

Fingerprint Recognition

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Figure 1: Source Image

Preprocessing

1. Normalization



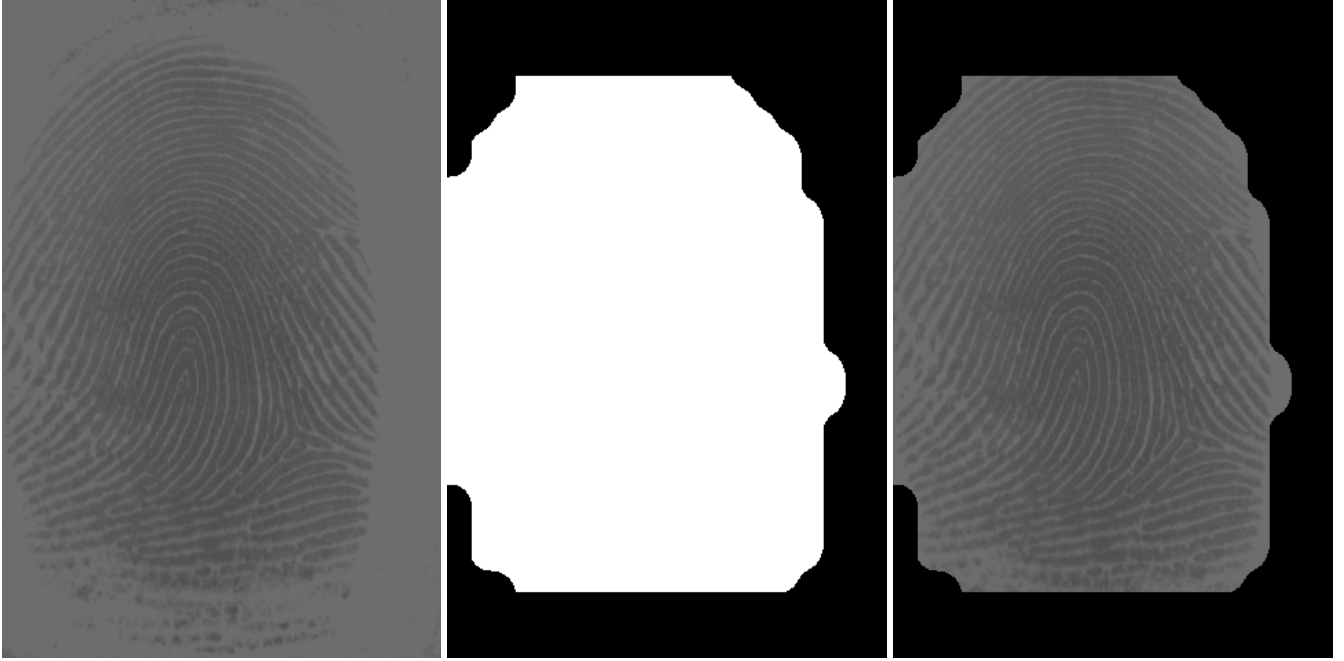
Figure 2: Normalization

$$S = Std(M) = \sqrt{\frac{\sum((M_{ij} - Avg(M))^2)}{Size(M)}}$$

$$\delta = \frac{\sqrt{S_0 \times (M_{ij} - Avg(M))^2}}{S}$$

$$M_{ij} = \begin{cases} Avg_0 - \delta, & \text{if } M_{ij} \geq Avg(M) \\ Avg_0 + \delta, & \text{if } M_{ij} < Avg(M) \end{cases}$$

2. Segmentation



A block K in image M is background if:

$$Std(K) \leq Std(M) \times \text{threshold}$$

Dilation, followed by Erosion are performed to unify the blocks.

Then, erosion followed by dilation are performed to exclude insignificant blocks.

3. Orientation



(The third image is only used for visualization only. It does not take part in any computing process.)

Sobel Operator is used for detect gradient along Ox and Oy .

For each pixel in image, we can calculate the gradient angle:

$$\theta = \tan^{-1} \frac{|\overrightarrow{Gx}|}{|\overrightarrow{Gy}|}$$

Then we can calculate the gradient angle for each block.