Fingerprint Match in Box

Biometrics: Theory, Applications, and Systems (2018)

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Motivation

- Address fingerprint recognition system limitations…
- Keep cost low
- Make systems which are easy to customize

(gelatin)   (wood glue)

(1) Spoofing Vulnerabilities

3-month-old thumbprint (500 ppi)
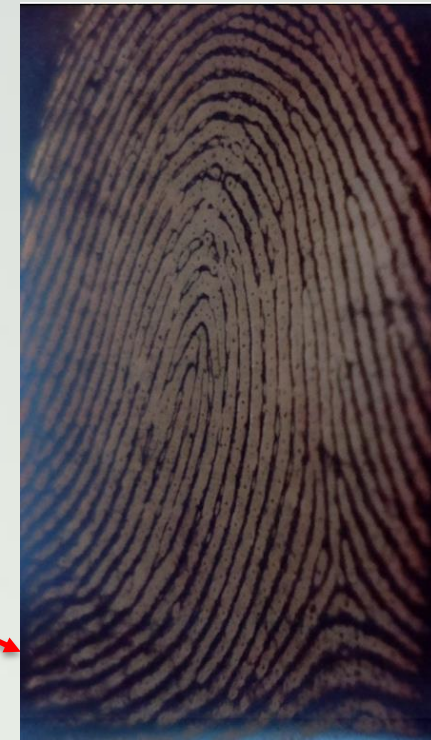
(2) Insufficient Infant Resolution

(3) Limited Portability

Previous Work: RaspiReader

direct image

raw FTIR image

RaspiReader internals: Dual camera, ubiquitous components ($175 USD)

J.J. Engelsma, K. Cao, and A.K. Jain, 2018. RaspiReader: Open source fingerprint reader. *IEEE transactions on pattern analysis and machine intelligence.*
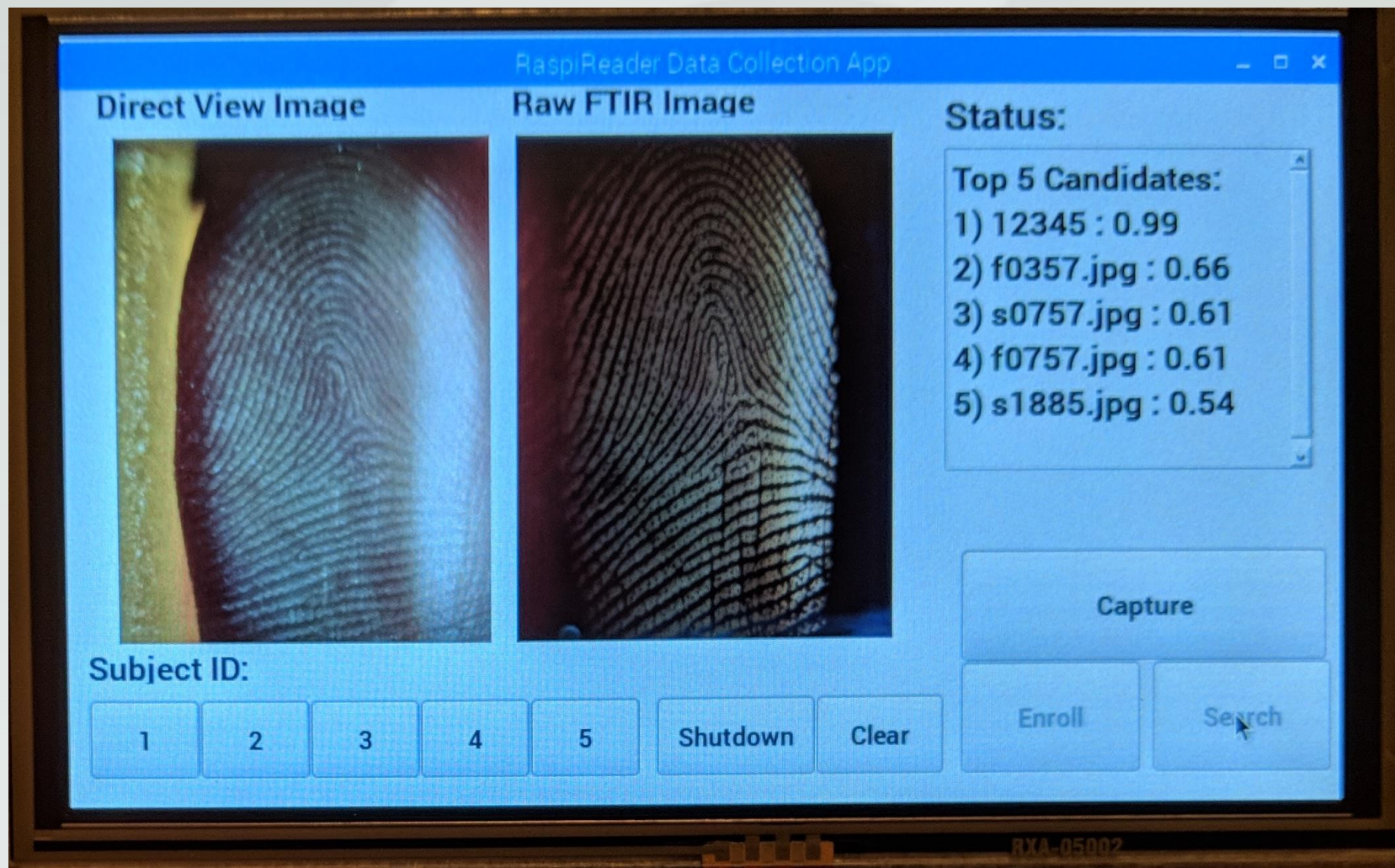
Fingerprint Match in Box

- Improve RaspiReader core functionality

- Make RaspiReader portable, end-to-end system
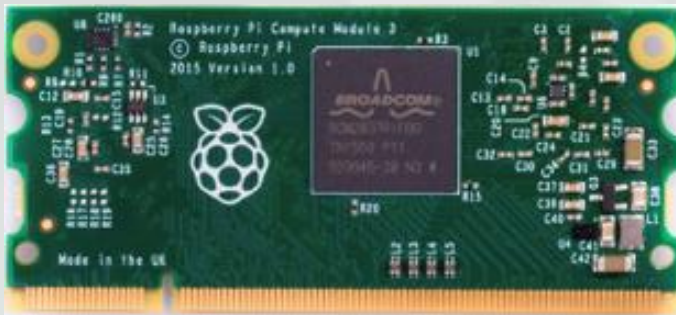
- Spoof detection and matching on-device
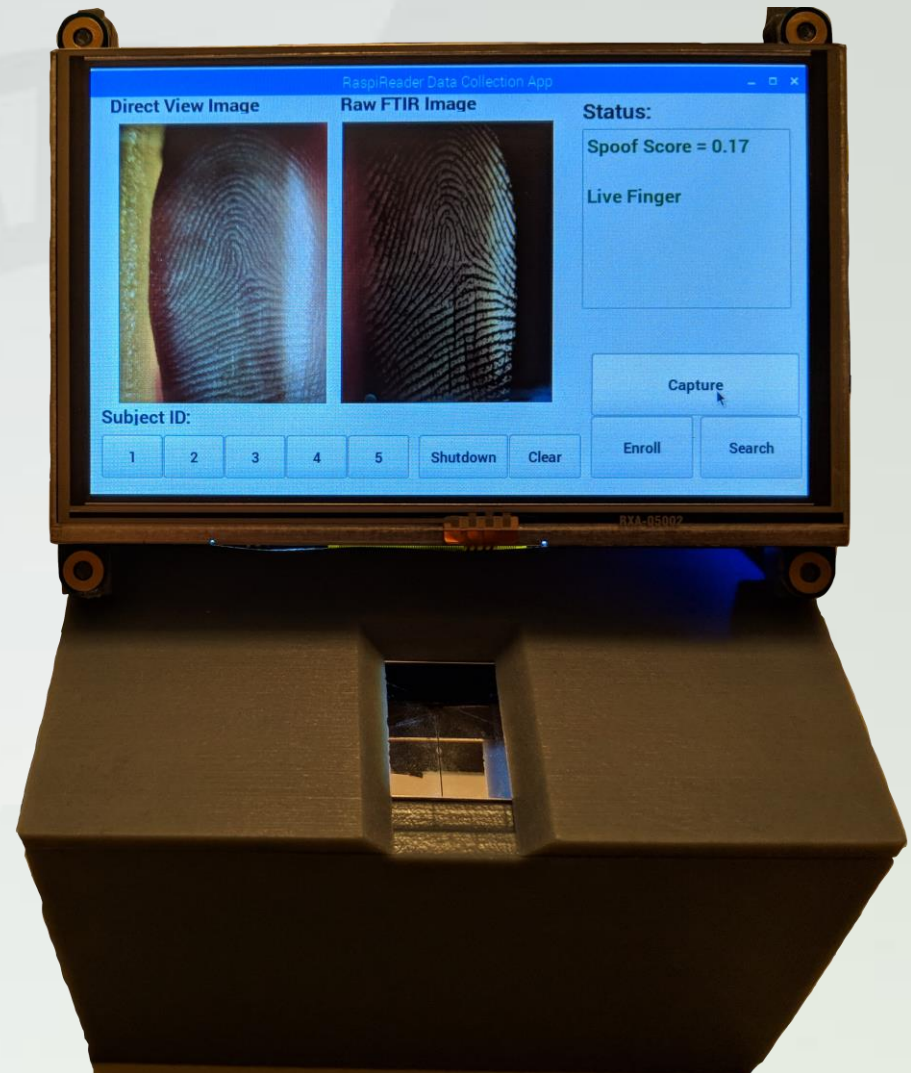
100 mm x 120 mm x 80 mm

Match in Box Functionality

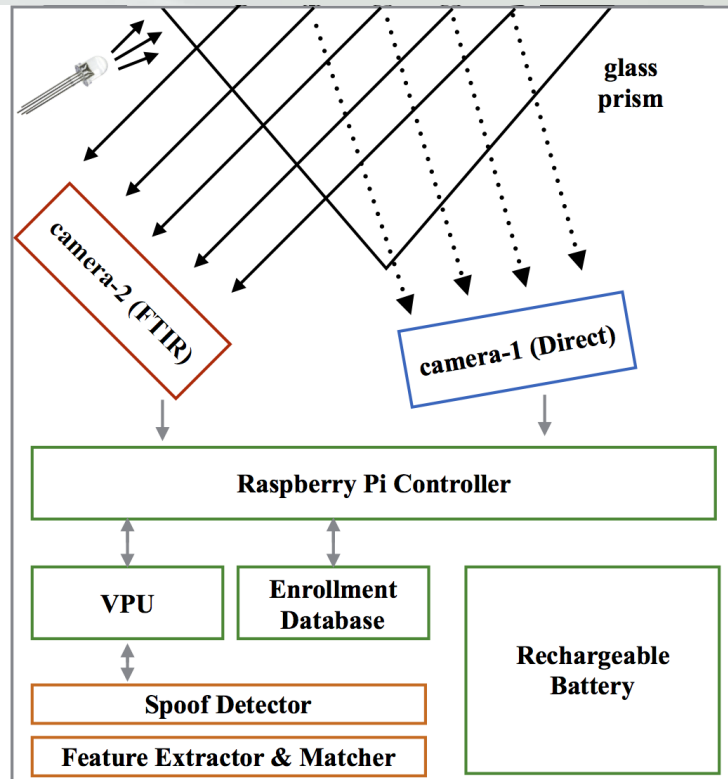(1) Capture Fingerprint, (2) Search 12345

Methods

- Low cost, ubiquitous hardware (Raspberry Pi Processor, Intel Neural Compute Stick)

- 3D print case (STL files are open sourced)

Raspberry Pi Processor

Intel Neural Compute Stick

glass prism

camera-2 (FTIR)

camera-1 (Direct)

Raspberry Pi Controller

VPU	Enrollment Database

Rechargeable Battery

Spoof Detector

Feature Extractor & Matcher

Schematic Diagram

Total cost ranges from $50 - $200 depending on requirements
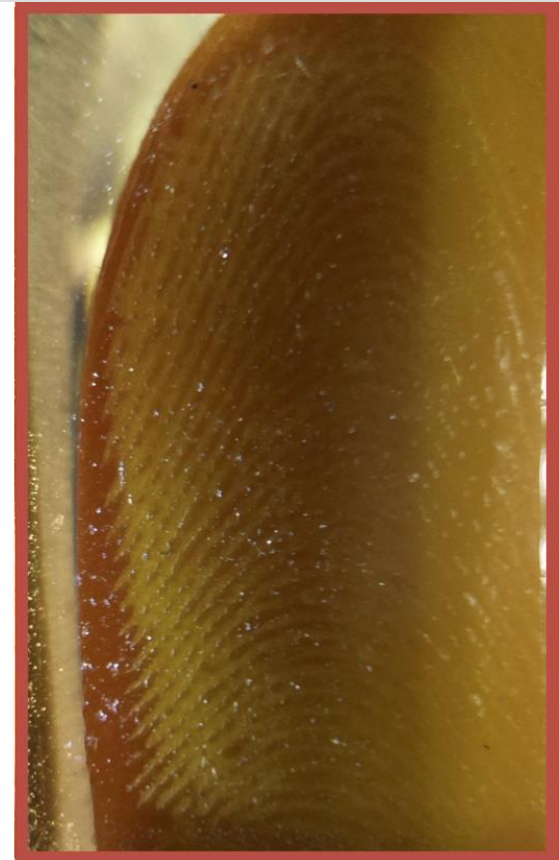
Spoof Detection Results

MSU PAD Dataset

Class	# Train	# Test
Live	2240	560
Spoof	1768	443

TDR = 98.5% @ FDR = 0.2%

speed: 120 milliseconds

(a) **(b)**

An additional camera enables direct-view imaging of (a) live fingers or (b) spoof fingers with highly discriminative PAD information.

Matching Results

MSU Matching Dataset

# Fingers	#Total Impressions
560	2800

Verification:
TAR = 98.0% @ FAR = 0.01%

Rank 1 Identification:
99.1%

Match in Box Speed

Feature Extraction	Matching
1.6 seconds	12 milliseconds

False Reject due to non-overlapping friction ridge area

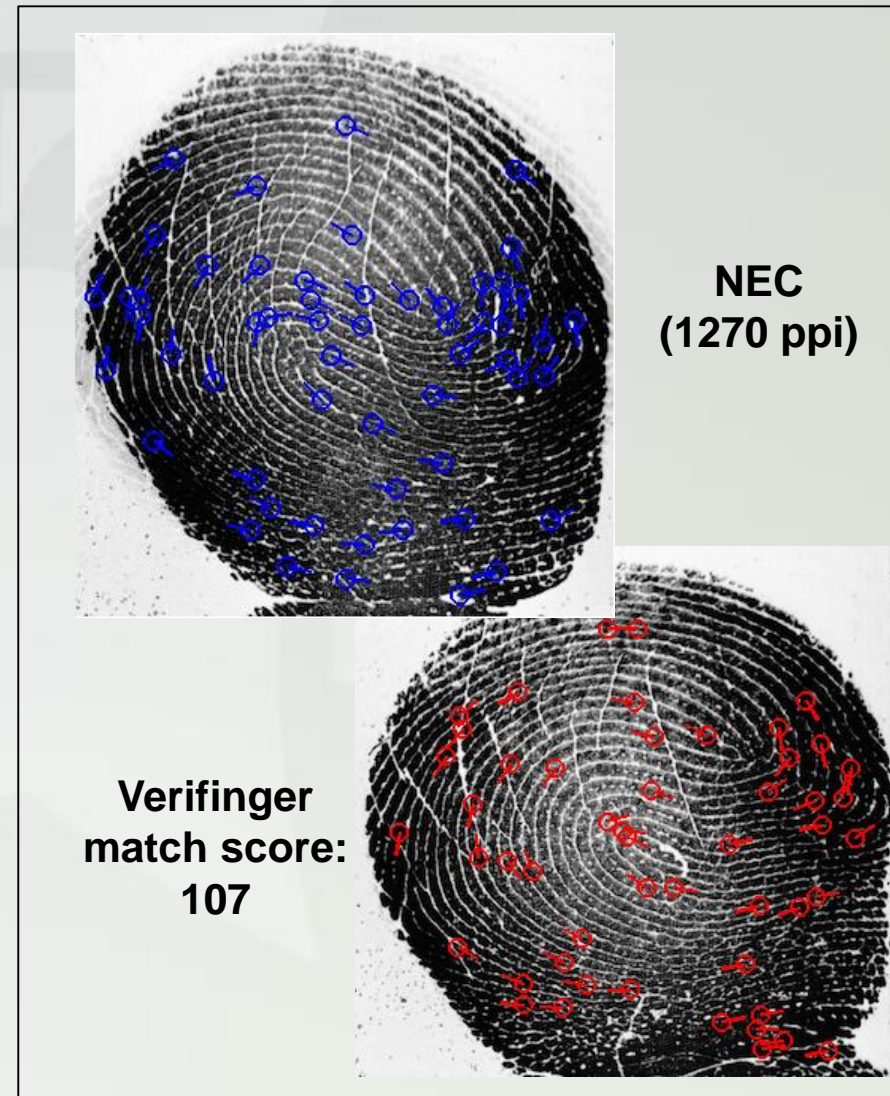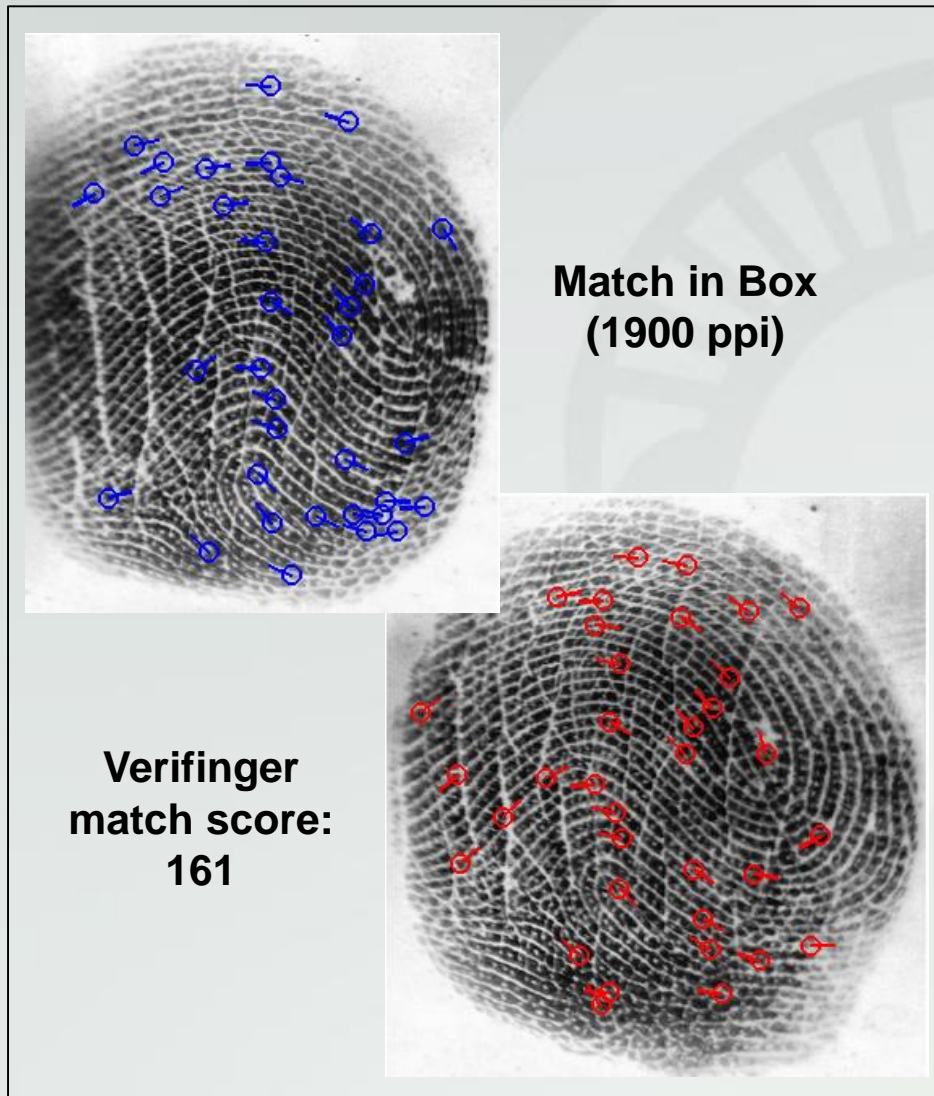**False Accept due to very similar friction ridge pattern**

High Resolution Infant Fingerprints

(i) Digital Persona U.are.U (500 ppi)   **(ii) Custom NEC Reader [1] (1270 ppi)**   **(iii) MSU Match in Box (1900 ppi)**

Fingerprint images of the right thumb of a 3 month old infant captured with (i) the 500 ppi Digital Persona U.are.U 4500 HD, (ii) a custom, NEC designed, 1270 ppi fingerprint reader for neonate fingerprint acquisition [1] and (iii) our 1900 ppi Match in Box.

[1] A. K. Jain, S. S. Arora, K. Cao, L. Best-Rowden, and A. Bhatnagar, "Fingerprint recognition of young children," IEEE Trans. Information Forensics and Security, vol. 12, no. 7, pp. 1501–1514, 2017

Infant Fingerprint Matching

**Match in Box
(1900 ppi)**

**Verifinger
match score:
161**

**NEC
(1270 ppi)**

**Verifinger
match score:
107**

Verifinger threshold = 33 @ FAR = 0.01%

Future Work

- Further reduce the size and cost of Match in Box

- Conduct a field study in India; collect fingerprints of infants over time with Match in Box

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