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Proof of Concept Report

REVISION OF IRIS SENSOR SPECIFICATIONS

FOR

DISCRETE/INTEGRATED AUTHENTICATION DEVICES

FEBRUARY 2016

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1. PoC at a glance: Introduction and Executive Summary

Unique Identification Authority of India (UIDAI) was set up with the mandate of providing Unique Identification Numbers (Aadhaar) to all residents of India and defining usages and applicability of Aadhaar for delivery of various services. Towards Aadhaar-enabled delivery of various services, UIDAI proposes online identity authentication. The online authentication may be done using demographic data, biometric data or OTP (One Time PIN).

Over the last five years, UIDAI and its partners have conducted successful field studies and implemented certification processes for fingerprint and Iris authentication devices. These successes have resulted in publication of biometric device standards and associated certification processes. Subsequently, Biometric devices thus certified have contributed to increased use of Aadhaar authentication.

UIDAI endeavors to bring latest advances in authentication devices into the ecosystem of Aadhaar authentication. In order to provide opportunity for authentication devices' ecosystem partners to test and certify their devices, UIDAI conducted a field testing activity (PoC) as a collaborative effort between 4th September 2015 and 7th October 2015.

This report covers the design framework, field implementation, data collection and analysis of this PoC. It concludes with a set of recommendations for authentication process and Iris device ecosystem.

UIDAI and STQC published the last revision of specifications for Iris devices in 2013. This PoC was conducted with the objective of updating the existing specifications considering two main drivers mentioned below:-

1. Advances and updates to biometric standards since the last publication of UIDAI/STQC authentication device standards.
2. Emergence of new category of handheld devices where biometric sensor is natively integrated in the consumer devices. This movement has begun to put biometric devices in the hands of consumer and has popularized use of biometrics for day to day transactions.

The PoC was planned with the below objectives:

1. Provide opportunity for UIDAI's device ecosystem partners to test their latest innovations in the areas of Iris capture hardware, software, and Iris cameras integrated into small form factor devices.
2. Provide opportunity for UIDAI and its certification partners to fine tune the device specifications used for Aadhaar authentication.

In this regard, UIDAI published an RFI dated 5th February 2015 (See references section) seeking inputs /suggestions on the possible improvements over the existing specifications and the solutions. The responses received as a part of the RFI exercise were collated and reviewed to arrive at a reference Iris sensor specifications which may help in realisation of smaller form factor devices

and integrated devices. The reference sensor specifications thus arrived contain a Spatial Resolution of ' > 50% at 1 LP/mm', a change from the existing ' >60% at 2 LP/mm '.

Based on these reference specifications, UIDAI published an EoI on 30th April 2015(See references section) addressing technology solution providers and device manufacturers developing Iris devices (as integrated devices[1] or as discrete devices[2]) that can be used for Aadhaar enabled biometric authentication. Through this EoI UIDAI invited interest from device manufacturers to actively participate in the PoC with their devices (production models or prototypes) that are grossly compliant to the reference specifications to prove the accuracy levels of the enhanced specifications in field environment.

The PoC was conducted with 10 devices of various form factors (both integrated and discrete) and a sample resident size of 3030 from two locations.

PoC Results at a glance – Devices with reference sensor specs

- The accuracy levels achieved with the reference specifications are on par with those of the existing specifications.
- 7 out of 10 prototype devices with reference Iris sensor specifications achieved ***accuracy levels in excess of 99% for image size 3.5 KB and above at an FAR of 1 in 1,00,000***.

2. Reference Specifications Suggested for the PoC

The industry's feedback obtained against UIDAI's RFI dates 5th February 2015 was collated and arrived at a reference Iris sensor specifications for testing integrated and discrete authentication devices.

[1] 'Integrated devices' refers to devices where biometric sensor is integrated into the device package. Examples of devices in this category include biometric sensors integrated into mobile phone/tablet etc.

[2] 'Discrete devices' refers to biometric devices which need to be connected to a host device such as PC/Laptop/Micro ATM etc. as an accessory.

The reference sensor specifications contain a Spatial Resolution of '> 50% at 1 LP/mm', a change from the existing '>60% at 2 LP/mm '. The EoI also mandated the adherence to the following requirement as a general pre-requisite for participation in the PoC.

"Iris authentication devices should support auto capture and segmentation SDK which produces output image in the CROPPED_AND_MASKED Iris image interchange format (previously known as kind 7) compliant to ISO 19794-6:2011. Device is expected to feature appropriate applications including authentication application compliant to UIDAI's Aadhaar Authentication API 1.6 Specification"

Vendors who participated in the PoC confirmed compliance to the reference specifications provided in the EoI as below:-

S. No	Device Characteristics	Shortlisted Specifications (Based on RFI inputs)
1	***Functional***	
1.1	Spatial Resolution	> 50% at 1 LP/mm.
1.2	Pixel Resolution	>10 pixels/mm
1.3	Image Margins	Left & right >= 0.6x Iris radius Top & bottom >= 0.2x Iris radius
1.4	Imaging Wavelength	700-900nm
1.5	Spectral Spread	Power in any 100nm band>35% of total power
1.6	Pixel Depth	minimum of 8 bits/pixel
1.7	Sensor Signal to Noise Ratio	> 30 db
1.8	Scan Type	Progressive
1.9	Output Image	IMAGE_TYPE_CROPPED_AND_MASKED format with various JPEG2000 image sizes (2KB, 3.5KB, 5KB**,** 7KB, 10 KB)
1.10	Contrast	The Iris image should have good grey level separation between the Iris and sclera and between the Iris and pupil and should have sufficient contrast to reveal the Iris texture. *The quantification of "Good" and "Sufficient" will be done after the PoC*.
1.11	Optical Distortion	The Iris image should not exhibit effects of optical distortion including spherical aberration, chromatic aberration, astigmatism and coma consistent with standard optical design practices
1.12	Noise	No image resizing. No image manipulation other than recommended by IMAGE_TYPE_CROPPED_AND_MASKED. Single pass JP2.
1.13	Capture time	<5 sec

1.14	Operating Temperature	0-50
2	***Safety***	Exempt Group per IEC 62471:2006-07
3	***Occupational Health-Safety***	RoHS compliant
4	***Software API***	Conforms to UIDAI Auth PoC API

3. Vendor Details & Device Categories

Figure 1: PoC Devices

Vendor (6)	Form Factor (10)	Iris Captured	Device Operability
Vendor 1	Discrete*	Dual	OA
	Discrete*	Dual	SS
Vendor 2	Integrated	Dual	SS
	Integrated	Dual	OA
Vendor 3	Discrete	Single	OA / SS
	Discrete	Dual	OA / SS
	Integrated	Dual	SS
Vendor 4	Discrete	Single	OA / SS
Vendor 5	Integrated	Single	OA
Vendor 6	Integrated	Single	OA

*discrete prototype device for which the vendors confirmed the feasibility of incorporating to the integrated & smaller form factors.

OA – Operator Assisted Model

SS – Self Service Model

4. PoC Preparation

4.1 PoC Hardware Setup

UIDAI decided to ensure that the real field conditions are reproduced in the PoC. Accordingly UIDAI used the production environment wherein the transactions from the PoC locations were received through a live AUA- ASA channel.

UIDAI's Sub-AUA server (with fail over server) was set up with connections to two production AUAs (primary and secondary) for meeting the High availability requirements of the PoC. The Sub-AUA server did not have any additional intelligence or MIS facility, but was capable of collating requests from participating devices and routing to AUA1 or AUA2. UIDAI's existing BI reporting facility was used for data preparation and analysis.

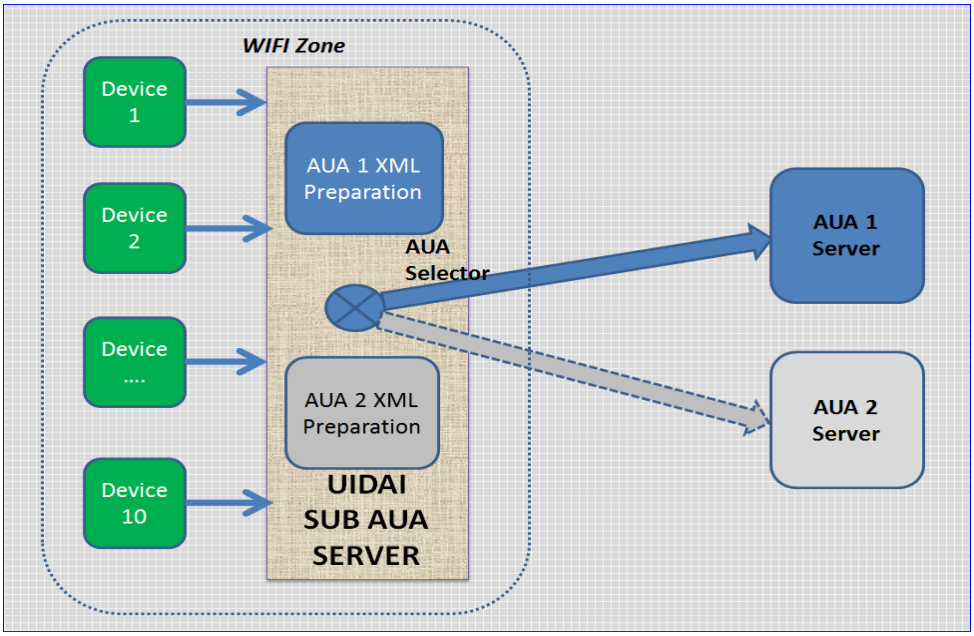

Figure 2: PoC Hardware Setup

4.2 PoC Client Software Specifications

Due to significant participation of integrated form factors which run on various operating systems and configurations, a common PoC client was not considered. Hence it was decided to provide generic software specifications for the vendors to adhere to.

The Java code for the basic client was provided (https://developer.uidai.gov.in/site/downloads) with additional instructions as below:

- The software shall create 5 different image compressions (5 XMLs) for each capture.

- **Format for TXN element:**
    - **a.** Format of the TXN should be "<timestamp>:<UDC>:<POSH>" . Timestamp should be up to milliseconds.
        - **i.** Example 1 : "YYYYMMDDHHMMSSmmm:ABCAB01020:LEFT"
        - **ii.** UDC should be as agreed with the vendor
        - **iii.** The POSH can be LEFT_IRIS, RIGHT_IRIS or UNKNOWN.
        - **iv.** The TXN element should be constructed out of the timestamp of the device real time.
    - **b.** The XMLs of different compressed images generated from a single capture should have the same Time stamp in TXN.
        - **i.** Example: If a LEFT Iris capture is made at "20150626101112123" the multiple XMLs created with various sizes of same source will typically have the following TXN ids.
            - ***a.*** *20150626101112123:ABCAB01020:LEFT* - For 2 KB image
            - ***b.*** *20150626101112123:ABCAB01035:LEFT* – For 3.5 KB image
            - ***c.*** *20150626101112123:ABCAB01050:LEFT* – For 5 KB image
            - ***d.*** *20150626101112123:ABCAB01070:LEFT* – For 7 KB image
            - ***e.*** *20150626101112123:ABCAB01100:LEFT* – For 10 KB image
    - ***c.*** Single eye cameras should maintain correct POSH wherever possible. If this cannot be maintained properly, POSH can be passed as UNKNOWN.

- **Dual Iris Camera:**
    - **a.** Dual Iris cameras SHOULD NOT send both Iris images in the same XML.
    - **b.** A single capture of Left and Right Iris should be treated as two separate images and should be used for constructing separate XMLs with only one <bio> element in PID. (Passing two <bio> elements in the single XML is not allowed)
        - **i.** Example: If a dual Iris camera captures both eyes at 20150626101112123, there would be 10 XMLs created as below. Same timestamp in TXN for all images from single source image applies here as well.
            - ***a.*** *20150626101112123:ABCAB01020:LEFT* – For 2 KB image
            - ***b.*** *20150626101112123:ABCAB01035:LEFT* – For 3.5 KB image
            - ***c.*** *20150626101112123:ABCAB01050:LEFT* – For 5 KB image
            - ***d.*** *20150626101112123:ABCAB01070:LEFT* – For 7 KB image
            - ***e.*** *20150626101112123:ABCAB01100:LEFT* – For 10 KB image
            - ***f.*** *20150626101112123:ABCAB01020:RIGHT* – For 2 KB image
            - ***g.*** *20150626101112123:ABCAB01035:RIGHT* – For 3.5 KB image
            - ***h.*** *20150626101112123:ABCAB01050:RIGHT* – For 5 KB image
            - ***i.*** *20150626101112123:ABCAB01070:RIGHT* – For 7 KB image
            - ***j.*** *20150626101112123:ABCAB01100:RIGHT* – For 10 KB image
    - ***c.*** For Dual Iris Camera's it is **mandatory** to maintain the POSH element properly.

- ***Work Flow Definition:***
    a. The client application should submit every successful capture for Authentication and should not allow for a retry of capture manually before submit to authentication.
    b. In other words, the maximum number of clicks allowed for a capture is one. The ideal workflow is as below.
    Note: The Vendors who were not able to implement this in time (due to various dependencies at the hardware level) have given their undertaking to abide by the workflow in a process level.

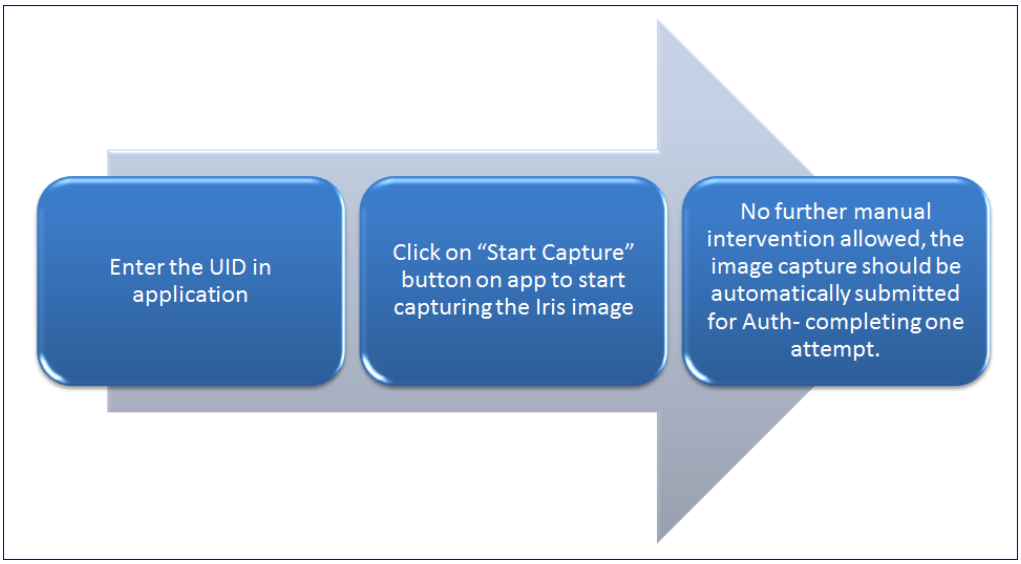

Figure 3: Client Application Workflow

- To maintain uniformity, images should be compressed to the standard sizes mentioned in the EoI (2, 3.5, 5, 7, 10 KBs)

4.3 Non-Disclosure Agreement (NDA)

The vendors signed an NDA with respect to the disclosure of certain proprietary, confidential information ("Confidential Information") and storage of PoC related properties in their application, host machines or anywhere else.

Definition of Confidential Information: For purposes of the Agreement, "Confidential Information" included all information or material that was received as part of the PoC exercise, the names and details of the vendors who are participating in the PoC, type of devices released by them, devices in pipeline, specifications on the devices, intellectual ideas, etc. The vendors were instructed to keep them as confidential unless there is written consent from UIDAI

Data Policy: Vendors were instructed not to store any biometric or PII data of the resident, anywhere in the client applications or host. The ownership of the data collected as part of the exercise is with UIDAI and vendors were asked not to keep them.

5. PoC Methodology

5.1 Lab Tests

With an intension to assess the device operability, software quality and other readiness factors for the PoC, two lab tests were conducted at UIDAI Tech Centre. On completion of each Lab Tests, vendors were given specific feedback for improvement of the devices.

The general areas of improvement include:

- Noise Levels.
- Segmentation
- Compression
- Incorrect image sizes.
- Usability aspects of the device

Lab Test	Dates	Number of Residents Participated
Test 1	29th and 30th June	25
Test 2	28th July	63

Figure 4: Lab PoC

5.2 Location and Dates for Field PoC

Following locations were identified for the PoC. It was ensured that the devices were tested at various levels of ambient light.

Location	Dates
CMR Institute of Technology (CMRIT) 132 AECS Layout, ITPL Main Road, Kundalahalli, Bangalore	4th September to 23rd September 2015
Ramakrishna Mission, Shivanahalli, Jigani Hobli, Anekal Taluq, Bangalore	24th September to 7th October 2015

Table 1: PoC Locations

5.3 Iris Station Setup and Capture Process

Operators were trained on capture processes and importance of quality and biometric capture sequence (left iris, right iris: up to three attempts for each eye). The operators were instructed to record the feedback of the attempts including the FTC for each resident.

Three stations were setup with 10 devices each. Order of the devices was rotated in a round robin fashion every day. The objective of the PoC was explained to the participants, and consent for participation was obtained. Each resident was made to go through 10 different devices arranged at a station.

A successful response for 3.5 KB image was considered as optimal capture to avoid undue delays by containing the number of attempts per resident.

Single eye camera: Each presentation was defined as image of one eye. Second attempt used different eye from the first. In other words, the recommended multiple attempt sequence was left eye, right eye, left eye. Attempts were stopped as soon as both Iris (3.5KB) passed online authentication or has completed 3 attempts on each eye.

Dual eye camera: Each presentation was defined as one image of each eye (two iris images) and creating two separate XMLs. Total captures allowed was three, hence completing three attempts on each eye. The operators were asked to stop capturing if they get 3.5KB succeeded on each eye before completing allowed attempts.

Fail to Capture (FTC): If for any reason the device was not able to capture the resident biometrics (for both the eyes) even after three attempts on each eye, it was marked as failure to capture (FTC).

Figure 5: Field PoC at Shivanahalli

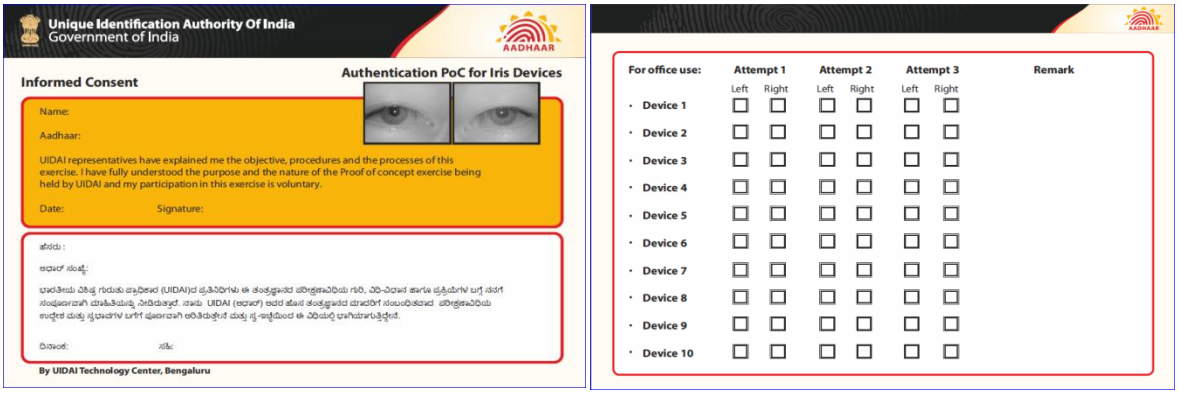

Figure 6: Consent and Remarks form

IEC materials were arranged at the PoC premises to spread awareness on the activity and attract residents for volunteering in this endeavor.

5.4 Exit Check

Exit Check process was setup to ensure that the resident has gone through all 10 devices.

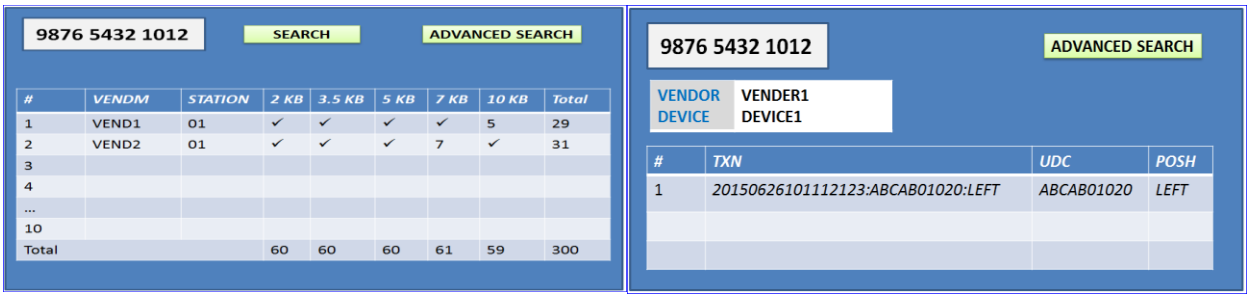

Figure 7: Exit Check Reference Screen

6. PoC Analysis and Results

Since all PoC transactions were recorded in the production environment, UIDAI's existing BI reporting facility was used for data preparation and analysis.

6.1 Data Set preparation

1. Following Error codes were excluded from the data set as they do not contribute to the success/failure rate of the device as defined in the objective of the PoC.

Error Code	Definition
100	"Pi" attributes of demographic data did not match. Demo auth performed
315	Number of IIR should not exceed 2
501	Invalid certificate identifier in "ci" attribute of "Skey"
505	Synchronized Key usage not allowed for the AUA
510	Invalid Auth XML format
561	Request expired
563	Duplicate Request
710	Missing "Pi" data as specified in "Uses"
811	Missing biometric data in CIDR for the given Aadhaar number
901	No authentication data found in the request
937	Technical error that are internal to authentication server
996	Cancelled UID
997	Suspended UID
998	Invalid Aadhaar Number

2. Following error codes were considered in the PoC data set.

Error Code	Definition
300	Biometric data did not match
800	Invalid biometric data

3. Operators' test transactions were excluded from the data set.
4. Residents who were not present in all devices and not marked as FTCs for missing devices were excluded from the data set.
5. For Residents who were present for all devices on more than one day, first day's transactions only were considered.
6. First six attempts of a resident only were considered wherever number of attempts was more than six for a day.
7. FTCs marked for a device were added as a failed attempt for the device across sizes.

6.2 Analysis & Results

The success percentage is defined as the number of residents who attempted Iris authentication and were successful in 3 or less attempts for each eye.

The two reasons why a resident may not be successful were:

- Failure to Capture (FTC)
- False Reject (FR)

Both the reasons were included when calculating the success percentages.

True Accept Rate (TAR) = 100-(FRR+FTC)

Table 2 shows the percentage accuracy as a function of the Iris image size. It is seen that the success percentage increases as the size of iris image is increased. However, a larger Iris image size will require a greater bandwidth. 3.5 KB iris image size is recommended as the best tradeoff between bandwidth and accuracy.

Device	Success Percentage against Sizes				
	2 KB	3.5 KB	5 KB	7 KB	10 KB
Device 1	99.70	**99.74**	99.74	99.67	99.73
Device 2	99.66	**99.76**	99.69	99.66	99.72
Device 3	95.10	**99.47**	99.64	99.47	99.56
Device 4	99.07	**99.37**	99.57	99.47	99.53
Device 5	99.17	**99.44**	99.57	99.47	99.53
Device 6	95.53	**97.46**	97.75	97.80	97.98
Device 7	97.35	**99.14**	99.17	99.23	99.43
Device 8	98.34	**98.98**	99.01	99.07	99.03
Device 9	99.14	**99.27**	99.31	99.23	99.09
Device 10	67.64	**83.97**	87.24	88.28	89.81

Table 2: Impact of Iris Image Size on Accuracy (TAR)

This PoC was conducted using the production setup and used the same success threshold as UIDAI production. Characterization of the production SDK has shown the threshold corresponds to an FAR value of 1 in 1,00,000.

Based on the sample size the PoC (3030 residents), the actual success rate of a device is within 1% of the measured success rate (90% confidence interval). Any two devices with accuracy percentage within 1% can be assumed to have equivalent accuracy.

Device	Total Residents	Success Percentage (3.5 KB)
Device 1	3030	**99.74**
Device 2	2928[3]	**99.76**
Device 3	3030	**99.47**
Device 4	3030	**99.37**
Device 5	3030	**99.44**
Device 6	3030	**97.46**
Device 7	3030	**99.14**
Device 8	3030	**98.98**
Device 9	3030	**99.27**
Device 10	2989[4]	**83.97**

Table 3: Transaction-wise Accuracy for 3.5KB (TAR)

Device	FTC %
Device 1	0.03
Device 2	0.03
Device 3	0.16
Device 4	0.03
Device 5	0.03

Device	FTC %
Device 6	0.10
Device 7	0.07
Device 8	0.07
Device 9	0.40
Device 10	1.17

Table 4: Device-wise FTC

[3 & 4] Devices could not be deployed in the field for a specific duration

7. Recommendations

1. Table 3 shows the accuracy results of the devices used for the PoC which are meeting the reference Specifications. It is important to note that the devices used in the PoC are prototypes with a scope of improvement on Hardware, Algorithm and Sensor levels and the accuracy levels are expected to be better on the production devices.

   The empirical results demonstrate that 7 out of 10 prototype devices participated in the PoC with reference Iris sensor specifications have got ***accuracy levels in excess of 99% for image size 3.5 KB and above at FAR of $1e^{-5}$***. The accuracy levels achieved includes both FRR and FTC and are comparable to the accuracy achieved through the devices confirming to existing specifications.

   It is recommended to use the reference specifications used in the PoC as a baseline for revision of Iris sensor specifications for UIDAI's Iris authentication device ecosystem.

   The final recommended specifications are furnished as Annexure - 1

2. It is evident that higher accuracy of authentication is being achieved through IMAGE_TYPE_CROPPED_AND_MASKED images of size 3.5 KB and above. Though 5 KB shows good performance, 3.5 KB is considered to be optimal for the real field conditions that include network latency due low band width internet options. Higher packet loss is observed for 7 KB and 10 KB images and hence they are not recommended.

   It is recommended to use 3.5 KB as the optimal image size for image type IMAGE_TYPE_CROPPED_AND_MASKED used in the Iris authentication device ecosystem.

Annexure -1

1. Revised Iris sensor Specifications -

The Iris sensor for discrete and integrated Authentication Devices should have following specifications:-

Device Characteristics	Recommended Specifications
Spatial Resolution	> 50% at 1 LP/mm.
Pixel Resolution	> 10 pixels/mm
Image Margins	Left & right >= 0.6x iris radius. Top & bottom >= 0.2x iris radius
Imaging Wavelength	Approximately 700-900 nm
Pixel Depth	Minimum of 8 bits/pixel
Sensor Signal to Noise Ratio	Noise should not be observable in the captured image
Scan Type	Progressive
Output Image	IMAGE_TYPE_CROPPED_AND_MASKED with JPEG2000 compression; needs to comply with the ISO standard for Iris Image Record (IIR) i.e. ISO/IEC: 19794-6:2011, Section 6.1, 6.4.
Contrast	The iris image should have good grey level separation between the iris and sclera and between the iris and pupil and should have sufficient contrast to reveal the iris texture.
Optical Distortion	The iris image should not exhibit effects of optical distortion including spherical aberration, chromatic aberration, astigmatism and coma consistent with standard optical design practices
Noise	No image resizing. No image manipulation other than recommended by IMAGE_TYPE_CROPPED_AND_MASKED. Single pass JPEG 2000.
Capture Mode	Auto capture with built-in quality check
Capture time	<5 sec
Capture Distance (in mm)	>= 100
Safety (Optical)	Exempt Group per IEC 62471:2006-07
Operational Performance	FRR < 1% at FAR of 1 in 1,00,000 with images conforming to IMAGE_TYPE_CROPPED_AND_MASKED of size 3.5KB

2. Non-Optical Parameters, Environmental Test Specifications and other parameters for Discrete Iris Authentication Devices

Device Characteristics	Environment Test Specification
Operating temperature	0…50 C (IEC 68-2-2)

Storage Temperature	0…50 C (IEC 68-2-2)
Dry Heat Test as per 60068-2-2	Temp: 50deg ± 2 C Recovery Period: 1 to 2 Hours
Damp Heat Cyclic Test (First Cycle) as per 60068-2-30	Temp: 40 C ± 2 C Humidity(RH): 90% ± 2% Duration of Test: 1 cycle of 24Hrs.(12h +12h) Recovery Period: 1 to 2 Hours
Cold test as per 60068-2-1	Temp: -10 C ± 2 C Duration: 16 Hrs. Recovery Period : 1 to 2 Hrs.
Damp heat Cyclic Test(Five Cycles) as per 60068-2-30	Temp: 40 C ± 2 C Humidity(RH): 90% ± 2% Duration of test: 5 cycles of 24 Hrs each (12 h + 12h) Recovery Period: 1 to 2 Hours
Durability Test(IP 54) as per IEC 60529	Dust Test Duration: 8 Hrs. Recovery Period: 1 to 2 Hrs
	Water Splash test: Test Duration: 10 Minutes Recovery Period: 1 to 2 Hrs.
Drop test as per 60068-2-31	No. of drops: Six drops (one drop on each face) Height of fall: 1000 mm unpacked Condition.
Vibration Test as per IEC60068 2-6	Frequency: 10…150 Hz, 0.15mm or 2.0g No. of Sweeps: 10 in each axis Condition: in Packed Condition

Other Parameters:

Device Characteristics	**Specification**
Occupational Health Safety	RoHS Compliant
Electro-Magnetic compatibility	
ESD Test as per IEC61000-4-2	Type of discharge: contact Type, Test Voltage: Air discharge+-8 KV ,contact type+-4Kv
Radiated Emission	FCC part15B/IEC:CISPR 22 CLASS B standard
Radiated Immunity	As per IEC/EN 61000-4 3:2006+A2:2010
Software API	Compliant with UIDAI API Specification
Connectivity	USB 2 And / Or USB-IF compliant

	Exempted for sensors embedded in Form factor designs such as POS terminals, Tablets etc
Usability and ergonomics	As specified below
Operating System Support	Minimum support of device drivers for Windows XP onwards/Android / Linux. For purpose of certifications tests, drivers need to be windows XP and above compliant including Software API compliant to UIDAI API specifications as cited above.

Usability and ergonomics

Device usability and form factor have a significant impact on image quality and matching accuracy. Following Usability requirements shall be adhered:

Ease of Use

- It is easy and quick to position/align the resident's eye, within the capture volume of the device
- It encourages the resident to sufficiently open their eyes and look (gaze) in a specific direction
- It should quickly and automatically capture the irises
- It gracefully handles effects from the motion of the camera in respect to the eye (linear and angular)
- It should be easy to use by residents with special conditions such as squint eyes, blindness, droppy eyes, lazy eyes and other handicaps

Usability Design

The features of iris devices required in improving device usability in the Indian context are classified into three categories:

- Capture aid: this refers to all the assistance provided to the resident in encouraging correct and quick usage of the device
- Actionable feedback: this refers to all the feedback provided to the operator to enable the operator to take a physical or verbal action during the iris capture
- Informative feedback: This refers to all the feedback provided to resident about the capture process.

The device design shall incorporate these features.

Capture Aid (for resident)

At least one of the below capture aids to be provided to the resident for ease-ofuse:

- Physical: Physical aids can be provided to make it intuitive for the resident to align the iris camera to their eye(s). The resident can get tactile feedback and intuitively position the device

correctly. The examples are eye cup, eye guard, goggles, etc. The physical structure can assist alignment in z and/or restrict the x and y alignment by utilizing position of the eyes and/or nose

- Visual: visual aid can be implemented in a number of ways, for example, by providing a viewfinder for the resident to look through, or look at the reflection of their own eyes in a mirror, or by changing colors of LEDs to convey some predetermined messages such as too far or too close, or a display such as LCD showing the resident and operator what to do for enabling quick capture.

- **Audio:** audio instructions can be provided to the resident by the device or host to aid the alignment and capture. Due to large diversity of languages in India, this is not expected to be very effective, except in case of blind/handicap residents.

Actionable Feedback (for operator)

At least one of the below methods of actionable feedback be provided to the operator for ease-of-use:

- **Visual**: visual feedback may be provided to the operator to take an action to assist the resident in iris capture. A viewfinder can be used by the operator to bring the iris camera to the eye level of the resident, LEDs of predetermined color and meaning can provide feedback to the operator if the resident is too far or too close to the iris capture device, or a display such as LCD can show in large icons or video. Note that it is better to have this feature on the device itself so that the feedback and the resident are both in the line of sight of the operator and the operator does not have to look at visual feedback that is in a different direction than the resident. If a cell phone or tablet is used as the host device to the iris camera, the host display can be used for showing actionable feedback since the operator can hold the host in the hand and have it in the same line of sight as the resident.

- **Audio**: audio can be used to provide actionable feedback to the operator. The operator then takes a physical action or provides a verbal instruction to the resident.

The actionable feedback to include the following:

- How to correct alignment in x, y, and z
- Open eyes wider (in case of occlusion from eyelids)
- Look straight or look at “object” (in case of incorrect gaze); the object can be reflection of one’s own eye, light source, or some other object
- Hold steady (in case of motion blur)
- Improve focus by moving closer or farther

Informative Feedback (for resident)

- **Visual**: LED/light is on when capturing and turn off when capture is finished;
  and/or
- **Audio or tactile**: a beep/click and/or vibration of the device can be used to indicate that capture is done.

The following informative feedback to the resident is required:

- Iris capture is in progress
- Capture complete

Actionable feedback streamlines the process, improves speed and avoid confusion.

Notes:

1. Per ISO/IEC 19794-6:2011, Annex B.1 measured by MTF using a sinewave target. In addition, upper limit of 1.05 on MTF is required at all frequencies to discourage image processing that produces excessive edge sharpening, which can add false details to an image. The output image of sine wave target shall not exhibit any significant amount of aliasing. Aliasing will be investigated by quantitative analysis and from visual observation of the softcopy-displayed image.

2. Per ISO/IEC 19794-6:2011, annex B.6, the image should have a dynamic range spanning 256 grey levels, allocating one byte (8 bits) per intensity value, and providing at least 7 bits of useful intensity information.

3.Non-Optical parameters, Environmental Test Specifications for Integrated Iris Authentication Devices

Characteristics	Environment Test Specification (for mobile devices incorporating IRIS Devices)
Operating temperature	0…50 C (IEC 68-2-2)
Storage temperature	0…50 C (IEC 68-2-2)
Dry Heat Test as per IEC 60068-2-2	Temp: 50deg±2 C Recovery period: 1to 2 Hours
Damp Heat Cyclic Test (First Cycle) as per IEC 60068-2-30	Temp: 40 C ± 2 C Humidity (RH): 90% ± 2% Duration of Test: 1 cycle of 24Hrs. (12h + 12h) Recovery Period: 1 to 2 hours
Cold test as per IEC 60068-2-1	Temp: -10 C ± 2C Duration: 16 Hrs Recovery Period: 1 to 2 Hrs
Damp heat Cyclic Test (five Cycles) as per IEC 60068-2-30	Temp: -10 C ± 2 C Humidity (RH): 90% ± 2% Duration of Test: 5 cycle of 24Hrs each(12h+12h) Recovery Period: 1 to 2 hours
Drop/Topple Test as per IEC 60068-2-31	One topple each on four bottom edges In unpacked condition
Vibration Test as per IEC 60068-2-6	Frequency: 10…150 Hz, 0.15mm or 2.0g No. of Sweeps: 10 in each axis In packed condition

For API compliance, refer “Other Parameters” under Section 2 of Annexure-1. Other tests specified under “Other Parameters” are not applicable for Integrated Iris Devices as these are governed by the host device (Mobile / Tablet) and as such the measurement on IRIS authentication device is not possible in isolation.

The “Usability and ergonomics” for the Integrated Iris Devices would be the same as specified in “Other Parameters” under Section 2 of Annexure-1.

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