A Novel Hybrid Fusion Combining Palmprint and Palm Vein for Large-Scale Palm-Based Recognition

Name-Saket Jain RollNo-210905

Brief Overview

This study suggests a novel way to combine palmprint and palm vein data in order to identify individuals in large databases. The method consists of two main steps: (1) coarse recognition, which quickly narrows down the number of possible matches by using a likelihood ratio test on palm vein scores, and (2) fine recognition, which carefully combines palmprint and palm vein scores using a weighted fusion method based on Wasserstein distance. This approach improves accuracy, speeds up processing, and guards against spoofing, making it suitable for safe access control and other real-world uses.

Dataset

Due to the unavailability of the dataset mentioned in the paper, I have tested my code using the alternate public dataset provided in the paper which has 12000 palmprints of 600 different people.

Data Loading and Preprocessing

Images are loaded from two folders, `session1` and `session2`, which represent images taken in two different sessions. Each image is resized and normalized to make sure they are all in the same format. This helps to keep the data consistent before extracting features.

Feature Extraction using Gabor Filters

In this stage, we use Gabor filters to extract important features from each image. Gabor filters help highlight patterns in different directions. We set parameters like frequency ω, orientation θ, and other values like σ, δ, and κ to control how the filter behaves.

Six Gabor filters are used with orientations $\theta_i = i \cdot \frac{\pi}{6}$ for $i = 0, 1, \ldots, 5$. These different orientations help capture various patterns in the images, making it easier to recognize different palms.

Generating Genuine and Imposter Scores

We compare the gallery and probe images by calculating cosine similarity for each pair of images. Let $\mathbf{f}_i$ and $\mathbf{f}_j$ represent the features of two images. Then, the similarity score S is calculated as:

$$S = \frac{\mathbf{f}_i \cdot \mathbf{f}_j}{||\mathbf{f}_i|| ||\mathbf{f}_j||}$$

If the two images belong to the same palm, we call this score a *genuine* score. If they belong to different palms, it is called an *imposter* score.

Adaptive Weight Calculation Using Wasserstein Distance

To see how different the genuine and imposter scores are, we calculate the Wasserstein distance between the genuine and imposter score distributions. This distance shows how well the two groups are separated. If the distance is large, it means the model can better tell apart the genuine and imposter images.

Decision Fusion with Weighted Scores

Finally, we use the scores from both the palmprint and palm vein features to make a final decision. We assign weights based on the Wasserstein distance, giving more importance to features that better separate genuine from imposter images.

The fused score F is calculated as:

$$F = \tau_k \cdot x_k$$

Results

Genuine scores shape: (59982)
Imposter scores shape: (35940018)
Percentage of genuine images: 74.80