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RESEARCH ARTICLE

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PATTERN RECOGNITION & MATCHING USING REFINE CHAIN CODE

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ABSTRACT

Pattern recognition is a major problem in image understanding and computer vision, where identification of shape is important. Pattern recognition is an extension of shape recognition. To recognize an pattern, it is necessary to identify first shape of object then extend it for Pattern recognition. This study focuses on recognizing a shape and finding out its edges or boundary and shape matching technique based on their chain codes. After detection edges complexity is reduced because we have only edges .The main advantage of chain code techniques is that it is invariant to translation, rotation and scaling. In this process I describe number of objects in the image, number of corners in each shape of the image and also describe types of shape The main goal of this paper is to matching two or more images with different Shape based on their chain code.

Keywords: Chain code, Feature Extraction, Feature Matching Image Processing.

I. INTRODUCTION

Pattern recognition aims to classify data (Shape) based on either a priori knowledge or on statistical information extracted from the Shape. The Pattern to be classified is usually groups of measurements or observations, defining points in an appropriate multidimensional space. Applications of Pattern recognition can be found in many areas, such as, medicine where we diagnosis many disease like cancer , space exploration, security mechanism, manufacturing, face detection, text analysis, defense and many others [1] [2].

A complete Shape recognition system consists of a sensor that collects the raw information about the pixels and after that we extract the features of data and than calculate the information about the object or Shape and match them on the basis of collected features. here "raw data" is the set of measurements provided by a sensor like(e.g. The pixels of an image provided by a digital camera). The first steps of the Shape recognition process are processing and edge detection that may include some signal processing such as smoothing and noise filtering and the extraction of higher level features which based on chain code than we match the image for which human knowledge about the task is essential.

In [3] [4] object Shape has been considered as an important feature of images for Shape matching. It is used to find a Shape representation, which is invariant to scale, translation and rotation, and a similarity measure, which conforms to human

perception and suitable for content-based image retrieval. In this current work, an efficient method for Shape matching is focused, in which object's Shape has been considered as an important feature of images. For Shape representation, one eight-directional chain code is used which is invariant to translation, rotation and scaling. The unique chain code is suitable for Shape matching on which Shape similarity can be computed easily.

For every image representation and description there are two type of descriptor, which are as follows

1. Boundary (Contour) Based Descriptor :
   In this method we used only boundary of an image for representation and description. There are different features used in boundary descriptor. Ex. Chain code, Fourier Descriptors, Shape signature.
2. Region Based Descriptor :
   In this method we used whole region of an image for representation and description. There are different features used in region descriptor.
   Ex.Texture, Skeleton of regions, convex hull, Moment, Principal axes.

Comparing with region based Shape representation; contour based Shape representation is more popular. Because moments combine information across an entire object rather than providing information just at a single boundary. So In this project I used chain code representation based on boundary descriptor method because rather than whole region I used only boundary of an image to generate chain codes, so so8me complexity reduced due to its boundary[10].

II. RELATED WORK

There are several approaches to Shape recognition based on chain code. In this paper [1] circle is very compact from other Shape. In our proposed solution also generate chain code for circle Shape with some modification of original chain code and generate refine chain codes for circle Shape. [2] This paper surveys the various techniques for Shape recognition and analysis with emphasis on robustness. Specifically, a review of boundary Shape analysis methods and techniques. In [3] [4] object Shape has been considered as an important feature of images for Shape matching. It is used to find a Shape representation, which is invariant to scale, translation and rotation In [5] uses Fourier theory based method and combine with chain code for Shape representation but in our method we use only chain code features, so complexity is reduced. In [6] a novel approach for contour representation algorithm for binary images which is an extension of the conventional chain code is proposed In this [8] paper Shape features of the are extracted according to the chain code characteristics, including circumference, area, circular degree, inscribed circle radius, graph complexity, concave rate, graph parameter, height and width, but our paper based on many Shape. In vertex chain code approach [9] chain code is represent the boundaries or contours of any discrete Shape composed of regular cells but our solution based on chain code which numbered from 0 to 7 digit. Here [10] also analysis and survey all methods related to pixels, chain codes and image processing and computer vision. In [10] review different method of Shape representation and descriptor technique, and also examine implementation procedures for each technique and discuss its advantages and disadvantages. In [12] edge detection tutorial is used for edge detection of input images.

III. PROBLEM DEFINITION

The Human eye can instantly perform matching of two Shapes are matched with deceptive effortlessness. To understand the difficulty of getting a computer to do the same and design a system that can take an image with collection of Shape or Shapes and then image Shape to be identified and matching of different Shape based on their chain code.

So this paper deals with the representation and recognition of different types of patttern or Shapes based on their chain codes. A software system needs to be developed which can not only matching of Shapes but also be able to show the output at intermediate steps involved. To the most basic functionality system should be able to work with monochrome images. Basic two dimensional images in a jpg or png format should

be handled. Chain codes are one directional codes. The properties of chain codes are invariant to rotation, translation and scaling. So there is a problem in matching of two Shapes. So author proposed a solution which is variant to translation, rotation, scaling using refine chain code .

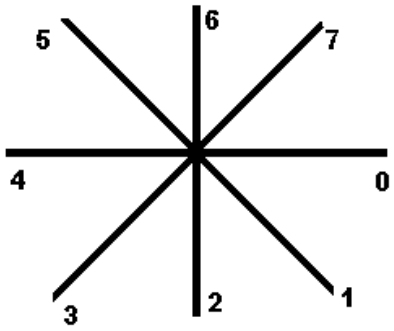


Figure 1: Eight-directional Chain Code.

In this process used eight directional chain codes for extraction of features from image file. In image file I describe number of objects or Shape in image file and also describe image description for example number of corner in every Shape in image file and Shape type is open or closed. For high performance also generate refine chain code which is enhancement of original chain codes.

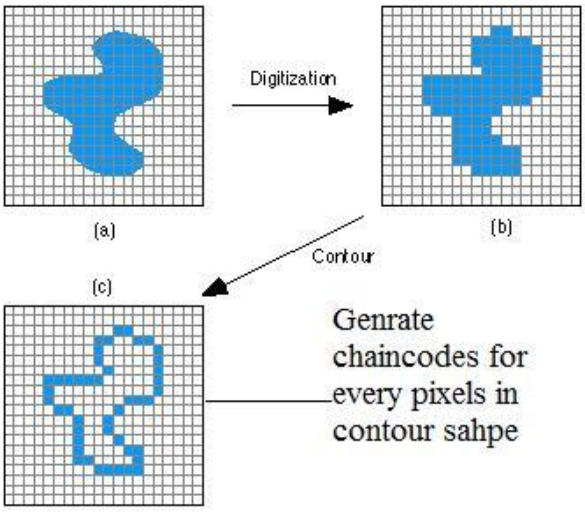
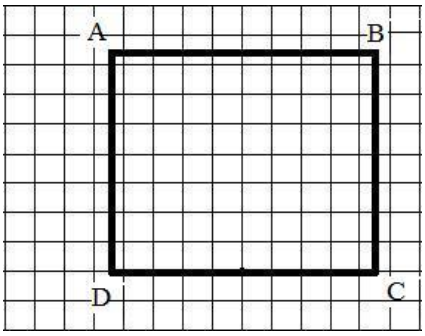


Figure 2: (A) Region (shaded) as it is transformed from (a) continuous to (b) discrete form and then considered as a (c) contour and finally generate chain code for every pixels in contour Shape.

For example tracing the given Shape in Figure 3 from stating point A using eight directional chain code moving in clockwise direction will produce following chain code sequence: 0000000000, 2222222222, 4444444444, 6666666666. Changing of chain code direction showing corners of the Shape.



IV. SYTEM ARCHITECTURE

The main function of system is recognize a basic Shape based on their chain codes and also match the Shape based on their generated 8 –direction chain codes as an input and checks that whether they match within a given tolerance limit or not. After feature matching final output shows number of Shape, number

of corners, Shape type information and finally how many Shape matched in both images. At the design stage the most important work is to make a clear understanding of what user's need. As the main function are clearly known from system architecture.

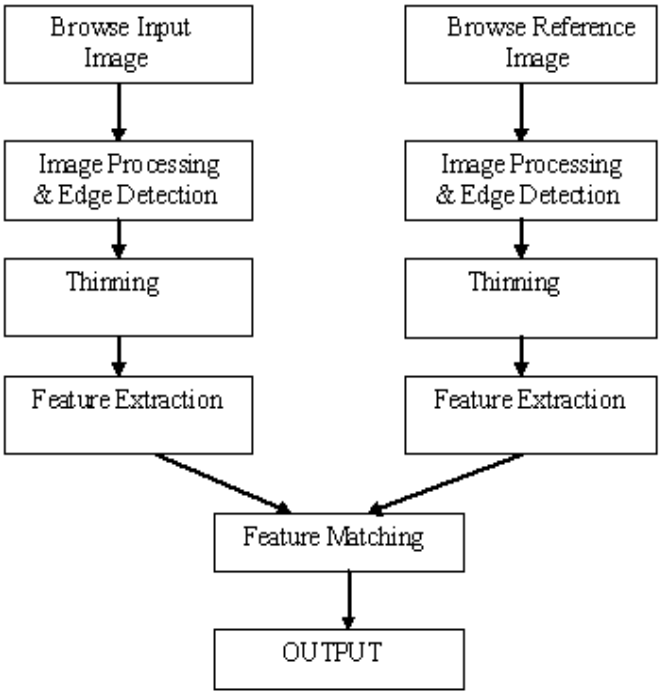


Figure 4: Shows a basic flow of sequence of steps followed in the application.

V. PROPOSED SOLUTION

In This we decomposed the problem for generating the features of image so that we can match the image.

- 1. Image Processing and Edge Detection
- 2. Thinning
- 3. Feature Extraction
- 4. Feature matching

1. Image Processing Phase and Edge Detection:-

Processing is the name used for the operations on the images at the lowest level of abstraction-both input and output are intensity images, It is necessary to realize that preprocessing does not increase image information content and also is very useful in variety of situations since it helps to suppress information that is not relevant to the specific image processing or analysis task. Thus the task of pre-processing is an improvement of the image data that suppress undesired distortions or enhances some features important for further processing.

Local neighborhood pre-processing-: Preparation of the image also involves scanning and capturing of image and converting the image into standard formats like JPG, PNG, and BMP etc. It involves smoothing and filtering of the image to remove any kind of noise and/or to prepare images for further processing such as edge detection. It also includes converting the colored image into the gray scale image for the implementation of edge detection algorithms.

Edge Detection: - In this phase we detect the edge of the Shape by edge detection algorithm. Here we use sobel operator for edge detection algorithm to find the edges or boundary of the Shape. After applying edge detection method our complexity is reduced because we have only edges. So we get the boundary of the Shape and rests of pixels are discarded.

The sobel is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. The sobel edge detector uses a pair of 3x3 convolution masks, one estimating the gradient in the x-direction columns and the other estimating the gradient in the y-direction (rows [11].

2. Thinning:-

Skeletonization was introduced to describe the global properties of objects and to reduce the original image into a more compact representation. A basic method for skeletonization is thinning. It is an iterative technique, which extracts the skeleton of an object as a result. Thinning is a morphological operation that is used to remove selected foreground pixels from binary images, somewhat like erosion or opening. It can be used for several applications, but is particularly useful for skeletonization. In this mode it is commonly used to tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning is normally only applied to binary images, and produces another binary image as output Thinning algorithm is used to convert the edge detected image to 1-pixel thick line. So we easily extract the chain code from thick single line. So for this I use skeleton algorithm.

3. Feature Extraction:-

After sobel edge detection and thinning we extract the feature of different Shape by using chain code. So here we used chain codes for representing a Shape of an object. Feature extraction is the ability to distinguish objects in a single image by their regions, edges, or corners to determine control points that can be compared against another similar image. Hence, one conventional eight directional chain code (Figure 1) is used to represent the Shape of each object in the image. The edges of a Shape are partitioned by fixed size line segment. The chain code of a line segment depends on the previous line segment based on the direction as shown in Figure 1. In this stage also generate scaled chain code which shows starting point of every direction in eight directional chain code for each Shape.

Here compute chain code by scanning the image to find the starting pixel of the object. From that pixel, we traverse the boundary and decide directions and save them as an array or list. This step is repeated until we reach the end pixel.

If end pixel not equal to start pixel then Shape is not closed.

And If end pixel =start pixel, then we have a closed Shape.

Depending on the number of corners and start and ending pixels, we can guess the number of sides and according to that form the Shape. For example if corner is 1 then object is point if corner is 2 then line and corner is 3 then triangle etc. To differentiate between rectangle and square, check the length of each side per Shape based on the chain code sequence. And also many Shape can be find based on corners.

Using the same coding convention, the chain code for rotational Shape representation and the chain

code for scaled Shape representation is generated in the following sections.

A. *Invariant Chain Code for Rotational Shape:-*

An object's Shape is shown in Figure 5. Using eight directional chain codes, the scaled chain code of the Shape is 0, 2, 4, 6; Assuming A as the starting point. Similarly, In another figure same starting point but figure is rotated at some angle then scaled chain code for this figure is 1, 3, 5, 7;

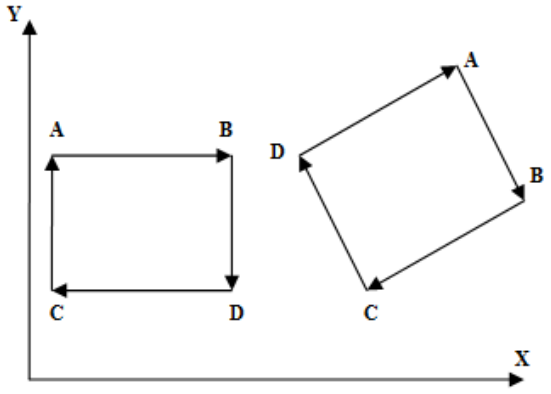


Figure 5: Rotational Shape representation of an objects Shape.

In circular way, the Shape is same but chain code sequences are different thus, this representation is invariant to rotation of a Shape. So for variation in rotational Shape I calculate the scaled chain of all figure and if two figure have same scaled chain then I calculate all possible scaled chain in all directional rotation. For rotational matching I use left shift of the scaled chain. In Figure 5. All possible scaled chain of 0,2,4,6 after rotation is (1357), (2460), (3571), (4602), (5713), (6024), (7135), (0246). In Figure5. I use left shift of scaled chain, then possible left shift of scaled chain 1,3,5,7 is (3571), (5713), (7135), (1357)

B. Invariant Chain Code for Scaled Shape Representation:-

The chain code sequence for the Shape in Figure 6 is 0, 2, 4, 6; In Shape 1 and in Shape 2 the chain code is 0, 0, 2, 2, 4, 4, 6, 6;

Considering A as the starting point. Both Shapes are same but Shape 2 is scaling of Shape 1. But both Shapes have different chain code length. For variation in scaled Shape first I calculate scaled chain, if scaled chain is same then I calculates scale factor of second Shape over the first Shape is the ratio of chain code length of both Shapes.

Shape.

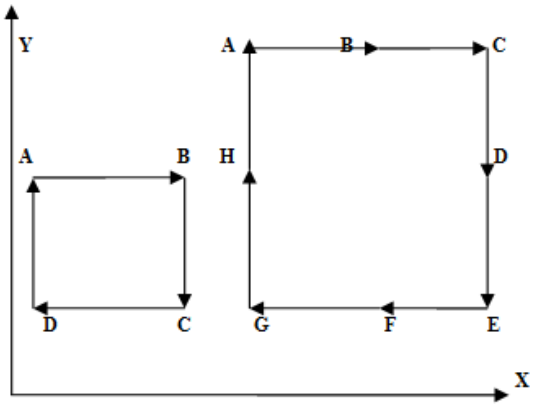


Figure 6: Scaled Shape representation of an objects Shape

C Invariant Chain Code for Translation Shape Representation:-

If X and Y two input chain codes for two Shapes, then for variation in translation Shape first I check if X and Y sequences are matched, then track any chain code from X and from that, detect the two endpoints (x_1, y_1) and (x_2, y_2) of its corresponding line segment, and find the corresponding matched code from Y and from that, detect the two end points (w_1, z_1) and (w_2, z_2) of its corresponding line segment. Translation factor for x and y direction is $(x_1 - w_1)$ and $(y_1 - z_1)$ respectively for the point (x_1, y_1) of first image and the point (w_1, z_1) of second image.

4. Feature Matching

Feature matching is used to measure the similarities between the different images after feature extraction is applied. In feature matching phase we match the object's Shape based on chain code. Feature matching is the process of detecting features in separate images that can be compared. In this paper, the algorithm that is used to match the chain code of two Shapes and find out the scale, rotation and translation factor of two images. In this module also describe number of objects, number of corners, Shape description and type of Shape in given input images.

In this paper, create the algorithm that is used to match the chain code of two Shapes and find out the scale, rotation and translation factor of two images. The steps of the algorithm are following.

Step 1: Input two images and apply image processing algorithm, that reducing noise in that images and also generate two Gray scale images.

Step 2: After that apply edge detection method that generate binary images that contains the edges of each Shapes.

Step 3: After edge detection apply thinning algorithm to get the one pixel thick line. And after thinning we use images to generate chain codes.

Step 4: Apply feature extraction technique to generate the chain codes of two Thinned images and store them in two temporary arrays X & Y.

Step 5: After feature extraction, In feature matching process match the two images based on their chain codes.

Step 6: If any variation likes scaling, rotation or translation are come in feature matching process then we calculate different factors.

Step 7: Input two chain codes X and Y for two Shapes. The scale factor S of second Shape over first Shape is the ratio of the chain code length of Y and the chain code length of X.

Step 8: The chain code X and Y are matched in circular way. The scaled chain of Shape X and left shift of scaled chain of Shape Y should be same (matched) in circular fashion if two Shapes are same.

Step 9: X and Y sequence are matched, then track any code from X and from that, detect the two endpoints (x_1, y_1) and (x_2, y_2) of its corresponding line segment, and find the corresponding matched code from Y and from that, detect the two end points (w_1, z_1) and (w_2, z_2) of its corresponding line segment.

Step 10: Translation factor for x and y direction is $(x_1 - w_1)$ and $(y_1 - z_1)$ respectively for the point (x_1, y_1) of first image and the point (w_1, z_1) of second image.

VI. RESULT

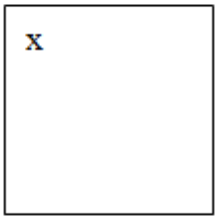
Paper deals with the representation and recognition of different types of Shapes or Shapes based on their chain codes and their features. Chain codes are one directional codes. They are invariant to rotation, translation, scaling So in tis paper we give solution which is variant to translation, rotation, scaling.

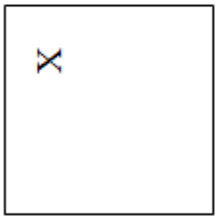
like take example if two image A and B take two image A and B first we generate chain code of both the images. if both images are exactly same then there chain code(features) also same so result correct match.

1.chain code invariant to rotations

but if in A image 1 object is there and second image B, 1 object is there. both object are are same Shape, .same size but it is rotated with some angle..according to freeman chain code this two images not matched. but both object are same so they show match result. so here in our paper we create algorithm that if objet is rotated so object starting point changed and chain code different

image A image B





According to result == not match

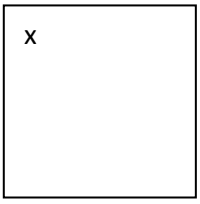
According to our result ====match and also result show that object is rotated with some angle.

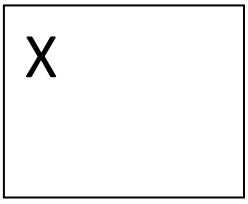
like chain code is 1234 for image A

chain code for image B is 2341

2. **chain code *Invariant Chain Code for Scaled Shape***

like same image but object in image A and image B is scaled ..but object is same..but there chain code value is just double or multiple of X





According to result == not match because there chain code not matched.

according to our result =====match and also result show that object is scaled.

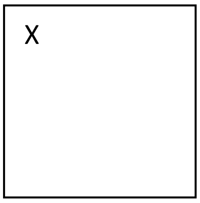
like chain code is 1234 for image A

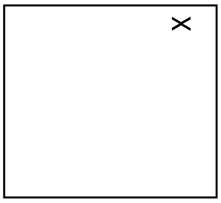
chain code for image B is 11223344

3.chain code invariant to translation

but if in A image 1 object is there and second image B, 1 object is there. both object are are same Shape,. same size but it is rotated with some angle..according to freeman chain code this two images not matched. but both object are same so they show match result. so here in our paper we create algorithm that if objet is rotated with any angle and transform some other place on xy axis..then it is show images. show it proves that

image A   image B



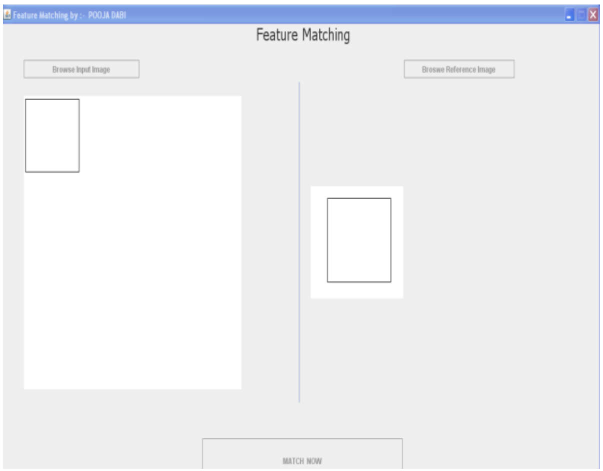


According to result == not match

according to our result =====match and also result show that object is rotated with some angle.

like chain code is 1234 for image A

chain code for image B is 2341 and also rotation angle.



Match Result

No of objects in the input Image is 1

Refined Chain

000000000000000000000000000000000000000000
000000000000000000000000000000000000000000
000000000000000000000222222222222222222222
222222222222222222222222222222222222222222
222222222222222222222222222222222222222222
444444444444444444444444444444444444444444
444444444444444444444444444444444444444444
444444444444444444444666666666666666666666
666666666666666666666666666666666666666666
6666666666666666666666666666666666666666

NO of Corners :4

TYPE OF SHAPE: CLOSED

QUADILATERAL

Scaled Chain:0246

No of objects in the Reference Image is 1

Refined Chain

000000000000000000000000000000000000000000
000000000000000000000000000000000000000000
000000000000000000000000000000000000000022
222222222222222222222222222222222222222222
222222222222222222222222222222222222222222
222222222222222222222222222222222224444444
444444444444444444444444444444444444444444
444444444444444444444444444444444444444444
444444444444444444444444444444444666666666
666666666666666666666666666666666666666666
666666666666666666666666666666666666666666
66666666666666666666666666

NO of Corners :4

TYPE OF SHAPE: CLOSED

QUADILATERAL

Scaled Chain:0246

The Image Seems to be Scaled

Starting Rotation Matching........

Possible Scaled Chain Codes After Rotation for Shape 1

0246
1357
2460
3571
4602
5713
6024
7135

Possible Shifted Scaled Chain Codes After Rotation for Shape 2

2460
4602
6024
0246

Total Figures Matched: 1

VII. Conclusions & Future Enhancement

In this paper, the basic chain code concept is extended to obtain the unique chain codes for Shape representation. This is quite significant because the unique chain code is invariant to translation, rotation and scaling. Based on the chain code sequence, the rotation, scale and translation factor of different images of objects have been derived. Shape matching is one of the most important tasks when integrating and analysing information from various sources. Major works under the scope of the Shape recognition and matching include implementation of matching of Shapes in two images. In future scope, object's 3D Shape can be considered for Shape recognition and matching. And also if 16 –directional chain code is used then also increasing performance but more

complexity because large number of chain code sequence is generated.

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