Recognizing Infants and Toddlers using Fingerprints: Increasing the Vaccination Coverage

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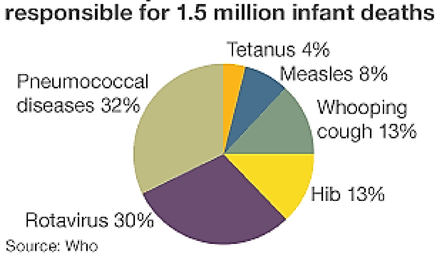
Introduction

- ~1.5 M children (<5 years old) die every year from vaccine preventable diseases



- Sub-saharan Africa and South Asia together account for 4 out of every 5 deaths

Universally recommended immunization schedule for infants by UNICEF

- *"Vaccine wastage rates are higher than 50% in some of the most challenging geographies. For every $100 in new vaccines purchased, $50 will never go into the arm of a child in need."*
  - VaxTrac

The Big Question

Can fingerprints, or, for that matter any other biometric modality, be used for tracking vaccination schedule of children (0-4 years)?

Capturing Fingerprint Images

Challenges

- Semi to non-cooperative subjects
- Oily/wet finger skin
- Small finger size

Desirable sensor characteristics

- Portability
- Usability
- Fast capture speed

Data Collection

- Digital Persona U.are.U 4500 (500 ppi) optical fingerprint reader

(a) (b)

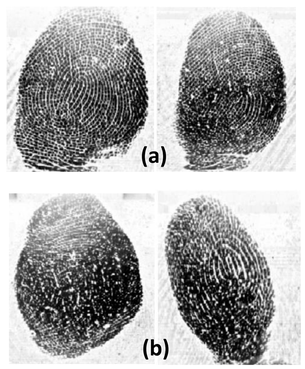
Fingerprint capture of (a) a five month old infant in East Lansing, and (b) a two month old infant in Benin

Database	East Lansing	Benin
# Subjects	20	70
# Sessions	5 (one week apart)	1 (two different health clinics)
# Fingers	4 (left and right index and thumb)	2 (left index and thumb)
# Impressions	4	3
# Total Images	1600	420

Details of the fingerprint databases collected in East Lansing and Benin

Sample Fingerprint Images

- **Subject Age: 4 months**
- **East Lansing data**



- **Subject Age: (a) 4 months (b) 5 months**
- **Benin data**

Benin: The real challenge

- High temperature and humidity
- Open air clinics
- Most subjects < 6 months old

Mothers wait to get their children vaccinated in a health clinic in Benin

A healthcare worker fingerprints an infant

Matching Fingerprint Images

Matching Challenges

Poor Quality | **Difficulty in feature extraction**

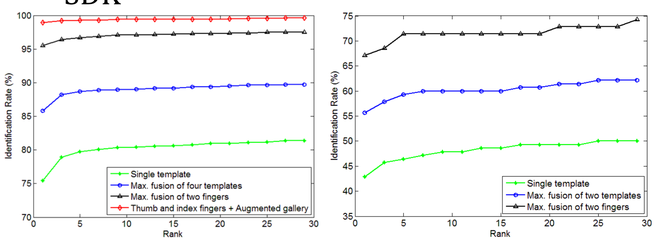
Large non-linear distortion | **Variations in finger skin condition**

Proposed Matching Strategies

- Up-sample the fingerprint image
- Capture multiple impressions per finger
- Fuse matching results of two fingers
- Update the gallery by including fingerprint impressions captured in all previous sessions

Results

- Latent SDK performs better than tenprint SDK



(a) (b)

CMC curves for (a) East Lansing, and (b) Benin data using a latent SDK (background database ~32k infant fingerprints)

Current Focus and Next Steps

- Explore alternative capture methods
- Collect longitudinal operational data