ID4Africa 2019

Spotlight on
Infant Biometrics

By

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1. Overview

The ID4Africa 2019 special session on Infant Biometrics fielded a diverse set of experts from academia, industry, and government agencies to speak on the motivations, challenges, and solutions for automated identification of infants. Anil K. Jain, University Distinguished Professor from Michigan State University, began the session by highlighting the life-saving importance of developing fast, reliable, accurate, and affordable infant identification systems. Subsequently, speakers Joshua Engelsma (Michigan State University), Yaseen Moolla (CSIR, South Africa), Eliah Aronoff-Spencer (UCSD), Paul Macharia (Ministry of Health, Kenya), and Barbara Iyayi (Element Inc.) presented their respective team's research and solutions.

2. Motivation

Jain noted in his opening remarks that every second, 4 new babies set foot on the planet. Lamentably, the mortality rates per 1,000 children remain incredibly high (as much as 49 per 1,000 in some low-income countries). Other speakers expounded on these statistics, mentioning the difficulty in providing adequate vaccinations and nutritional supplements to children due to a lack of reliable and accurate identification methods. The consensus among speakers was that biometric recognition of infants would provide a more reliable, longitudinal, accurate, and affordable solution for infant identification and subsequent caregiving than traditional (paper-based) identification methods.

3. Requirements

Jain concluded his opening remarks by highlighting the need for infant identification methods to be designed while being aware of (1) persistence and uniqueness (can this biometric trait recognize the infant over time?), (2) compatibility with legacy systems, (3) ergonomics (is this system easy to use by health-care workers and acceptable to both mothers and infants?), (4) throughput (can we recognize this infant in a timely manner?), and (5) low-cost. Aronoff-Spencer confirmed the necessity of a "human-centered" design, which could longitudinally recognize children in a manner that was compatible with legacy recognition systems. Engelsma spoke about the different biometric traits which could be used for infant identification (including fingerprint, footprint, palmprint, face, and iris). He spoke about the considerations which need to be made in selecting a biometric trait for infants (permanence, collectability, and cost). In a similar manner, Moolla described reasons for selecting various traits for their multimodal biometric system. There was a general consensus among speakers that fingerprint was the most promising biometric, however, Iyayi and Moolla also spoke about the value of multi-modal biometric systems, where multiple physical traits could be used to recognize the infants.

4. Technical Solutions

The general consensus among the speakers was that the technical solutions necessary for infant identification needed to be high-resolution (to capture the minuscule physical traits of infants) and ergonomically designed to quickly capture high quality images from uncooperative infants. Several speakers spoke about conducting data-collection in a rural setting and the difficulty of collecting infant fingerprints without specially designed devices.

Discussion also followed on the importance of collecting the data and performing authentication in a very timely manner, given the long line of mothers at various clinics waiting in intense heat. Most agreed that the collection and authentication needed to happen in less than a minute of time.

Speakers diverged in their respective technical solutions aimed at tackling infant identification. What follows is a concise summary of each team's technical approach:

- **Engelsma:** A low-cost (< $100), 1900 ppi, ergonomic, contact-based, open-source fingerprint reader combined with a high-resolution fingerprint matcher.
- **Moolla:** A high-resolution, contactless fingerprint reader for infant fingerprint recognition. This system was supplemented by other traits (ear and iris) for improved recognition accuracy.
- **Aronoff-Spencer:** A 3500 ppi, ergonomic, contactless fingerprint reader, combined with off-the-shelf fingerprint matching algorithms.
- **Macharia:** A 2400 ppi, contact-based fingerprint reader combined with off-the-shelf fingerprint matching algorithms.
- **Iyayi:** Multi-modal biometric recognition of infants (palm, ear, foot) using only a smartphone camera for sensing and deep learning techniques for matching.

5. Conclusions

Several teams presented very promising results, on infant identification, obtained in an in-situ longitudinal study. In particular, they showed that they could enroll an infant's fingerprints and still recognize them months later. It remains difficult to gauge where state-of-the-art in infant fingerprint recognition sits without a more standard evaluation on benchmark datasets by a third party such as a government agency specializing in measurement science, (e.g. the United States National Institute of Standards and Technology).

The results that were presented are encouraging so far as they seem to suggest state-of-the-art in the field has been pushed forward over the last 5 years. However, each team still faces technical challenges moving forward (such as peeling skin on a newborn's fingerprints, fingerprint distortion, timely capture / authentication, longitudinal recognition accuracy, and durability of the systems during field deployment). With continued research in this area, accurate and reliable biometric identification of infants seems a likely possibility in the near future.

6. Further Reading

- https://arxiv.org/pdf/1904.01091.pdf
- https://ieeexplore.ieee.org/document/8703520
- https://gatesopenresearch.org/articles/3-1477
- https://www.nec.com/en/press/201906/global_20190620_01.html
- https://www.discoverelement.com/