AN EDGE TRACING METHOD DEVELOPED FOR OBJECT RECOGNITION

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ABSTRACT

In this study a new developed edge tracing method was applied to the pixel set formed from the numerical image of an object in order to obtain the characteristic vector which is very important in the recognition of an object. In this method, instead of detecting all elements of the pixel set, only the pixels with contour lines were traced by scanning the set for a given order. Therefore, it was shown that the edges of basic nonconvex and convex objects could be determined easily.

Keywords: object recognition, characteristic vector, edge tracing, feature detection.

INTRODUCTION

What is desired in the detection of the characteristic vector of an object is to evaluate the information included in the appearance of the object, and to eliminate the unnecessary information causing time loses in recognition of the object [Türko96]. Edge tracing is one of the most fundamental subject of image analysis. In image analysis and classification of objects the edge tracing has become very interesting and popular.

Edge tracing plays an important role in object recognition. We can explain it as follows: Human seeing system looks at any object first,
during the recognition period. When we apply this approach to the artificial seeing systems, it is essential to trace the edge of object effectively to reach a good recognition [Bagci94]. In another word, the edge tracing plays an important role in recognition the edge too. Many images do not include concrete objects and to understand these objects depends on their structural features. The detection of these features depends on edge tracing [Banks90].

The recognition can be achieved with the aid of direction changes of edge. For this, any edge line of the object is accepted as the starting point and the edge is traced. Consequently, the number of direction changes is compared with the changes in the edge of the model objects in data-base and the type of the object is determined. For example, suppose that the shape is a triangle. Any edge of this triangle is taken as the starting point. There are totally three direction changes from this point. These

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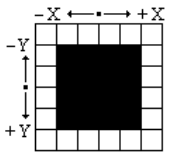
changes helps to understand that the object is a triangle. Tracing continues as far as the beginning point [Uzuna92].

Edge tracing algorithms are expected to achieve a very high success rate besides realising a rapid, two dimensional seeing process in automation systems. The most important thing is to be independent of the changes in the dimensions, brightness, place and posture. In addition there must not be any information loss during image processing. On the other hand, whole image processing takes a very long time. There are tracing only the edge of the objects, desired quickness and performance can be achieved [Duda89].

EDGE TRACING METHOD

The most important information from the edge tracing is the boundaries of the object. Statistical or geometrical characteristic vectors are obtained with the information about boundaries [Maref90].

In order to follow the edge of an object in lines there are some methods like Hough [Shira87] and Rotational Transformations [Kang91] but here a new algorithm developed by us and resembled with a pixel set is given. The algorithm can follow the edge of any object as dots. The image of an object on a data-base and the directions for edge tracing algorithm are given in Fig.1.



Directions for edge tracing algorithm on matrix database.

Figure 1

Step 1 : The first edge of the object is found by tracing the matrix data-base from the first line in the direction $+x$.

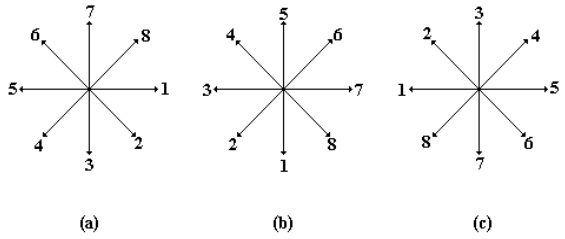
Step 2 : The subsequent points are traced like in fig.2.a. The first point found during this ordered tracing is accepted as the subsequent point of the object.

Step 3 : The coordinates of the edge point found in the second step are processed as follows;

- If the point is a point in $(+x,+y)$ direction, the tracing order is taken like Fig.2.a.
- If it is in $(-x,+y)$ direction, the tracing order in Fig.2.b is used.
- If it is in $(+x,-y)$ direction order, the tracing order in Fig.2.c is used.
- If it is in $(-x,-y)$ direction, the tracing order in Fig.2.b is used.

Step 4 : If there is no point following in any direction, this shows a broken off.

Step 5 : The edge tracing process is completed when reached the beginning point by following the steps given above.



The edge order of any side points.

Figure 2

Which edge order will be used is decided according to the neighbouring positions given in Fig.3.

(x-1,y-1)	(x,y-1)	(x+1,y-1)
(x-1,y)	**(x,y)**	(x+1,y)
(x-1,y+1)	(x,y+1)	(x+1,y+1)

The neighbouring positions of any (x,y) point.

Figure 3

The mathematical expressions to determine the advancing direction is as follows ;

$$x = x + f(\cos j) \quad (1)$$

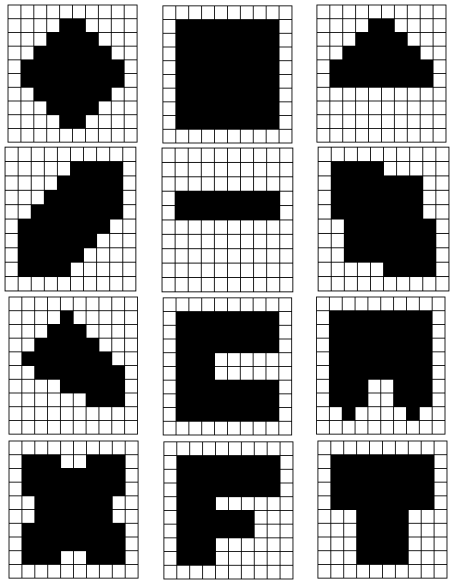
$$y = y + f(\sin j) \quad (2)$$

$$f(z) = \begin{cases} z < -0.5 & -1 \\ z > 0.5 & 1 \\ other & 0 \end{cases} \qquad (3)$$

The change in j angle can only be in an interval of 45^o and $Dj = 360$ a+ maximum. In other words;

- for the order in Fig.2.a.
  $j = 0; \quad j \le 360; \quad j = j + 45$
- for the order in Fig.2.b.
  $j = 90; \quad j \le 450; \quad j = j + 45$
- for the order in Fig.2.c.
  $j = 180; \quad j \le 540; \quad j = j + 45$

Some objects recognized successfully by the edge tracing algorithm in the limits given above are shown in Fig.4.



Some objects which is defined successfully by the edge tracing algorithms.

Figure 4

CONCLUSION

Instead of obtaining the edges by emptying inner side of an object in object recognition process, with this new method, only the contour of the object can be traced directly. Thus getting the characteristic vector in shorter times. In addition, the method is independent of rotation or translation of the object. The disadvantages of the method are those: not to be able to trace the edges of the inner object if there is, to sense the multiple objects as a single one and to mistrace the edges of the objects which have intersections.

REFERENCES

Bagciogullari, F. and C.H : *A Edge detection algorithm developed for object recognition system*, The Symposium of 2. Signal Processing and Applications, s.47-52, 1994.

Banks, S: *Signal Processing, Image Processing and Pattern Recognition.* Sheffield University, 1990.

Duda R.O. and Hart, P.E : *Pattern Classification and Scene Analysis*. Stanford Research Institute, 1989.

Kang, C. W. etc : *Extraction of Straight Line Segments Using Rotation Transform: Generalized Hough Transform*, Pattern Recognition, vol. 24 (7), pp. 633, 1991.

Marefat, K : *Geometric reasoning for recognition of 3-D object feature*, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol.12, pp.950-964, 1990.

Shirai, Y: *Three – Dimensional Computer Vision*, Springer – Verlag, 1987.

Türkoglu, I. and Arslan, A: *Recognition of Distorted Pattern with Artificial Neural Networks*, Firat University Science Institute Journal, p.147-158, 1996.

Uzunalioglu, H : *Model-Based Recognition of Polyhedral Objects*, Master Thesis, METU Science Institute, 1992.