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A review on various approaches for content based image retrieval based on shape, texture and color features

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Abstract
It is the process of fetching hidden knowledge from a wide store of raw data. The knowledge must be new, and one must be able to use it. This paper presents a method to extract color and texture features of an image quickly for content-based image retrieval (CBIR). CBIR refers to image content that is retrieved directly, by which the images with certain features or containing certain content will be searched in an image database. The main idea of CBIR is to analyze image information by low level features of an image, which include color, texture, shape and space relationship of objects etc., and to set up feature vectors of an image as its index. In this paper various approaches from image retrieval that are based on color, shape and texture has been elaborated.

Keywords: CBIR, DIP, gabor filter, DWT, K-mean clustering

1. Introduction

1.1 DIP

Digital image processing has been widely used in the processing of various images so that images can be used from analog to digital formation. In this process of images processing various tools have been used so that image can be preprocessed so that these can be easily utilized in different applications. Images that have been used in digital image processing are of two dimensional images such that these can be used in different applications. Images are mainly of two different types that are color images and grey scale images.

1.2 Content-based image retrieval (CBIR)

Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of machine vision strategies to the picture recovery issue, that is, the issue of hunting down computerized pictures in huge databases. Substance based picture recovery is restricted to customary idea based methodologies [Syam, B, 2013].

"Content based" implies that the inquiry dissects the substance of the picture instead of the metadata, for example, catchphrases, labels, or depictions connected with the picture. The expression "content" in this setting may allude to colors, shapes, compositions, or whatever other data that can be gotten from the picture itself. CBIR is attractive in light of the fact that ventures that depend simply on metadata are reliant on annotation quality and culmination. Having peopled physically clarifies pictures by entering decisive words or metadata in an extensive database can be drawn out and may not catch the catchphrases wanted to depict the picture. The assessment of the viability of catchphrase picture hunt is subjective and has not been decently characterized. In the same respect, CBIR frameworks have comparative difficulties in characterizing achievement.

1.3 CBIR Techniques

Numerous CBIR frameworks have been produced, yet the issue of recovering pictures on the premise of their pixel substance remains generally unsolved.

1.3.1 Query Techniques

Diverse executions of CBIR make utilization of distinctive sorts of client questions. Question by illustration is an inquiry procedure that includes furnishing the CBIR framework with a case picture that it will then base its pursuit upon. The hidden inquiry calculations may fluctuate relying upon the application; however result images should all share normal components with the given sample [W. Y. Ma, 1997].

1.3.2 Semantic retrieval

Semantic recovery begins with a client making an appeal like "discover pictures of Abraham Lincoln". This sort of open-finished undertaking is extremely troublesome for machines to perform - Lincoln may not generally be confronting the cam or in the same stance. Numerous CBIR frameworks accordingly for the most part make utilization of lower-level gimmicks like composition, color, and shape. These gimmicks are either utilized as a part of mix with interfaces that permit simpler data of the criteria or with databases that have as of now been prepared to match peculiarities, (for example, confronts, fingerprints, or shape matching). In any case, as a rule, picture recovery obliges human input keeping in mind the end goal to distinguish more elevated amount ideas [Xavier, 2011].

1.3.3 Relevance Feedback

Consolidating CBIR seeks procedures accessible with the extensive variety of potential clients and their goal can be a troublesome errand. A part of making CBIR fruitful depends completely on the capacity to comprehend the client intent. CBIR frameworks can make utilization of pertinence input,

where the client dynamically refines the query items by stamping pictures in the results as "important", "not significant", or "nonpartisan" to the inquiry question, then rehashing the hunt with the new data. Illustrations of this kind of interface have been developed.

1.3.4 Iterative/Machine Learning

Machine learning and application of iterative systems are getting to be more basic in CBIR.

1.3.5 Other query methods

Other inquiry strategies incorporate searching for instance pictures, exploring tweaked/various leveled classes, questioning by picture district (instead of the whole picture), questioning by numerous illustration pictures, questioning by visual portrayal, questioning by immediate detail of picture gimmicks, and multimodal inquiries (e.g. consolidating touch, voice, etc. [Xavier, 2011]

1.3.6 Content comparison using image distance measures

The most widely recognized technique for contrasting two pictures in substance based picture recovery (ordinarily a sample picture and a picture from the database) is utilizing a picture separation measure. A picture separation measure looks at the similitude of two pictures in different measurements, for example, color, composition, shape, and others. Case in point a separation of 0 implies an accurate match with the question, regarding the measurements that were considered. Query items then can be sorted focused around their separation to the questioned image. Many measures of picture separation (Similarity Models) have been created.

1.3.7 Color

Processing separation measures focused around shade similitude is attained to by registering a color histogram for each one picture that recognizes the extent of pixels inside a picture holding particular values. Examining pictures focused around the colors they contain is a standout amongst the most broadly utilized procedures in light of the fact that it can be finished without respect to picture estimate or orientation. However, inquire about has additionally endeavored to section shade extent by locale and by spatial relationship among a few shade regions [Ahmed J, 2012] [1].

1.3.8 Texture

Surface measures search for visual examples in pictures and how they are spatially characterized. Compositions are spoken to by Texel's which are then set into various sets, contingent upon what number of surfaces is identified in the picture. These sets not just characterize the composition, additionally where in the picture the surface is located. Composition is a troublesome idea to speak to. The distinguishing proof of particular compositions in a picture is accomplished essentially by demonstrating composition as a two-dimensional ash level variety. The relative splendor of sets of pixels is figured such that level of differentiation, consistency, coarseness and directionality may be estimated. The issue is in distinguishing examples of co-pixel variety and partners them with specific classes of compositions, for example, smooth, or unpleasant [Ahmed J, 2012] [2].

2. Review of literature

C. W. Niblack, R. Barber *et al.* (1993) [6] "QBIC project: querying images by content, using color, texture, and shape", CBIR system developed by IBM and allows queries by color, texture and shape features using query by example or query by sketch approach. The extracted color features consists of a 3D color vector within several color-spaces and 256-dimensional histogram for each RGB component. The texture features are modified versions of the tree more meaningful Tamura's features. The shape features consist of area, circularity and peculiarity. It uses GEMINI to speed up indexing, using the KL transform to reduce dimension and R*-trees to index the feature vectors.

W. Y. Ma, B. S. Manjunanth, *et al.* (1997) "Netra: A toolbox for navigating large image databases," Netra image retrieval system was developed at UC Santa Barbara [40]. This system utilizes Color, shape, spatial location and texture information of segmented image to explore and retrieve alike regions from database. It enables the users to frame queries like, retrieve each and every image which include regions that have similar color, texture and shape of objects, and lie in the upper one-third of image, where individual objects region can belongs to dissimilar images.

M. Ortega, Y. Rui, K. Chakrabarti *et al.* (1997) "Supporting similarity queries in mars", MARS image retrieval system was developed by University of Illinois, and [34] allows complex queries using Boolean operators over color, texture and shape and metadata. Color features are Hue and Saturation histograms extracted from the HSV color space in 5 × 5 sub-images. Texture features are a value for contrast and the coarseness and directionality histograms also in the same 5×5 sub-images. The shape features are the boundary coordinates represented by Fourier descriptors. In MARS, the feature vectors are indexed using a hybrid trees.

C. Carson, M. Thomas, S. Belongie *et al.* (1999) [3] "Blobworld: A system for region-based image indexing and retrieval", Blobworld was developed by the University of California; the Blobworld system allows users to assign the importance to selected regions (blobs) and the importance of the color, texture, shape and location features. The color features uses a 218 bin histogram for each coordinate in the Lab-space, texture features are the mean contrast and anisotropy over each blob and the shape features are the area, eccentricity and orientation. These feature vectors are then mapped into a lower feature space using singular value decomposition (SVD) and indexed using R-trees.

C. R. Shyu, C. E. Brodley, A. C. Kak, *et al.* (1999) [4] "Assert: A physician-in-the-loop content-based retrieval system for hrct image databases", this system was developed at Purdue University. It was designed especially for high resolution computed tomography images, since it uses some perceptual features specific to those images. It also include gray-level features, like mean and standard deviation, texture features like contrast, entropy and homogeneity and shape description such as the area. The feature vectors are indexed using the multi-hash method.

J. Z. Wang, J. Li, G. Wiederhold, *et al.* (2001) [10] "SIMPLICITY: Semantics-sensitive integrated matching for

picture libraries", Semantics-sensitive Integrated Matching for Picture Libraries image retrieval system developed by Stanford University [42], in which images are represented via a set of regions that nearly corresponds to items that can be categorized via their color, shape, location and texture properties. Segmentation of region is achieved by a straightforward algorithm based on k-means clustering in feature space. As opposed to region-wise retrieval, images are retrieved as a whole with the help of region matching techniques which incorporate properties of regions within the image to measure similarity. This overall similarity approach is to decrease the influence of inaccurate segmentation.

3. Approaches Used

Discrete wavelet transformation (DWT)

DWT is used to transform an image from spatial domain into frequency domain. The wavelet transform represents a function as a superposition of a family of basic functions called wavelets. Wavelet transforms extract information from signal at different scales by passing the signal through low pass and high pass filters. Wavelets provide multi-resolution capability and good energy compaction. Wavelets are robust with respect to color intensity shifts and can capture both texture and shape information efficiently. The wavelet transforms can be computed linearly with time and thus allowing for very fast algorithms. DWT decomposes a signal into a set of Basis Functions and Wavelet Functions.

K-Means Clustering

K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early group age is done.

Gabor Filter

Gabor filters transform is a good multi-resolution approach that represents the texture of an image in an effective way using multiple orientations and scales. This approach has a spatial property that is similar to mammalian perceptual vision, thereby providing researchers a good opportunity to use it in image processing. Gabor filters are found to perform better than wavelet transform and other multi-resolution approaches in representing textures and retrieving images due to its multiple orientation approach. We use the Gabor filter approach to extract global texture features from the whole image, and to extract texture features from image regions. A Gabor function is obtained by modulating a complex sinusoid by a Gaussian envelope.

Color

The chromatic attribute of an image is firstly interrelated with color, which is a part of 3-D module and system. The color image is used to assign the appropriate color space. RGB (Red, Green, and Blue), CMY (Cyan, Magenta, and Yellow), HSV (Hue, Saturation and Value) and LHS (Luminance, Hue and Saturation) are the most popular color spaces. Like Histogram, color moments, color co-relogram, color based image retrieval can be extracted in many ways. Commonly used color based image is color histogram. Probability of color finding pair at determines pixel distances are acknowledged.

These methods are explained in following way-

Color Moments

The color distribution of the image is characterized by its moments. First, second and third central moment of each of the color channels is stored as a color feature.

Color Histogram

This is a graphical representation of numerical data. This is estimation of the distribution of continuous variables. For the construction of a histogram, first step is Bin that is responsible to divide the entire range of value.

Shape

This is a very important attribute of image segmentation. Its effective and vigorous representation plays an important role in retrieval of images. Shape features in images are extracted using many approaches.

They are 1-D function for shape Representation, Polygonal approximation, spatial inter-relation, Moment, Scale-Space Method, and Shape Transform Domain. An important shape feature has to be picking over depending upon the situation and the nature of the image. Some of the shape features are discussed in this section.

Histogram of edge directions

The edge histogram extracts the general shape information in the image. In the image, the edge information contained is acquired, using edge detection algorithms like canny, sobel, etc. The edge directions are quantized into a number of bins. For achieving scale invariance, the histogram is normalized with respect to the number of pixels in the image.

Region Moments

Among this descriptor, moments are very popular. Some of them are invariant moments, Zernike moments and Legendre moments.

4. Conclusion

CBIR is the process of extraction of the images from the dataset on the basis of relevance of the contents. On the basis of content, relevant images have been retrieved from huge dataset. Various techniques have been used that are implemented for retrieval of the images from the dataset based on query images. Texture, color and shape based features have been used in the process of feature extraction from the images. In this paper various approaches have been discussed that has been used for feature extraction based on CBIR process. On the basis of these approaches effective features have been retrieved from the dataset images so that maximum relevant images can be easily extracted from the dataset.

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