Region and Shape Features Based Image Retrieval

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Abstract—Object detectors determine whether a given object category is present in an image. Object detection are performed by using several features of images. The common approaches scan the image for candidate objects. Continuous scanning the images for extraction features consumes more computation time. We propose an approach to object detection by using geometrical shapes available within regions of an image. An image is segmented into different regions using Region Growing algorithm. Region Growing is an iterated process of image segmentation in which neighboring pixels are examined and added to a region class till no edges are detected. Several features such as geometrical shapes, selected chords, centroid and diagonal of a zone of different regions of an image are extracted using region split and merge algorithm. Then clusters of features are created based on shapes. It uses the 2D shapes such as lines, rectangle, square, circle etc. to detection objects based on the statistical measures of distribution of points on the bitmap image of a shape. Each extracted features from the regions of an images are compared with the specific cluster of images based on their stored features. These combine merits of region split and merge algorithm based on geometrical shapes features within regions of an image helps in speedy retrieval of images and detection of objects.

Keywords—Shape detection, feature extraction, geometric features’ region retrieval

I. INTRODUCTION

Human being get image information by seeing, perception and analysis etc. However object detection system performs several processes to retrieve the images and detects them. The visual features of an image such as color, shape, texture etc. have been used for image retrieval from a large database. This study uses an approach of object detection process by using geometrical shapes available within regions of an image. The image is segmented into different regions using available region growing algorithm[1]. Region Growing algorithm is an iterated process used for image segmentation. In this the neighboring pixels are examined and added to a region class till no edges are detected. Several features such as geometrical shapes, selected chords, centroid and diagonal of a zone of different regions of an image are extracted using region split and merge algorithm [2]. Then clusters of features are created based on shapes. Some of the 2D shapes uses for this study for object detection are lines, rectangle, square, circle, semi-circle etc. Each extracted features from the regions of an images are stored in specific cluster of images based on their geometrical shapes. Then the extracted features of a query image are compared with the features of image database. A typical object retrieval system is provided below. The user gives a query image, and then the features of a query image are retrieved for detecting the object. The features are stored in clusters based on shapes such as objects having circle shape, objects having rectangular shapes etc. The indexes are setup to connect the features along with the shapes.

II. RELATED WORK

Some of the related image retrieval techniques are provided below. Text-based image retrieval is based on the text or keywords of index images by Mich. et. al. [3]. Text-based image retrieval was used to annotate the images with text to perform image retrieval. Content-Based Image Retrieval is describes by Long et. al. [4] describes content based image retrieval system query is in the form of image and its low level features are used as content describing the image. Low level features include colour, shape and texture of an image. These features are extracted from the image as well as for all the images in a database using different feature extraction techniques. Content-based image retrieval system is based on visual features such as color, texture and shape information of image which helps in detecting similarity and distance between the features of an image by Orongo. et. al. [5]. The color features of an image are color vector of an object or the whole image in RGB. The texture features of an image are coarseness, contrast and directionality etc. The shape features consist of shape area, circularity, eccentricity, major and minor axis and its orientation, perimeter and a set of algebraic moment invariants. The region-based image retrieval system extract features of segmented regions and performs similarity comparison of the region. [Ling et. al.,6]. It enhances the ability of capturing features and representing the focus of user’s perception of contents of an image. There are global and local features which help to detect the objects. Global features include the geometrical shapes, texture, size and colour etc.
Due to the large volume of literature on recognition and feature extraction, we review approaches closest to work. Tripathi et al. [7] present a review on different image segmentation techniques i.e. region based and edge-based segmentation. Biederman [8] describes objects can be known by components. Elhagara et al. [9] describe partition path precisely and then the numerals are separated before restoration is applied. Abuhaiba et al. [10] uses a global and region content for image retrieval. Manjunath et al. [11] uses a Netra toolbox which is based on colour features (efficient colour indexing), texture and shape features (contour representation, Fourier-based shape description), image segmentation and grouping in segmented image regions. This system is developed by UCSB ADL (Alexandria Digital Library). They use an automated image segmentation algorithm to represent the image at the object level. Hamandlu et al. [12] and Ranjan et al. [13] have reported grid based features that divided the input image into 24 zones. After that, they computed the vector distance in the grid from the bottom left corner and normalized. Accurate segmentation of the object from realistic clutter is difficult without the familiarity of the shape[14]. Ling et al. [6] represents a region-based image retrieval framework that integrates efficient region-based representations. Kohonen et al. [15] uses self-organizing map for clustering the image into some objects. Evidence from human perception suggests that familiarity plays a large role in figure/ground assignment by Peterson et al.[16]. Segmentation uses part detection, but do not use global shape descriptors by Shi et al. [17]. Doermann et al. [18] use shape codebook that specify the object centroid by using Triple Adjacent Segmentation feature. Kim [19] proposed a work which has a main focus on Query By Layout (QBL), they are not considered about all the regions of an image so ultimately it reduces the time and also reduces the accuracy of the system. Manjunath et al. [20] uses edge histogram descriptor for image retrieval with non-uniform textures. Yang et al. [21] uses texture bounding encoding system. Gupta et al. [22] propose techniques for shape (line, triangle, rectangle, square, circle, etc.) detection by using geometrical features such as angle of an object, chord feature, segmentation of an image into some objects etc. Singh et al. [23] use a window and subwindow technique for speedy object detection so ultimately it reduces the time. Gupta et al. [24] define the number of techniques on object detection for visually impaired people. Hebert et al. [25] propose another way to go beyond individual edges, by encoding relation between all pairs of edges. Belongie et al. [26] propose the shape context, which captures for each point the spatial distribution of all other points about it on the shape. This semi-local representation allows establishing point-to-point correspondences between shapes even under non-rigid deformations. Jain et al. [27] uses a combination of texture and shape with color for image retrieval. Singh et al. [28] extracts the texture and colour features through wavelet transformation and colour histogram and combination of these features is used to scaling and translation of the object in an image. For colour feature they use colour space selection and quantization, colour histogram. For texture feature they use Haar Discrete Wavelet Transform.

III. PROPOSED METHODOLOGY

In this study, we proposed an approach tool object detection by using geometrical shapes and regions of an image. An image is segmented into different regions. Several features such as geometrical shapes, selected chords, Centroid and diagonal of a zone of different regions of an image are extracted. It creates clusters features availed from the regions. Some brief information about the study is provided below. Some information on each feature is provided.

A. Some theory of the study

1. Region Growing Method
   Region growing methods are used for segmentations of images having well-observed edges. It started by choosing any seed pixel within an initial set of small areas are iteratively merged according to similarity conditions. The region is grown from the selected seed pixel by adding in neighboring pixels that have similar properties such as gray level, color, shape etc. Once the growth of one region stops, it chooses another seed pixel that does not belong to any region. This whole process is continued until all pixels belong to some region[29].
2. Region split and merge method
The above region growing methods are simple, however, computationally expensive because they start from such small initial regions. This can be made more efficient by recursively splitting the image into smaller regions until all individual regions are coherent by start by considering the entire image as one region. If the entire region is coherent (i.e., if all pixels in the region have sufficient similarity), leave it unmodified. Otherwise split it into four quadrants and recursively apply these steps to each new region. The splitting phase builds a quadtree [30].

B. The features of the study
1. Geometrical shapes
An example of these features is lines, rectangle, square, circle etc. Creating the dynamic clusters based on the shape of the object help to have a speedy feature selection for object detection. It indexes the location of shape in each cluster for speedy access. During the detection of the object the feature of a query image is first comparing with the mean value of clusters. The detail of such related study is shown in earlier study [22]

2. Chord Feature Extraction:
For finding the chord, it finds the relationship between boundary edges of an image, which relates to the interior segmentation [31][32]

3. Centroid Feature Extraction:
It finds the centroid of each zone and calculate the distance and angle from starting point to centroid and ending point to centroid[22]

4. Diagonal Feature Extraction:
It extract the diagonal features of each zone (right and left diagonal). Diagonal of a matrix 'A' is the collection of entries A (i, j) where i is equal to j. Then the diagonal value has been summed up to get a single subfeature of left and right diagonal of each zone. For diagonal which does not have any foreground pixels are taken as zero.

C. The proposed algorithm
The diagram of proposed method for feature extraction and detection of objects is shown in figure 3. The sample of the proposed algorithm for retrieval of images and detection of objects is given below:

1. Accept a query image.
2. Perform segmentation on the inputted image to get the different regions (r1,r2....n).
3. For each regions
4. Step 5: Divide the object into number of zones (z1,2...n)
5. For each zones
6. Calculate the features (geometrical shapes, chords, diagonals) of each zone and store them in an array known as feature vector.
7. Compare the features vectors of query image with the features vectors of clustered database images.
8. If the feature vectors of query image match with the feature vectors of clustered database images then the object is detected otherwise the object is not detected.

IV. EXPERIMENTS AND RESULTS

This study has taken samples of objects from MPEG-7 databases as describes by Sikora [33] and ETHZ Shapes [34]. The performance is measured regarding its recall and precision. Recall measures the ability of the system to retrieve all the models that are relevant, while precision measures the ability of the system to retrieve only the models that are relevant. The number of relevant images retrieved is the number of returned images that are similar to the query image.

A. The performance metrics

Precision and recall to measure the performance of the system are given.

\[
\text{Precision} = \frac{\text{number of relevant images retrieved}}{\text{total number of images retrieved}} \quad (1)
\]

\[
\text{Precision} = \frac{\text{number of relevant images retrieved}}{\text{total number of relevant images}} \quad (2)
\]

Let's assume:
- L - Represents the number of relevant images that are retrieved
- M - Represents the number of irrelevant images
- N - Number of relevant images that are not retrieved.

B. The results

We compare our algorithm to baseline region growing and basic region split and merge algorithm. Our goal is to demonstrate the advantage of using geometrical features such as shapes, chords, diagonals within a region of an image over a random selection of a seed pixel of available region growing algorithms. For the execution of baseline algorithms, we use the authors’ publicly available code. The proposed algorithm scores more accurate evaluation of detections and better in computation. Some extensive execution of the study is due. Figures give the statistical results of some selected objects from MPEG-7 databases and ETHZ Shapes.

Figure 4: Some sample segmented images

V. CONCLUSION

The proposed approach shows image retrieval by using geometrical shapes available within regions of an image. The reason is the images are segmented into different regions based on several features such as geometrical shapes, selected chords, Centroid and diagonal of a zone of different regions. Then clusters of features are created based on shapes. The combined merits of region split and merge algorithm based on geometrical shapes features within regions of an image helps in speedy retrieval of images. The clustering of features based on the shapes also contribute to help to score more accurate evaluation and better in computation time. As per the results of execution of baseline algorithms, our proposed algorithm shows the little better result.

REFERENCES

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