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Fetal Brain Border Detection from MRI using Chain Code Algorithm

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***Abstract*—** Magnetic Resonance Imaging of fetal brain facilitates to evaluate in-utero fetal brain development. Segmentation of fetal brain from MRI is a challenging task due to significant changes in terms of geometry as well as tissue morphology. In order to make ease of segmentation, fetal brain border is detected using chain code algorithm. Detected brain border is used further through in which query images will be extracted from fetal MRI database. This work will be extended with feature extraction and 3D modeling of fetal brain in a little while.

***Keywords*—**fetal brain,chain code,feature extraction.

I. INTRODUCTION

This work makes use of chain codes as features for image boundary detection. The boundary is further used to automatically retrieve the fetal brain shapes from a MRI database. In general, Shape descriptors [1] are classified as: region based methods and boundary based methods. The area within the image region is considered for shape description by region based methods. Hence, more computation time and storage space are required. The contour based methods require only the pixels lying on the boundary region. So, it require less time and space for description. In this paper, we used contour based shape description using chain code [2] for boundary detection in order to achieve images retrieval. Chain code methods have numerous advantages. The chain codes [3],[4] are compact and translation invariant for representation of a binary object. In addition, chain code methods can be applied to calculate any shape feature as since it is a complete representation of any object or curve. The remaining part of the paper is organized as follows.

In section II, we present the boundary detection using chain code methodology, Section III describes results and discussion, Section IV concludes research work with future directions.

II. METHODOLOGY

Boundary Detection and Chain code

Chain code [5] is constructed with preprocess of boundary detection. Chains represent the boundaries of any discrete shape such as binary object. The objective is to find the boundary pixels in the given image. The contour is recognized as a connected pixels lying along the boundary of the object. The neighborhood for image pixel is connected as 4-connected neighbor and 8-connected neighbor, as shown in Figure 1.

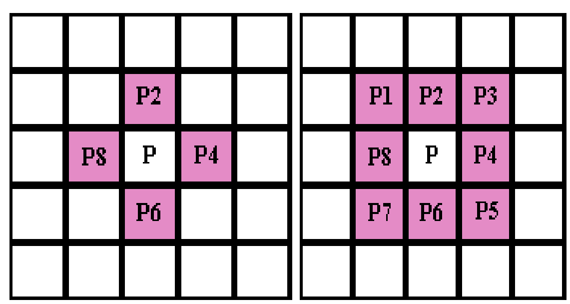

Figure1. Pixel connectedness (a) 4- neighbour pixels (b) 8-neighbor pixels

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The 4-connectedness allows adjacent pixels in vertical and horizontal directions, whereas the 8-connectedness includes pixels in diagonal directions also. 4-connectedess failed to produce the diagonal points where such points are very helpful for boundary detection in most of the applications. In order to solve this issue, we use 8-connectedness for chain code. The direction of the chain code is given in Table 1 The boundary of a binary image is computed by chain code[6] as array of integer values X={x_0,x_1,…,x_{n-1}} where xi from the set {0,1, … ,7} for *i*=0, 1, … , *n*-1. The length of the chain code depends on the number of elements in the array. The starting and ending point of the chain code is represents x0 and xn-1. The process starts from the initial point to ending point. The tracing through this directions may change based on the requirement and shape of the images, and thus the chain code [7] obtained. The positions of subsequent pixels are given in Table 2.

Table 1. Direction of chain code

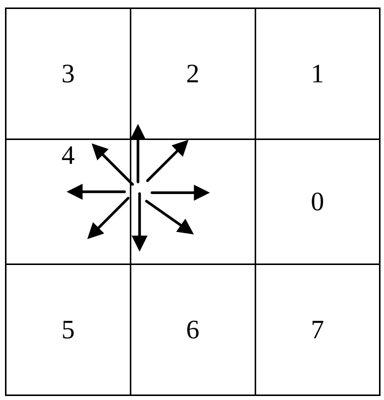

Table 2. Position of subsequent pixels

Current pixel coordinate (i,j)		
Code	Next row	Next column
0	i	j+1
1	i-1	j+1
2	i-1	j
3	i-1	j-1
4	i	j-1
5	i+1	j-1
6	i+1	j
7	i+1	j+1

III. RESULTS AND DISCUSSION

Experiments done by detecting fetal brain boundary (Figure 2) using fetal brain mask which comprises difference in curvature, corner sharpness and anomaly along the boundary curves.

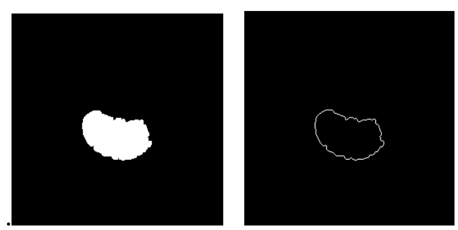

Figure 2 (a) Fetal brain Mask (b) Brain Boundary

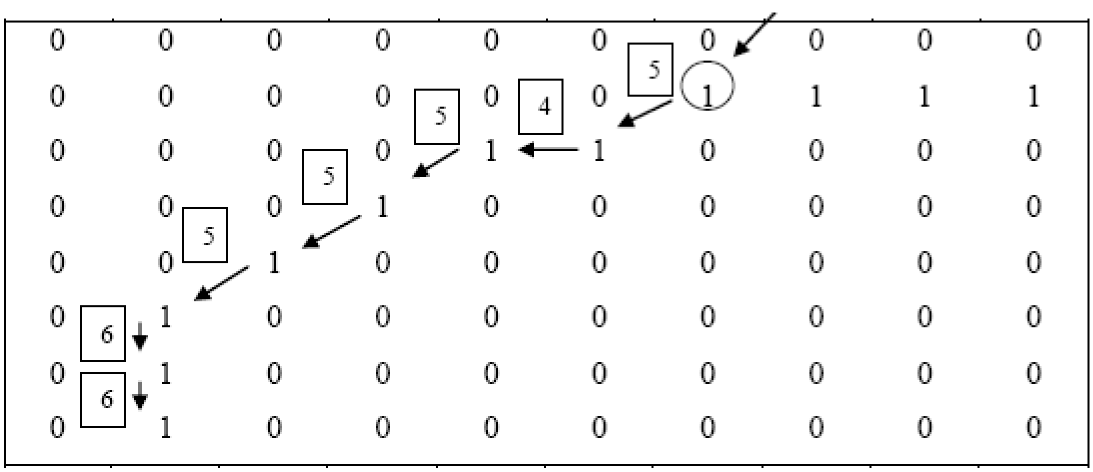

Figure.3 Sample code for deriving chain code starting from the initial location X_0

Next chain codes for the boundary pixels are calculated. The number of direction changes for each pair of pixels in the contour is determined. For example, from the figure.3 we note that the chain code method starts from point X_0. The sample chain code is obtained and thus the values are 5 4 5 5 5 6 6 in 8-directional. Here, from point 1 to point 2 the chain code is 5. The change in chain code at point 2, a corner will be detected. The chain code for point 2 to point 3 is 4, here the chain code again change so in point 2 yet again a corner will be detected. In the same way, the method proceeds for all boundary pixels to obtain the chain code. The sample chain code extracted for the fetal brain boundary is given in figure 4.

Figure 4 Sample chain code extracted for fetal brain boundary image

Columns 1 through 19
5 4 4 5 4 5 4 5 5 6 6 5 6 5 6 6 6 6 6
Columns 20 through 38
6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 6 6 6 6
Columns 39 through 57
6 7 6 7 7 7 7 7 0 0 7 0 0 0 0 0 0 1 0

VII. CONCLUSION and Future Scope

Our work shows that the chain code approach is used to achieve fetal brain boundary detection. By using this brain boundary, retrieval of fetal brain from the database is simple and fast. Further this work will be extended for feature extraction and finally to produce a 3D model for fetal brain MRI.

REFERENCES

[1] Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, " *Digital Image Processing Using MATLAB*", 2nd edition,pp 440-488.

[2] Jahne, B., "*Practical handbook on image processing for scientific and technical applications*", CRC Press, p.494,2004.

[3] Neeta Nain, Viajay Laxmi, Ankur Kumar Jain and Rakesh Agarwal,"*Morphological Edge Detection and Corner Detection Algorithm Using Chain-Encoding*", IPCV'2006, pp 1-5,2008.

[4] Baji F, Mocanu M, "*Chain Code Approach for Shape based Image Retrieval*",Indian Journal of Science and Technology,vol.11,2018.

[5] Boodoo-Jahangeer, N.B. and Baichoo, "*Face recognition using chain codes*",Journal of Signal and Information Processing, vol.4,p.154,2013.

[6] Parmar DA., "*Content MRI Brain Image Retrieval using Shape Descriptors and Relevance Vector Machine (RVM)*",International Journal of Advance Research in Computer Science and Management Studies,vol.4,2016.

[7] Anjan Bikash Maity,Sandip Mandal,Ranjan Podder,"*Edge Detection Using Morphological Method and Corner Detection Using Chain Code Algorithm*",IJCSI International Journal of Computer Science Issues,vol.8, 2011.

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