AUTOMATIC LATENT FINGERPRINT MATCHING

MICHIGAN STATE UNIVERSITY

Department of Computer Science & Engineering

Paulino A. A.[a], Jain A. K.[a], Feng J.[b] - [a]Michigan State University, USA, [b]Tsinghua University, China

{paulinoa, jain}@cse.msu.edu, jfeng@tsinghua.edu.cn

ABSTRACT

Identifying suspects based on impressions of fingers lifted from crime scenes (**latent prints**) is extremely important to law enforcement agencies. Latents are usually poor quality images –**blurred, smudgy, small area**. Our goal is to improve latent matching accuracy by using few manually marked features. We propose to align the latent with the fingerprint in the database using a descriptor-based Hough Transform, establish minutiae correspondences, and compute a global similarity score. Our experimental results show improvement in the performance compared to a commercial matcher.

INTRODUCTION

- Matching latents to plain or rolled fingerprints that are stored in law enforcement databases is a very challenging task.
- Features extracted from a latent need to be matched to a very large database (often millions of rolled images) in order to identify one or a list of suspects.
- It is very difficult to automatically extract reliable features from latents.
- Features in latents such as minutiae (most used feature in fingerprint matching), region of interest (roi), singular points, are typically manually marked by latent experts (time consuming).
- **Our goal is to improve latent matching accuracy by using as few manually marked features as possible.**

Fig. 1: Rolled, plain and latent fingerprints with typical fingerprint features (singular points, minutiae, roi)

LATENT MATCHING ALGORITHM

- Input to matcher: manually marked minutiae in latents and automatically extracted minutiae using commercial matcher in rolled prints.
- The proposed latent matching approach consists of three main modules: alignment, minutiae pairing, and score computation.

Algorithm 1 High level algorithm

INPUT:
- Two sets of minutiae: $\{m_i\}$ from latents and $\{m_j\}$ from rolled prints, where $m = (x, y, \theta)$.

ALGORITHM:

Build local minutia descriptors for each minutia in both sets.
Compute local descriptors similarity for every pair $\{m_i, m_j\}$.
for each pair m_i, m_j **do**
  Compute translation and rotation parameters.
  Discretize parameters.
  Increase evidence for the set of parameters obtained proportional to descriptor similarity.
end for
L = list of parameter sets ordered by highest evidence.
for $i = 1$ to 10 **do**
  Find matched minutiae pairs for parameter set L_i by thresholding the Euclidean distance and direction difference between minutiae.
  Compute similarity score s_i as the average of descriptor similarities of matched minutiae pairs.
end for

OUTPUT:
- The final score: $\max_i s_i$

OVERVIEW OF LATENT MATCHING

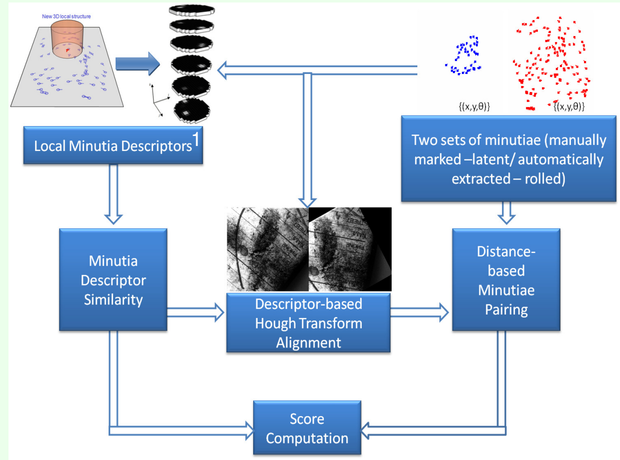

Fig. 2: Overview of latent fingerprint matching approach

EXPERIMENTAL RESULTS

- Database: *NIST Special Database 27 (*258 latent fingerprints and mated rolled prints)

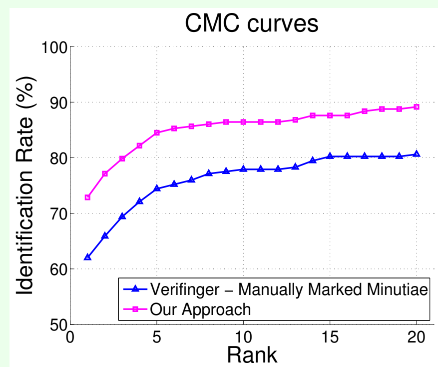

Fig. 3: Cumulative Match Characteristic (CMC) curves

- Our approach outperforms the commercial matcher Verifinger due to the better performance of our descriptor-based alignment, which also leads to a better minutiae pairing.

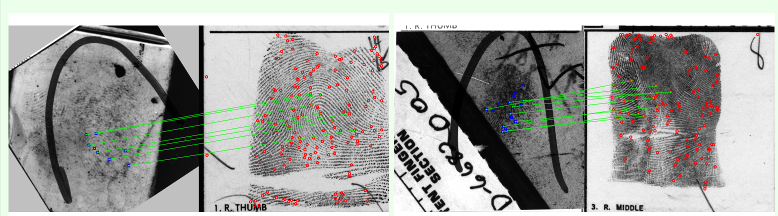

Fig. 4: Examples of successful and unsuccessful matches

CONCLUSIONS

- Latent fingerprint matching is a challenging problem.
- The proposed alignment scheme leads to performance improvement (~10%) over a commercial matcher.

REFERENCE

[1] Cappelli R., Ferrara M., Maltoni D., “Minutia Cylinder-Code: A New Representation and Matching Technique for Fingerprint Recognition”, *IEEE Trans. on Pattern Analysis and Machine Learning*,2010.

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