A Review on Content Base Image Retrieval Techniques

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ABSTRACT

Image retrieval technique has taken its improvements with the growth in image volumes and its application in various fields. Image retrieval technique is an interesting and a vast field yet to be researched more. Images are described through its color, texture, shape, clarity and many more. Image retrieval will use some its features like the texture, colors, spatial relation, shape, correlation and Eigen values. In this paper we discuss the various methods used for content based image retrieval and a comparison study is also made on the various techniques.

KEY WORDS: CBIR, color, texture, shape.

1. INTRODUCTION

Content based image retrieval is based on the visual contents of the image which is stored in a large database. This technique has undergone several research works to improve the concept both practically and technically. It still has several problems attached to it due to which researches are still attracted towards this area of research. On the whole a content based image retrieval (CBIR) system will retrieve some of the aspects image like shape, texture, color and spatial information of each image which is placed in the database and then stores the feature details in a different database called the feature database. The feature database contains the feature data of all the images present in the main database. The feature data is very small in size when compared with the original image. The feature database holds the description of the main image in a compact format. It holds data about the color, shape, texture and spatial information in a fixed length real-valued multi component feature vectors or signature.

The user will input the query image to the system. The CBIR will derive the image attributes of the query image similar to the feature extraction of the database image. After extracting the features of the query image it compares it with the images in the database to identify the right image whose vectors match to that of the query image. It matches based on the best similar value. During the process of image retrieval the system uses the compact feature vector than the original large image. In this way the computation expenses and time is reduced and is efficient than the text-based retrieval method.

CBIR works in two ways namely:

- Retrieving the exact image matching.
- Retrieving the most closely match image.

The complete architecture of CBIR is demonstrated in Fig.1. With the recent increase in visual and digital data and with distributed nature of the image/video database over the internet it is the need of the day to have an accurate and efficient image retrieval technique. Pattern classification can reduce these loop holes as applying it as a pre-processing step to reduce the computational complexity involved in the process. The problem involved in retrieving encrypted data and image has become a field of investigation. Secure search mechanisms are being used widely where the data owner will encrypt the data and then store it in cloud servers. The servers will provide the search service without knowing the actual plain text content. Earlier researches support only Boolean keyword search on encrypted data. The recent studies are diversified to apply the secure searchable system as a multi-dimensional range search multi keyword ranked search.

Nearest neighbor search is common nowadays when it comes to content-based image retrieval (CBIR) systems. This method simply represents the images in the form of feature vectors or in the form of high-dimensional feature space. The images are said to be similar if their points are close in the high-dimensional space based on the distance measurement. The query is processed by finding a value k which is the nearest images to the given example image in the feature space. The main limitation in this approach is the weak correlation between the retrieval images and their appearance in images. The image can have various color patterns and diverse shapes from various angles. Hence the most matching image may not be necessarily be placed near each other in the feature space.

Features used for CBIR:

Color: The main feature that helps humans to distinguish between images or to recognize the image is through the color of the image. Color depends mainly on the reflection of light. Color is used to differentiate between images, objects, places and to identify the time of the day. Advantages of characterizing images using color features.

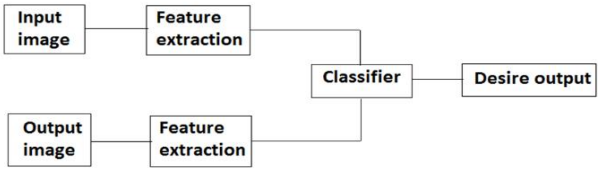

Figure.1. Architecture of CBIR

Simplicity: Construction of the color histogram is simple which includes scanning of the image, resolution of histogram, assigning color values and finally building the histogram with color components as indices.
Efficiency: The success rate in identifying the exact image against the query image is high.
Strength: The color histogram is independent on the rotation of the image in the view axis and only minor changes happen if rotated otherwise or scaled. It also does not depend on the changes in the image and histogram resolution and occlusion.
Texture: Texture cannot be defined accurately in terms of image processing and computer vision. Texture is based on the kind of method you use like the texture analysis method and the features derived from the image. Texture is also an important attribute to define an image similar to the color. It is an essential feature to be considered while querying the image in the database. Texture cannot be defined as a point it is defined in terms of periodicity, scale, coarseness, contrast and direction. Texture can be felt and recognized but not easy to define it. It is represented as repeated patterns in the form of pixels in a spatial domain. The addition of noise to the patterns and the repetition frequencies will result in textures which is unstructured and randomly placed. Texture can also be defined as the property which describes visual patterns having homogeneity. It helps in deriving information about the structures in the image like leaves, fabric, cloud, bricks, etc. It also helps us to analyze the link between the background and the image. Texture classification is done by identifying the textured region from a given set of texture classes. These regions have unique texture quality. Statistical methods like entropy, contrast, homogeneity and GLCM are used.

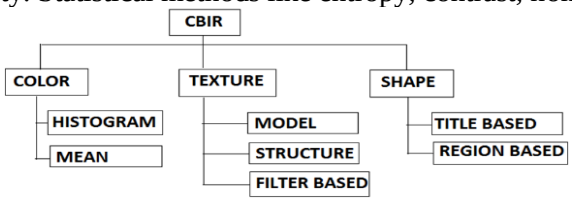

Figure.2. Classification methods based on color, texture and shape

Shape: Shape is another important feature to explain an object or an image. It is the surface configuration of an object or otherwise called as the outline or contour. Shape helps to distinguish the object from its surrounding and it is categorized into two divisions.

- Boundary based and
- Region based

Boundary based only defines the outline of the image or the outer boundary of the shape. This is done using the pixels in the object boundary. The region based is complete contrast to the former method. It uses the complete image region by considering the entire pixels in the shape region. The shape of the object is defined with binary image representation. In region based the shape is defined using two dimensional regions and in boundary based the shape is represented using its outline. In general simple algorithms and feature vectors are used in region based. However this method does not have greater success rate while retrieving the exact image.

Feature Extraction in CBIR: Feature extraction is the important process in content based image retrieval. Feature extraction is involved in all the CBIR processes since computers cannot use a raw image. This is because it has high dimension and secondly a lot of redundant image is present in the raw image. Hence extracting the most relevant and expressive representation of the image is done. The process of extracting the expressive part of an image is called as feature extraction and the result of this process is a feature vector. It is simply said as the process of mapping the image from image space to the feature space. Finding the best feature of an image is still an area of development. In this paper work we use several features for image retrieval from the database.

Tat Loong Chan & Ling Guan (2002), implemented a semi automated method to pre process the images and segregate them into groups for faster retrieval of data. Wavelet transform method is implemented to extract the low level features such as texture, color and shape of the image. These extracted images help in organizing the images using novel neural network. The classified images are trained using feed forward neural network for identifying the image classes and incoming query image.

This method keeps only a significant number of relevant images and reduces the computational time involved in retrieving the images. The image classification has drastically reduced the computation time and the search period is also short.

Hang Cheng (2015), proposed a hybrid method of combining stream cipher and permutation encryption methods to encrypt JPEG images. The encrypted data is then stored in the database server. The server is unaware of the original content and extracts the features from the transition probability matrices of AC coefficients of encrypted query image. The coefficients are modeled using Markov process. The Support Vector Machine (SVM) converts the features of the extracted image into a vector of low dimensionality. The encrypted database images are converted these vector forms, the similarity between the encrypted image and the database image is calculated using their corresponding vectors. The encrypted image delivered by the server is then decrypted to plaintext image using the

encryption key of the client. This method is applicable to secure the privacy-preserving images and preserve the file size and file compliance of the encrypted image.

Ederson Dorileo (2008), introduced color image processing method for dermatological images in CBIR system. The experiment was conducted on necrotic tissue, skin lesions, mixed composition, fibrin and granulation. An expert dermatologist uses the black yellow-red model to classify the color components. The indexing and retrieval processes are based on texture attributes derived from blue, red, hue, green and saturation components of the color images. The performance is ranked against recall and precision. The results demonstrate 70% success rate in characterization of mixed tissue composition.

Mahendra Kumar Gurve and Jyoti Sarup (2012), used features like texture, color and shape from the satellite image repository for Content -Based Image Retrieval (CBIR) system. Histogram values are used to derive the grey level and color properties of the image. Four functions namely energy, correlation, entropy and contrast of the texture feature is implemented in this method. Shape features like perimeter, area and metric are extracted from morphological operations. The extracted feature vectors and the images are saved in the database.

Hua (2006), has derived a new image retrieval paradigm called as the Query Decomposition model. This method retrieves the semantically similar images from the various neighborhood images present in the feature space. The end set of images that are retrieved is denoted as k. An experimental result is illustrated to show the efficiency and effectiveness of this method against content-based image retrieval.

Better query Results: The k-NN image retrieval method uses only a single neighborhood in the feature space. Whereas in the QD approach multiple neighborhoods are considered, hence it is a challenge in this method to retrieve the semantically image.

More Efficient Query Processing: The traditional relevance feedback method which performs k-NN on the entire database in each round and in QD approach the k-NN is calculated only in the localized small sub clusters in the final round.

More Scalable: Since the relevance feedback mechanism in the QD approach uses only a part of the database, it is fast and easy to compute and leaves the server free on the client machine. This type of approach is unique in the QD technique.

Kommineni Jenni and Satria Mandala (2014), proposed that preprocessing the image is another invent to solve the problems involved in image retrieval. This is done by using k-means clustering and genetic algorithm. Several features like color, image, Boolean edge density, edge density and histogram information are used as input attributes. This method has infused some performance metrics like the precision graph and F-measures and confusion matrix for measuring the accuracy of the proposed method. The simulation results show that the clustering purity in almost half of the clusters is 90% purity.

In the k-means clustering algorithm several features are used for pre-processing the image in database. A 136 dimensional feature vector is created using features like color, histogram pixel information, Boolean edge density and many more. Color component is measured using the average and variance in ROB space and histogram bins. Edges are derived from stable edge detector and later the edge density and Boolean edge density is derived. The features extracted from 1000 images are provided as input to the k-means clustering algorithm. Now the genetic algorithm objective function is used to find the best cluster center position by using the minimum mean square error. 500 iterations are processed to arrive at 15 best cluster centers. After the preprocessing image database s completed, Euclidean measure is applied to derive to the most relevant images as a result. The performance metric used in this proposed method is the confusion matrix. This matrix shows that more than half of the clusters deliver 90% purity. The final analysis is demonstrated using F-measures.

Sirikunya Nilpanich (2010), proposed Lazy-processing relevance feedback framework to solve the three problems present in a conventional relevance feedback framework. Over-fitting, long response time and biased learning are the three main problems that are considered in this method. This method approaches to reduce the system response time during user relevance feedback, uses data clustering to attain more stable local classifiers, random sampling method is implemented to get image samples from various subspaces and semantic gap problem.

Takashi Samatsu (2009), used the Fuzzy retrieval in the field of selecting cars. This method can take any kind of fuzzy input queries from the user. When a user wants to purchase a car the Fuzzy system answers all the unrelated queries and expresses the results in grade values. To make it more user friendly a GUI approach is presented to the customer with a menu chart in it. This method helps in calculating the curvature by the car shape through image processing and also helps in calculating the roundness and sharpness.

This method helps a person who doesn't know much about cars to decide on the design and structure. The unspecific conditions are finally shown as grades in the result. The main objective of introducing this method is to analyze man's subjectivity and fuzziness, but all the humans have their own approach and thinking capabilities.

Tohid Sedghi (2010), introduced a hierarchical algorithm to improve the retrieval performance and also enhance the similarity distance computation. This algorithm helps in generating the initial number of clusters and

the cluster centers. The simulation results show that the algorithm gets higher retrieval accuracy than other conventional methods. This method delivers improvement in image segmentation and retrieval accuracy.

Clustering algorithm along with similarity distance measure helps in improving image segmentation. This method was compared with algorithms like IRM, histogram, Fuzzy, etc and the results show that the proposed algorithm performs better than the histogram method for all classes and demonstrates better performance than the fuzzy and IRM method.

Anucha Tungkasthan and Wichian Premchaiswadi (2013), introduced a Hadoop Map Reduce method to practice distributed processing in CBIR system. Hadoop Map Reduce framework helps in increasing the performance of data insertion and query processing. Hence the main agenda of this paper is distribution of the image data over a large number of nodes. Parallel processing of indexing, image indexing and retrieval are the methods used in this approach.

This paper explains in detail about merging Hadoop MapReduce processing method on CBIR system. This method helps in performing parallel processing of CBIR. The author also explains image processing functions through Map reduce scheme. Shuffle, Reduce and Map are the three steps involved in performing parallel distributed process.

Analysis of Various Methods for Feature Extraction:

DT-CWT (Dual-Tree Complex Wavelet Transform): The decomposition of image is handled through dual-tree complex wavelet transforms and dual-tree rotated complex wavelet filters and captures the orientation information in 12 different directions. Texture image retrieval application is done using 2-D dual tree rotated complex wavelet filters and dual-tree complex wavelet transform jointly.

Drawbacks: This method shows redundancy when compared with the DWT.DT-CWT has limited results and shows poor directional ability and shift variant property.

LBP (Local binary patterns): It evaluates the performance results of both the texture measures.

Drawbacks: The control groups do not demonstrate consistency and hence it is difficult to draw conclusions from this method.

LTP (Local_ternary_patterns): The face recognition is done with uncontrolled lighting based on robust preprocessing and LBP local texture descriptor.

Drawbacks: This method cannot apply to spatial non uniform variations.

GLBP (Gateway Load Balancing Protocol): A novel hybrid LBP scheme is used for global rotation invariant matching through local variant LBP features for texture classification.

Drawbacks: The time consumed for the comparison of the matching schemes is huge.

LMEBP (Local maximum edge binary pattern): This method uses the LMEBP operator for texture image retrieval and object tracking applications. LMEBP extracts the required information from the images using maximum edges.

Drawbacks: Theoretical analysis is complex. The probability distribution changes for iteration to iteration. The research is based on experiments and not on theoretical aspects.

2. CONCLUSION

Image Recognition and classification are rapidly increasing its application in various fields due to the growth in visual data. Content based image retrieval plays a major role in this. With huge amount of irrelevant data placed in the database it leads to time consuming and complicated search results. On the other hand a classifier search simplifies the search process and restricts the search to a specialized class only. Content based image retrieval reduces the search space for retrieving visual data. In this paper we have discussed the various CBIR techniques and the comparison of the techniques are done along with its pros and cons.

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