Infant-Prints: Fingerprint Recognition of Infants

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http://biometrics.cse.msu.edu/

ID4Africa, June 19, 2019

Who is this Infant?

- **Authentication:** Is this the infant his parents claim him to be?
- **Search:** Have we seen this infant before?

Why Infant Identity?

Birth registry
Baby swapping
Vaccination
Nutrition

Vaccination Clinic

Food distribution

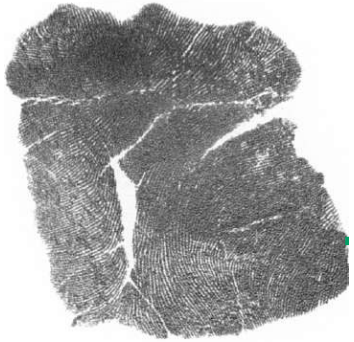
U.N. Sustainable Development Goal (16.9):

"By 2030, provide legal identity for all, including birth registration"

Biometric Recognition

- **ID Bands:** damaged or switched; 1 mistake in 1,000 baby transfers
- **Biometrics:** Automated recognition of infants from their biological traits

Which Biometric Trait?



Palmprint

Face

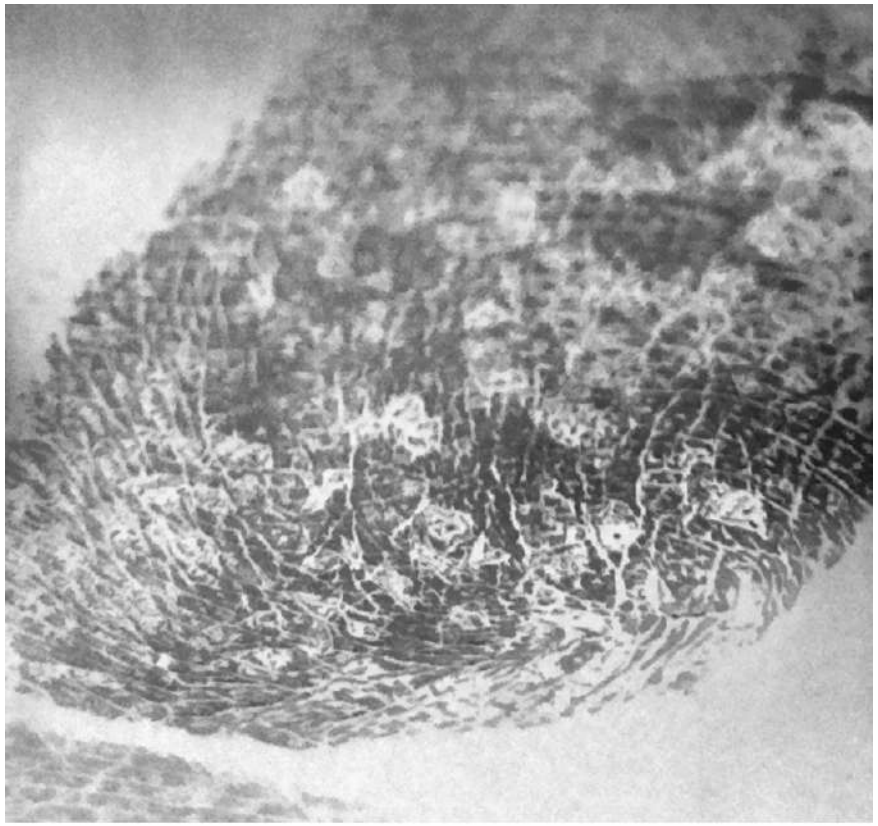
Iris

Fingerprint

Footprint or Ballprint

Permanence, uniqueness, ergonomic, throughput, low cost, lifelong usability

Why Fingerprints?



Day 1

Permanence
(Stable over time)

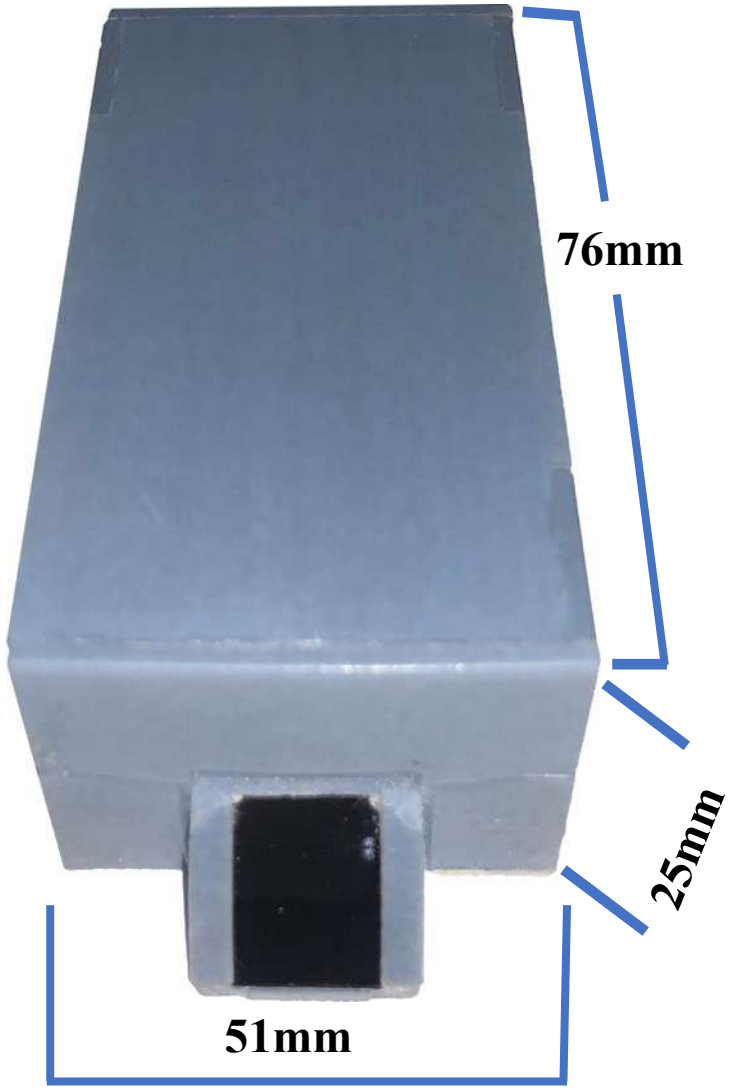
Uniqueness
(Distinct for each person)

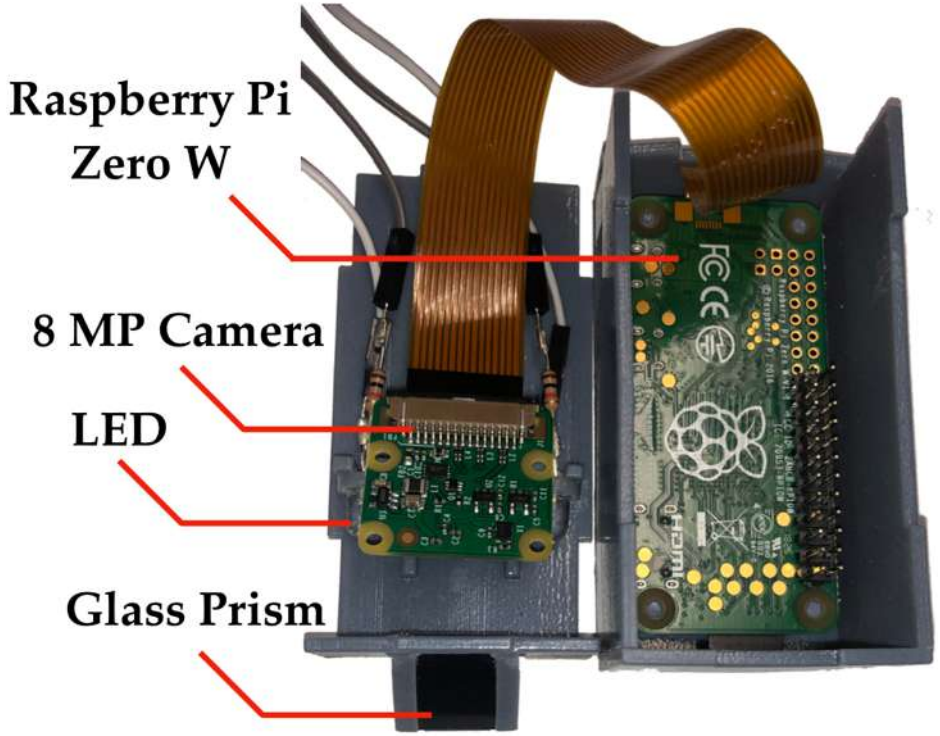
Portability, acceptability, cost
(Accessible to all)

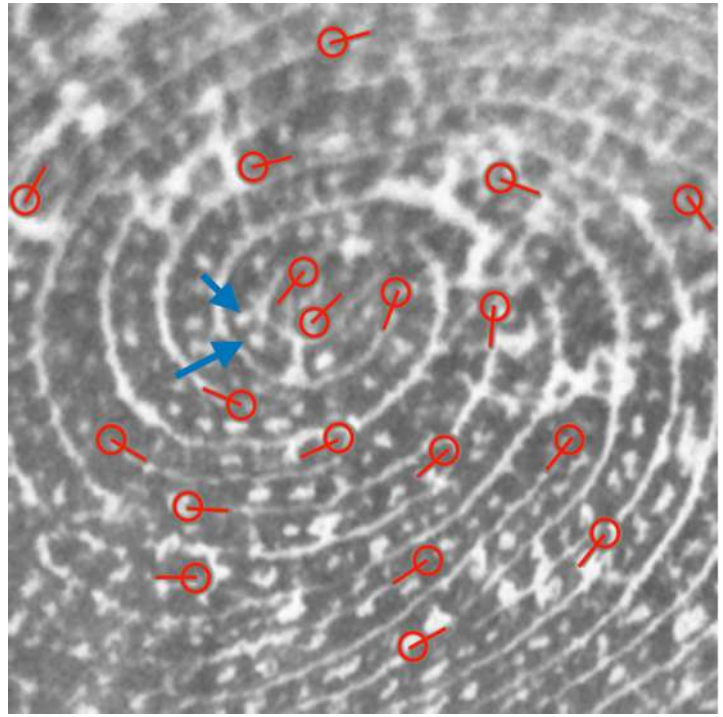
Challenges in Infant Fingerprint Recognition

- Motion blur and image distortion
- Small finger size
- Dry/wet/dirty fingers
- Small inter-ridge spacing (4-5 pixels) vs. (9-10 pixels) for adults

MSU Infant-Prints Reader



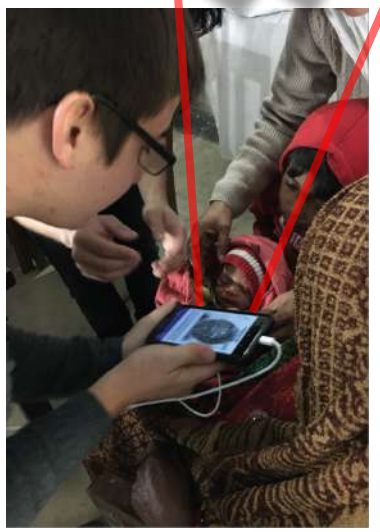




Reader: 1,900 ppi; cost: $85; assembly time: <2hours

Open source: *https://bit.do/RaspiReader*

MSU Infant-Prints In Action

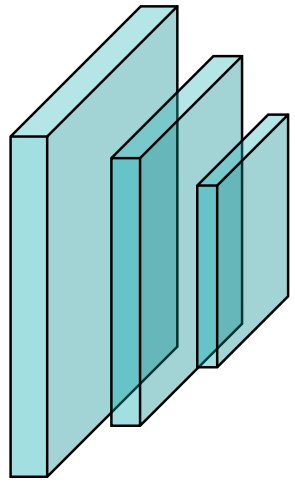


Fingerprint Capture

Infant-Prints App

1,900 ppi Image

Enhanced Image

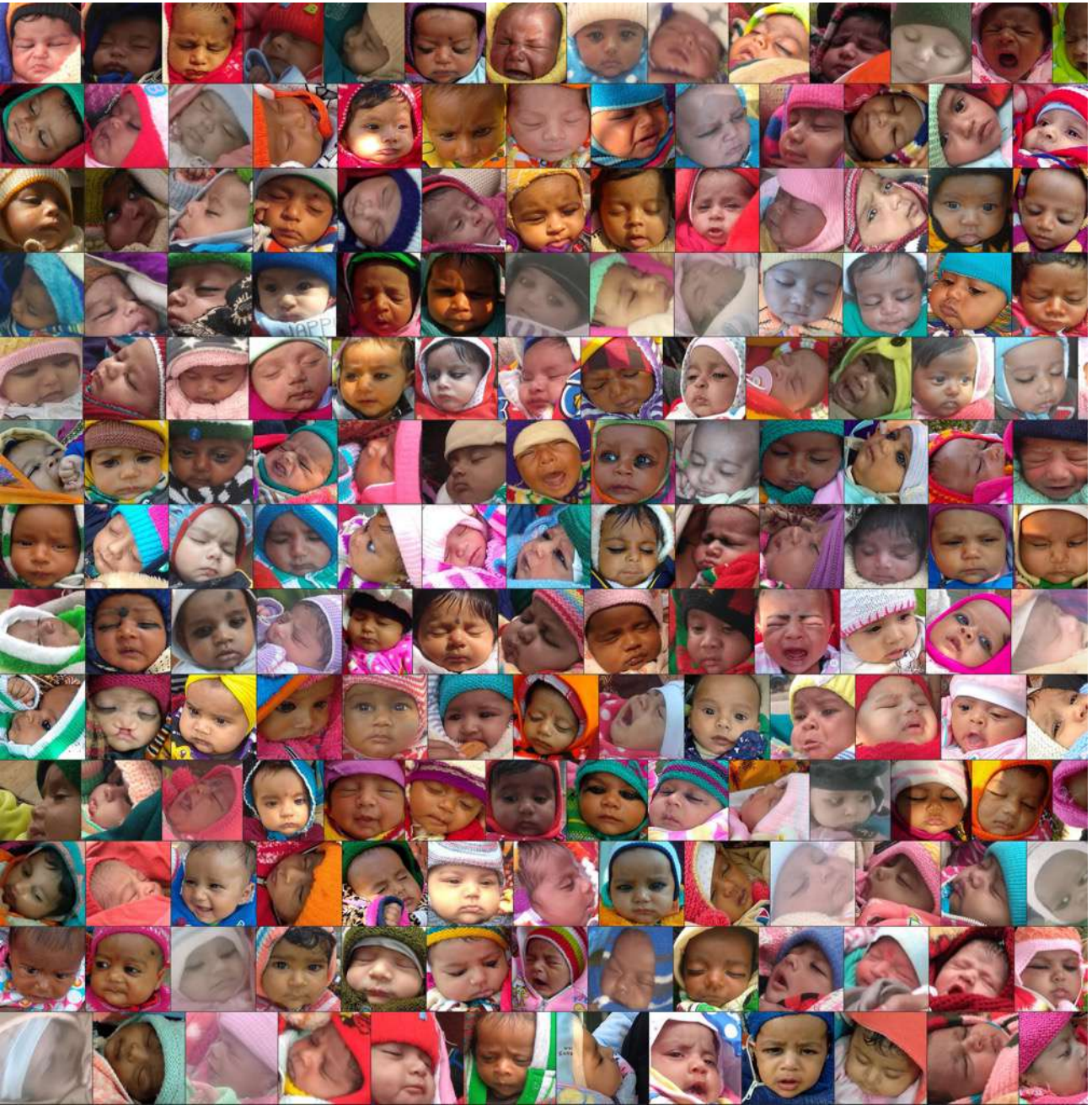


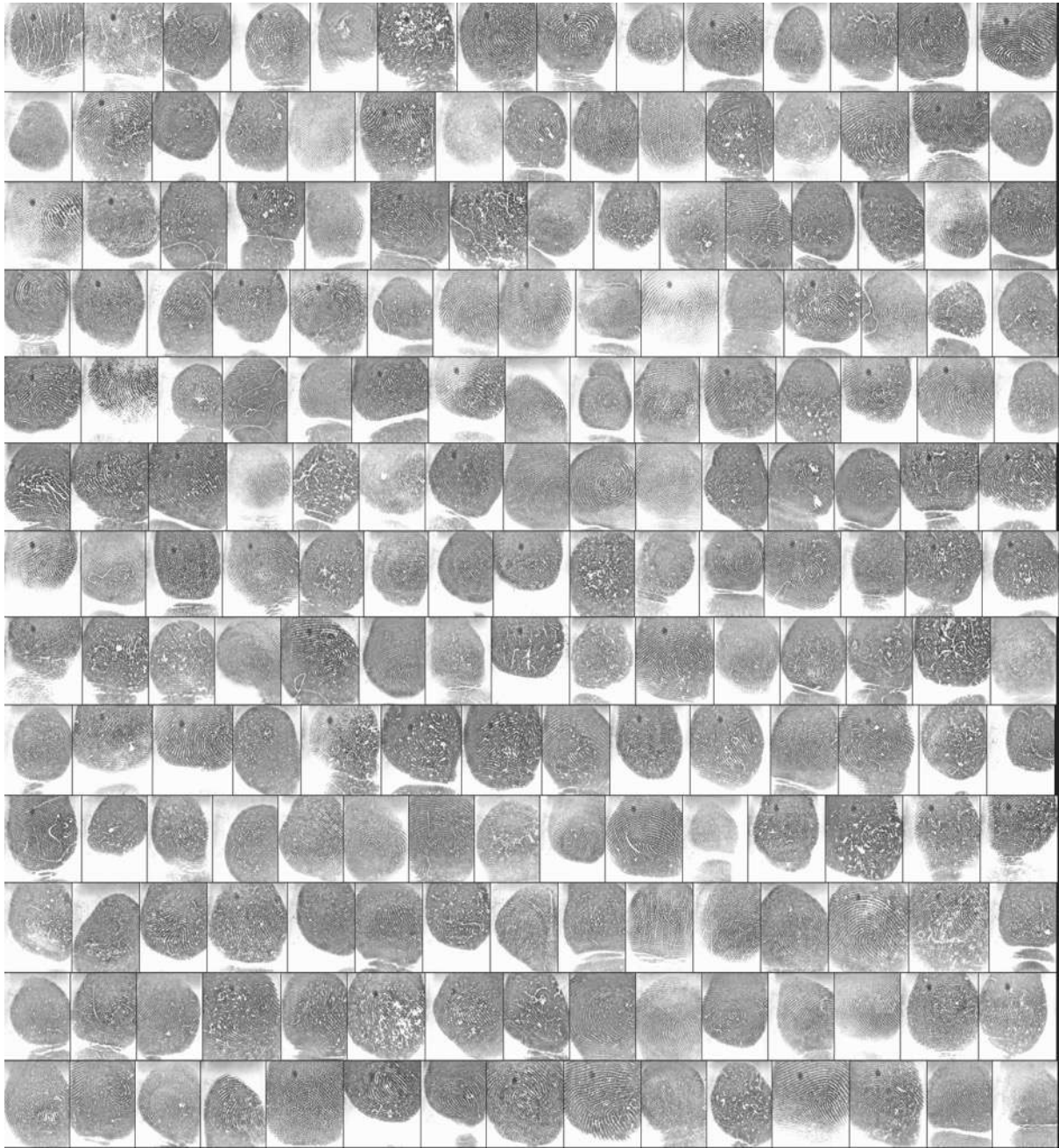
Fingerprint Matcher

Verify

Search

Our Dataset: 194 infants





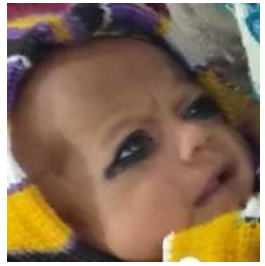
6 days

8 days

2 Months, 27 days

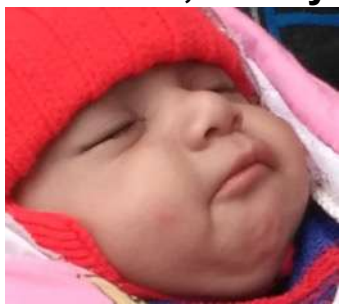
1 Month, 12 days

1 Month, 14 days



4 Months, 5 days

2 Months, 13 days



2 Months, 15 days

5 Months, 5 days

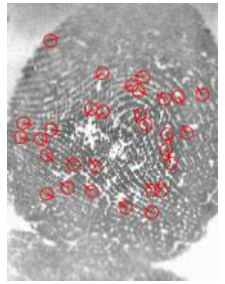
3 Months, 13 days

3 Months, 15 days

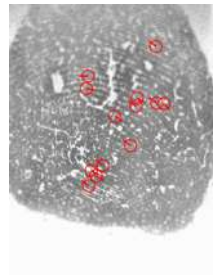
6 Months, 5 days

Longitudinal

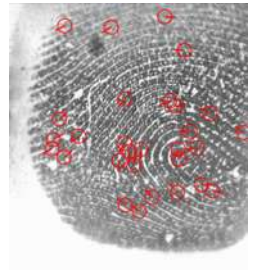
6 days



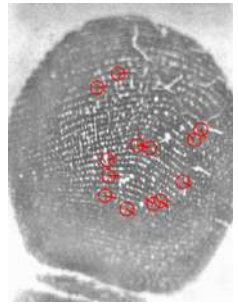
8 days



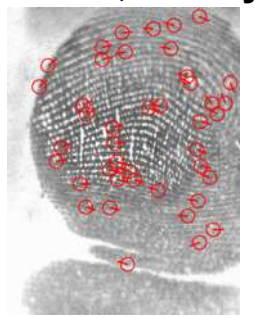
2 Months, 27 days



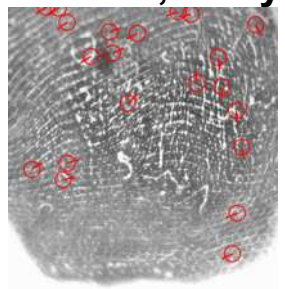
1 Month, 12 days



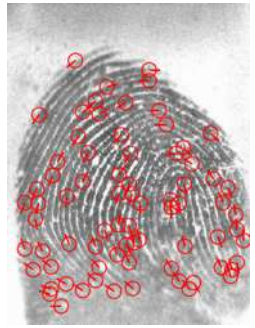
1 Month, 14 days



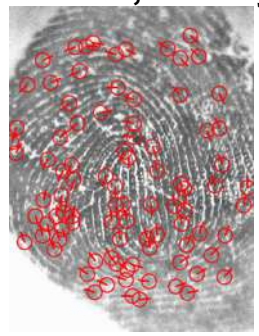
4 Months, 5 days



2 Months, 13 days

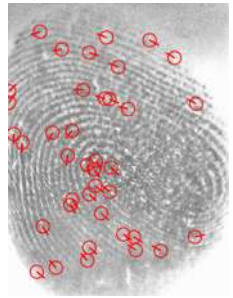


2 Months, 15 days

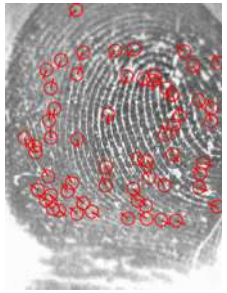


5 Months, 5 days

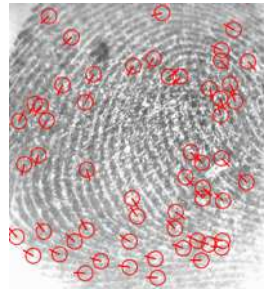
3 Months, 13 days



3 Months, 15 days

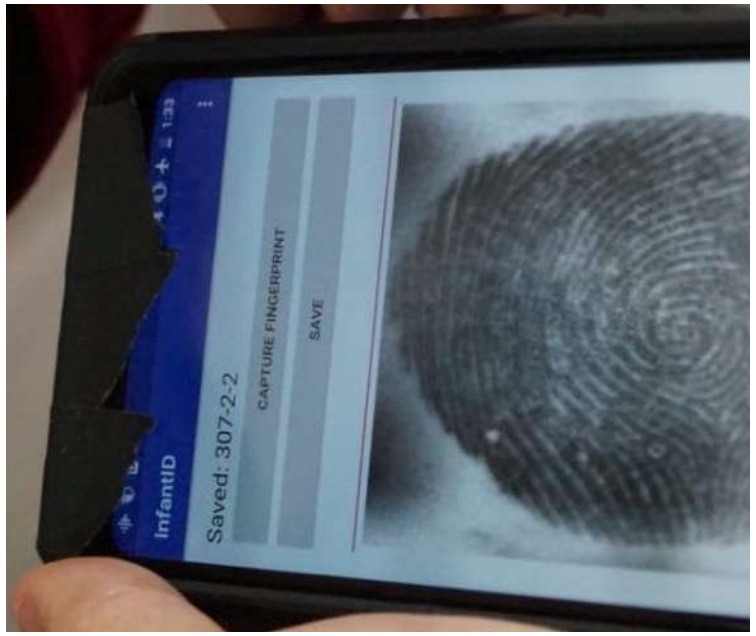


6 Months, 5 days



In-situ Evaluation:

Saran Ashram Hospital, Dayalbagh, Agra, India



Enrollment	0-3 Months	1-3 Months	2-3 Months
Left Thumb	59.0% (65.4%)	62.3% (69.6%)	76.5% (82.4%)
Right Thumb	55.8% (58.4%)	60.9% (63.8%)	68.4% (74.5%)
Thumbs Fused	66.7% (78.2%)	75.4% (85.1%)	90.2% (94.1%)

- **TAR @ FAR = 0.1% (1.0%)**
- **Authenticate after 3 months**
- **Fusion of 3 matchers**

Summary

- **Biometrics ensures reliable authentication of infants**
- **Fingerprint provides low-cost, acceptable, high-resolution solution for life-long identification**
- **MSU Infant-Print Reader: 1900 ppi, compact (25 mm x 50 mm x 75 mm), low-cost (US $85), open-source system for recognizing persons of *ALL* ages, including infants.**