A Study on the Enhancement of Tracking Capability for Iris Image

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Abstract—**An enhancement of tracking capacity to find a position of the Iris images is presented in this paper. The propose algorithm is called FFDP (Four Points Diagonal Positioning) that the image is positioned with arbitrary 4 points on the edge of iris and the selective 4 points are drawn by a diagonal line on the cross. The experiment result shows that the algorithm is efficient to track on the eyelid.**

I. INTRODUCTION

The technique for tracking of iris is presented in this paper. The main idea is that we point out an arbitrary 4 points in edge of iris and after connecting 4 points by diagonal line. We obtain a point of intersection using vertical bisector line. This point is the position what we find a tracking point. With a breakthrough of computer technology, the need and requirement of human interface technology is required in IT (Information Technology) field. This technique is applicable to the human interface system. In previous work, keyboard or mouse is used but speech recognition, character recognition and visual recognition technology is more natural than previous technology. Among the new technology, by focusing the monitor, user can operate a mouse cursor and select an icon on monitor display. At this time, human interface technique is essential to express motion and user's interested position. The related work is studied in many countries [1]. The application of tracking of position by eye is very practical. The general application is the computer interface that handicapped person cannot use his hands. The proposed technique in this paper can be used in the field of human interface. The previous algorithm finds a position of iris to tract position of eye. This method can find a poison by calculating a moved width after designating a fixed coordinate or variable template. But, in the case of the iris, the error range of position track increase as the part of shadowed area by eyelid increases. In this paper, to improve an exactness, we use a boundary of iris not area of iris and tract the point of iris shadowed by eyelid.

II. Algorithm of positioning tracking for Iris

To tract a position of iris, the image of eye is captured and the boundary should be accurate by binary of image. We extract a boundary of iris and select a circular part that of it. We remove a distortion of image by eyelid and find a middle point using arbitrary 4 points. To realize an upper process, we obtain a JPEG image and convert into gray image. To differentiate a boundary of an eye and pupil of the eye, we used a critical value. The image is depicted as shown in figure 1.

(a) Binary image

(b) Boundary of lower part of eye

Fig 1. Extraction of boundary of iris image

To remove an irregular point of edge of iris by eyelid, we designate edge of eyelid with i and j as shown in figure 2. It does not use an upper part of i and lower part of j. First, we increase Y coordinates from minimum value and maximum value at arbitrary X coordinates which does not penetrate the edge with i and j. Second, we designate arbitrary 4 points pixel connected with edge of iris as shown in figure 2. To find middle 4 points, we use equations as follows and obtain coordinate both f and g.

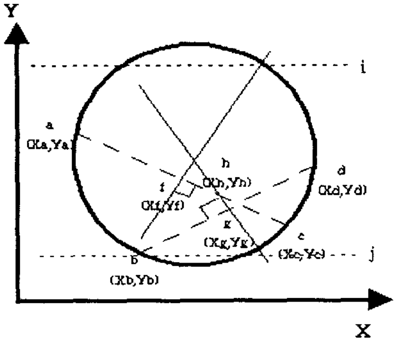


Fig. 2. Tracking of position using edge of iris

$$Xf=\frac{1}{2}(Xa+Xc) \quad (1)$$

$$Yf=\frac{1}{2}(Ya+Yc) \quad (2)$$

$$Xg=\frac{1}{2}(Xb+Xd) \quad (3)$$

$$Yg=\frac{1}{2}(Yb+Yd) \quad (4)$$

Equation (5) shows a straight line by passing f and h coordinate. A is Y coordinate, B is gradient, C is X coordinate and D is a Y intercept. To get A value and Y-intercept of D, we multiply –1 value to gradient which is positioned a and c and can obtain a gradient of straight line equation. We put coordinate of f into equation (5). The result is equation (6). We can obtain equation (7) after arranging D. Finally, we can get a straight line equation (8) passing f and h after putting equation (7) into equation (5).

$$A = BC + D \quad (5)$$

$$Yf = -\frac{Yc-Ya}{Xc-Xa}Xf + D \quad (6)$$

$$D = Yf + \frac{Yc-Ya}{Xc-Xa}Xf \quad (7)$$

$$A = -\frac{Yc-Ya}{Xc-Xa}C + Yf + \frac{Yc-Ya}{Xc-Xa}Xf \quad (8)$$

By using same method, we can get an equation (12) through equation (9) to equation (11). To obtain straight line equation (8) passing f and h and equation (12) passing g and h, we subtract equation (12) from equation (8) and the result is equation (13). The final equation is equation (15). The value of C in equation (14) is Xh coordinate and the value of an A in equation (15) is Yh coordinate.

$$E = FG + H \quad (9)$$

$$Yg = -\frac{Yd-Yb}{Xd-Xb}Xg + H \quad (10)$$

$$H = Yg + \frac{Yd-Yb}{Xd-Xb}Xg \quad (11)$$

$$E = -\frac{Yd-Yb}{Xd-Xb}G + Yg + \frac{Yd-Yb}{Xd-Xb}Xg \quad (12)$$

$$0 = -\frac{Yc-Ya}{Xc-Xa}C - (-\frac{Yd-Yb}{Xd-Xb}G) + Yf + \frac{Yc-Ya}{Xc-Xa}Xf - Yg + \frac{Yd-Yb}{Xd-Xb}Xg \quad (13)$$

$$C = -Yf - \frac{Yc-Ya}{Xc-Xa}Xf + Yg + \frac{Yd-Yb}{Xd-Xb}Xg \quad (14)$$

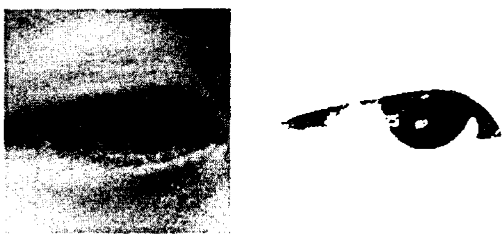
$$A = -\frac{Yc-Ya}{Xc-Xa}(-Yf - \frac{Yc-Ya}{Xc-Xa}Xf + Yg + \frac{Yd-Yb}{Xd-Xb}Xg) + Yf + \frac{Yc-Ya}{Xc-Xa}Xf \quad (15)$$

The proposed algorithm is suggested as above. The algorithm is FPDP (Four Points Diagonal Positioning). FPDP algorithm is based on the finding a middle point by fixing arbitrary points over remained edge, though the gap is reduced by difference of i and j by eyelid.

III. Simulation Results

3.1 Tracking Process of Position of iris

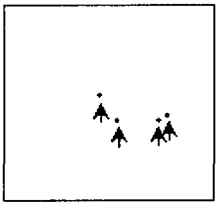
We have estimated the algorithm using FPDP method at edge of iris image to track the iris position. To realize exact experimental setup, we establish the camera and fluorescent body in upper position and remove the shadow beneath the iris. By using CCD camera, we obtain 256x256 pixel input image as shown in figure 3(a) and fix the critical point of 50 and get a binary code value as shown in figure 3(b).

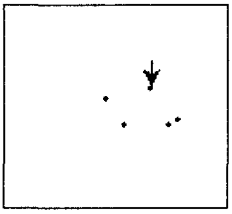


(a) 256*256 pixel input image (b) Binary code of iris image

Fig 3. Phase detecting methods comparison

(a) Edge of input binary image





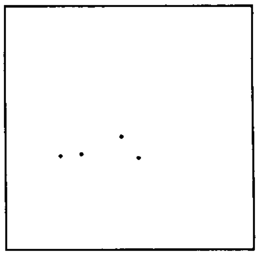
(b) Arbitrary 4 points next to edge (c) Image of Result

Fig 4. Result of the propose FPDP

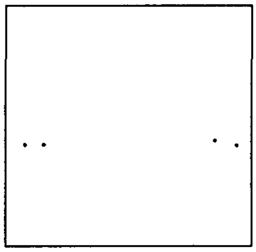
The shadow under iris is removed by fixing a camera and fluorescent in upper position more than position of eye. We increase the Y coordinate value from minimum value to maximum value at all X coordinate, the circular part of iris is contacted first. We can find 4 points by moving according to the middle coordinate as basis of contacted pixel. To remove an irregular part by eyelid, edge of iris is fixed at edge of eyelid with i and h as shown figure in 2. The upper parts of i and the lower parts of j are not used. We have to fix arbitrary pixel 4 points connected with edge of iris as shown in figure 4(b) by increasing Y coordinate from minimum value to maximum within the limit of X coordinate. The middle points of iris are obtained by using FPDP algorithm and the results are depicted in figure 4(c).

3.2 Image occurred by error

The critical value and pixel value occurred by error can generate errors. As the difference of brightness of input image and critical value of binary coded value increase, we obtain an obscure image such as iris and white part of eye or edge of eye as shown in figure 5(a). By fixing an arbitrary point on the edge of iris, the arbitrary 4 points can be shown in different part of edge not edge of iris as shown figure 5(b).



(a) (b)



(c) (d)

(a) Binary image by difference of critical value
(b) Error of detection by (a)
(c) Image in moving wide opened pupil of the eye
(d) Error of detection by (c)

Fig 4. Image of error of iris

As shown in the figure 5(c), we move into edge to the left of iris or edge that the white part of right part disappears. Like figure 5(d), arbitrary 4 points usually designate at the point of not having an edge of iris. Therefore, the adjustment method is required.

3.3 Measurement of exactness

We can measure the exact image as distance of middle coordinate value by using FPFP method applied at the input image. The error by moving range of iris beneath eyelid is shown in table 1. We can obtain the magnitude of error by putting equation (17) into errors of X coordinated and Y coordinate, respectively. The result of equation (17) is prime number. Element of pixel is natural number and counts fractions of 0.5 and over as a unit and cut away. Error over 10 pixels is depicted as X. The equation of error is as follows as shown in equation (17)

$$E = \sqrt{X^2 + Y^2} \qquad (17)$$

Table 1. Error of degree of iris to magnitude of iris

	Left 30°	Left15°	Middle	Right15°	Right30°
0.3cm	X	X	X	X	X
0.7cm	X	6	6	7	X
1.0cm	X	5	5	5	X
1.2cm	X	4	4	4	X
1.5cm	X	3	3	4	X

From the table 1, if the magnitude of extracted iris is over 0.7cm, the rest part of 30 degree of left and 30 degree of right give an error below 7 pixels. The parts of 30 degree of left and 30 degree of right have a only one boundary side of iris. This part can not be extracted point. Then it has error over 10 pixels. Therefore, the middle point is taken from below 15 degree. We can find a position of iris using our scheme even though the eyelid is covered with a portion of iris.

IV. CONCLUSIONS

An enhancement of tracking capacity for the positioning of the Iris images is presented in this paper. The algorithm FFDP (Four Points Diagonal Positioning) is that the image is positioned with arbitrary 4 points on the edge of iris and that points are drawn a diagonal on the cross. The experiment result enables the positioned hidden iris to track on the eyelid. Even though the iris is covered with eyelid, the magnitude of iris is over 0.7 cm and has a middle point within 7 pixels at the degree of 15. The propose algorithm is applicable to human interface such like mouse cursor something like that in future.

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