Assignment #1: Fingerprint Recognition

Biljana Vitanova
IBB 2024/25 , FRI, UL
bv7063@student.uni-lj

***Abstract*—The goal of this assignment was to familiarize oneself with the fingerprint recognition pipeline. This involved extracting minutiae points, calculating similarity scores between fingerprint images, and classifying whether two images belong to the same person.**

I. Introduction

Fingerprint recognition is a biometric modality that verifies identity by extracting and analyzing unique fingerprint features, such as minutiae points or singular points. The process involves comparing these features to distinguish between genuine and impostor matches.

II. Methodology

To identify genuine matches, I calculated similarity scores for all image pairs in the dataset. I then iterated through each unique similarity score, selecting the one that maximized the F1-score as the optimal threshold.

III. Experiments

For this task, I used the FVC2000 DB1 dataset [1], which consists of 10 fingers with 8 plain impressions each. Of these, 25 samples are of the Right Loop type, 49 are Left Loop, and 6 are Whorl. Among the 196 unique Bozorth3 scores, the optimal threshold value used was 24.

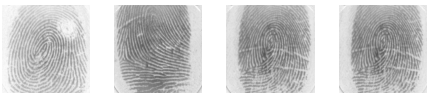

Fig. 1: Sample fingerprint images from the dataset.

IV. Results and Discussion

A. Results

TABLE I: Classification Accuracy obtained

Classification Method	**Accuracy [%]**
All vs. All Samples	0.986
Sub-classified by Fingerprint Type	0.977

B. Discussion

From Fig 4., the similarity scores for genuine matches in the first and last individuals are not distinct enough from impostor scores, leading to overlap and frequent Type 2 errors in these regions (as shown Fig 5.).

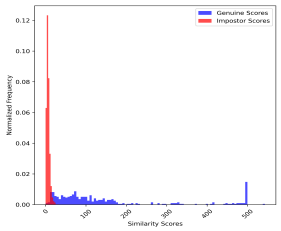

Fig. 2: The graph shows the distribution of genuine (blue) and impostor (red) matches.

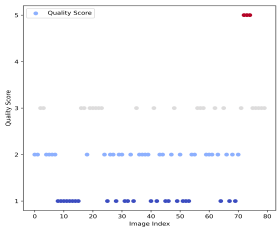

Fig. 3: Plot displaying the quality of each sample.

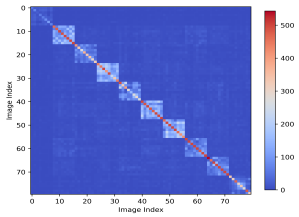

Fig. 4: Similarity matrix of Bozorth3 scores for all fingerprint pairs.

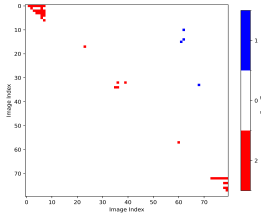

Fig. 5: Error matrix showing Type 1 errors (blue), Type 2 errors (red), and no-error (white) regions.

Fig 3. shows that quality scores of 1-3 are most common, but there is no clear correlation between image quality and matching accuracy, as regions with incorrect matches (Fig 5.) do not necessarily contain lower quality images.

Using the F1-score effectively addressed the high imbalance between the two classes as seen from Fig 2.

V. Conclusion

The classification approach achieved high accuracy (98.6% overall, 97.7% for sub-classes). However, the absence of train-test splitting limits generalizability. Future work should involve using larger datasets with proper splitting.

References

[1] "Fvc2000 db1," 2000, available at: http://bias.csr.unibo.it/fvc2000/download.asp.