

Fingerprints: Giving Child an Identity

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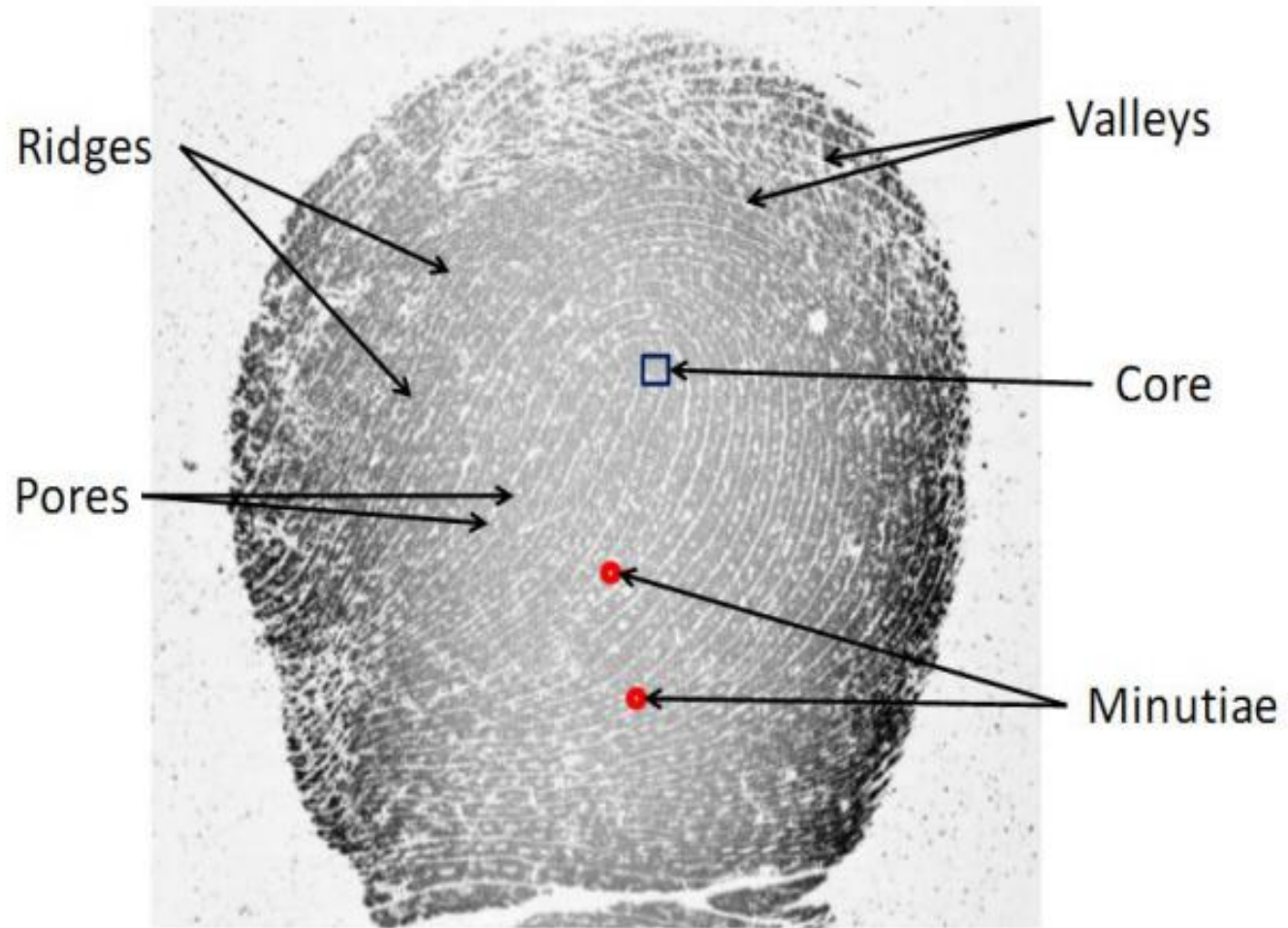
April 28, 2017



Six-hour Old Child



Six-hour Child's Fingerprint



1270 ppi NEC reader

Persistence of Biometric Recognition



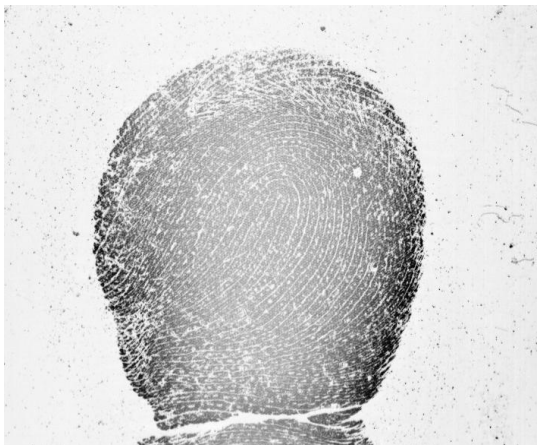
6 hours old



2 days old



3 months old



National ID



~25 million births per year in India

Vaccination



Vaccination camp in Benin

Food Distribution



~1 in 2 children undernourished in Bangladesh

Missing & Abducted Children

MISSING ALERT

Missing
BRUNO COUTURE
Missing: 2/18/2016 Age Now: 5
Missing From:
MIAMI SPRINGS, FLORIDA

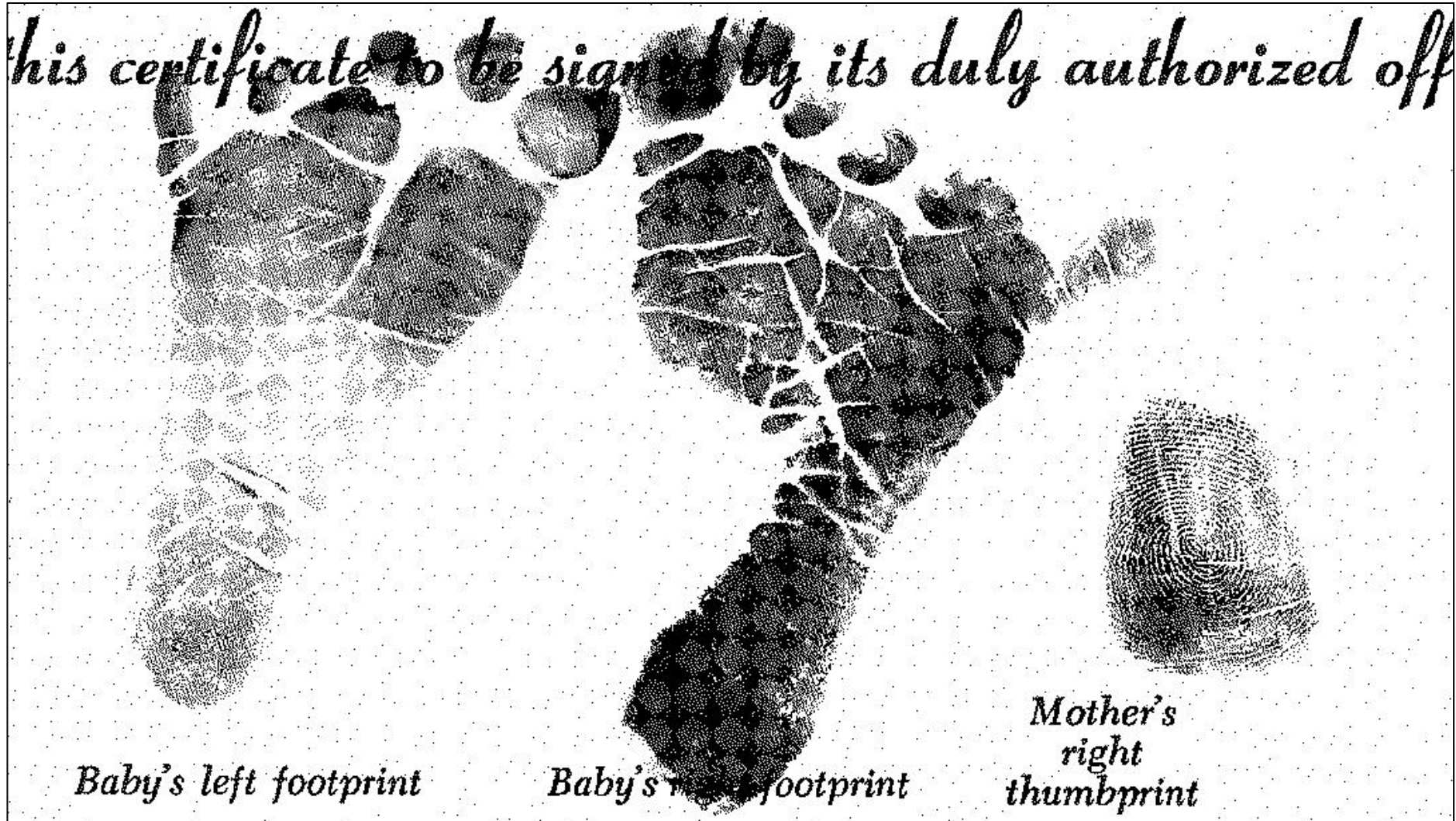
Both photos shown are of Bruno. He is biracial. Bruno is White and Hispanic. He may be in the company of his father. They may still be in Florida or they may travel to Canada.

ANYONE HAVING INFORMATION SHOULD CONTACT:
Miami Springs Police Department (Florida)
1-305-888-9711 or the National Center For Missing AND Exploited Children at 1-800-THE-LOST (1-800-843-5678)

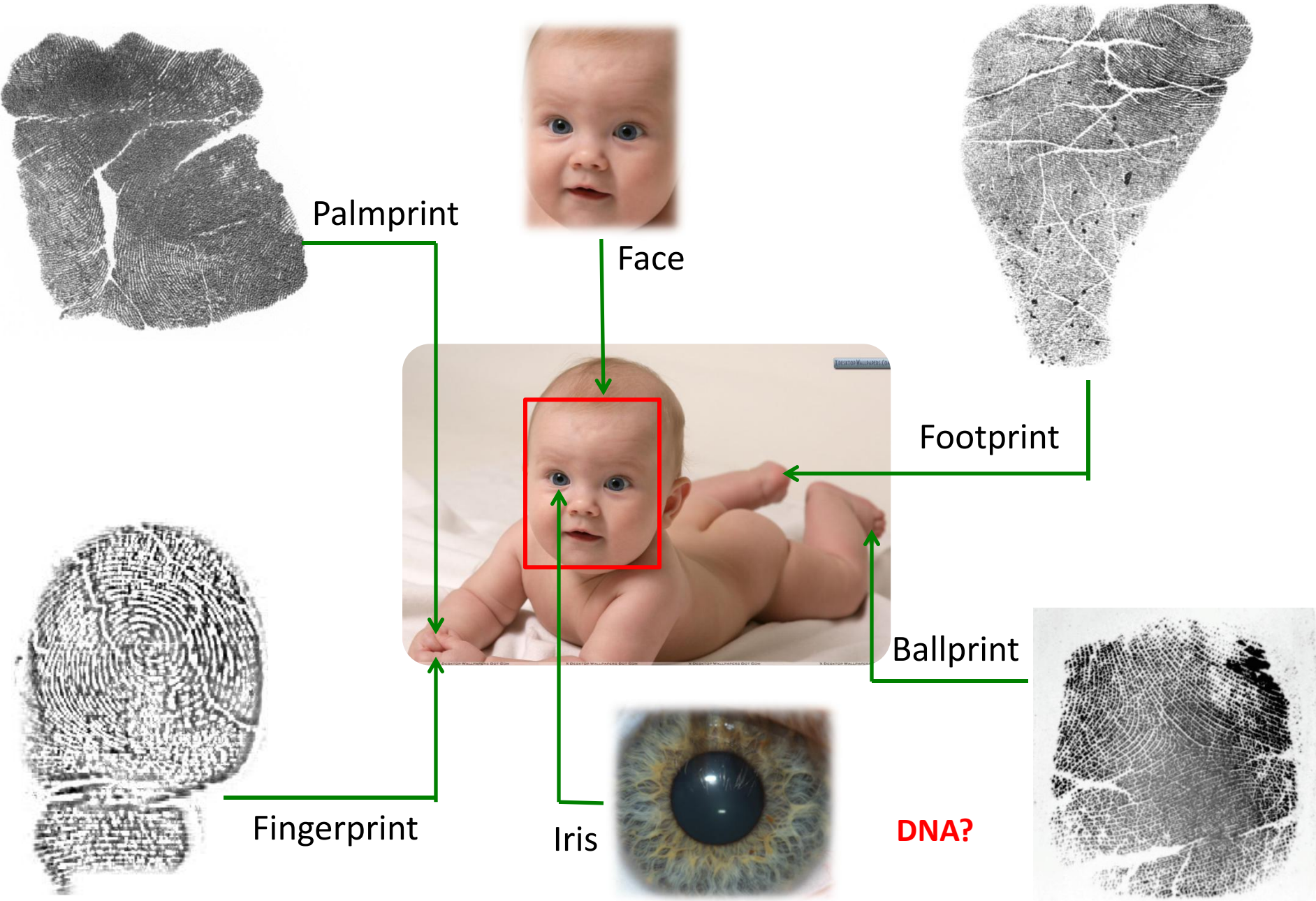
 

http://miamisprings.com/news_story.asp?storyid=441

Linking Child and Parent Biometrics



Biometric Traits



Which Biometric Trait?

Biometric trait	Ease of capture	Change over time	Parental concerns	Use cases
Face	Moderate (variation in illumination, expression, eyes closed)	Significant (facial aging)	Minor	ID documents, surveillance
Fingerprint	Relatively Easy (operator holds child's finger)	Minor	Moderate	Forensics, national ID, immigration
Iris	Difficult (child sleeping, crying)	Minor	Major (infrared illumination, obtrusive capture)	Immigration, national ID, refugees
Footprint	Difficult (dirty feet, socks and shoes)	Not known	Minor (used in U.S. hospitals)	Few
Palmprint	Difficult (fist closed, concavity in palm)	Minor	Moderate	Moderate

Objectives of This Study

- Feasibility of child recognition via fingerprints
- Conduct longitudinal study



Age: 16 months



Mar. 2015
16 months



Sept. 2015
22 months



Jan. 2016
26 months



Mar. 2016
28 months

Fingerprints from 500 ppi Digital Persona Reader

Longitudinal Fingerprint Collection



March, 2015; Sept. 2015; Jan. 2016; March 2016

Mar. 2015
(6 months)

Sept. 2015
(12 months)

Jan. 2016
(16 months)

Mar. 2016
(18 months)

Face



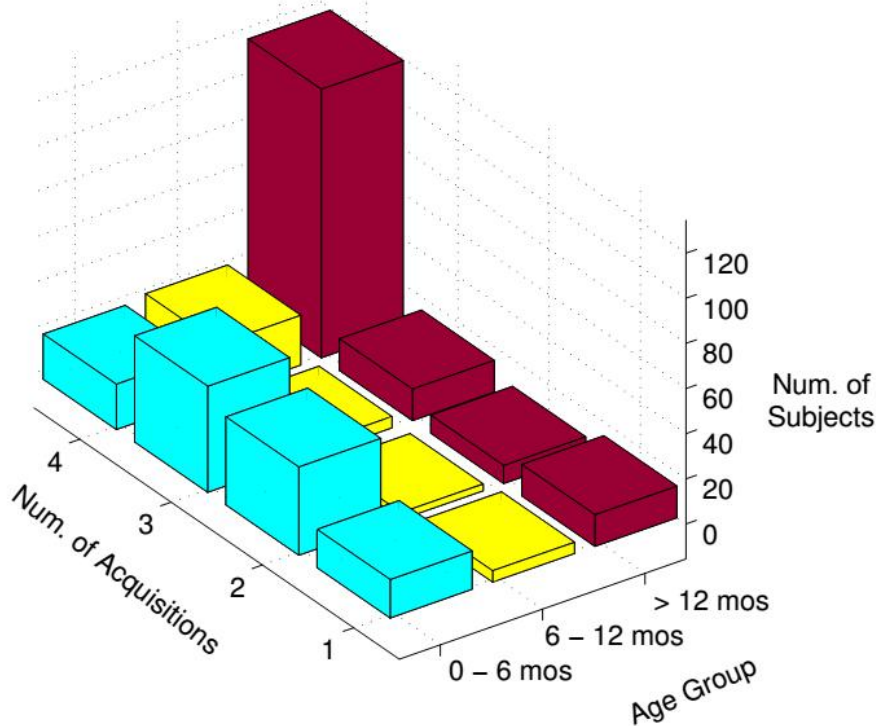
Right
Thumb
500 ppi



Right
Thumb
1,270 ppi



Longitudinal Fingerprint Database



- 3 prints/thumb/session
- 3 face images/session
- 309 children in total
- 161 came to all 4 sessions

Subset	First Session	# Subjects (males)	Age Range (median age)	# Ret. Sess. 2	# Ret. Sess. 3	# Ret. Sess. 4	Time Lapse (ΔT)
Subset A	1 (Mar. 2015)	204 (95)	0-5 (2.0) yrs	167	180	178	12 mos
Subset B	2 (Sep. 2015)	65 (33)	0-42 (6.1) weeks	<i>n.a.</i>	52	50	6 mos
Subset C	3 (Jan. 2016)	40 (18)	0-42 (7.6) weeks	<i>n.a.</i>	<i>n.a.</i>	30	2 mos

Fingerprint Comparison: Same Finger



12 months of age



24 months of age

Input fingerprints

Fingerprint Comparison: Same Finger



12 months of age



24 months of age

Enhanced fingerprints

Fingerprint Comparison: Same Finger



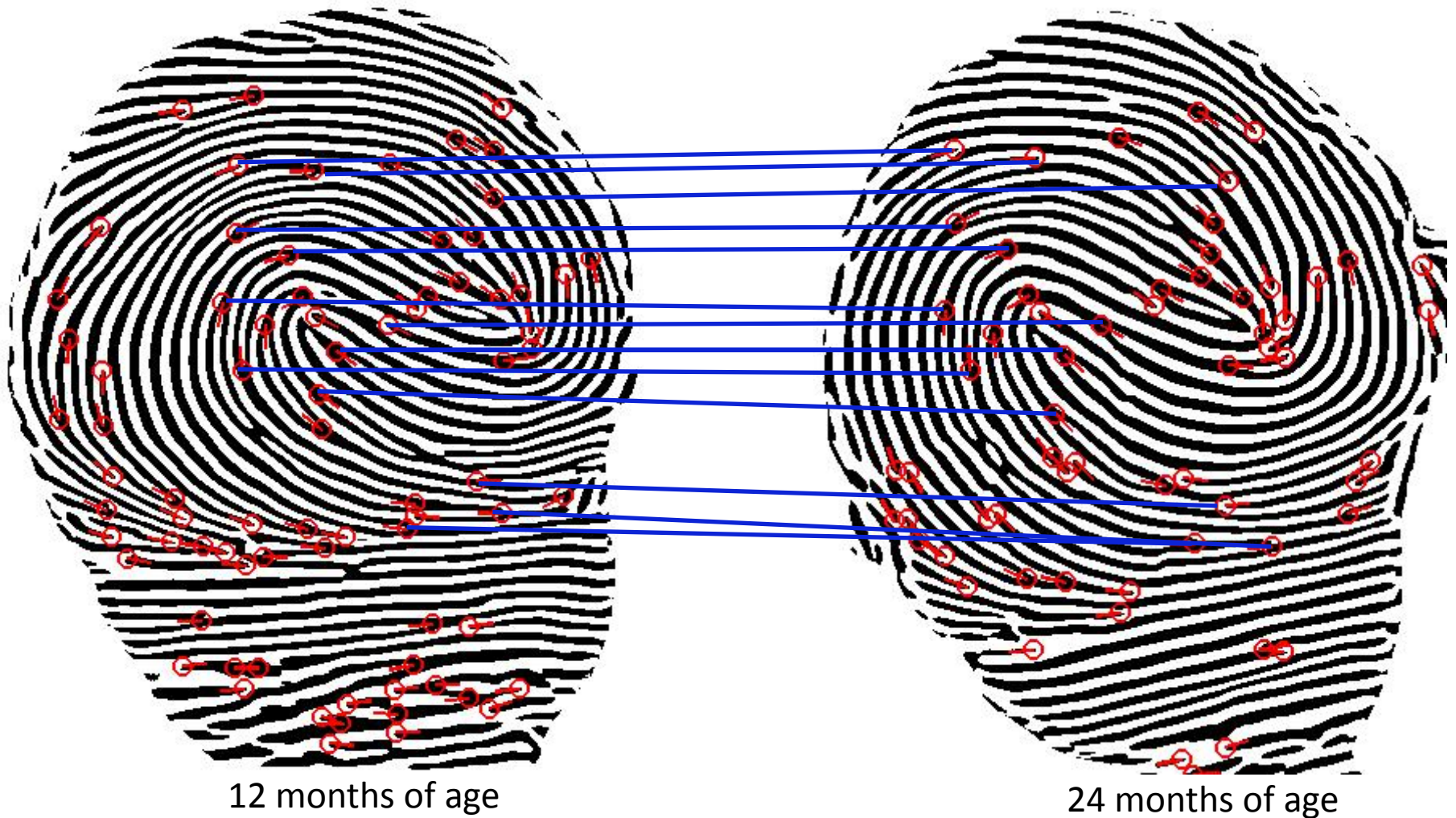
12 months of age



24 months of age

Minutiae points

Fingerprint Comparison: Same Finger



Minutiae correspondences

Score = 9999

Fingerprint Comparison: Different Fingers



Minutiae correspondences

Score = 0

Experimental Results: Verification

- 500 ppi reader: Age at enrollment > 12 months
 - **~100% accuracy over 12 months time gap**
- 1270 ppi reader: Age at enrollment > 6 months
 - **~98.9% accuracy over 6 months time gap**

A. K. Jain, S. S. Arora, K. Cao, L. Best-Rowden and A. Bhatnagar, "Fingerprint Recognition of Young Children", *IEEE Transactions on Information Forensics and Security* 2017

Fingerprint Image Quality

**Good
Quality**

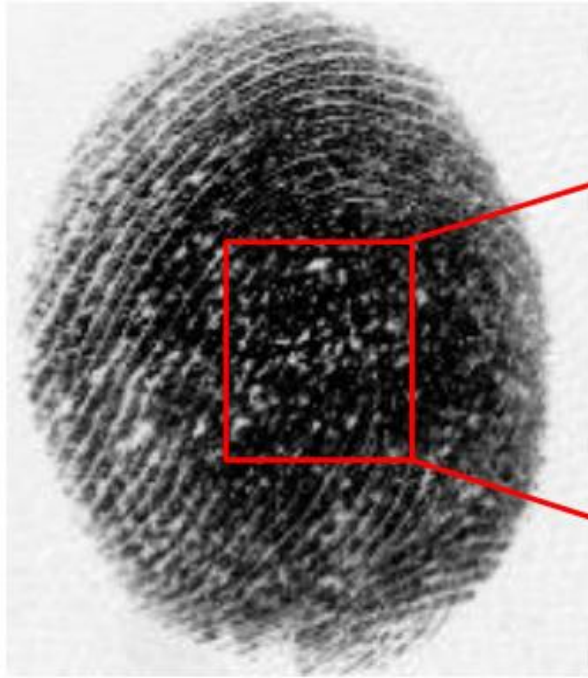


**Poor
Quality**



Fingerprints of two 6 month old children collected using 500 ppi sensor

Fingerprint Image Resolution



DP U.are.U 4500 (500 ppi)



NEC Zakuro (1270 ppi)

6-week old child

Contributions

- First longitudinal fingerprint study for children
- Fingerprints of ~300 children in age group [0, 48] months, collected over 12 months, showed
 - **Children can be recognized with 99% accuracy when age at first enrolment is > 6 months**
- Future work:
 - Repeat study over longer durations
 - Develop low cost, compact, high resolution reader
 - Design robust and accurate fingerprint matcher
 - Operator training for fingerprint capture

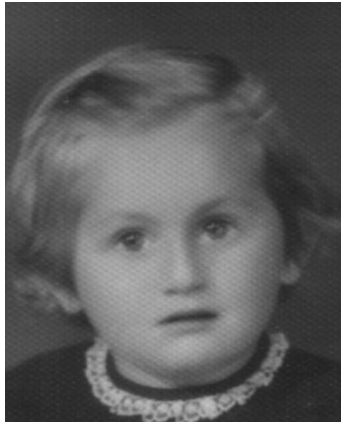
Identity for Life



Age: 2 ... 7 ... 13 ... 17 ... 19 ... 25 ... 27 ... 34 ... 41 ... 45 years old

Images from FG-NET Database

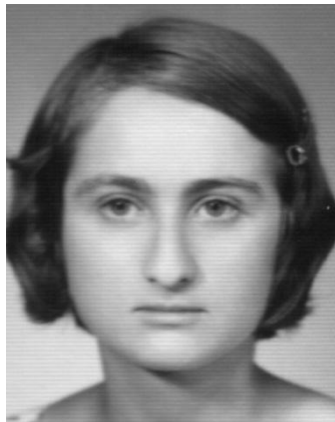
Identity for Life



2



7



13



17



19



25



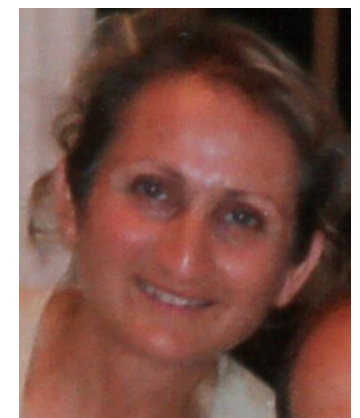
27



34



41



45

Images from FG-NET Database