Computer vision Homework7

Thinning

Description

Write a program which does thinning on a downsampled image (lena.bmp).

The program is based on homework6

(a) Binarizing and downsampling Lena from 512x512 to 64x64

Using the method used in homework6. (Source Code 12~33)

(b) Process Yokoi Operator.

Using the method used in homework6. (Source Code 34~119)

- (c) Scan the pixels in the downsampled image. Delete the current pixel if it is satisfied all of the conditions below. Repeat the thinning operator until there is no change.
 - i. Check if the current pixel is the edge by yokoi connectivity number.
 - ii. Check if the current pixel is 'p' in pair relationship Operator.
 - ➤ H function: (m="1", means "edge" in Yokoi)

•
$$h(a,m) = \begin{cases} 1, if \ a = m \\ 0, otherwise \end{cases}$$

Output:

•
$$y = \begin{cases} q, & \text{if } \sum_{n=1}^{4} h(x_n, m) < 1 \text{ or } x_0 \neq m \\ p, & \text{if } \sum_{n=1}^{4} h(x_n, m) \ge 1 \text{ and } x_0 = m \end{cases}$$

iii. Check if the current pixel is 'g' in connected shrink operator.

H function: (yokoi corner => "q")

•
$$h(b,c,d,e) = \begin{cases} 1, if \ b = c \ and \ (d \neq b \ or \ e \neq b) \\ 0, otherwise \end{cases}$$

Output: $f(a_1,a_2,a_3,a_4,x) = \begin{cases} g, if \ exactly \ one \ of \ a_n = 1, n = 1{\sim}4 \\ x, otherwise \end{cases}$

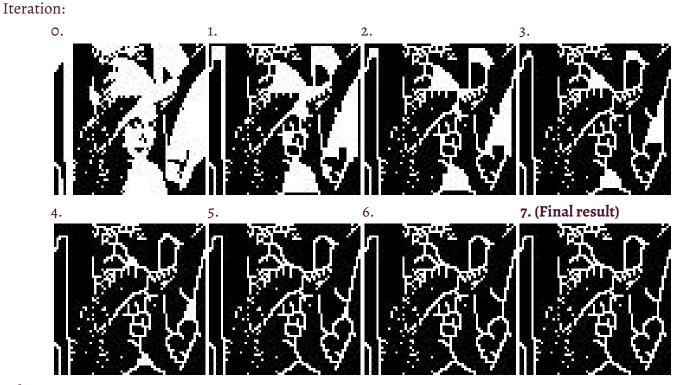
```
f_shrink(int a1, int a2, int a3, int a4, int x6
if (a1 == 1 || a2 == 1 || a3 == 1 || a4 == 1) {
                                                                                              int count = 0;
if (a1 == 1) {
                                                                                                    count++;
⊡int h_shrink(int b, int c, int d, int e) {
                                                                                                    count++;
                                                                                               if (a3 == 1) {
                                                                                                    count++;
        return 0:
                                                                                               if (count == 1) {
    return 'g';
                                                                                         else {
                                                                                               return x0;
```

```
//i. Obtain the value of x0~x8
if (j != 0) {
                                                          //ii. Calculate the value of a1~a4
                                                          char a[4];
                                                          a[0] = h_shrink(x[0], x[1], x[6], x[2]);
                                                          a[1] = h_shrink(x[0], x[2], x[7], x[3]);
                                                          a[2] = h_shrink(x[0], x[3], x[8], x[4]);
   x[4] = down.at<uchar>(i + 1, j);
                                                          a[3] = h_shrink(x[0], x[4], x[5], x[1]);
if (i != 63 && j != 63) {
                                                           return f_shrink(a[0], a[1], a[2], a[3], x[0]);
   x[5] = down.at<uchar>(i + 1, j + 1);
if (i != 0 && j != 0) {
if (i != 0 && j != 63) {
if (i != 63 && j != 0) {
```

Main

```
//thinning
int time = 1;
while (time <= 1000) {
   int change = 0;
    string name = to_string(time) + ".jpg";
   yokoi(down);
    for (int i = 0; i < 64; i++) {
        for (int j = 0; j < 64; j++) {
    if (yokoi_m[i][j] == 1 && pair_op(i,j) == 'p' && shrink(i, j, down) == 'g') {</pre>
                down.at<uchar>(i, j) = 0;
                 change++;
            else if (down.at<uchar>(i, j) == 0) {
                 down.at<uchar>(i, j) = 0;
                 down.at<uchar>(i, j) = 255;
    imwrite(name, down);
    if (change == 0) {
        cout << "Iterations: " << time << endl;</pre>
        break;
    time++;
```

Result



Reference:

- 1. Pdf in homework7
 http://cv2.csie.ntu.edu.tw/CV/_material/CV1_CH6_2018_thinning-operator.pdf
- 2. lecture slide