Report

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The yokoi function is use HW6's function

```
char yokoi_h(int b, int c, int d, int e) {
        if (b == c && (d != b || e != b)) {
                return 'q';
        }
        if (b == c && (d == b && e == b)) {
                return 'r';
        }
        return 's';
}
```

```
int yokoi_f(char a1, char a2, char a3, char a4) {
        if (a1 == a2 && a2 == a3 && a3 == a4 && a4 == 'r') {
                return 5;
        }

        int total = 0;
        if (a1 == 'q') {
                total += 1;
        }
        if (a2 == 'q') {
                total += 1;
        }
        if (a3 == 'q') {
                total += 1;
        }
        if (a4 == 'q') {
                total += 1;
        }

        return total;
}
```

The Pair Relationship Operator function:

```
int pro_h(char a, char m) {
        if (a == m) {
                return 1;
        }
        return 0;
}
```

```
char pro_f(int a1, int a2, int a3, int a4, int x0) {

        int total = 0;
        if (a1 == 1) {
                total += 1;
        }
        if (a2 == 1) {
                total += 1;
        }
        if (a3 == 1) {
                total += 1;
        }
        if (a4 == 1) {
                total += 1;
        }

        if (total < 1 || x0 != 1) {
                return 'q';
        }
        if (total >= 1 && x0 == 1) {
                return 'p';
        }
}
```

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

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

Connected Shrink Operator function:

```
int cso_h(int b, int c, int d, int e) {
        if (b == c && (d != b || e != b)) {
                return 1;
        }
        return 0;
}
char cso_f(int a1, int a2, int a3, int a4) {
        int s = a1 + a2 + a3 + a4;
        if (s == 1) {
                return 'g';
        }
        else {
                return '0';
        }
}
```

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

$$f(a_1,a_2,a_3,a_4,x) = \begin{cases} g & \text{if exactly one of } a_1,a_2,a_3,a_4 = 1 \\ x & \text{otherwise} \end{cases}$$

Line 165:

```
while (sss < 7) {
```

(1)It will do 7 iterations for the thinning.

Line 279:

```
namedWindow("downSample as 64x64", 0);
                imshow("downSample as 64x64", img_binx64);
waitKey(500);
```

(2)When a loop done, it will wait 500ms and update the graph.

Line169:

```
for (int i = 0; i < img_binx64.rows; i++)
```

(3)First, do yokoi operation to original picture.

Line 212:

```
for (int i = 0; i < 64; i++)
```

(4)Second, the loop is to count Pair Relationship from (3).

Line 244:

```
for (int i = 0; i < 64; i++)
```

(5)Finally, the loop is to count Connected Shrink Operator by (4) result.(It will set the return value from Connected Shrink Operator function zero if its return value is ‘g’)

The program does 7 iterations will get the picture as follow: