

SIL775 BIOMETRIC SECURITY

ASSIGNMENT-1 FINGERPRINT RECOGNITION SYSTEM

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In this Assignment, we had to implement the following Fingerprint recognition algorithms

1. Alignment using Hough transformation and Minutiae matching
2. Genetic Algorithm
3. Using Core point as a frame of reference

To run

```
python hough.py image1 image2
```

```
python core.py image1 image2
```

```
python genetic.py image1 image2
```

I have implemented all the above algorithms. The following modules are there in my code.

1. Preprocessing (Thinning, skeletonization, Segmentation, enhancement)
2. Orientation (calculate angles)
3. Hough, Core Point, GA matching

Pre-processing of Fingerprints:

For matching the fingerprints, these are prior steps that need to be done.

Above is the original image fingerprint image before applying any pre-processing step.

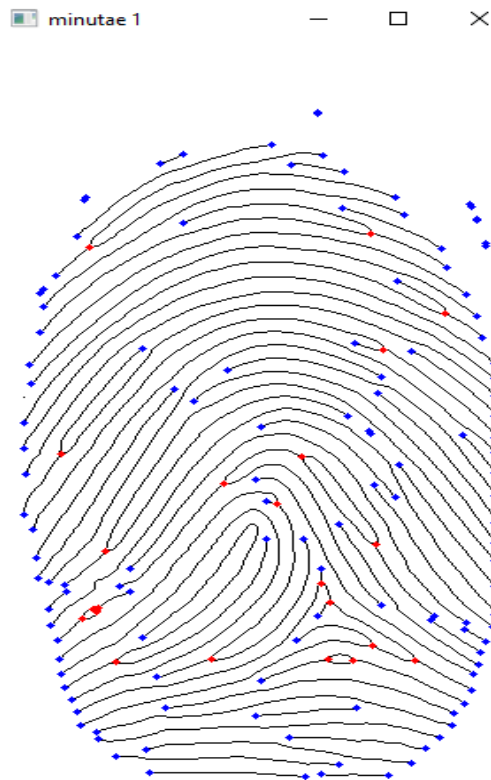
- **Fingerprint Enhancement**- This enhances the visualization of ridges and valleys. It connects the broken ridges and separates the joined ridges.
- **Fingerprint Segmentation**- It separates the foreground image from the background image.
- **Fingerprint Normalization**- this step normalizes the greyscale intensity values to keep them within a range between 0-255.
- **Fingerprint Binarization**- This step converts an 8-bit grey-scale fingerprint image into a 1-bit ridge image.
- **Fingerprint Skeletonization/thinning**- this process reduces the thickness of ridges into a single pixel width.



2. Identifying fingerprint orientation fields using a Gradient-Based Method:

Gradient-based method is used to find the orientation fields of ridges in the fingerprint image.

3. Minutiae Extraction- After performing all the pre-processing steps the required skeletonized image is obtained and upon applying the minutiae extraction method ridges end, bifurcations, core, delta, and whorl are obtained.



4. Fingerprint Matching

METHOD 1. Hough Transformation:

First, the global transformation parameters (ds , dx , dy , $d\theta$) is calculated after that the points of the query image is transformed and then the matching is done.

I have taken tolerance in distance 16, and tolerance in angle 15 degrees.

METHOD 2: Genetic Algorithm: In t

METHOD 3- Core point for fingerprints matching

The core point is determined by the singularity extraction method then after obtaining the core point, taking this point as a reference point further minutiae points are matched by taking parameters of distance and angle between the points.

First, I have detected the core points and then calculate the euclidian distance and angle with taking the core points as the frame of reference for all the minutiae points and then match the minutiae points taking tolerance in distance 12, tolerance in angle 0.21 radian.

