Analysis of Shape Signature Using Centroid based Local Features

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***Abstract*:- Content-based image retrieval (CBIR) work includes the selection, object representation, and matching. If a shape is used as feature, and the edge detection might be the first step of the feature extraction. Here the proposed novel shape descriptor for image retrieval uses centroid based shape signature. The descriptor can express information residing on boundary of the shape as well as in the inside region. Also it is a combination of edge pixel processing and region based processing. Here the proposed method plans to employ a feature extraction technique that is fast, efficient and eliding compact shape signature. The descriptor considers the centroid of bounding box of image as center and distance from that centroid to farthest edge point of image with minimum bounding box as radius to draw a circle that encompasses the image shape of bounding box. The circle is segmented into number of bins with equal size of bins. The ratio of no of pixels of each bin to the total pixel in the whole image is computed. These ratios for all the bins will serve as a shape signature for the image. This ratio value is computed for each bin and is stored as a scalar for shape matching and retrieval.**

Keywords:- Centroid, Contour, Bounding box.

1. INTRODUCTION

As information objects are digitized, more and more images have been generated in digital form around the world. There is a growing interest in finding images in large collections or from remote databases. In order to find an image in the large collection, the image has to be described or represented by certain features. Shape is an important visual feature of an image. Searching for images using the shape features has attracted much attention. There is an urgent demand for effective tools to facilitate the searching of images. The goal to find a similar image from large collections or from remotely distributed databases is shared not only by researchers, educators and professionals, but also by general users. Shape is an important visual feature and it is one of the basic features used to describe image content. Shape analysis is used in many application fields including emerging virtual environments or 3D model market, security applications, medical imaging and many more. A Shape descriptor (or Signature) is the simplified representation of images. These shape descriptors carry important image information to store and makes easy the comparing of different shapes. The proposed shape descriptor is based on centroid based local features of the image. The type of shape descriptor used here is region-based. The descriptor considers the centroid of bounding box of image as center and the distance from that centroid to farthest edge point of image with minimum bounding box as radius to draw a circle. That encompasses the image shape in the bounding box. The circle is segmented into number of equal sized bins. The ratio of no of pixels of each bin to the total pixel in the whole image is computed.

2 . TYPES OF IMAGE RETRIEVAL

Recognition and retrieval of images can be done based on the following categories:

Shape-based retrieval: Shape characteristics of an image plays a vital role is searching of images which are similar. The complexity in shape representation of an image causes the shape feature to be developed in fewer proportions as compared to texture and color counterparts. The shapes found must not change the features such as location, translation, the scaling and the rotation.

Color-based retrieval: Color is the most obvious and intuitive feature of an image. Color is robust and very stable. It is also insensitive to scale changes and translation and rotation as well. The color-based method is simple in calculation and very commonly used where there is difficulty in region identification and segmentation.

Texture-based retrieval: Texture feature help in classification and segmentation of images. Texture of an image can be analyzed by statistical and structured approach. In Statistical approach, texture of the image is taken as a quantitative measurement of arranging intensities in a region of image. Computation is easier and is used widely. The Structured approach is considers texels set in the texture of an image that is repeated or regular pattern.

3. SHAPE DESCRIPTORS

A descriptor in general is a structure describing the pertaining information. A descriptor tries to describe or represent shape in all possible ways so that it meets the human perception. A shape descriptor, for efficient retrieval must find and match shapes that are similar from a dataset. The features collected by shape descriptors must be compact so as reduce the execution complexity.

Many methods of representing shape and descriptors have been proposed. The main two methods are boundary (or

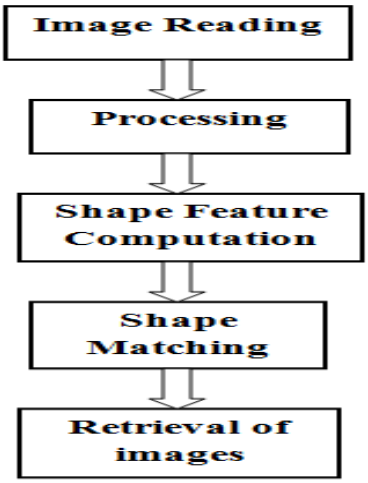
outline) based shape descriptors and region (portion of or complete image including outline) based shape descriptors.

Outline-based shape descriptors: The boundary (or outline) based shape descriptor obtains information only at the boundary of the shape. Contour is composed of edge fragments or curve which displays certain geometric aspects that are meaningful. The boundary contents plays vital role in recognizing of objects. Some of the important characteristics of boundary-based shape descriptor are: it can differentiate shapes having region-shapes similar in properties but having distinct outline properties. It helps in searching of shapes that have similar semantics but contains significant differences in inter-class.

Region-based shape descriptor: The descriptor can express information residing on boundary of the shape as well as in the inside region. All the pixels of the shape are considered for evaluation. Simple objects and complex objects having many regions that might be disconnected can be described by this descriptor. The salient features include efficiency and compact properties. The descriptor can sustain segmentation noise and it is robust along with fixed size compact feature set.

4. PROPOSED SHAPE SIGNATURE

The proposed shape signature is a region-based shape signature for efficient image retrieval. Dataset used here is MPEG 7. The steps involved in this method are as follows



4.1 Block Diagram of Shape Signature Image Retrieval

Image Reading

The input images are accessed from the dataset. The function imread() is used to read the images from the dataset. The path of the folder where the dataset is stored is specified in the function while reading along with the image name.

Processing

Read images are converted into binary format. This makes the computation easy. Then the pixels that form the outline of the image are found out as edge. Once boundary pixels are obtained, then they are stored separately for further computations.

Fig 4.2 Binary image with tight bounding box

The edge pixels that form the shape of the image object are determined. The technique applied for edge pixel detection is called zero-crossing technique. According to this technique, if a pixel's 8-neighbouring pixel positions are completely occupied then the pixel is considered as non-edge pixel. Suppose if the pixel's neighboring pixel count is less than 8, then the pixel is an edge pixel.

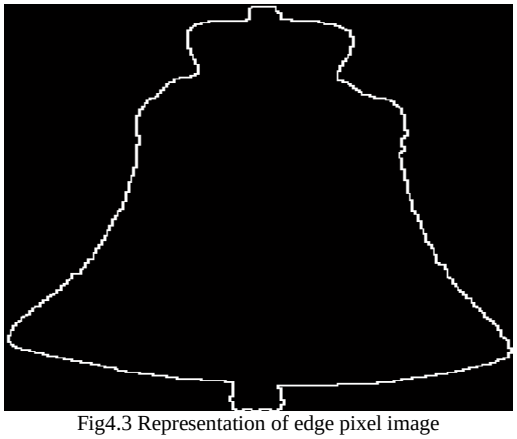


Fig4.3 Representation of edge pixel image

Shape Signature Computation

The computation of shape signature is done through Binning. i.e the circle encompassing the cropped image is segmented into 36 bins. The bin percentage distribution of the pixel is obtained by the ratio of no of pixels of each bin to the total pixel in the whole image. It takes the both edge pixels and the regions pixels of the image.

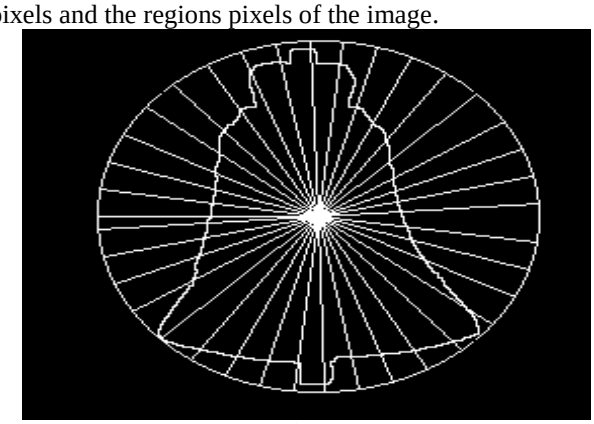


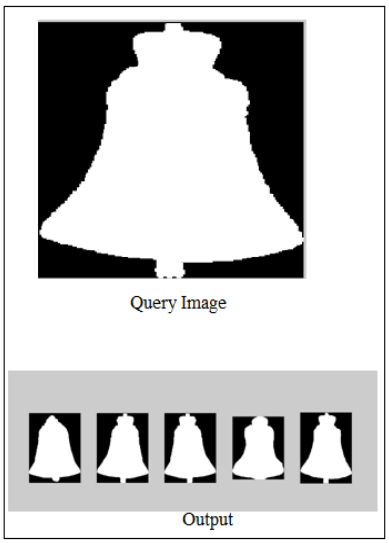
Fig 4.4 Circle fitting and binning

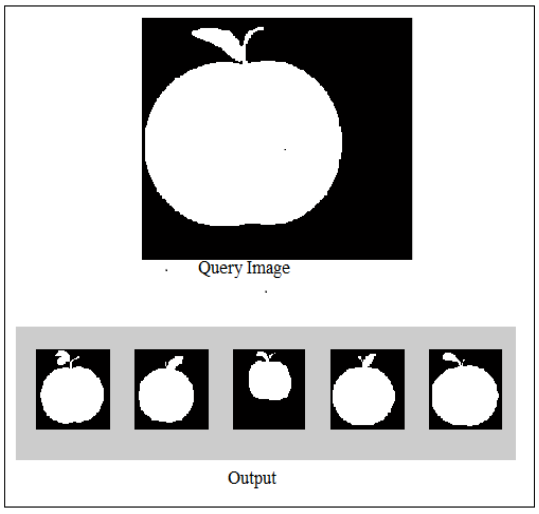
Retrieval of images

Since the features computed are local features rotational invariance has to be taken care off. For this a matching scheme is proposed in which the query feature set (comprising 36 bins) is matched with target image (36bins) with the target feature set rotated one bin at a time (both clockwise and anti clockwise). The matching procedure is 36+36 stage activity and the smallest distance among these 72 matches is taken to be the distance between two images. Also as an alternative the matching between image was tried using Earth Movers Distance (EMD).In which one bin of query image is matched with one bin of target image that gives the smallest distance.

5. RESULTS

Dataset consists of the 70 classes and each class having 20 images in that class. The proposed shape signature method is executed for all the images in the dataset and the feature set for each image is calculated and stored. A randomly chosen image can be taken as query image and shape matching occurs between the query image and all other images in the dataset one by one. The results obtained are as shown below.





The evaluated performance of the shape signature is shown in the below table. The table shows the top results gained.

Performance in percentage (%)

'APPLE'	[100]
'BAT'	[60]
'BELL'	[100]
'BONE'	[100]
'BRICK'	[100]
'CAR'	[100]
'CATTLE'	[80]
'CELLULAR_PHONE'	[100]
'CHILDREN'	[100]
'CUP'	[80]
'DEER'	[80]
'DEVICE1'	[100]
'DOG'	[80]
'FACE'	[100]
'GLAS'	[100]
'HAT'	[60]
'HEART'	[60]
'HORSE'	[60]
'HORSESHOE'	[80]
'LIZZARD'	[60]
'MISK'	[100]
'PENCIL'	[60]
'PERSONAL_CAR'	[100]
'POCKET'	[60]
'RAY'	[80]
'SHOE'	[100]
'SPRING'	[60]
'WATCH'	[100]

CONCLUSION

The proposed shape signature is a combination of region-based and edge based shape signature for efficient image retrieval. The descriptor can express information residing on boundary of the shape as well as in the inside region. All the pixels of the shape are considered for evaluation. Simple objects and complex objects having many regions that might be disconnected can be described by this descriptor. This method is efficient and yields good retrieval of images in the top few positions and with features being compact. The shape descriptor also provides invariance towards mirroring effect, translation, rotation and scaling.

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