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Highlights

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UIDAI Releases Biometrics SDK API Specifications for Developers

The Unique Identification Authority of India (UIDAI) has released API (Application Programming Interface) specifications for biometrics SDK developers. These specifications are expected to provide a single unified interface across the multiple modalities, *i.e.*, face, fingerprint and iris, for software developers to expose their functionality to various modules of *Aadhaar* system. The key purpose of common SDK API is to ensure vendor neutrality, interoperability, plug-n-play capability while allowing the use of best breed of algorithms , *e. g.*, dynamic selection of one fingerprint algorithm for the younger subjects while another one for the elderly. The weblink http://uidai.gov.in/images/aadhaar_biometric_sdk_api_2_0.pdf provides released API specifications. For developing the SDK which can fully comply with the released API specifications, the developers are also provided Java class files and documentation which can be downloaded from this link; https://developer.uidai.gov.in/site/bio_sdk_api. Released technical specifications for SDK implementations require them to be thread safe with small SDK memory footprints, statelessness, linear scalability with zero data storage and provide multi-level logging support.

UIDAI has already released *Aadhaar* Authentication API specifications earlier this year. It contains details including API data format, protocol, and security specifications. Released specifications also cover authentication using public devices. These APIs are primarily intended for the industry professionals working with various applications to help them enable their applications from biometrics data using the Aadhaar authentication. The details can be viewed from: http://uidai.gov.in/images/FrontPageUpdates/aadhaar_authentication_api_1_5_rev2.pdf

Biometrics Tutorials on YouTube

The tutorials held during recently concluded International conference on Biometrics, ICB 2012 held in New Delhi, are now available online. The organizers have now provided free access to all four tutorials via YouTube (i) *Iris Recognition* by John Daugman, (ii) *Biometrics Best Practices* by Jim Wayman, (iii) *Face Recognition* by Stan Z. Li, and (iii) *Fingerprint Recognition* by Davide Maltoni. All the tutorial materials and presentations can be downloaded/accessed from http://icb12.iiitd.ac.in/presentations.html

Spotlight

The National Institute of Standards and Technology (NIST) is a non-regulatory federal agency of the U.S. Department of Commerce, whose mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

In the field of biometrics, NIST's activities mainly focus on the following three aspects: (1) research on the various biometric modalities; (2) standards development enabling the open exchange of biometric data and the interoperability of biometric systems world-wide; (3) technology testing and evaluation. It has so far focused on four popular biometrics modalities, *i.e.*, face, fingerprint, iris and speech. Recently, researchers at the NIST have developed and published a new protocol named WS-Biometric Devices (WS-BD), which greatly improved the interoperability of biometric systems by incorporating a device-independent web-services layer. The NIST surely plays a key role in the assessment of biometrics algorithms and the standardization of various biometric systems. We have asked a few questions which have been answered from the NIST at topmost level and are shown in our *spotlight section* on the next page.

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Spotlight: Biometrics Standards and Evaluations

NIST

INTERVIEW QUESTION

Charles H. Romine, Director of ITL
National Institute of Standards and Technology, U.S.A.

NIST has organized several challenge problems (MBGC, FRGC, ICE, etc.) and competitions in biometrics during last 20 years (2013 will mark the twentieth anniversary). How successful have you been in achieving the goals of such technological evaluations and developments?

NIST has conducted large technology challenges for a variety of purposes. The MBGC, FRGC and ICE programs were conducted to challenge the face and iris recognition communities to break new ground on biometric frontier research problems. The Iris Exchange (IREX) and Minutia Exchange (MINEX) programs have engaged a global community to give quantitative support for biometric data interchange standards development, to measure conformance and interoperability, foster standards adoption, and support global deployment. The Face Recognition Vendor Tests (FRVT) and the Multi-biometric Evaluation (MBE 2010) have been conducted to assess capabilities of face recognition prototypes for one-to-many identification and one-to-one verification. They have measured accuracy gains over the last decade that are well beyond an order magnitude. This program has recently been extended to test gender and age determination for emerging digital signage applications. The Speaker Recognition Evaluations (SRE) program has long challenged that community to improve speaker identification capabilities and to make implementations more robust and versatile. The Fingerprint Validation and Test Evaluation (FpVTE) program was developed in response to statutory mandates to established performance standards for fingerprint identification.

By running these activities in an open, documented, independent, fair, and repeatable manner, these programs have achieved success in a) fostering a competitive diverse ecology of algorithms, b) establishing common metrological techniques for biometric testing and reporting, c) assisting implementers in developing and calibrating their technologies and d) allowing end-users to understand properties, behaviors, and capabilities of state-of-the-art biometric algorithms.

There are variety of new biometrics imprints and emerging challenges in biometrics. Say for example finger knuckle is being added as new biometric while biometrics systems are increasingly vulnerable to sensor level spoof attacks. Would you please help to summarize strategies from NIST to address such emerging challenges?

As new modalities come along, their properties and suitability must be determined. While detailed consideration of each new modality is beyond scope, NIST has been active in supporting quantitative testing of such technologies. NIST has, for example, been active in developing sensor calibration targets for contactless fingerprint sensors. It has supported development of the multi-part ISO/IEC 19795 biometric performance testing and reporting standard, the various parts of which are key to uniform, correct assessment of (new) technologies. The parts standardize aspects ranging from core practices and metrics, environmental considerations and test design, through operational tests and physical access control systems. One part of the standard, for performance of on-card comparison systems, underpins so-called match-on-card as a security paradigm that impedes initiation of a spoofing attack.

More directly, NIST has recently initiated a standard, ISO/IEC 30107, to specifically address the testing, calibration and terminological aspects surrounding detection of active attacks on biometric systems during the analog-digital sensing phase. NIST has recently been active in developing content for, and initiating, a new standard on testing of template protection schemes.

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Spotlight: Biometrics Standards and Evaluations

NIST

What is NIST's perception of the future of biometrics and identity management?

Biometrics has always had strong ties to identity management. The future is likely to continue current trends-that is, the addition of new modalities and capabilities as technologies both mature and are evaluated on larger scales.

For example, in NIST SP 800-76-2, the document that provides guidance for biometrics for PIV, iris recognition has now been added as an acceptable modality. Identity management is extremely broad in scope-both in subject matter and in the number of people and systems it affects.

Given this, the role of biometrics in these systems will continue to evolve and grow at a steady pace.

From your perspective, when will "Biometrics in the Cloud" become a reality?

This depends on what is meant by biometrics in the cloud.

With respect to web services, over the past two years, NIST has been involved with developing specifications for how to access biometric capabilities via web services. NIST SP 500-288 Specification for WS-Biometric Devices details a protocol for describing how to command and control biometric sensors via web services. NIST also played a leadership role in moving the OASIS Biometric Identity Assurance Services specification to an official OASIS Standard, an effort was initiated by DHS US-VISIT in 2006. So in some ways, biometrics in the cloud is already a reality.

Alternatively, if biometrics in the cloud implies unattended remote authentication, then there are still two open research problems to overcome. Before it is routine for users at home to log on to a website using a biometric, we need both highly accurate liveness detection and a reliable way to protect and cancel credentials derived from biometrics.

What are the biggest unexpected challenges that the NIST has recently faced with the emerging biometrics technologies? Would you like to share some of the experience gained?

The biggest challenge NIST has faced is the sheer breadth of emerging biometrics technologies, for which NIST potentially has an interest in supporting standardization of data and other aspects. Determining whether to support standardization is made more difficult by uneven assessments that appear in the available literature, whether the proponents have an active position toward or against standardization, and whether the technology affords some potential advantage over conventional and more mature methods.

One mechanism NIST has pursued to address this challenge is the publication of standard reference databases that can be used to benchmark new technologies. For example, NIST defined and published a challenge problem consisting of video sequences of people walking, to support gait recognition as a potential biometric.

Similarly we maintain a) annotated face databases to support soft-biometric augmentation of face recognition prototypes, b) databases to support the new field of automated latent fingerprint processing, and c) datasets for multi-biometric fusion studies.

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Distinguished Biometrics Lecturers

IEEE Biometrics Council has introduced the *Distinguished Lecturers Program* (DLP) to support education related activities for the biometrics community. The purpose of DLP is to increase awareness about topics relevant to Biometrics by creating a pool of leading experts who are willing to speak in meetings hosted by IEEE Chapters and Sections. The council has recently endorsed two Distinguished Biometrics Lecturers who are briefly introduced in the following.

Kevin Bowyer

Kevin W. Bowyer is the Schubmehl-Prein Professor and Chair of the Department of Computer Science and Engineering at the University of Notre Dame. His research efforts currently focus on biometrics and on data mining. His biometrics work includes efforts in support of the Face Recognition Grand Challenge, Face Recognition Vendor Test, and Iris Challenge Evaluation programs. His paper "A survey of approaches and challenges in 3D and multi-modal 3D+2D face recognition," published in Computer Vision and Image Understanding, was number one on the CVIU most-downloaded list for two quarters and in the top ten for seven consecutive quarters. His paper "Face Recognition Technology: Security Versus Privacy" published in IEEE Technology and Society, was recognized with a 2005 "Award of Excellence" from the Society for Technical Communication.

Professor Bowyer is the *founding General Chair* of the IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS). He is a Fellow of the IEEE, and a Golden Core Member of the IEEE Computer Society. He has served as Editor-in-Chief of the *IEEE Transactions on Pattern Analysis and Machine Intelligence*, and serves or has served on the editorial boards of Computer Vision and Image Understanding, Image and Vision Computing Journal, Machine Vision & Applications, International Journal of Pattern Recognition and Artificial Intelligence, Pattern Recognition, Electronic Letters in Computer Vision and Image Analysis, and the Journal of Privacy Technology.

Jim Wayman

Jim Wayman is a research administrator in the Office of Graduate Studies and Research at San Jose State University. He received the Ph.D. degree in engineering in 1980 from the University of California, and has worked continuously in the field of automated human recognition since 1984. In the 1980s, under contract to the U.S. Department of Defense, he invented and developed a biometric authentication technology based on the acoustic resonances of the human head. He joined San Jose State University in 1995 to direct the Biometric Identification Research Program, serving as Director of the U.S. National Biometric Test Center from 1997-2000.

He is the co-editor of Biometric Systems (Springer, London, 2005), a Fellow of the British Institution of Engineering and Technology, a Principal UK Expert (PUKE) of the British Standards Institution (BSI) national body to the ISO/IEC JTC1 SC37 standards committee, a "technical assessor" in the (US) NIST Voluntary Laboratory Assessment Program, and international editor of ISO/IEC 19794-13 standard on voice data format. He represents BSI on the JTC1 Information Technology Vocabulary Maintenance Team.

Professor Jim previously served as a member of the U.S. National Academies of Science/National Research Council (NRC) "Whither Biometrics?" and "Authentication Technologies and their Implications for Privacy" committees and Panel on Information Technology. He holds 4 patents in speech processing and has served as a paid biometrics advisor to 9 national governments.

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Cross Sensor Iris Recognition

Jaishanker K. Pillai[1], Maria Puertas[2] and Rama Chellappa[1]
[1]University of Maryland, College Park, USA [2]Recognition Group at Universidad Autonoma de Madrid, Spain

Iris recognition has become one of the most popular approaches for non-contact biometric authentication. Over the past decade, sensors for acquiring iris patterns have undergone significant transformations: existing ones have been upgraded and new ones have been developed. Some of the current iris acquisition systems are the LG4000, Iris on the Move portal system, Combined Face And Iris Recognition System (CFAIRs), HBOX™ and the Eagle-Eyes™ system. The availability of numerous systems for acquiring biometric signatures poses new questions about their interoperability. For instance, consider an access control application, where an older acquisition technology is upgraded to a newer and more accurate one.

Due to the large number of users, possibly in millions, enrollment is expensive and time-consuming. Hence it is infeasible to re-enroll the users after the new technology is deployed. In practice, the iris images acquired with the newer sensor will have to be matched against those enrolled using the older one.

Cross sensor iris matching often leads to lower accuracy when compared to same sensor matching. This is illustrated in Figure 1, using iris samples acquired using LG 2200 (sensor 1) and LG 4000 (sensor 2). Observe that the receiver operating characteristics (ROC) of cross-sensor matching is significantly lower than that of the same sensor ones, indicating inferior performance.

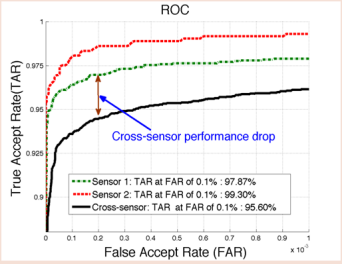

Figure 1: Cross Sensor Iris Matching

The authors have recently developed a sensor adaptation algorithm [1] to improve cross sensor iris matching. The algorithm is based on a novel optimization framework for learning transformations having desired properties. Using this framework, a transformed space is learned where the iris samples from different sensors behave in a similar manner. Using suitable constraints, this transform learning problem becomes a convex optimization problem, which is solved efficiently using Bregman projections. Matching is performed after projecting the iris samples onto this transformed space.

The developed algorithm has a training stage where the parameters of the transformation, called the "Adaptation Parameters" are learned. This requires only a small number of subjects (typically five) collected using both the sensors. Thus, the proposed algorithm significantly reduces the need for re-enrollment of the users, when a new iris sensor is deployed. During verification, the test iris sample is adapted using the learned adaptation parameters before matching. Different steps in the sensor adaptation algorithm are illustrated in Figure 2.

The developed algorithm is evaluated on the Notre Dame cross sensor iris dataset which is now available in public domain [2]. Iris samples during the enrollment stage are acquired using the LG 2200 sensor. Iris Verification is done using samples collected from the LG 4000 sensor in same and different sessions. Iris samples from five subjects collected using both the sensors are used for learning the adaptation parameters. The results summarized in Table 1 illustrate that the verification accuracy after adaptation is significantly higher than that before adaptation. Furthermore, due to the discriminative constraints enforced during adaptation, performance after adaptation is often better than that of the same sensor accuracies.

Table 1: True Acceptance Rate (TAR) at a False Acceptance Rate (FAR) of 0.1%

	TAR (%) at FRR=0.1%			
			Cross Sensor	
Session	LG2200	LG4000	Non Adapted	Adapted
Same	97.8	99.4	95.5	98.2
Diff.	-	96.5	94.0	97.6

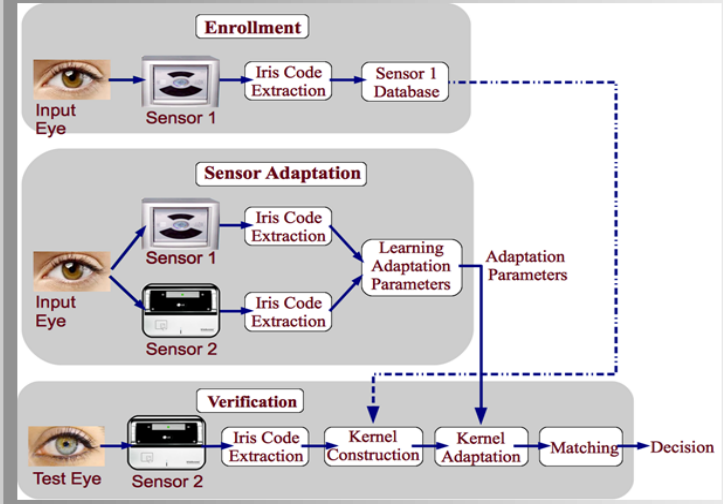

Figure 2: Sensor Adaptation for Iris Recognition

References

[1] Jaishanker K. Pillai*, Maria Puertas* and Rama Chellappa, "Sensor Adaptation In Iris Recognition", under review for publications in *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 2012 (* indicates equal contribution).
[2] ND-CrossSensor-Iris-2012 Dataset http://www.nd.edu/~cvrl/CVRL/Data_Sets.html

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Forthcoming Biometrics Conferences

International Conference on Automatic Face and Gesture Recognition
FG 2013, Shanghai, China, 22-26 April 2013
http://fg2013.cse.sc.edu/

The IEEE Conference on Automatic Face and Gesture Recognition (FG 2013) is the premier international forum for research in image and video based face, gesture, and body movement recognition. Paper submissions are invited now and the deadline is September 15, 2012.

International Conference on Biometrics
ICB 2013, Madrid, Spain, 4-7 June 2013
http://atvs.ii.uam.es/icb2013

The 6th IEEE/IAPR International Conference on Biometrics (ICB 2013) will have a broad scope and invites papers that advance biometrics technologies, sensor design, feature extraction and matching algorithms, analysis of security and privacy, and evaluation of social impact of biometrics technology. The deadline for ICB 2013 paper submission is December 15, 2012.

Biometrics: Theory, Applications and Systems
BTAS 2012, Washington DC, USA, 23-27 Sept, 2012
https://sites.google.com/a/nd.edu/btas_2012/

The IEEE Fifth International Conference on Biometrics: Theory, Applications and Systems (BTAS 2012) will be held in the September 23-27, 2012 time period in the Washington, DC area. BTAS 2012 includes advances in fundamental signal processing, image processing, pattern recognition and statistical and mathematical techniques relevant to biometrics.

International Conference of the Biometrics Special Interest Group
BIOSIG 2012, Darmstadt, Germany, 6-7 Sept 2012
http://www.biosig.org/biosig2012

The BIOSIG 2012 conference addresses issues of deployed systems, new modalities acquisition techniques, security and convenience applications efficient fusion techniques for multimodality systems, security of the biometric system, security analysis and certification of security properties. The conference will present innovations and best practices that can be transferred into future applications.

IEEE International Conference on Technologies for Homeland Security
HST' 12, Walthma, MA, USA, 13-15 Nov 2012
http://ieee-hst.org/

The twelfth annual IEEE Conference on Technologies for Homeland Security (HST '12), will be held 13-15 November 2012 in Massachusetts. HST'12 brings together innovators from leading universities, research laboratories, Homeland Security Centers of Excellence, small businesses, system integrators and the end user community and provides a forum to discuss ideas, concepts and experimental results.

IEEE International Workshop on Information Forensics and Security
WIFS'12, Tenerife, Spain, 2-5 Dec, 2012
http://www.wifs12.org

The IEEE International Workshop on Information Forensics and Security (WIFS) is the primary annual event organized by the IEEE's Information Forensics and Security Technical Committee (IEEE IFS TC). The scope of WIFS is broader than that of other more specific conferences, and it represents the most prominent venue for researchers to exchange ideas and identify potential areas of collaboration.

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Review of Introduction to Biometrics

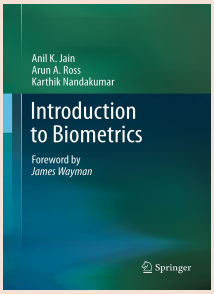
Anil K. Jain, Arun A. Ross, and Karthik Nandakumar

Review by *Rangachar Kasturi*

This textbook on Biometrics by leading experts in the field is very timely. After many decades of significant research advances, Biometrics has matured to its current state in which products deploying this technology have become a part of our daily lives. This book written primarily at an introductory level would be popular among not only educators, students, and practitioners but also among those in the technology industry who have a need to have an understanding of the basic principles, strengths, and limitations of various biometrics modalities.

Principal biometrics modalities of fingerprint, face, and iris recognition are covered in depth in their own chapters where as other evolving modalities based on traits such as gait, ear, and hand geometry are introduced in a single chapter. An excellent coverage of the topic of combining evidence from multiple modalities, indispensible in very large scale deployments such as those in national identity systems, is provided in the Multibiometrics chapter. The book concludes with a chapter on the security of biometric systems, an important concern for everyone, which includes an analysis of its vulnerabilities and available countermeasures.

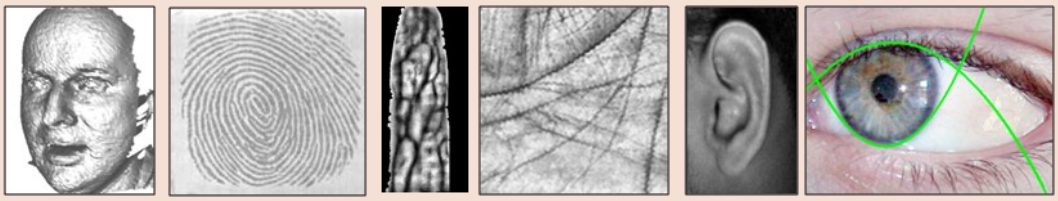
While most chapters contain introductory material appropriate for upper level undergraduate students or for those who wish to learn on their own, advanced topics which are a significant part of some of the chapters require a good background in statistical pattern recognition and image analysis. I had used a draft of the book to teach a semester long first year graduate course in biometrics at my university last year. Not all of my students had taken formal courses in these background topics. While they had some difficulty to follow advanced sections in iris and face recognition chapters, they were quite comfortable in understanding the concepts presented in the rest of the book. I would recommend the authors to include necessary background material in appendices to such topics in a future edition of the book or on the book's website to prepare such readers. I much enjoyed teaching this course and appreciated the value of having a book which covered all important biometrics topics.



In summary, *Introduction to Biometrics* is an excellent contribution to the literature and would be of immense help to the large community of people working as researchers, designers, developers, and practitioners in this rapidly growing field.

Biometrics Compendium

IEEE introduces its first virtual journal, the IEEE Biometrics Compendium



- A collection of recently published IEEE Transactions and Conference papers
- Includes biometrics papers from *T-IFS*, *T-PAMI*, *T-IP*, *T-SMC* A/B/C, and more…
- Papers organized into face, fingerprint, iris, fusion, hand, spoofing and more…
- Value-added commentary from technology/area experts
- Produced by IEEE Biometrics Council, published quarterly
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New Biometrics Databases in Public Domain

Several new biometrics databases have been made publicly available recently to promote research and evaluation efforts. The databases detailed below are all freely and publicly accessible from their respective web links.

1. The Osaka University - Institute of Scientific and Industrial Research (OU-ISIR) Gait Database

The OU-ISIR Gait Database is believed to be the world's largest gait database. The images are acquired while persons are walking on *a treadmill* surrounded by the 25 cameras at 60 fps, 640 × 480 pixels, and is distributed in a form of silhouette sequences registered and size-normalized to 88 × 128 pixels size. It is subdivided into 4 subsets with different covariates. Among them, the dataset D characterized in gait fluctuation is composed of gait silhouette sequences of 185 subjects from side view with various gait fluctuations among periods. The other three subsets, dataset A, B, C are labelled as "speed variation", "clothes variation" and "view variation", respectively. This database also constructs a larger database that includes 4007 subjects and described in recently published *IEEE Trans. IFS* paper. Please visit http://www.am.sanken.osaka-u.ac.jp/GaitDB/index.html for details and access.

2. The University of Milano Bicocca 3D Face Database (UMB-DB)

This database consists of 1473 total multimodal (3D + 2D colour images) facial acquisitions from 143 subjects (98 male and 45 female), among which 883 are non-occluded acquisitions while the remaining 590 are occluded acquisitions using various objects such as hair, eyeglasses, hats and so on. Besides, acquisitions in this database are released with full annotation. The data was captured from a Minolta Vivid VI-900 laser depth scanner. The database can be requested online from the web link http://www.ivl.disco.unimib.it/umbdb/request.html.

3. University of Notre Dame Cross Sensor Iris (ND-CrossSensor-Iris-2012) Dataset

The ND-CrossSensor-Iris-2012 dataset consists of 264,945 iris images collected in 27 sessions of data with 676 unique subjects. An average session contains 160 unique subjects which have multiple images from both the LG2200 and LG4000 iris sensors. Every subject occurs in at least two sessions in the data set. 117503 images were collected from the LG2200, and the data sets contains the originals plus 117,503 resized versions of the same images. 29939 images from the LG4000 are also contained in the data set. This data set spans three years, 2008 to 2010. Access to this dataset can be requested from http://www.nd.edu/~cvrl/CVRL/Data_Sets.html.

4. Indraprastha Institute of Information Technology - Delhi (IIIT-D) Sketch Database

The IIIT-D sketch database comprises three types of sketches: Viewed Sketches, Semi-forensic Sketches, and Forensic Sketches. The Viewed Sketches part comprises a total of 238 sketch-digital image pairs drawn by a professional sketch artist for digital images collected from different sources. The Semi-forensic part, is drawn by a sketch artist based on his memory of 140 digital images from the Viewed Sketches part. The Forensic Sketches part, however, is drawn by a sketch artist from the description of an eyewitness based on his/her recollection of the crime scene. More details about this database can be found from http://research.iiitd.edu.in/groups/iab/sketchDatabase.html.

5. University of Notre Dame Iris Time Lapse (ND-TimeLapseIris-2012) Dataset

This dataset contains 6797 images collected from 23 subjects (46 different irises) between January 2004 and October 2008. It corresponds to the data set used in the authors upcoming publication to demonstrate the effects of elapsed time between probe and gallery image acquisition on iris recognition system performance. Access to this database can be requested using the respective license agreement available from http://www.nd.edu/~cvrl/CVRL/Data_Sets.html.

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Please visit IEEE biometrics council website for more details on council activities. We welcome all your comments/suggestions and our mailing address is: Ajay.Kumar@inet.polyu.edu.hk

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