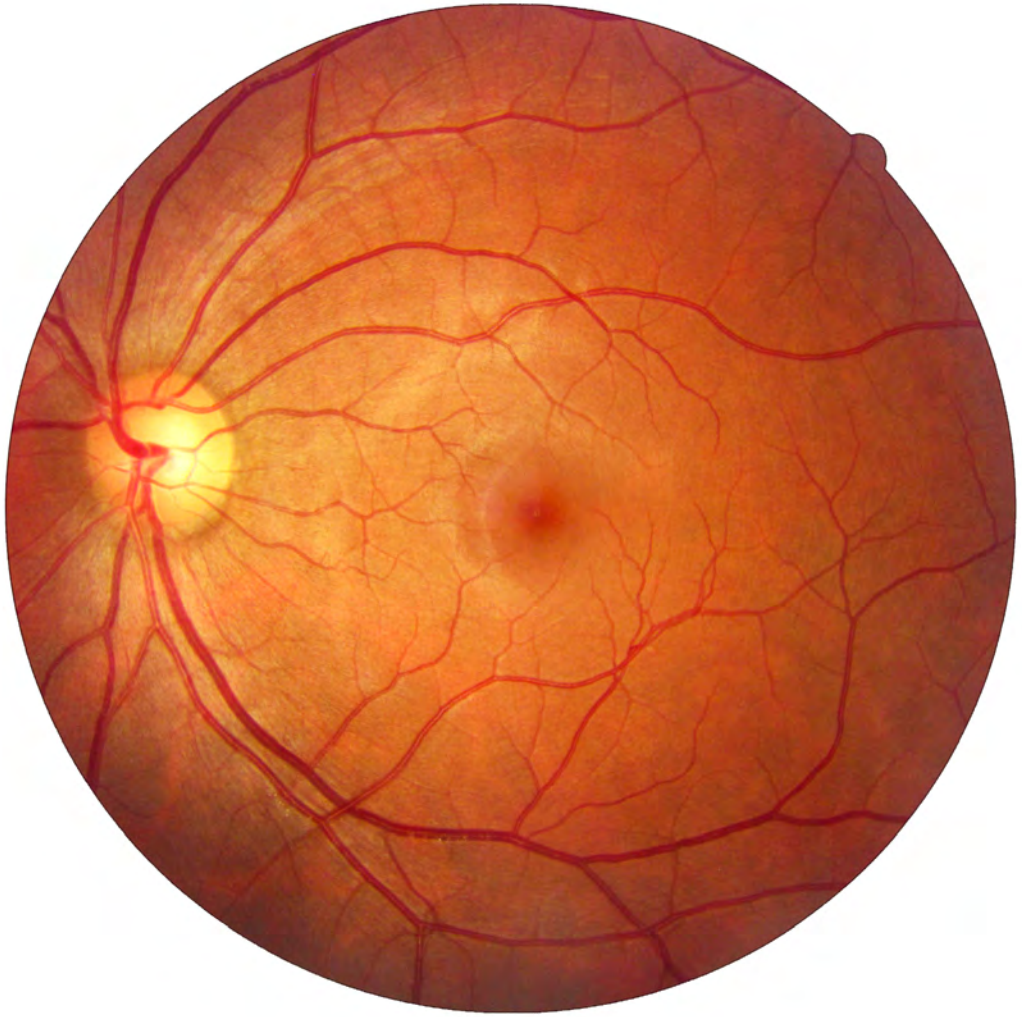
What is an iris?


Pupil
Iris
Sclera


Hyaloid canal
Macula
Fovea centralis
Optic nerve
Central retinal artery and vein
Retina
Choroid
Vitreous humor
Sclera
Conjunctiva
Ciliary body
Cornea
Lens
Pupil
Iris

Iris

Retina



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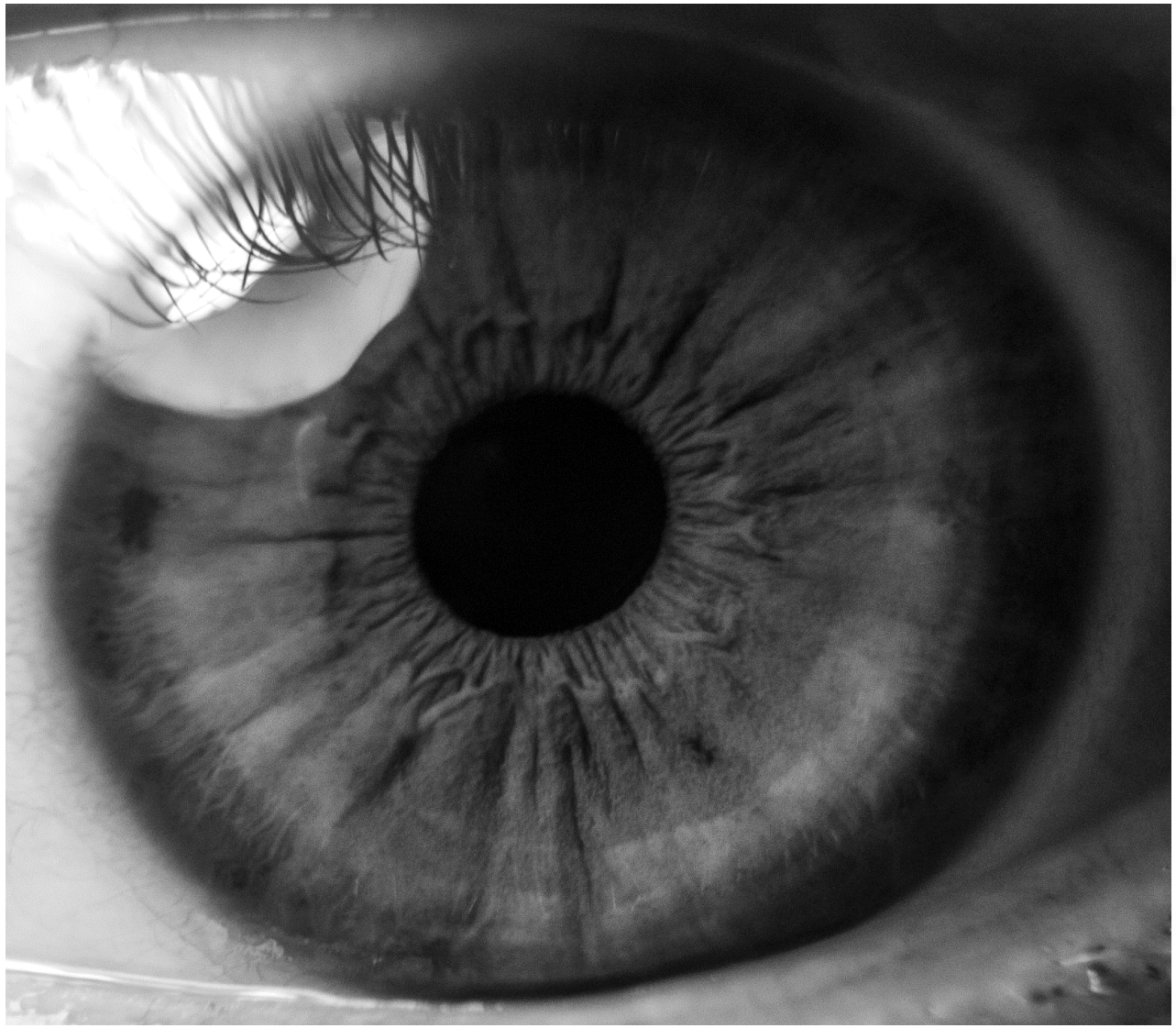
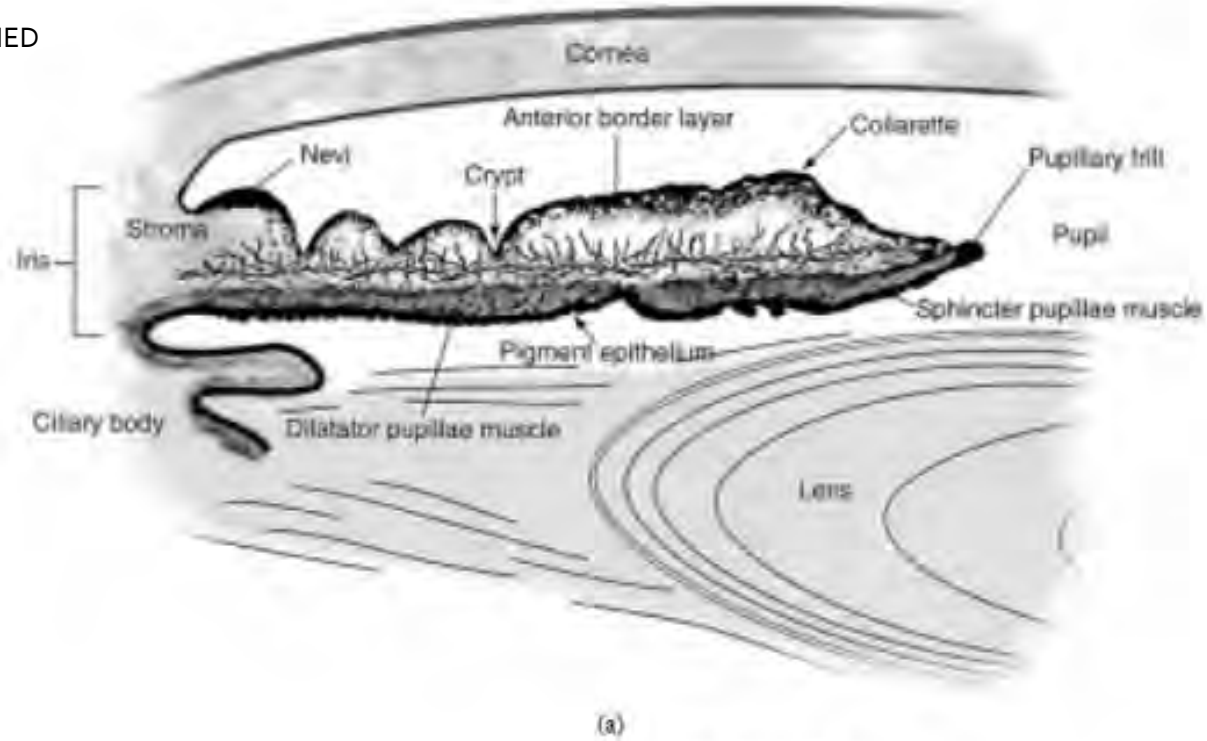
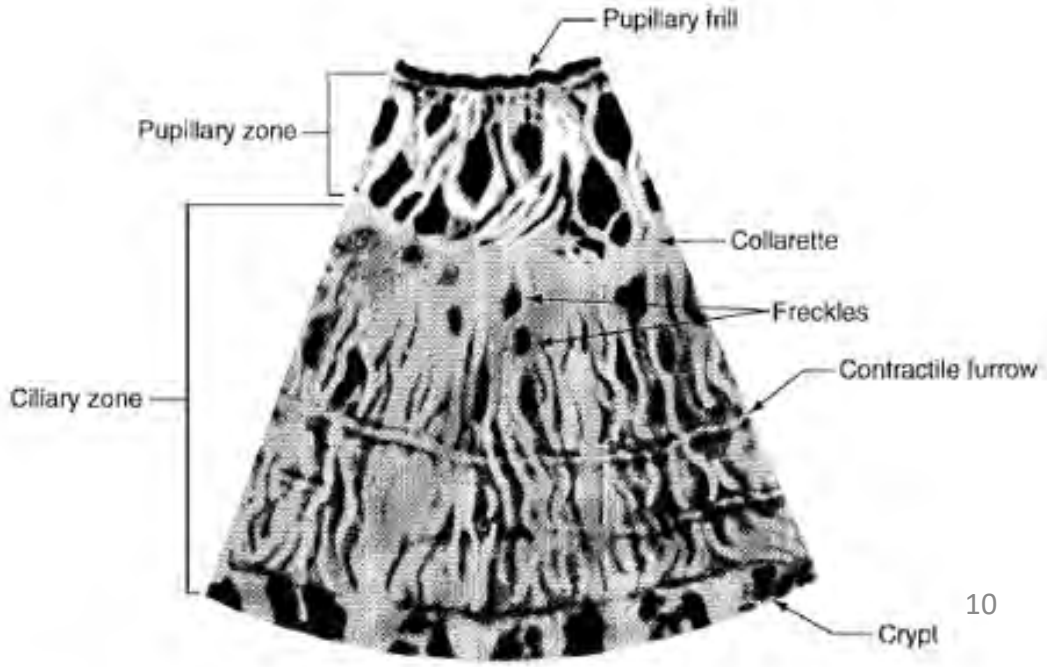
What makes an iris unique?





(a)



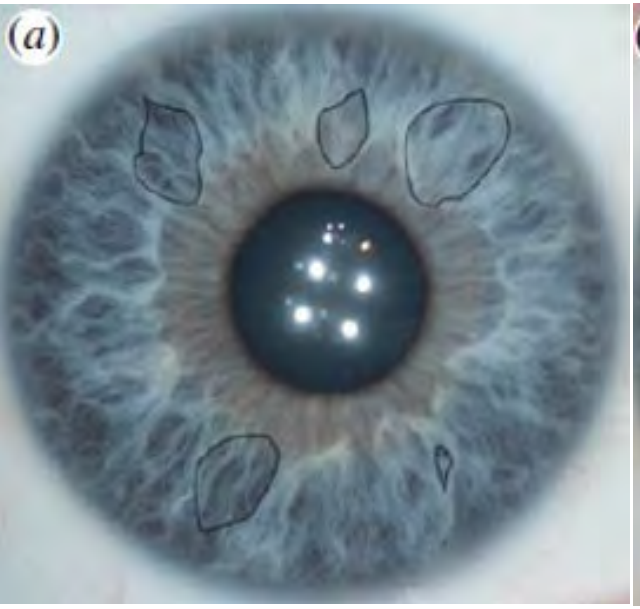
Wildes, Richard P. 1997. Iris Recognition: An Emerging Biometric Technology. Proceedings of the IEEE, Vol. 85, No. 9, September 1997.

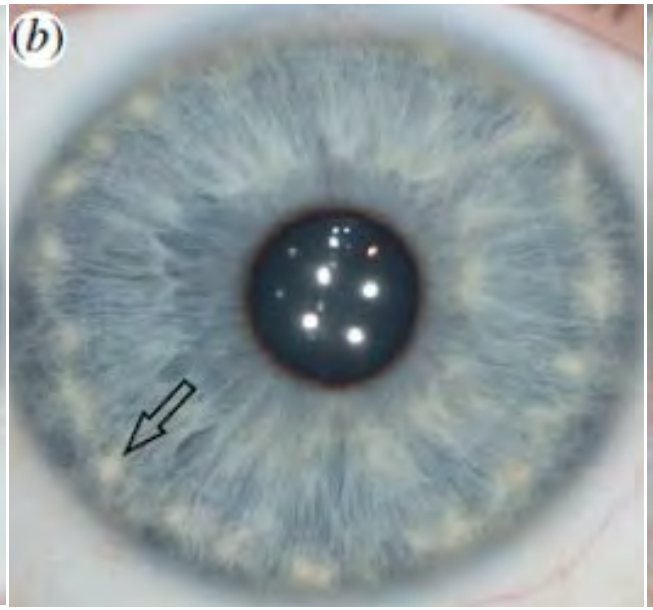
Crypts

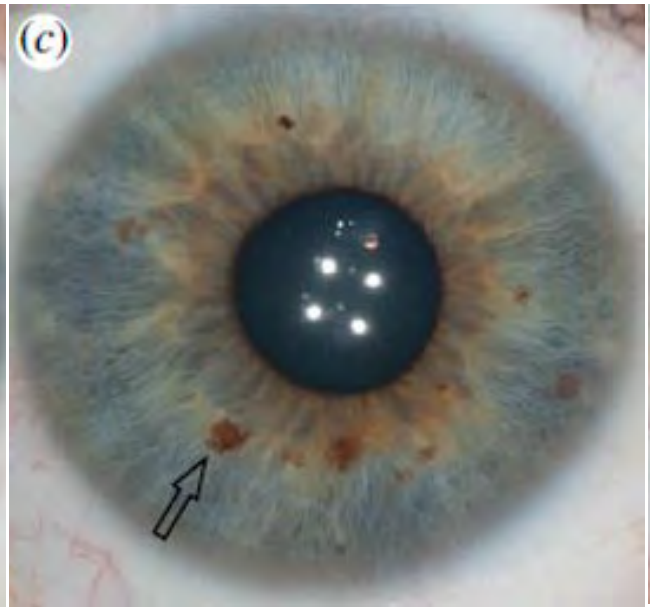
Wolfflin Nodules

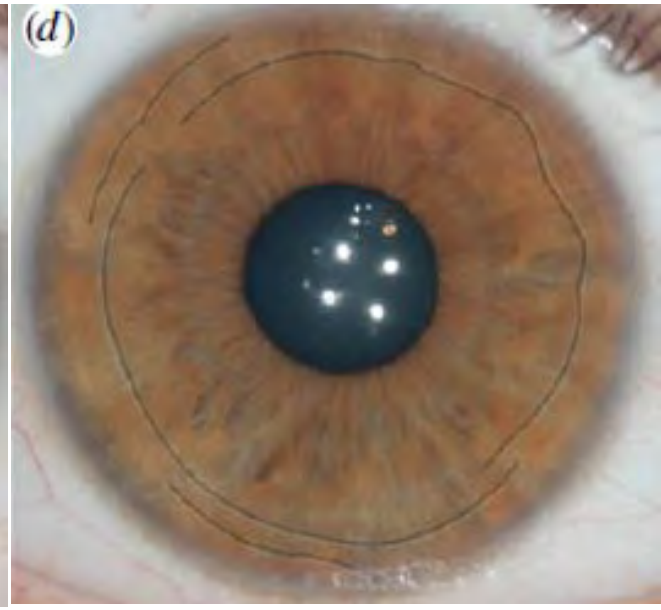
Pigment Spots

Contraction Furrows









Edwards M, Cha D, Krithika S, Johnson M, Parra EJ. 2016 Analysis of iris surface features in populations of diverse ancestry. *R. Soc. open sci.* 3: 150424.

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Can iris be used for identification?

Introduction
Leaderboard
Detection-Error Trade-off Plots
Rank Accuracy
Computation Time
Demographics
Automated Quality Assessment
Algorithm Fusion
Enrollment Database Size
Twins Dataset
How to Participate
Contact Info

NIST National Institute of Standards and Technology U.S. Department of Commerce

IREX 10: Identification Track

API | FAQ | CONOPS Document | irex@nist.gov

▶ Introduction

▼ Leaderboard

Two-eye Accuracy:

	Developer	Accuracy (FNIR)	Search Time (sec)	Template Creation Time (sec)	Template Size (bytes)	FTE	Submission Date
1	Idemia	0.0052 ± 0.0005	39 ± 27	0.80 ± 0.04	59 148 ± 850	0	Dec 2019
2	Neurotechnology 2	0.0053 ± 0.0005	17.2 ± 0.7	0.14 ± 0.02	5 208 ± 0	0	Feb 2021
3	EyeCool	0.0074 ± 0.0006	42 ± 12	0.40 ± 0.02	46 872 ± 0	0	May 2021
4	NEC	0.0090 ± 0.0006	12 ± 3	0.83 ± 0.08	14 180 ± 0	0	Feb 2021
5	Dermalog	0.0106 ± 0.0007	0.48 ± 0.03	0.73 ± 0.05	3 821 ± 60	0	Jun 2021
6	IrisID	0.0188 ± 0.0007	2.0 ± 0.4	0.102 ± 0.007	11 266 ± 0	0	Mar 2021
7	Neurotechnology 1	0.025 ± 0.001	0.05 ± 0.01	0.14 ± 0.02	5 208 ± 0	0	May 2021
8	SOAR	0.030 ± 0.001	35.9 ± 0.4	0.69 ± 0.07	1 964 ± 0	0.000003	Sep 2020

CSV

Accuracy Metric : FNIR (i.e., "miss rate") at an FPIR of 0.01(± 90% confidence)
Results updated May 3, 2021 to remove searches where left/right eye labels were found to be erroneous.
Dataset: Operational Dataset 4th pull
Samples used: Both eyes
Enrolled Population: 500K people
Enrollment Method: One enrollment session per person

The number after the ± indicates either the 90% confidence interval (for accuracy) or the standard deviation (for times and sizes).

https://pages.nist.gov/IREX10/ (Accessed: 7/8/2021)

FBI Iris Pilot

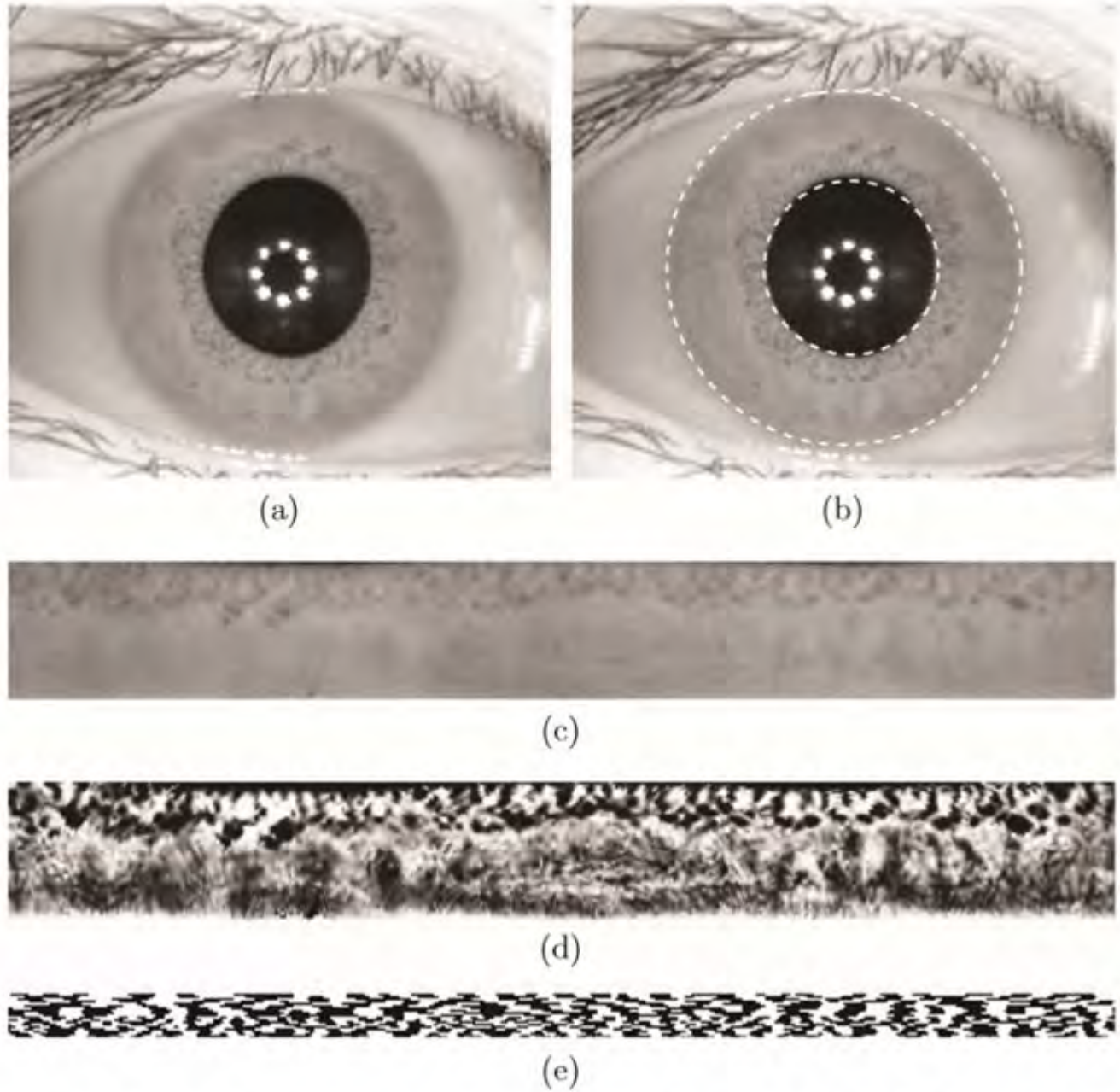


Fig. 2. Common processing chain in iris recognition: (a) image of eye (b) detection of pupil and iris (c) unrolled iris texture (d) preprocessed iris texture (e) sample iris-code.

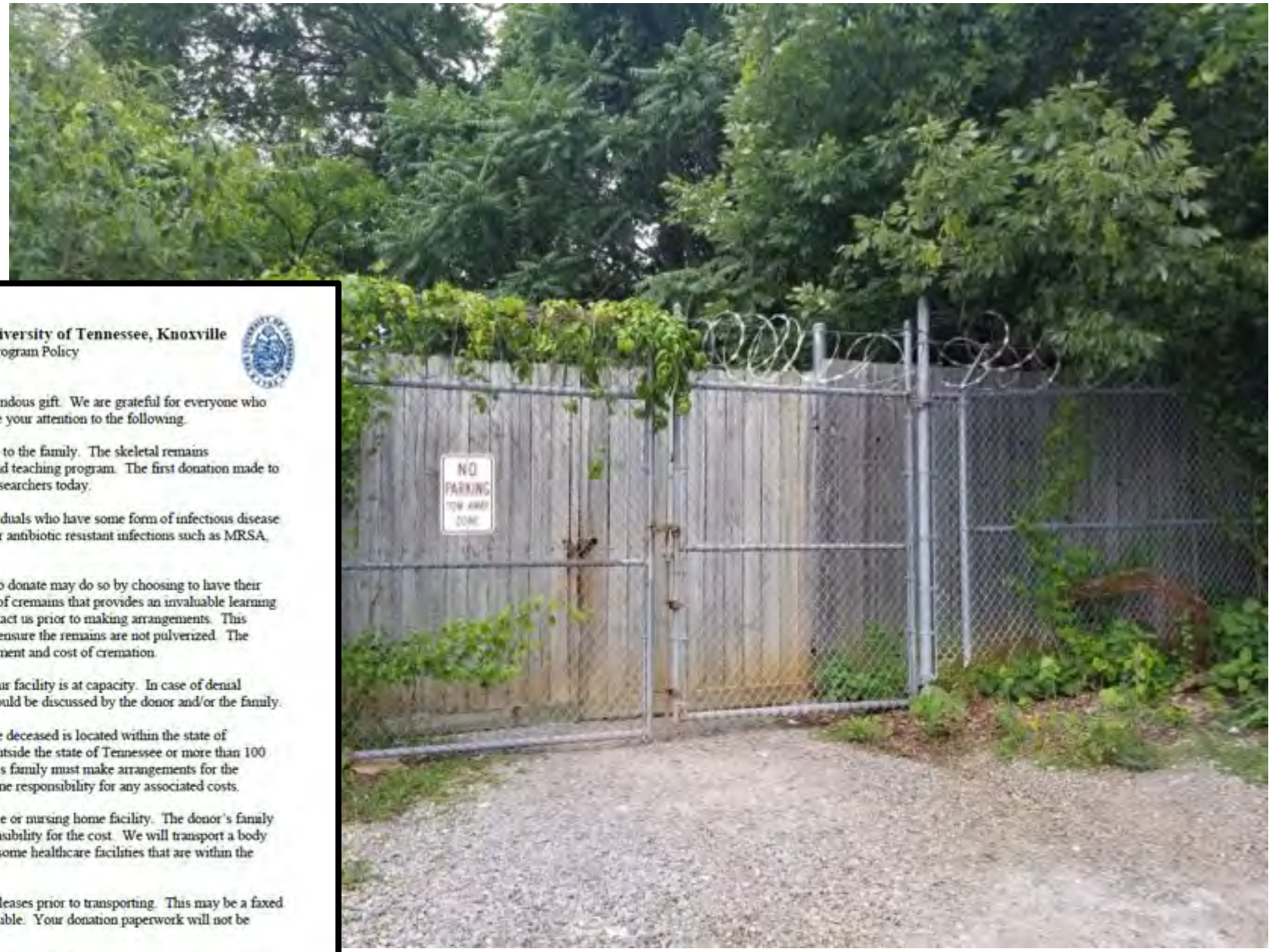
Rathgeb, C., Uhl, A. 2011. The state-of-the-art in iris biometric cryptosystems. In: Yang, J, Nanni, L. (eds.) State of the art in Biometrics, pp. 179–202. InTech, New York.

Kumar, Nikhil. "Arrest of National Geographic's 'Afghan Girl' Highlights Growing Pressures on Afghan Refugees". Time. October 27, 2016. https://time.com/4547345/national-geographic-afghanistan-cover-pakistan-refugees/ (Accessed: 7/6/2021)

Daugman, John. "How the Afghan Girl Was Identified by Her Iris Patterns". https://www.cl.cam.ac.uk/~jgd1000/afghan.html. (Accessed: 7/6/2021)

Daugman, John. "How the Afghan Girl Was Identified by Her Iris Patterns". https://www.cl.cam.ac.uk/~jgd1000/afghan.html. (Accessed: 7/6/2021)

O'Hagan, Sean. "We are family: Nicholas Nixon's 40 years photographing the Brown Sisters". The Guardian. November 19, 2014. https://www.theguardian.com/artanddesign/2014/nov/19/nicholas-nixon-40-years-brown-sisters-portraits-moma. (Accessed: 7/8/2021)



Forensic Anthropology Center, University of Tennessee, Knoxville
Body Donation Program Policy

The donation of a person's body after death is a tremendous gift. We are grateful for everyone who expresses an interest in body donation. We appreciate your attention to the following.

1. Unlike medical schools, we **do not** return remains to the family. The skeletal remains are a very important component to our research and teaching program. The first donation made to our program in 1981 continues to be studied by researchers today.

2. We reserve the right to decline donations of individuals who have some form of infectious disease such as HIV, tuberculosis, hepatitis of any kind, or antibiotic resistant infections such as MRSA, even if contracted after donation is arranged.

3. Donors with an infectious disease who still wish to donate may do so by choosing to have their remains cremated. We have a growing collection of cremains that provides an invaluable learning resource. People choosing this option should contact us prior to making arrangements. This allows us to work with the crematory involved to ensure the remains are not pulverized. The family must assume responsibility for the arrangement and cost of cremation.

4. We also reserve the right to decline a donation if our facility is at capacity. In case of denial by the University, alternate final arrangements should be discussed by the donor and/or the family.

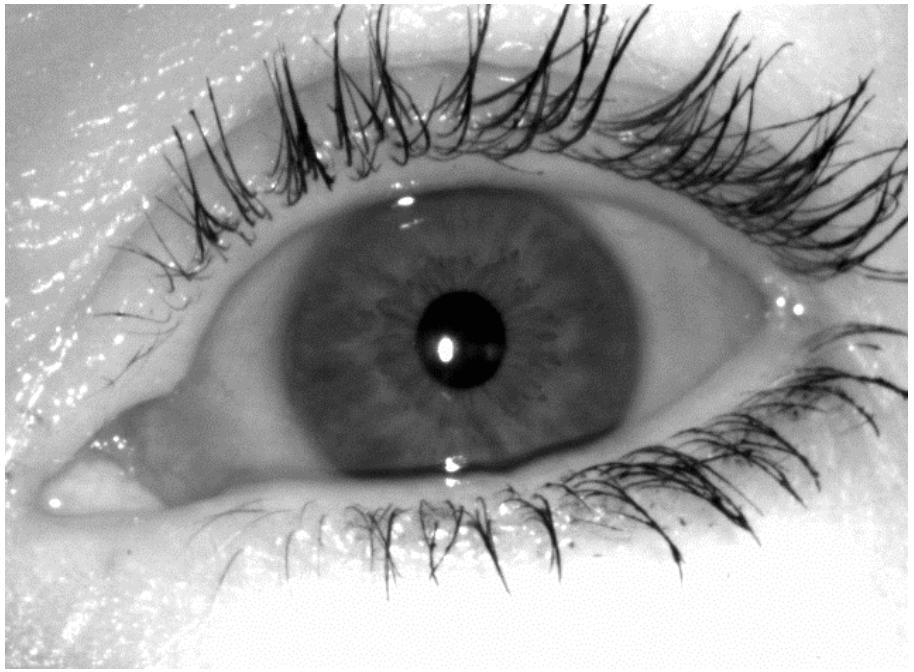
5. We will arrange transportation to our facility if the deceased is located within the state of Tennessee **and** within 100 miles of Knoxville. Outside the state of Tennessee or more than 100 miles from Knoxville, the donor and/or the donor's family must make arrangements for the transportation of the body to our facility and assume responsibility for any associated costs.

6. We are unable to transport from a private residence or nursing home facility. The donor's family must arrange for transportation and assume responsibility for the cost. We will transport a body from a hospital, funeral home, forensic center, or some healthcare facilities that are within the geographic limits stated above.

7. We need to have signed donation documents or releases prior to transporting. This may be a faxed copy, but the original must be sent as soon as possible. Your donation paperwork will not be complete until originals are returned.

8. Pre-donor paperwork needs to be returned to the Forensic Anthropology Center at the time of completion in order for a file to be established. Changes of address or medical status should be sent to keep donor files up to date.

http://fac.utk.edu/wp-content/uploads/2016/03/Body_Donation_Packet_2017.pdf (Accessed: 7/6/2021)



Left Iris

Left Thumb

Antemortem

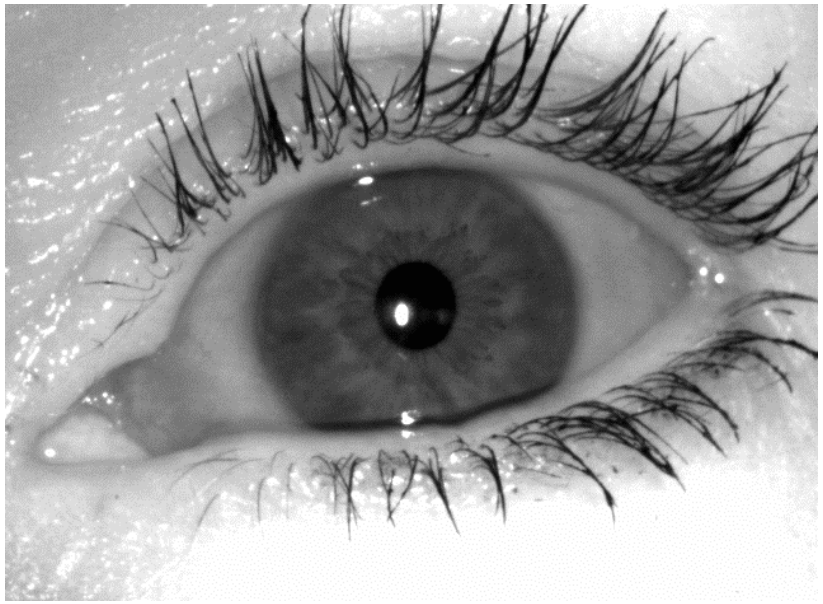
Intake (Day One)

Six days after death.

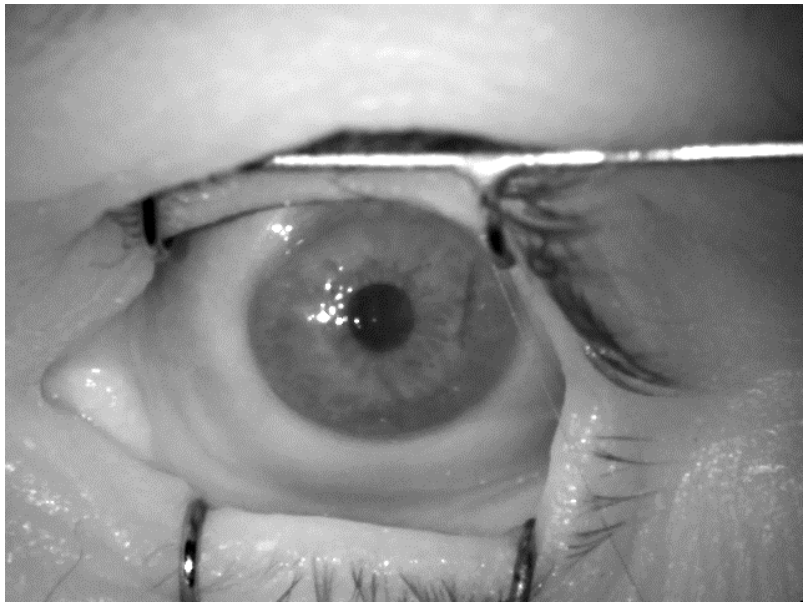
Day Two

Seven days after death.
November/41 to 50 degrees.

Antemortem

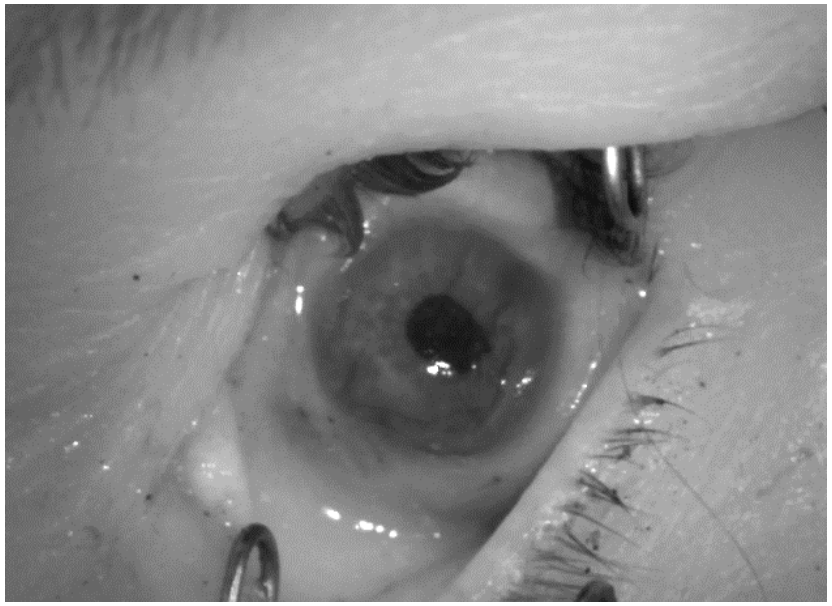


Intake (Day One)



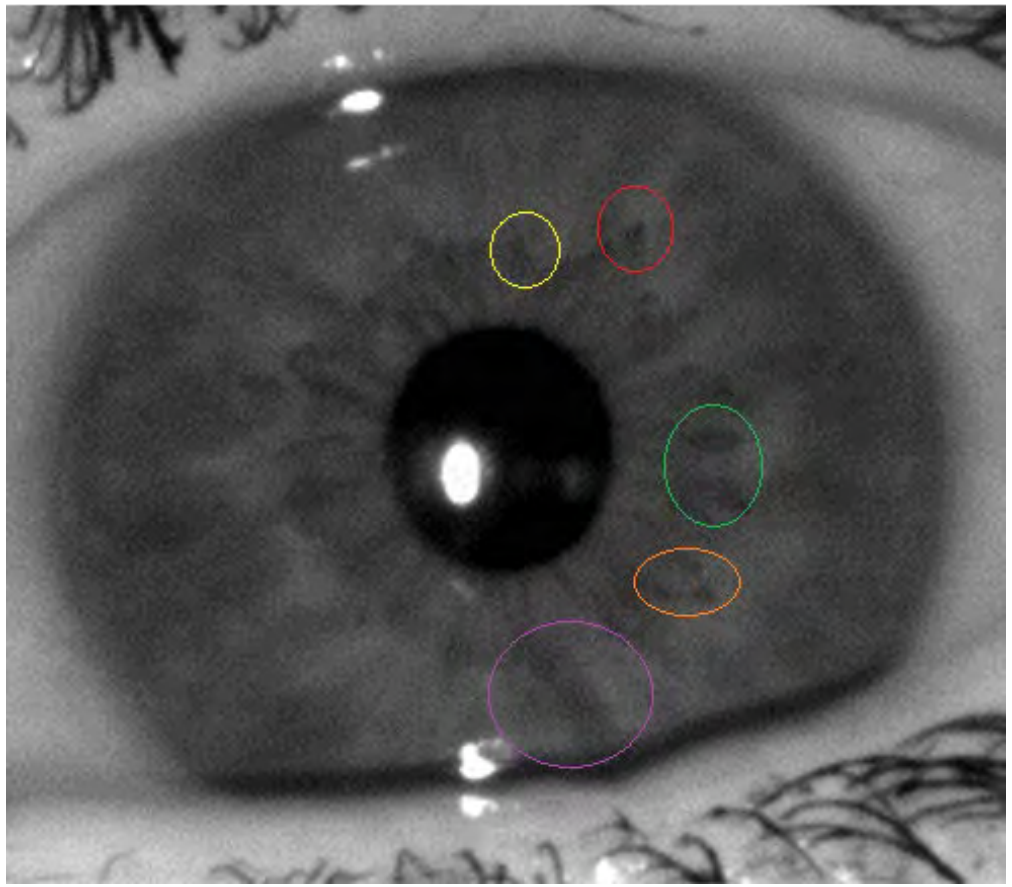
Six days after death.

Day Two

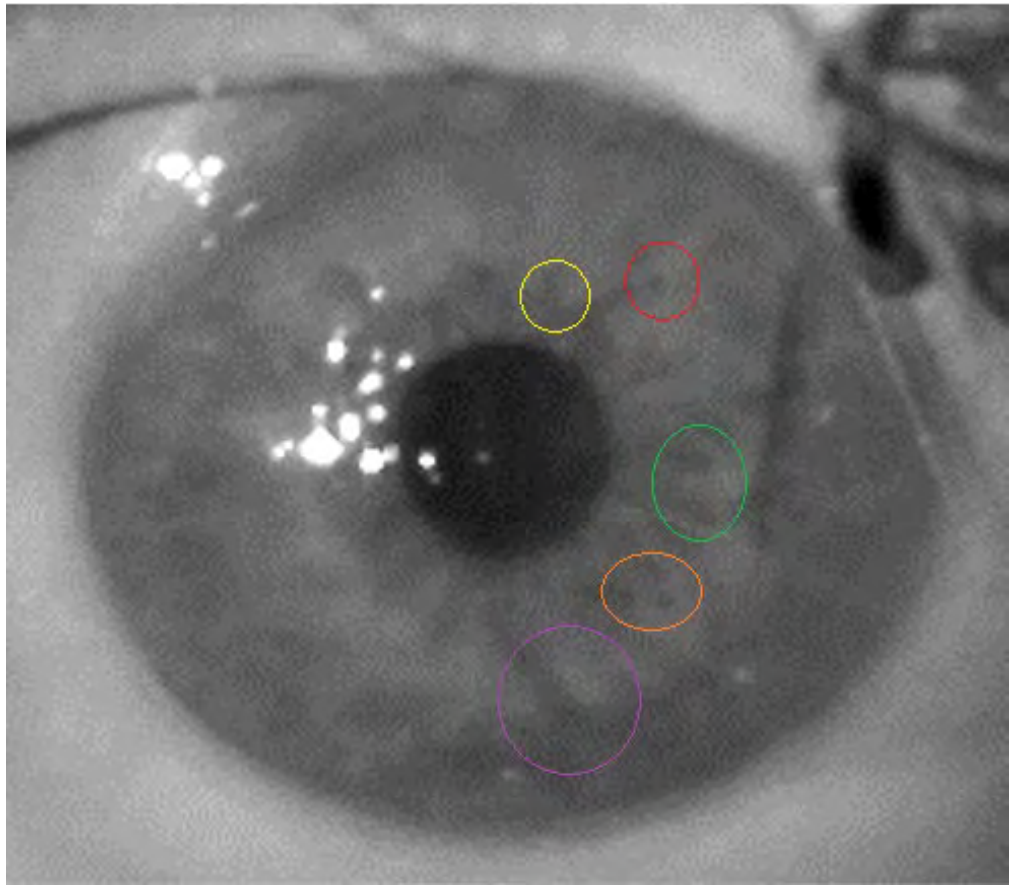


Seven days after death.
November/41 to 50 degrees.

Antemortem



Intake



Six days after death.

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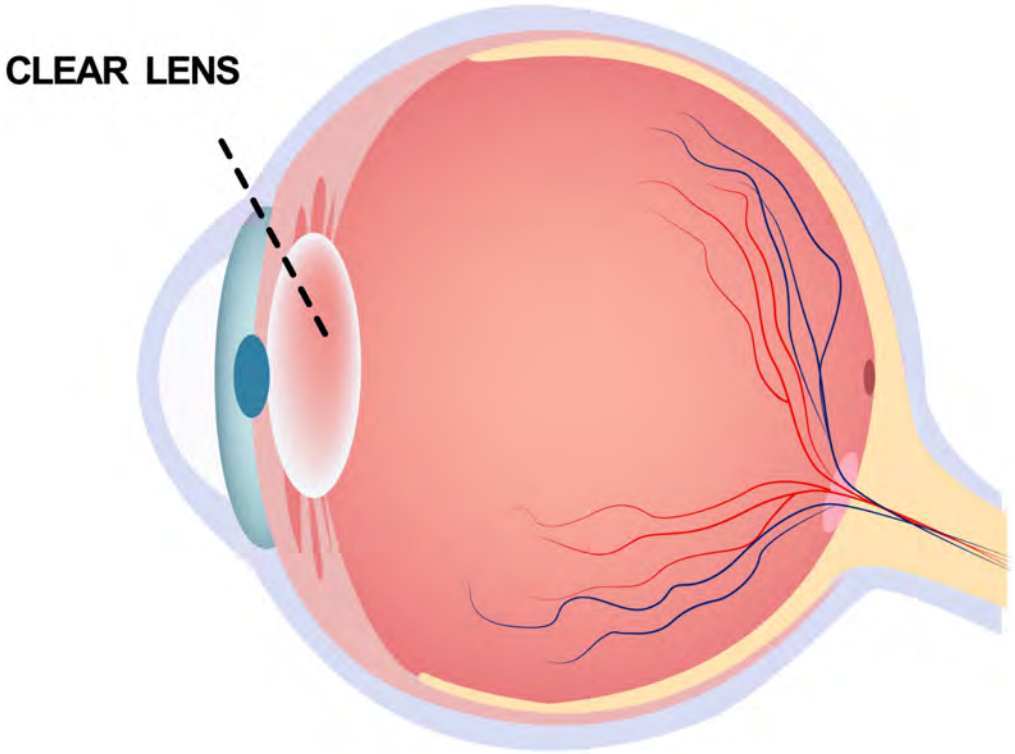
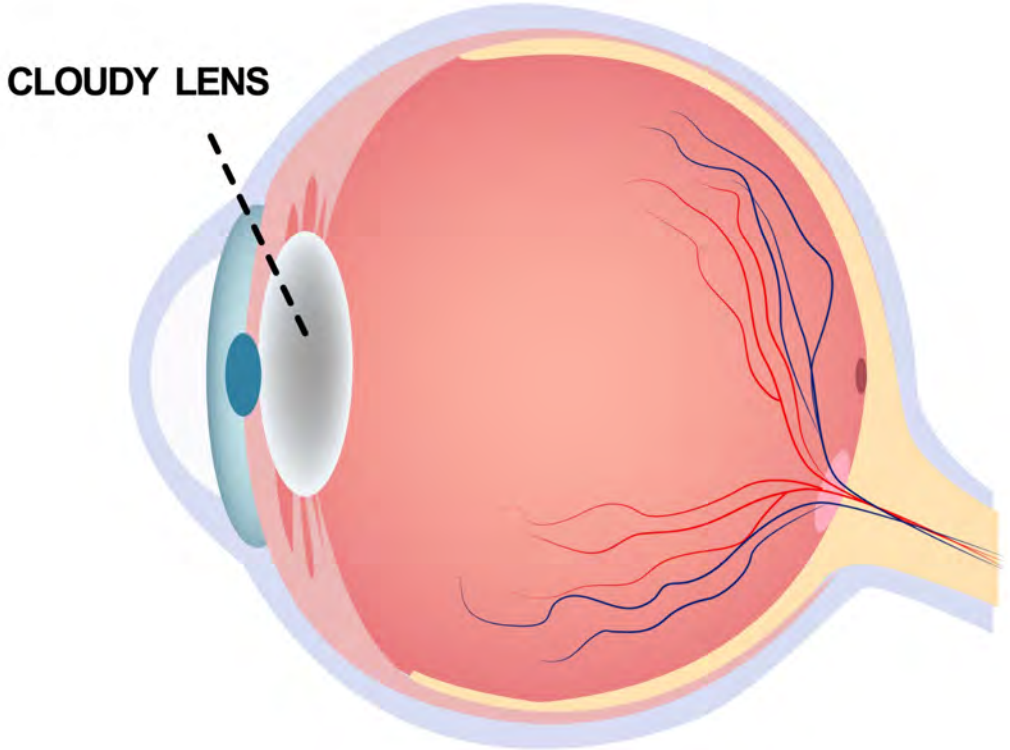
Is an iris pattern stable?

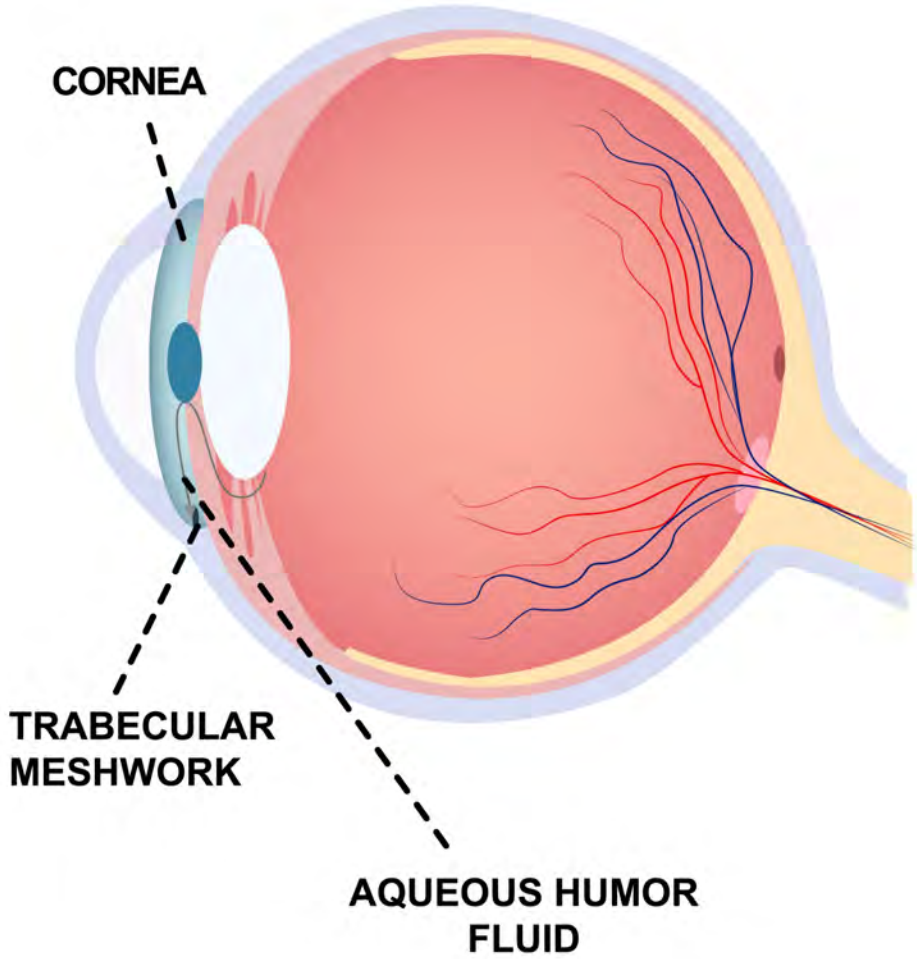
NORMAL EYE



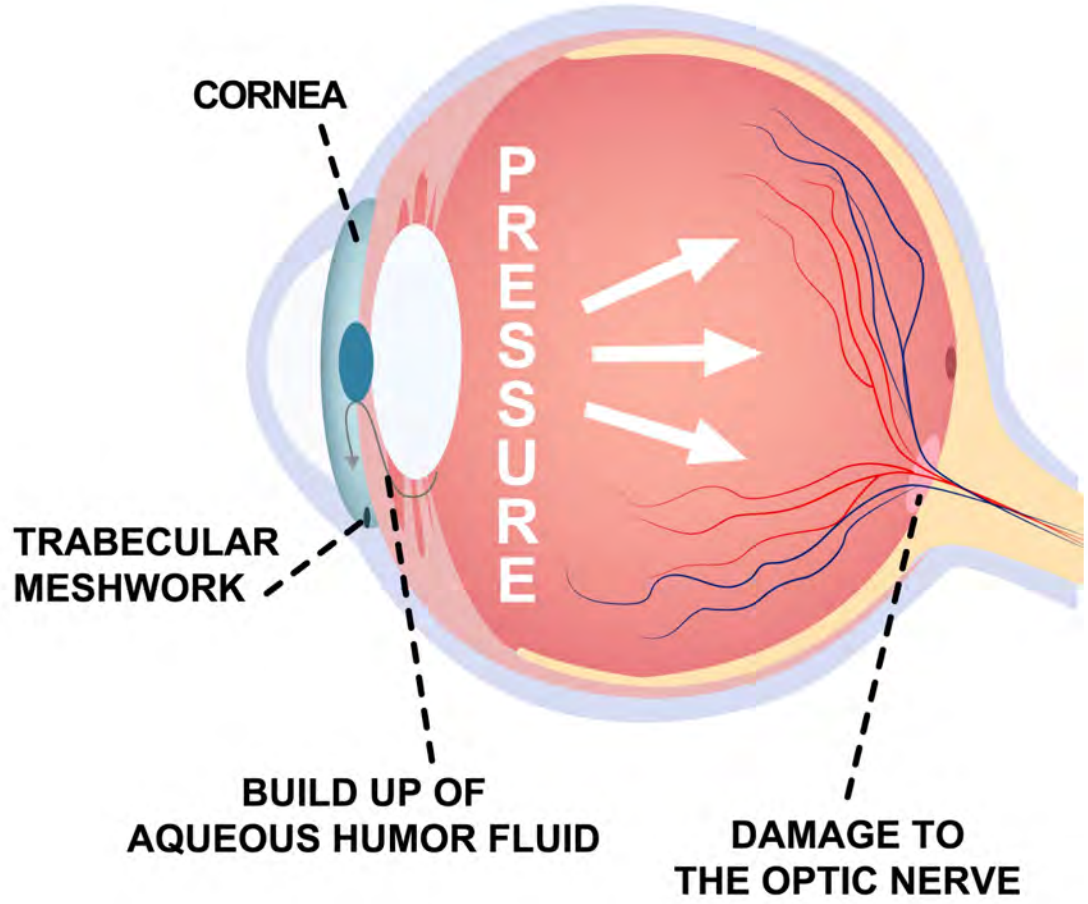
CATARACTS



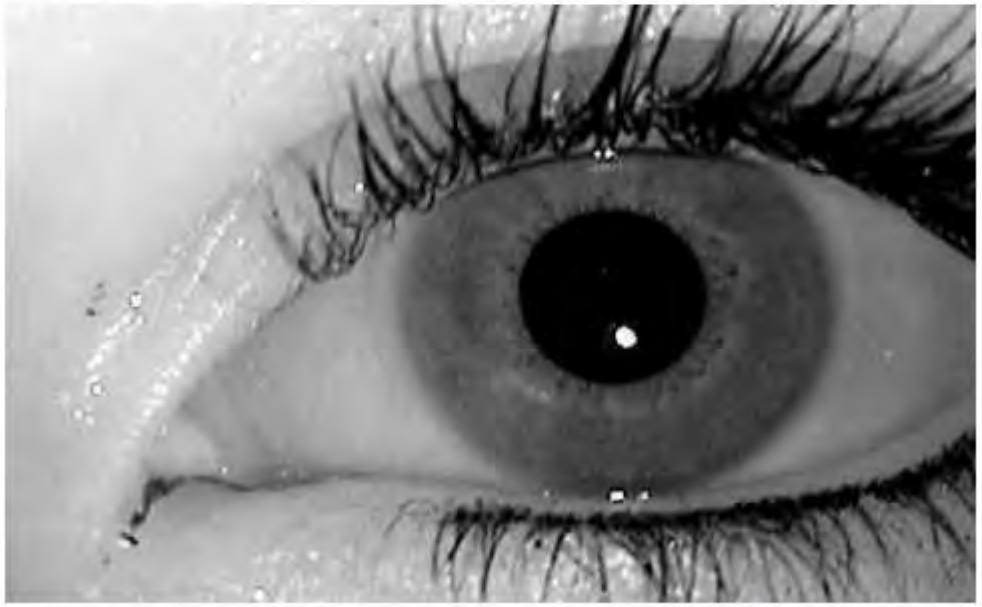
NORMAL EYE



GLAUCOMA



(a) Subject with cosmetic contact lens - 04780d133



(b) Subject without cosmetic contact lens - 04780d140

Fig. 5. Example of subject 04780 with and without a cosmetic lens

Baker, S. E., Hentz, A., Bowyer, K.W., and Flynn, P.J. 2009. Contact lenses: Handle with care for iris recognition. In IEEE Int. Conf. on Biometrics: Theory Applications and Systems (BTAS). IEEE, Washington, DC, USA, 1–8.

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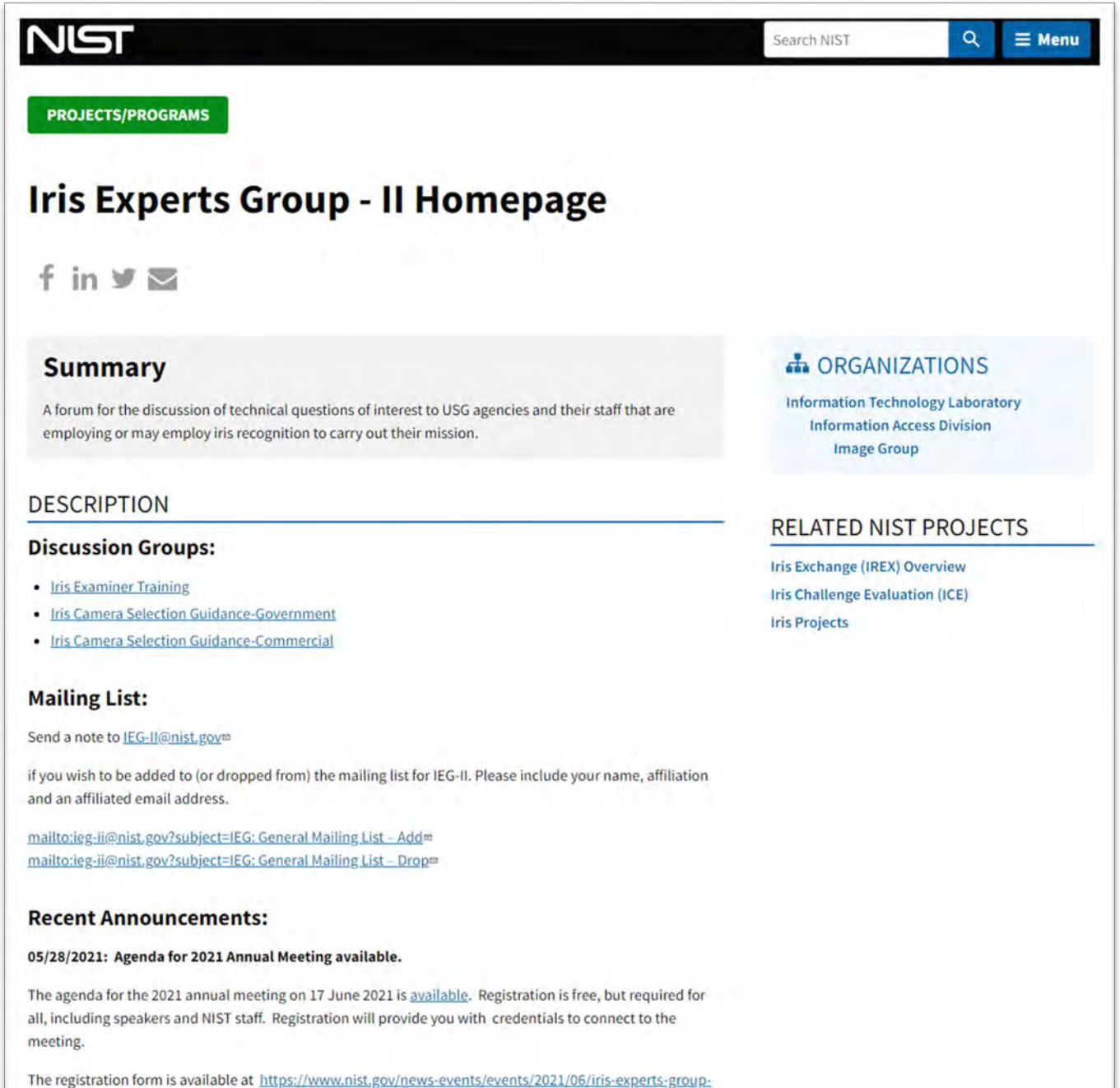
Interested in learning more?



NIST

Search NIST

Menu

PROJECTS/PROGRAMS

Iris Experts Group - II Homepage

Summary

A forum for the discussion of technical questions of interest to USG agencies and their staff that are employing or may employ iris recognition to carry out their mission.

ORGANIZATIONS

Information Technology Laboratory
Information Access Division
Image Group

DESCRIPTION

Discussion Groups:

- Iris Examiner Training
- Iris Camera Selection Guidance-Government
- Iris Camera Selection Guidance-Commercial

RELATED NIST PROJECTS

Iris Exchange (IREX) Overview
Iris Challenge Evaluation (ICE)
Iris Projects

Mailing List:

Send a note to IEG-II@nist.gov

if you wish to be added to (or dropped from) the mailing list for IEG-II. Please include your name, affiliation and an affiliated email address.

mailto:ieg-ii@nist.gov?subject=IEG: General Mailing List – Add
mailto:ieg-ii@nist.gov?subject=IEG: General Mailing List – Drop

Recent Announcements:

05/28/2021: Agenda for 2021 Annual Meeting available.

The agenda for the 2021 annual meeting on 17 June 2021 is available. Registration is free, but required for all, including speakers and NIST staff. Registration will provide you with credentials to connect to the meeting.

The registration form is available at https://www.nist.gov/news-events/events/2021/06/iris-experts-group-

Iris Experts Group (IEG-II)

https://www.nist.gov/programs-projects/iris-experts-group-ii-homepage

Mailing List:
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Next Generation Identification (NGI)
Iris Service

iris@fbi.gov

304-625-4747

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Thank you for your attention!

Questions?

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