Measurement of Very Large Scale Biometric Systems: India's UID Project

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UID Introduction
Goal of the UID

• Provide a Unique number to every resident of India
  – Earlier databases plagued by duplicates and errors
  – remove ghost identities

• To improve government service delivery

• Provide ubiquitous verifiable identity proof
  – Deliver govt. subsidies
  – banking
  – access control
**Authentication Status**

- Auth services live
- Formally launched in Feb 2012
- 8 PoCs were conducted – summary published
- 3 Pilots underway

**Enrollment Status**

- 1M/day enrollment per day
- 36,000 enrollment stations, 87K certified operators
- 11 models of certified devices
- 200 Million enrolled
- 150 trillion person matches/day
UID Biometric Innovations

- Multi-ABIS system
- Dynamic Allocation to ABIS
- Biometric Accuracy
  - Absolute/Relative methods
- Accuracy as gallery grows
ENROLLMENT
Enrollment Process

1. Certified devices
2. Standardized Processes
3. Standardized Data Transfer
4. Data Processed at CIDR
5. Registered Post delivery
Enrolment Accuracy Study
based on a sample size of 84million
Image Quality - Definitions

• Methodology
  – Quality metrics embedded in enrollment packet

  – Face: ICAO-- (slightly relaxed)

  – FP: Poor quality when there is at least one finger with NFIQ >3 in each of three slaps (4, 4, 2)

  – Iris: Poor quality when “Irisness” score < 50 (proprietary)
Image Quality - Results

• Govt. Policy - everyone must be enrolled
  – ie FTE=0%

• Biometric FTE: 0.14% (no FP & Iris captured)

• Poor Quality FP & Iris: 0.23%

• Poor Quality
  – FP: 2.9%,
  – Iris: 3.0%
Under the Hood

• Face Quality: 85%
• Iris (L & R): 93.4% & 92.5%
• Fingerprint
  – Slap: 93.4% (L), 93.6%(R)
  – Thumbs: 91.6%
• Quality improves over time (learning curve)
Analysis & Interpretation

• Multiple modality improves FTE by 10 to 25x

• Quality is comparable to Western results
  – Diverse demographic
  – Effect of manual labor (FP)

• Good biometric obtainable from 5 yrs age

• Senior population difficult but still feasible

• Considering age specific algorithms – for Auth
IDENTIFICATION
Accuracy Methods

• Absolute
  – Traditional method - Ground truth is pre-determined

• Relative
  – Multi-Algorithm comparison and manual review
Biometric De-duplication Stage – Step 1 Insert

Oper <br>ator <br>Check <br>Inserts

ABIS API <br>Identify <br>E-Ph1 1 <br>E-Ph2 <br>E-Ph3 3 <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M

ABIS API <br>Identify <br>E-Ph1 1 <br>E-Ph2 <br>E-Ph3 3 <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M

ABIS API <br>Identify <br>E-Ph1 1 <br>E-Ph2 <br>E-Ph3 3 <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M <br>M M M

Insert 10G <br>Resident <br>Enrollment <br>Database

ABIS Solution 1 <br>ABIS Solution 2 <br>ABIS Solution 3
Biometric De-duplication Stage – Step 2 Identify

Operator Check → Inserts → Identify 50% 30% 20% → Aadhaar

Not-Duplicate 99.943%

ABIS Solution 1 → ABIS Solution 2 → ABIS Solution 3
Biometric De-duplication Stage

**Step 3 – Tool + Manual Adjudication**

Operator Check  →  Biometric De-duplication

- Insert
- Identify
  - 50%
  - 30%
  - 20%

Duplicate  →  Reject

Not-Duplicate  →  Aadhaar

ABIS API

**ABIS Solution 1**

Insert 10cr

Resident Enrollment Database

ABIS Solution 2

Insert 10cr

Resident Enrollment Database

ABIS Solution 3

Insert 10cr

Resident Enrollment Database
Multi ABIS Multimodal Results

- **FPIR**
  - Probe size: 4M

- **FNIR**
  - Probe size: 32,000
  - False accept: 11

- **FPIR**: 0.057%
- **FNIR**: 0.035%

@ Gallery = 84 Million

**NIST 7112 Ten FP Results**
- FPIR: 0.035%  @ Gallery= 1 Million

Multiple modality provides similar accuracy
For 100X larger gallery
Verified by Absolute Method

- Gallery: 130 Million
- 21,000 Demographically verified duplicates as probes
- FNIR: 0.0004%
  Note: These duplicates seemed to have better image quality to overall population

*Relative method produces comparable results*
Mixed and Anomalous Biometrics

• 40% of suspected duplicates
• Operator using their biometrics to help residents
• Mixed
  – Different persons in different attempts
  – New process eliminates them
• Anomalous
  – Different persons in an attempt
  – Problematic for ABIS doing sequential fusion
Lessons

• 10 to 100X improvement through 2 modalities

• Competitive advantage of using 3 ABIS & SDKs

• Continuous FPIR/FNIR measurements

• Possible to maintain low FPIR/FNIR over wide range of gallery size
References

• Enrollment:
  – [http://uidai.gov.in/UID_PDF/Front_Page_Articles/Documents/Publications/Aadhaar_ABIS_API.pdf](http://uidai.gov.in/UID_PDF/Front_Page_Articles/Documents/Publications/Aadhaar_ABIS_API.pdf)

• Verification:
  – [http://uidai.gov.in/images/FrontPageUpdates/aadhaar_authentication_api_1_5_rev2.pdf](http://uidai.gov.in/images/FrontPageUpdates/aadhaar_authentication_api_1_5_rev2.pdf)

• UIDAI Documents
ONE DOWN...

1.2 BILLION TO GO.

INDIAN ID Registration (Aadhaar)

1 B To GO
Thank You