Blurred And Compressed Trademark Image Retreival Under Noise And Orientation Based On Curvature Shape Descriptor (Csd)

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Abstract

Digital images are a convenient media for describing and storing spatial, temporal, spectral, and physical components of information contained in a variety of domains (e.g.. aerial/satellite images in remote sensing, medical images in telemedicine, fingerprints in forensics, museum collections in art history, and registration of trademarks and logos). Retrieval of digital images is one of the challenging issue in any Digital Image Processing system. Although advances in image compression algorithms have alleviated the storage requirement to some extent, the large volume of these images makes it difficult for a user to browse through the entire database. Therefore, an efficient and automatic procedure based on curvature shape descriptors is proposed, which make use shape descriptor along with compression techniques to make database feasible to store large number of images and retrieve image under noise, blurrring and orientation changes. In CSD approach, the image is subjected to compression and then later it is represented in its contour format by its coordinates and are mathematically processed for curvature evolution over various sigma levels so as to remove the unevenness caused by some external disturbances. For each sigma level, zero crossing points are evaluated which are used as the features for image retrieval along with arc length.

Keywords: Arc length, Blurring, Compression technique, Curvature Shape Descriptor (CSD), Noise, Orientation changes, Zero crossing points

1. Introduction

Colour, texture and shape information have been the primitive image descriptors in content based image retrieval systems[3]. Traditionally, textual features, such as filenames, caption and keywords have been used to annotate and retrieve images. Nonlinear modified discrete Radon transform [5] has been applied to estimate visual contents of textural information of an image, such as orientation, directionality, and regularity. Images of either individual or multiple textures are best described by distributions of spatial frequency descriptors, rather than single descriptor vectors over presegmented regions. A retrieval method based on the Earth Movers Distance [6] with an appropriate ground distance is shown to handle both complete and partial multi-textured queries. But, there are several problems with these methods. First of all, human intervention is required to describe and tag the contents of the images in terms of a selected set of captions and keywords. In most of the images there are several objects that could be referenced, each having its own set of attributes. Further, we need to express the spatial relationships among the various objects in an image to understand its content. As the size of the image databases grow, the use of keywords becomes not only complex but also inadequate to represent the image content. The keywords are inherently subjective and not unique. Often, the preselected keywords in a given application are context dependent and do not allow for any unanticipated search. If the image database is to be shared globally then the linguistic barriers will make the use of keywords ineffective.

Color is one of the most widely used low-level features in the context of indexing and retrieval based on image content [7]. It is relatively robust to background complication and independent of image size and orientation. Typically, the color of an image is represented through some color model. One representation of color content of the image is by using color histogram. For image retrieval, histogram of query image is then matched against histogram of all images in the database using some similarity metric. However, color histograms do not incorporate spatial adjacency of pixels in the image and may lead to inaccuracies in the retrieval.

Although color can be an effective means of querying, color alone as a retrieval cue cannot be effective for querying large image databases. Applications with grayscale or binary images have to use other cues such as shape and texture for retrieval. Although, humans can effectively use color to differentiate among natural objects, many artificial (manmade) objects cannot be distinguished on the basis of color alone. Moreover, humans when presented with binary or grayscale images can easily distinguish among these.

Image description consists in one of the key elements of multimedia information description. In the Multimedia Content Description Interface (MPEG-7) images are described by their contents featured by color, texture and shape. The shape descriptor aims to measure geometric attributes of an object to be used for classifying, matching, and recognizing objects.There are several techniques available for shape representation as Fourier descriptors, Wavelet descriptors, grid-based, Delaunay triangulation, among others. Shape description techniques are classified into boundary based and region based methods. Boundary based methods use only the contour of the objects' shape, while the region based methods use the internal details in addition to the contour. The specified Shape representation methods proposed fail to satisfy one or more of such as criteria Invariance, Uniqueness, Stability, Efficiency, Ease of implementation, and Computation of shape properties.

The classical Curvature Scale Space method for contour representation captures describes and compares characteristic shape features of objects[1][2][4]. It represents two dimensional shapes at different resolutions. Maxima (peaks) of CSS images are used to describe the shape and to perform matching between two curves under analysis. The matching scheme is based on the Euclidean distance between the peaks of the CSS images. This scheme is very complex and expensive

High-resolution images can occupy large amounts of storage (around 17.5 Mb for one A5 color image scanned at 600 dpi). The need to compress image data for machine processing, storage and transmission was therefore recognized early on. To overcome these effects specified, CSD approach has been proposed, which is an efficient and automatic procedure is required for indexing and retrieving images from databases. In this approach the image is subjected to compression and then later it is represented in its contour format by its coordinates and is mathematically processed for curvature evolution over various sigma levels so as to remove the unevenness caused by some external disturbances. For each sigma level, zero crossing points are evaluated which are used as the features for image retrieval along with arc length.

Data compression is the technique to reduce the redundancies in data representation in order to decrease data storage requirements and hence communication costs [8][9][10]. Reducing the storage requirement is equivalent to increasing the capacity of the storage medium and hence communication bandwidth. Thus the development of efficient compression techniques will continue to be a design challenge for future communication systems and advanced multimedia applications. A technique to Image compression is the application of Data compression on digital images. The discrete cosine transform (DCT) is a technique for converting a signal into elementary frequency components. It is widely used in image compression. DCT separates images into parts of different frequencies where less important frequencies are discarded through quantization and important frequencies are used to retrieve the image during decompression.

The rest of paper is organized as follows. In section 2, we explain the algorithm for proposed method. In section 3, the results of the proposed system are shown and its performance is analysed. Section 4 gives concluding remarks

2. NOVEL APPROACH FOR IMAGE RETRIEVING

This section describes novel approach for image retrieving using Curvature Shape Descriptor. In this approach the trained images are subjected to compression and then later it is represented in its contour format by its coordinates and is mathematically processed for curvature evolution over various sigma levels so as to remove the unevenness caused by some external disturbances. For each sigma level, zero crossing points are evaluated which are used as the features for image retrieval along with arc length. Later the retrieval module receives user query, applies CSD approach to obtain image features arc length and zero crossing points .The retrieval module is based on Euclidean distance that compares query image features with trained images in the database. The design architecture for proposed approach is specified below

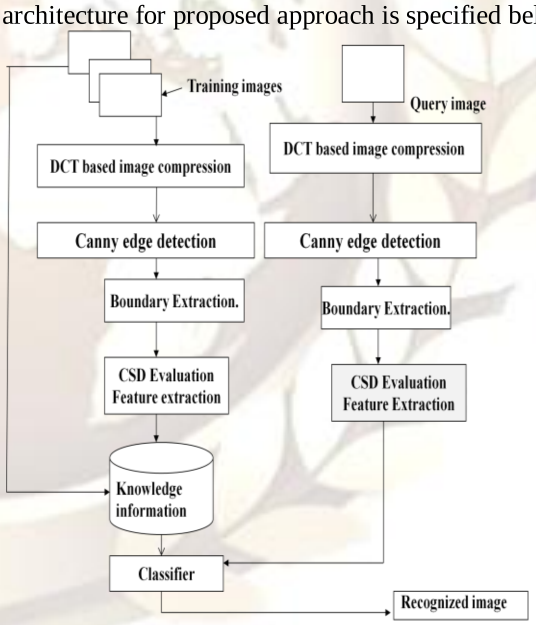


Fig 2.1 system architecture

The designed system architecture is as presented in figure 2.1 The algorithm for proposed approach is specified below.

2.1 DCT BASED COMPRESSION High-resolution images can occupy large amounts of storage (around 17.5 Mb for one A5 color image scanned at 600 dpi). The need to compress image data for machine processing, storage and transmission was therefore will continue to be a design challenge for future communication systems and advanced multimedia applications. A technique to Image compression is the application of Data compression on digital images. The discrete cosine transform (DCT) is a technique widely used in image compression. [10]DCT separates images into parts of different frequencies where less important frequencies are discarded through quantization and important frequencies are used to retrieve the image during decompression. Typically, input taken images are compressed in macroblocks of 8 rows by 8 columns, where each block is linearized into a one-dimensional vector. Various level of compression can be achieved using this algorithm. The compressed image is passed to preprocessing unit (canny edge detection) for minimising the surrounding effects.

2.2 CANNY EDGE DETECTION

The compressed and smoothened image is passed as input for canny edge detection unit. This edge detection is performed using defined canny edge operators. Once the preprocessing operation is done the obtained edge information is passed for CSD evaluation, where the initial operation is to evaluate the contour of the given edge information.

2.3 BOUNDARY EXTRACTION

Contour is defined as outermost continuous bounding region of a given image. For the detection of contour evaluation all the true corners should be detected and no false corners should be detected. All the corner points should be located for proper continuity. The contour evaluator must be effective in estimating the true edges under different noise levels for robust contour estimation. For the estimation of the contour region an 8-region neighbourhood-growing algorithm, once the contour is detected the curvature for the obtained contour is calculated.

2.4 CURVATURE EVALUATION

To evaluate the curvature for the obtained contour of given image following approach is made. For a given a contour co-ordinates (p (u), q(u)) the curvature of the given contour is given by

$$C(u) = \frac{p'(u) * q''(u) - q'(u) * p''(u)}{[(p'(u))^2 + (q'(u))^2]^{(3/2)}}$$

Where (p', q') are first derivative of given contour co-ordinates and (p'', q'') are the double derivative of p and q.

C (u) is the curvature of the given image

.For the obtained curvature, CSD is obtained by applying smoothening operation to reduce the zero crossing co-ordinates in bounding contours. The smoothening is continued by incrementing the Gaussian value (σ) on the obtained contour until no zero crossing exists.

2.5 CURVATURE SMOOTHENING

The curvature smoothening is done using equation

$$C(u, \sigma) = \frac{P'(u,\sigma) * Q''(u,\sigma) - Q'(u,\sigma) * P''(u,\sigma)}{[(P'(u,\sigma))^2 + (Q'(u,\sigma))^2]^{(3/2)}}$$

Where , P = conv (p, g) and Q = conv (q, g), g is Gaussian distribution function and u is the arc length parameter

P' and Q' are the first order derivative of p, q and P'', Q'' are the second order derivatives.

C (u, σ) is smoothened curvature.

For the obtained smoothened curvature at each gaussian level, zero crossings are computed.

2.6 ZERO CROSSING COMPUTATION

After smoothening the given curvature a zero cross is evaluated, where the zero cross is found when the tracing come across a pixel variation from 0 to 1 or 1 to 0 level.

2.7 SHAPE DESCRIPTOR (CSD) EVALUATION

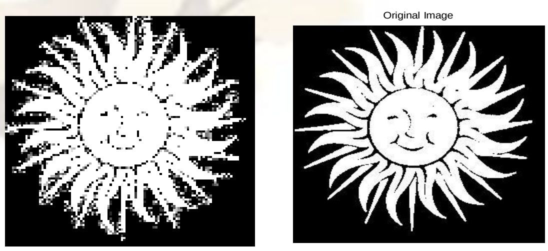
Once the zero cross were obtained they are buffered for a corresponding arc length (u) and given Gaussian value (σ), once all the zero cross were found they are been plotted for arc length v/s sigma. From the obtained CSD plot important curvature features are extracted. To obtain the important curvature feature a threshold is set given by Threshold (T) = 0.6 * max. Peak value. This indicates that a CSD peak of more than 60% of the obtained curvature information is used for image feature representation. This approach eliminates the consideration of lower peaks resulting in elimination of shape information generated due to external noises. This noise used to be reduced by filtration approach in conventional methods.

2.8 FEATURE EXTRACTION AND RECOGNITION:

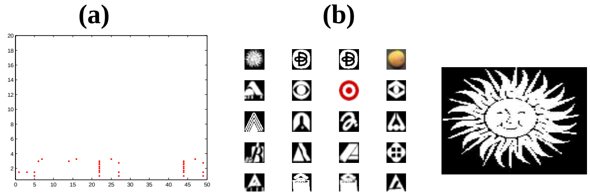
Once the CSD plot is obtained, features are extracted from the selected CSD peaks, then grouped together for matching and classification, given as Feature={(σ_1,arclength$_1$), (σ_2, arclength$_2$)…(σ_n, arclength$_n$)},Where n= no. of peaks crossing the threshold limit. This feature extraction is done for the given database information and query image which are used for recognition. Once the knowledge is created the recognition operation is performed.

3. EXPERMENTAL RESULTS AND PERFORMANCE ANALYSIS

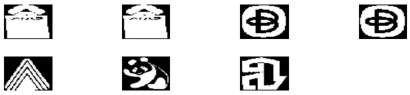
3.1.RESULTS



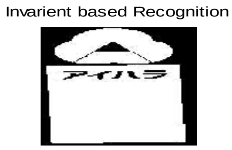
(a) (b)



(c) (d) (e)



(f)



(g)

Fig 3.1 (a) input image (b) test image subjected to compression,blurring and rotation,(c)CSD plot (d)classified images in CSD method (e) CSD based recognized image (f)classified images in Invarient moment method (g) Invarient method based recognition

A trademark query image shown in Fig 3.1(a) is subjected to blurring and is 25% compressed and rotated at 90 degrees as shown in Fig 3.1(b) which is passed to the algorithm for retrieval purpose. Based on the features of CSD shown if Fig 3.1(c) and the moments (M1 to M_7) of Invariant moment method, Classification has done and shown in Fig 3.1(d) and Fig 3.1(f) respectively. From Fig 3.1(e) and Fig (g), it can be observed that the CSD method is again more efficient in retrieving images when it is blurred and compressed and when subjected to noise and orientation changes.

3.2 PERFORMANCE RESULTS

The Figures given below specifies performance analysis between CSD and Invariant Moment based methods under compression, blurring and compressed with noise corrupted and subjected to orientation cases. figure 3.3 shows that retrieving accuracy of CSD high, when compared to Invariant-Moment based method and also CSD method requires less retrieval time which is compared to Invariant-Moment based method for retrieving the same image shown in figure 3.2.

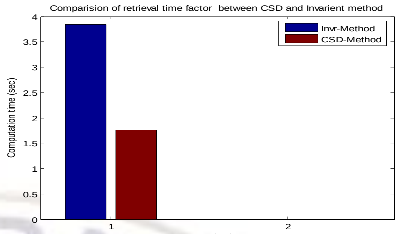


Fig3.2

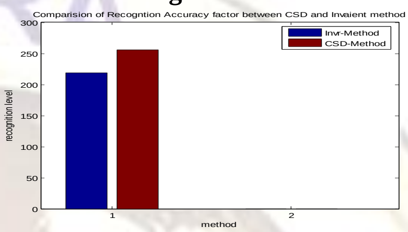


Fig3.3

4. CONCLUSION

An efficient shape-based retrieval algorithm has been developed to retrieve image which have shown to be a promising technique for shape-based image database retrieval. The CSD based method is compared with the invariant based estimation algorithm and observed to be robust under compression, blurring, rotation, and noisy versions of the database images. Further it is observed that the CSD based estimation outperforms the existing techniques with higher accuracy and less classifications for retrieval of an image.

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