RidgeBase: A Cross-Sensor Multi-Finger Contactless Fingerprint Dataset

***Bhavin Jawade**, Deen Dayal Mohan, Srirangaraj Setlur, Nalini Ratha, Venu Govindaraju*
University at Buffalo

Dataset Link:
https://www.buffalo.edu/cubs/research/datasets/ridgebase-benchmark-dataset.html

Introduction

- Contactless fingerprint matching using smartphone cameras alleviates many concerns associated with contact-based matching while also making the acquisition process easier, faster, and portable.
- Collected a new cross-sensor fingerprint dataset which overcomes many drawbacks of existing datasets and is designed to promote practical contactless fingerprint matching research.
- Developed an extensive tasks and protocols suite for RidgeBase that emulates real-world scenarios and ensures reproducibility.

Dataset Statistics

Property	Count
Number of Smartphones	2
Backgrounds and lighting conditions	3
Number of unique fingers	704
Number of unique hands (four fingers)	176
Number of four-finger contactless images	3374
Number of four-finger contact-based images	280
Number of contactless finger images	13484
Number of contact-based fingerprint images	1120

Table 1: Summary of Dataset Statistics

Tasks and Protocols

- **Single Finger Matching**
- **Four Finger Matching**
- **Set-Based Matching** To overcome the inconsistencies and distortions observed in real-time unconstrained capture of fingerprint images using smartphone camera, we introduce a set-based matching protocol.

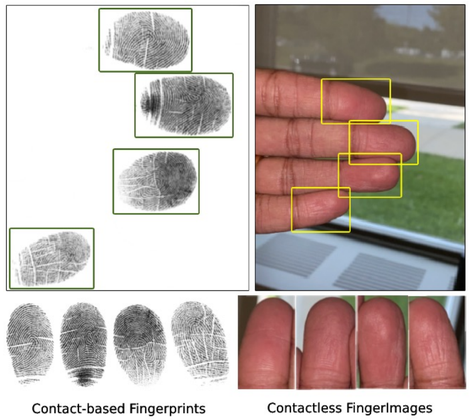

Figure 1: Sample contact and contactless four finger images and segmented distal

Segmentation

- Designed a heuristic approach to automatically generate pseudo annotations for finger-distal.
- Utilized these pseudo annotations to train a Faster R-CNN for fingerprint segmentation.

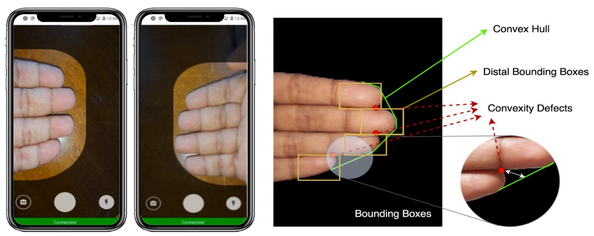

Figure 2: Left: Screenshot from the data collection app. Right: Segmentation pipeline for data annotation heuristic

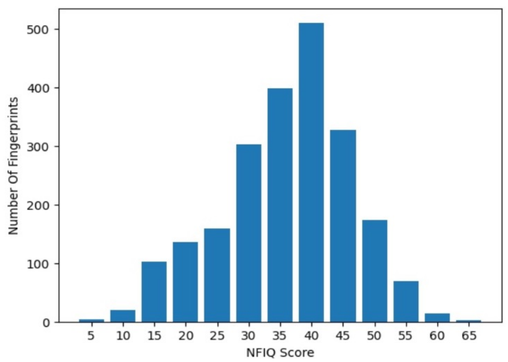

Figure 3: NFIQ 2.0 score distribution for enhanced fingerprints in evaluation split

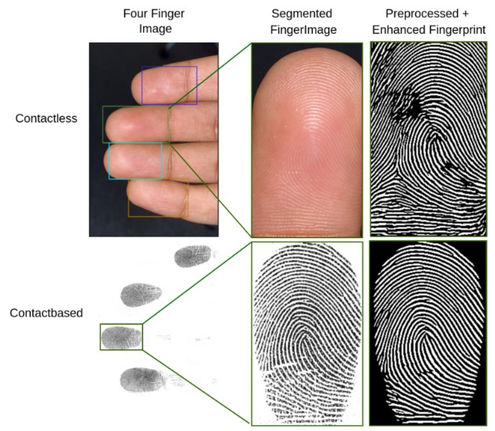

Figure 4: Sample enhanced contactless and contact-based images

Benchmark Results

Table 2: CL2CL – 1:N Identification

Task 1 - Distal Matching				
Method	R@1	R@10	R@50	R@100
Verifinger	85.2	91.4	93.8	95.4
AdaCos (CNN)	81.9	89.5	94.1	95.9
Task 2 - Four Finger Matching				
Method	R@1	R@10	R@50	R@100
Verifinger	94.1	99.0	99.8	100.0
AdaCos (CNN)	91.5	97.3	99.6	99.8
Task 3 - Set Based Distal Matching				
Method	R@1	R@10	R@50	R@100
Verifinger	91.5	99.5	100.0	100.0
AdaCos (CNN)	86.5	99.0	100.0	100.0

Table 3: CL2CL – 1:1 Verification

Task 1 - Distal Matching		
Metric	Verifinger	AdaCos (CNN)
EER (%)	19.7	21.3
TAR(%)@FAR=10^{-2}	63.3	61.2
AUC(%)	89.3	87.7
Task 2 - Four Finger Matching		
Metric	Verifinger	AdaCos (CNN)
EER (%)	13.1	14.8
TAR@FAR=10^{-2}	79.8	70.9
AUC(%)	92.1	92.6
Task 3 - Set based Distal Matching		
Metric	Verifinger	AdaCos (CNN)
EER (%)	7.90	9.5
TAR(%)@FAR=10^{-2}	86.1	86.5
AUC(%)	95.3	96.3

Table 4: C2CL - 1:N Identification - Verifinger

Task	R@1	R@10	R@50	R@100
Task 1	72.5	89.2	95.5	97.5
Task 2	85.4	96.7	100.0	100.0
Task 3	80.0	97.0	99.5.	100.0

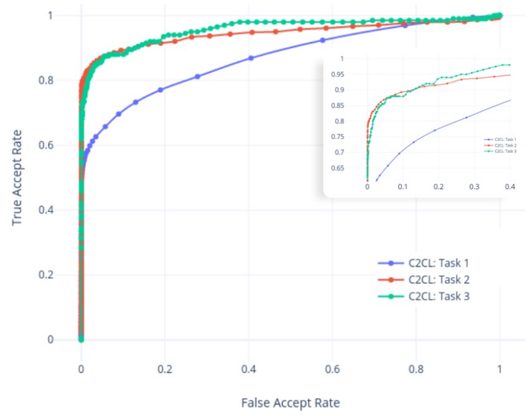

Figure 5: 1:1 Verification ROCs for Contact-2-Contactless (Method: Verifinger)

Conclusion

- Ridge Base will help advance new avenues for contactless fingerprint matching, promoting methods that could leverage different parts from the four-finger region for matching.
- With the set-based matching protocol introduced along with Ridge-Base, novel contactless fusion algorithms can be investigated to achieve better query-set to gallery-set matching performance. Along with this dataset, we release the cross-platform app developed to collect the finger-photos.

Acknowledgments

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