Communauté
UNIVERSITÉ Grenoble Alpes

18th January 2019

Digital analysis of fingerprints

Castells Thibault, Çoba Xhenis, Hernández Mayra, Pantović Anja

Pixel Manipulation

- Useful tools: CImg, Eigen libraries

- min $= 0 \rightarrow$ black
- max $= 255 \rightarrow$ white

Pixel Manipulation

Figure 1: Symmetry with respect to x, y and the diagonal axis

Is the pixel swapping operation a rotation?

Figure 2: Rotation for π and symmetry with respect to x-axis

Pressure Simulation

To simulate finger pressure according to a given center, the pixel operation to be performed on the original fingerprint is as follows:

$$g(x, y) = c(x, y)f(x, y), \tag{1}$$

$c(x, y) \in [0, 1]$ - weight coefficient,
$g(x, y)$ - resulting image,
$f(x, y)$ - original image.

Isotropic functions

Function is said to be **isotropic** if it does not depend on the direction.

$$c(r) = (e^{-r})^{10} \tag{2}$$

$$c(r) = \frac{1}{1 + r^{15}} \tag{3}$$

$$c(r) = \frac{1}{1 + (\frac{r}{40})^2}. \tag{4}$$

Isotropic functions

Figure 3: Isotropic functions applied to *cleanfinger*

Isotropic Gaussian function

$$c(r) = e^{-\alpha r^2} \tag{5}$$

(a) $\alpha = 0.002$ (b) $\alpha = 0.0002$

Communauté
UNIVERSITÉ Grenoble Alpes

Anisotropic functions

An **anisotropic** function is dependent on the direction in which it is observed.

$$dist(x, y; x_{center}, y_{center}) = \sqrt{(\frac{x - x_{center}}{a})^2 + (\frac{y - y_{center}}{b})^2}.$$

Anisotropic Gaussian function

$$c(r) = e^{-\alpha r^2}$$

$$dist(x, y; x_{center}, y_{center}) = \sqrt{(\frac{x - x_{center}}{a})^2 + (\frac{y - y_{center}}{b})^2}$$

Geometrical Warps

Definition: image warping is the process through which the pixel coordinates (x,y) of an image are transformed according to a motion model.

Methods proposed:

- Translation
- Rotation

Translation

- Moves the image along x and y axis

initial image translated image

Rotation

We propose 3 methods:

- Simple rotation
- Rotation, then bilinear interpolation
- Rotation and bilinear interpolation

Method 1: Simple Rotation

Drawback:

- information is lost

initial image

rotated image

Method 2: rotation, then bilinear interpolation

Drawback:

- higher complexity of algorithm

Advantage:

- more accurate result than the first method

initial image

rotated image

Method 3: rotation and bilinear interpolation

Advantage:

- accurate result

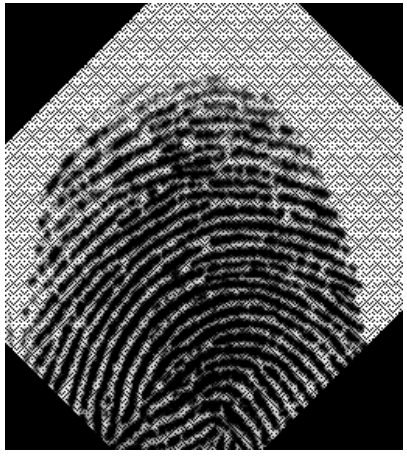
initial image

rotated image

Inverse rotation

initial image

simple rotation



inverse rotation

For the next two weeks:

- Deeper understanding of Geometrical Warps
- Optimization for Image Registration
- Final report and presentation