Fingerprint Matching and Verification Using SIFT Keypoints

Under the guidance of :

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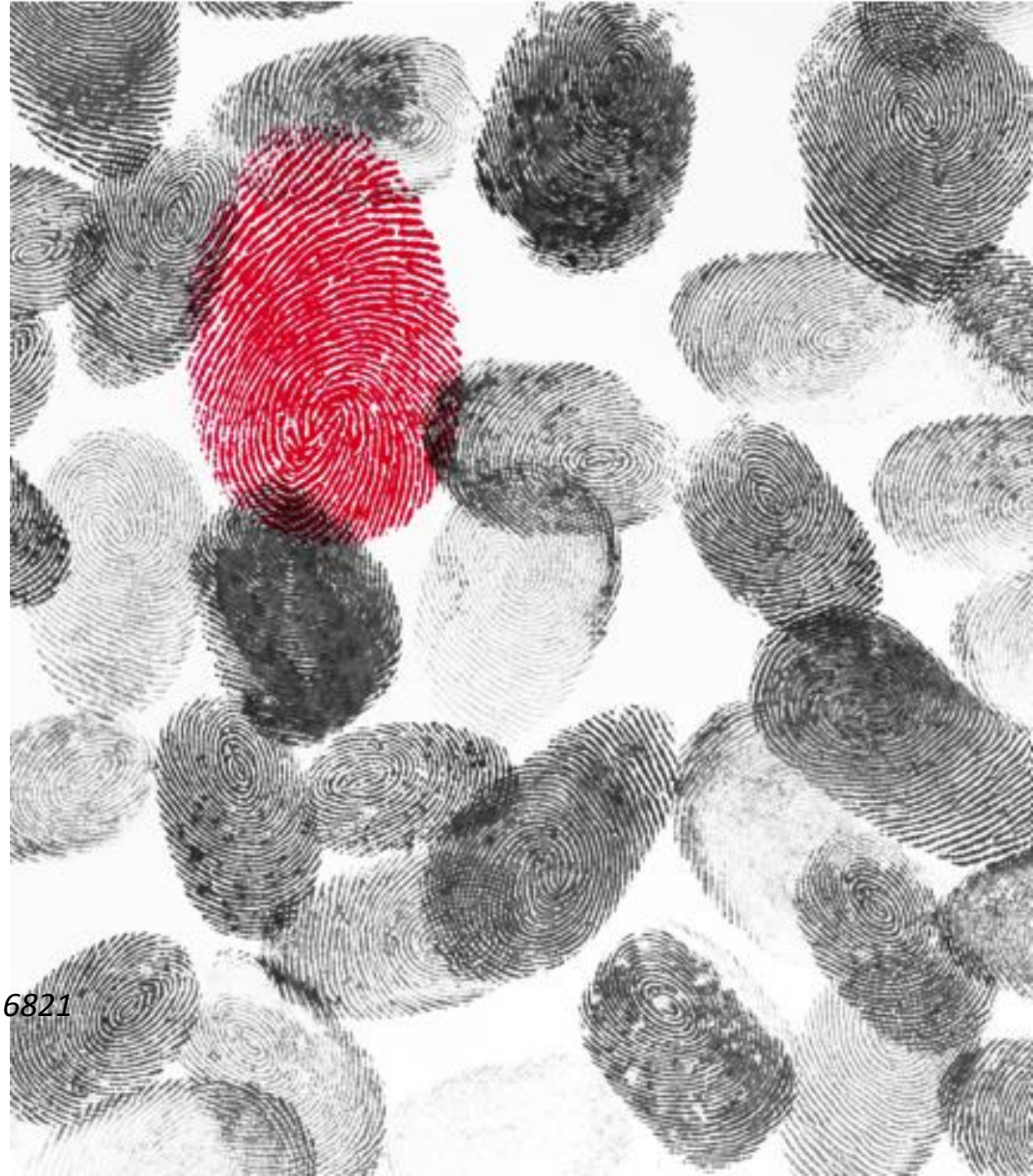
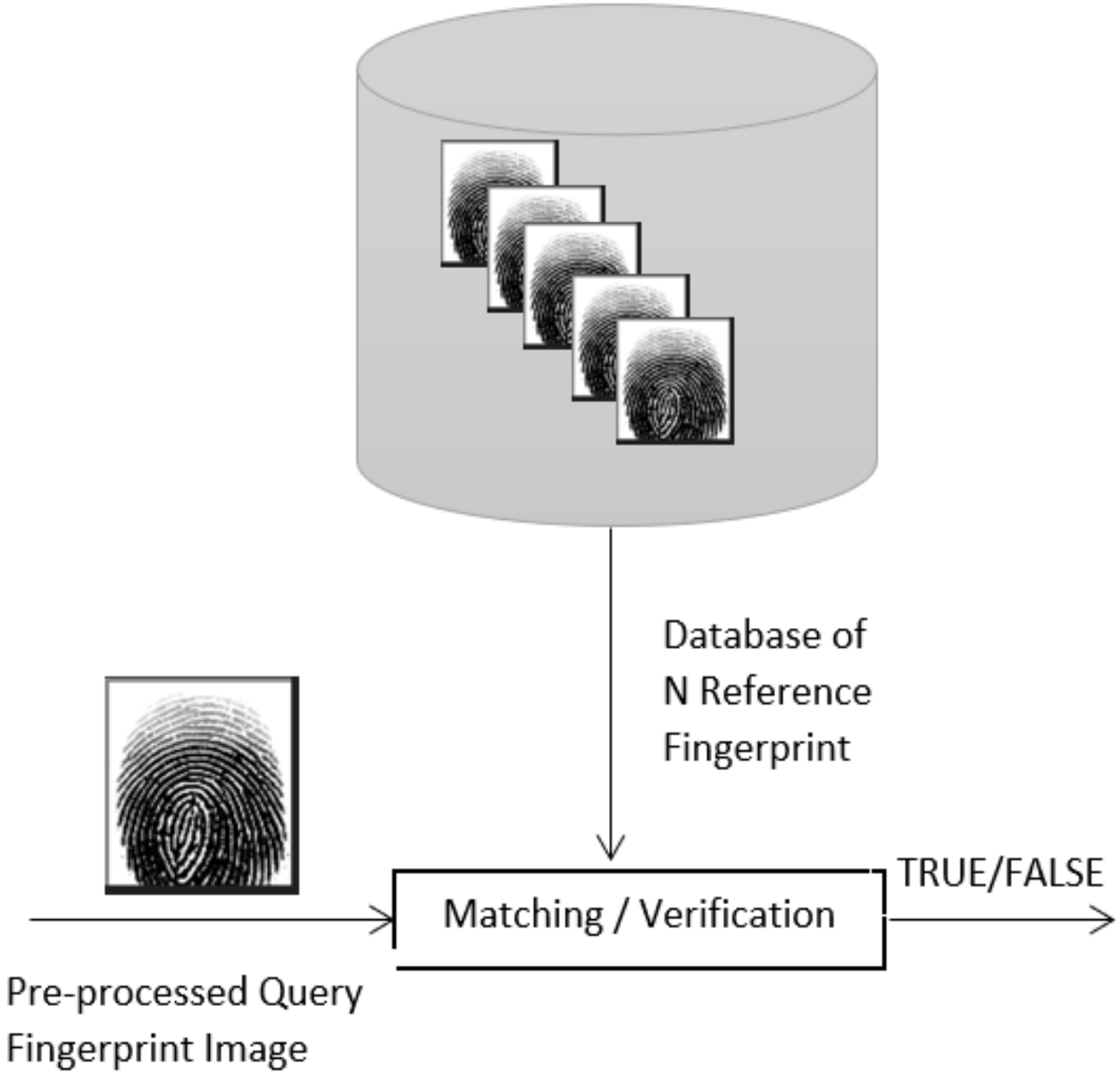


WHY SIFT ?

- *Minutiae points - absence of sufficient minutiae features in partial images and altered images*
- *Harris Corner Detector*
- *Other algorithms assume that the two templates are approximately of the same size*
- *Size of the image matters – SIFT is scale invariant.*
- *Rotation invariant*
- *Create comparatively large number of feature points*

Steps


Database of
N Reference
Fingerprint
Matching / Verification
TRUE/FALSE
Pre-processed Query
Fingerprint Image

STEP:

1

- **Query Image as Input**
- **Compare with each image from the Database**

STEP:

2

Detect keypoints using SIFT algorithm and compute the descriptors

1. *detectAndCompute()*

1. **Scale – space Extrema Detection**
2. **Key-point Localization**
3. **Orientation Assignment**
4. **Key-point Descriptor**

STEP

3

Find "good" matches

Brute-Force Matching

BFMatcher

FLANN based matching

FLANN

STEP

Find "good" matches : Distance Threshold

4

- Higher Value - False positive
- Lower value – Missing Good matches

Distance Threshold :120

STEP

5

Determination of matching score based on good matches and keypoints

$$m\left(I_q(x,y), I_r(x,y)\right) = \frac{p}{\max\{k_r, k_q\}} \in [0,1]$$

p: Number of matched SIFT-keypoint pairs
k_r: Number of SIFT-keypoints in $I_r(x,y)$
k_q: Number of SIFT-keypoints in $I_q(x,y)$

STEP

6

Decision of selection based on Decision threshold

DECISION_THRESHOLD = 0.1

- Lower Value - False positive
- Higher value – Missing right verification

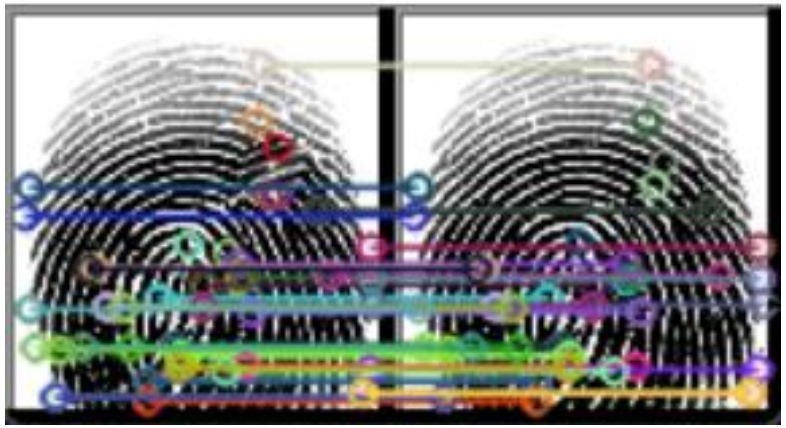
7

Draw the "good" matches

```
cv::drawMatches()
```

RESULTS

SUCCESSFUL CASE



```
Query Image: 1__M_Left_index_finger_Zcut.BMP
Reference Image: 1__M_Left_index_finger.BMP
Keypoints of Query Image: 54
Keypoints of Reference Image: 48
Number of Good Matches: 43
Matching Score: 0.796296
Matched: True
```

RESULTS

```
Query Image: 1__M_Left_index_finger_Zcut.BMP
Reference Image: 10__M_Left_index_finger.BMP
Keypoints of Query Image: 54
Keypoints of Reference Image: 42
Number of Good Matches: 0
Matching Score: 0
Matched: False
```

NON - SUCCESSFUL CASE

FINDINGS

td = 0.1 and distance 100

Easy = 100%
Medium = 98.96%
Hard = 94.73%

td = 0.1 and distance 120

Easy = 100%
Medium = 99.65%
Hard = 95.95%

td = 0.1 and distance 150

Easy = 497/299

Higher distance Value - False positive

td = 0.05 and distance 150

Easy =658/299

Higher distance Value - False positive

td = 0.2 and distance 100

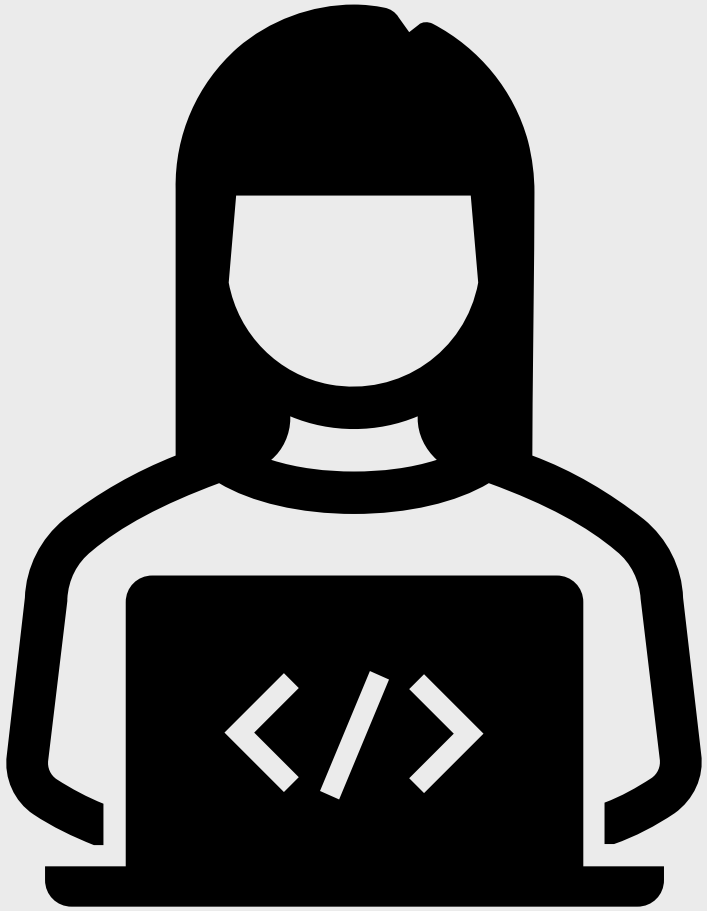
Easy = 99.66%

10__M_Left_little_finger_Obl.BMP
Matching score: 0.160714

Higher td Value – Missing Good matches

Altered Easy = 299/299 (100%)
Altered Medium = 290/291 (99.65%)
Altered Hard = 237/247 (95.95%)

Limitation faced even for td= 0.1 & distance =120



DEMO