Digit Recognition Using Freeman Chain Code

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ABSTRACT

Shape of object representation has always been an important topic in image processing and computer vision. In order to detect the shape of the object, Contour plays a key role. Applications of shape recognition can be found in many areas such as medicine, space exploration, manufacturing, defense and many others. Chain code techniques are widely used to represent an object because they preserve information and allow considerable data reduction. In this paper ,we propose an effective chain code algorithm detecting contour for the binary object and also this chain code is used for machine learning i;e; the system can recognize the input digit.

Keywords: Chain code, Contour

1. INTRODUCTION

A human being can differentiate between various objects by observing their shape, color, texture and features. To impart this intelligence into a system, we need to implement techniques like contour detection to help the system in recognizing the shapes of objects. Here we apply this to digits or character recognition. The term Contour can be defined as an outline or a boundary of an object. Contour detection deals with detecting various objects in an image. Boundary detection plays a key role in the areas of image processing and computer vision. This paper presents a new simple approach to find the contour of a digit and we can also find the binary code of it from that we finally obtain the freeman code (which was proposed by Freeman in 1961) or chain code finally the chain codes are compared to recognize the input digit.

2. Background Work

Chain Code or Freeman code : Chain code[1] is used to represent a boundary by a connected sequence of straight line segments of specified length and direction. Typically this representation is based on 4 (or) 8 connectivity of the segments (as shown in figure1a, 1b). The direction of each segment is coded by using a numbering scheme. A boundary code formed as a sequence of such directional numbers is referred to as a Freeman Chain Code. The chain code of a boundary depends on the starting point. Working with code numbers offers a unified way to analyze the shape of the boundary. Chain Code follows the contour in counter clockwise manner and keeps track of the directions as we go from one contour pixel to the next.Figure1(a) shows 4-connectivity[2] and Figure1(b) shows 8-connectivity of freeman chain code.
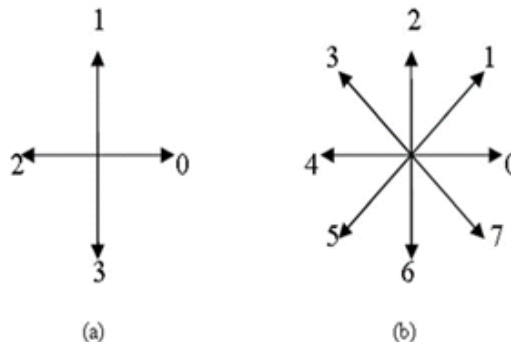

Figure1 Neighbour Directions of Freeman Chain code

The main disadvantage of 4-connectivity is that we lose the diagonal points where these points are very useful in most of the image applications. so, inorder to overcome the disadvantage of 4-connectivity here we use 8-connectivity.In 8-connectivity each code can be considered as the angular directions, in multiples of 45^0,that we must move to go from one contour pixel to the next. if we consider figure2, we calculate freeman code using 8-connectivity as follows..
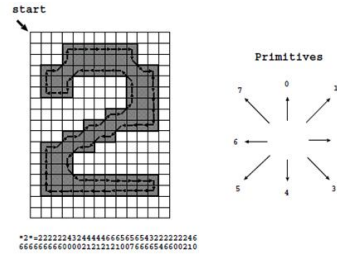
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Figure2 Representation of a digit 2 drawn on the left using Freeman code
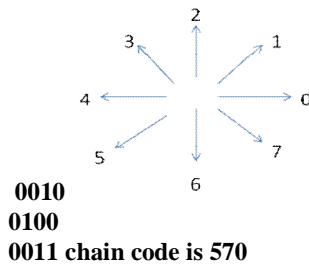
Contour:
Contour of an image means boundary of the image.

3. Related Work

How to find the chain code for 8-connectivity?
 In 8-connectivity we have only the digits from 0 to 7
Ex: first we consider this binary code

  0010
0100
0011 chain code is 570

Explanation:
First it checks for non zero pixel (or for 1) to start, here it is in first row , third position from that it checks for another non zero which is in second row second position so , by 8-connectivity the direction from first one to second one is 5 (from the above figure)and it checks for a non zero pixel again it is in third row third position and the direction from second row one to third row first one according to 8-connectivity is 7 and from that it checks for non zero again it is present in its next position the direction is 0. so , finally the freeman code or chain code for this example is 570.

4. Effective Work :

Algorithm to get freeman code of an image and from that we can recognize the digit
1) Here, First user draws an image(any digit from 0-9) with the help of a mouse here.
2) The digit contour(boundary) is saved.
3) The binary code of the digit is saved i;e; the border pixels are 1's and the remaining pixels are 0's.
4) From the binary code we get the freeman code using 8-connectivity.
5) Similarly we find the freeman codes of all the digits (from 0-9) when we draw a test image its freeman code is compared with all the training data and finally the digit is recognized.
6) For comparison of freeman codes we find the number of 0's, number of 1's ….to number of 7's since it is 8-connectivity only 0 to 7 digits present. It checks for both training data and test data.
7) After that we compare by finding those differences in code and recognize the digit with minimum difference by the method[3] .
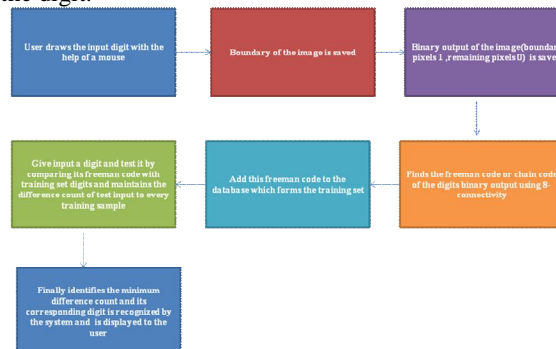8) Finally the system recognizes the digit.

Figure 3: Process flow for recognizing the digits by the system

The above figure represents how the digits are recognized by the system here the input digits boundary only saved so for that boundary the binary code is identified (only contour pixels 1 remaining all 0)after that we find the chain code and for several inputs i ;e, for ex: if we consider only for digits 0-9 we save these freeman codes and we can also save the digits written in different forms for ex :we write digit 4 in different forms so save all these digits in different forms and when we give the input to test it compares the total difference count of test input with all the other training samples and identifies the one with minimum count and finally the digit is recognized by the system.

5. Experiment Results:
Here the boundary of an input digit 2 and its binary code and freeman code are displayed as follows.

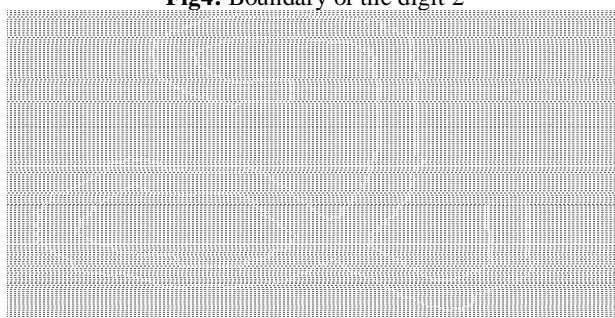

Fig4: Boundary of the digit 2

Fig5: Binary code of the digit 2

23222222222222221232222222322223123244431243322444444435444344443
4365444444444444444444444444444444444444433455445443544534544554454
455446544654354533333332343324333332222212111211110000000000000007
00000000000022222222224444444444444444444444443354445455547555654
6565444546547656776677776670776007777677677707775565554665546556665
75656666566766666666654767567607767676765476766667670007776707760
71070107010007110002100022211111111111100022211321332244332222322
22222222222211332243433333443333434333312100021001001010010010000
711000100000000000000000000000000000007000070100700757077666667
66667666666666666666666565565556543444333432332322221222222222444
444444466666666666666557676660075677607607776007710000700010007122
101221021211122222

Fig:6 Freeman code of the above digit2

6. Conclusion
Finally from this the system can recognize the digits or any characters with the help of freeman or chain code.In future we can also extend this to the size variant inputs.

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