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Feature Extraction Technique using Shape Context Descriptor for Image Retrieval

KEYWORDS: Shape Context, Shape descriptor, Morphological operation

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ABSTRACT *With the increasing popularity of the use of large volume image database in various applications, it becomes essential to build an automatic and efficient retrieval system to browse the entire database. Techniques using textual attributes for annotations are limited in applications. The present approach relies on image feature that exploit visual cues such as shape. This paper describes contour based shape context descriptor for gray scale image retrieval. The proposed shape context descriptor will improve efficiency by using shape parameter and shape representation method. Shape context descriptor has properties like translation, rotation and scale invariant. The paper shows the good retrieval accuracy by applying shape context descriptor in gray scale dataset.*

1.Introduction

Digital images are a convenient medium for describing and storing spatial, temporal, spectral and physical components of information contained in a variety of domains. Due to the low cost of scanners and storage devices, digital images are now playing an important role in depicting and disseminating pictorial information. As a result, large image databases are being created and used in number of applications including criminal identification, biometric, Government offices, hospitals, academia etc. These databases consist of thousand of images, taking up gigabytes of memory space. Therefore an efficient and automatic procedure is intended for retrieving images from databases. Traditionally, textual feature such as filename, caption and keywords have been used to annotate and retrieve images but there are several drawbacks in these methods. It is subjective, time consuming and inconsistent. The keywords are inherently subjective, context dependent and not unique. It is generally preferable that image retrieval based on image content in a number of applications. As a result, there is a need to automatically extract visual features from images and to retrieve images based on visual primitives. Humans use color, shape, and texture to understand and recollect the content of images. Therefore, it is natural to use feature based on these attributes for image retrieval. Content based image retrieval (CBIR) consists of three steps: Feature extraction, indexing and Matching. Content includes color, shape, texture or grouping of these for retrieval. In this paper we had taken shape is important parameter for retrieval. Shape is an important visual feature and it is one of the basic features used to describe image content. Shape representation and description is a difficult task. Shape can be determined by applying segmentation or edge detection techniques. There are two types of shape representation methods: contour based and region based. Contour shape technique only exploit shape boundary information while in region based method, all pixels within a shape region are taken into consideration to obtain the shape representation. Contour based methods are most popular than region based because human beings are assumed to differentiate between the shapes by using their boundary features and generally most applications they do not require inner content. In contour based method it subdivides into global and structural based approach. There are various features had been designed including shape signature, signature histogram, shape invariants, moments, shape matrix, shape context, spectral features etc. The Shape context is one of the contour based global descriptor. Due to its robustness to rotation, scaling and its effectiveness in object recognition, shape context is employed as a global shape feature. The section 2 describes literature survey based on shape context algorithm, section 3 describes research elaboration section 4 describe result section 5 describe conclusion of this work.

2. Literature Survey

The shape based feature extraction and representation are classified based on their processing approaches. Shape representation can be classified into one dimensional shape representation, polygonal approximation, spatial interrelation feature, moments, scale space methods and shape transform domains[1][8][9]. The shape context method belongs to spatial interrelation feature technique. In this method the representation is done by using the geometric features like area, length, curvature, distance, relative orientation and location and so on.

More practically shape can be represented by discrete set of points sampled from the internal or external contours on the object. For each point p_i on the first shape, we want to find the "best" matching point q_j on the second shape. For this we have to find novel shape descriptor. Shape context is powerful tool for object recognition task and it is one of the contour based global descriptor. Because of its robustness to rotation and scaling .and its effectiveness in object recognition, shape context is employed as a global shape feature. It describes the coarse distribution of the rest of the shape with respect to a given point on the shape. Shape context analysis begins by taking N samples from the contour of the shape. The shape context descriptor of a given point on the shape is the histogram of the polar coordinates relative to all other points. The basic idea of shape context is illustrated in figure below: Fig.1(a) and (b) the random sample points are taken of two shapes. Fig 1(c) shows the diagram of log-polar histogram bins used in calculating the shape contexts. A shape context is a histogram that counts the number of sampled points along with their orientation and distance with respect to a reference point. The descriptor can be given by

$$h_i(k) = \#\{q \neq p_i : (q - p_i) \in bin(k)\} \quad [7]$$

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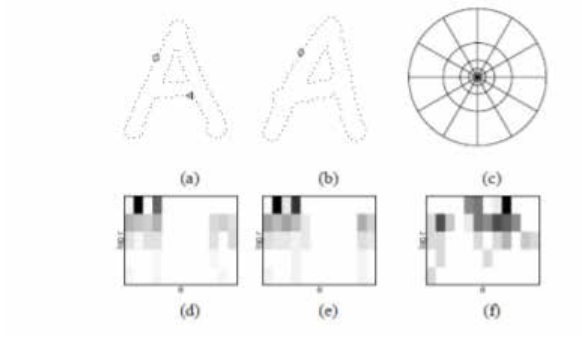

Figure 1: Shape Context [7]

In Fig:1 (d),(e) and (f) a large value of bin is represented as a dark block. It has been observed that the shape context of Fig:1 (d) and (e) are similar due to the representation of relatively similar points on two shapes.[8]

Shape context matching is often used to find the corresponding points on two shapes. It has been applied to a variety of object recognition problem.

3: Research Elaborations

The algorithm for building shape descriptor for gray scale image is mentioned below:

1. Read the query image
2. Perform preprocessing for gray scale images
   a. Apply median filtering (5 X 5) convolution mask is used which help in preserving the boundary.
   b. Perform morphological operation: close operation where first apply dilation followed by erosion.
      $X \bullet B = (X \ominus B) \ominus B$
   c. Close operation fills the holes and gaps in a single pixel object. It smoothes contours and maintain shapes and sizes of objects.
3. Apply chain code (8-connectivity) boundary tracing algorithm. This extracts the contour of the shape from query image.
4. Compute shape context of all images in dataset which will be stored in database.
5. Take N=100 equidistance sample points from total no. of points from contour. From each point calculate angular and radial direction of each point.
6. Calculate log polar histogram.
7. The above steps repeat for all other sample points.
8. Calculate shape context and create shape descriptor for sample points.
9. Find the distance between query shape and all other dataset images using chi-square distance
10. Sort the distance. Calculate mean of the distances.
11. If distance < threshold then retrieve images else reject images from database.

4.Result

In this experiment, gray scale images of leaf shape dataset are used. It contains 10 categories of leaf dataset and in each category 100 grayscale images are there. For each category as a input gray scale image is inserted and retrieval performance. The below figure shows the gray scale images of leaf dataset[3]

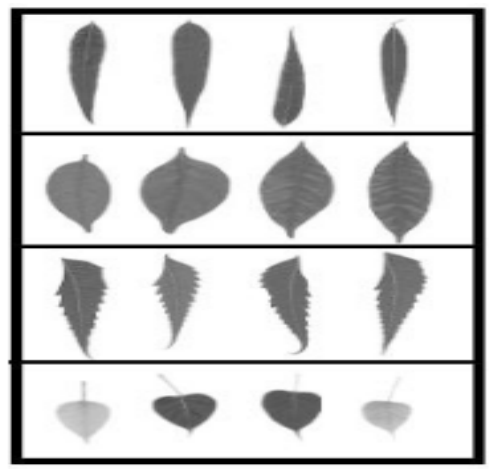

Figure 2 : Dataset of Leaf (gray scale images)

The below table shows the accuracy of image retrieval of leaf dataset of each category.

Class	Shape Context
Class 1	100
Class 2	60
Class 3	58
Class 4	72
Class 5	77
Class 6	79
Class 7	65
Class 8	58
Class 9	54
Class 10	100
Average	72.3

5. Conclusion:

This paper presented a shape context descriptor in gray scale images and it shows good retrieval result. Experiment results prove the algorithm to be effective in describing shape context for gray scale image retrieval purpose.

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