



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A SURVEY ON TECHNIQUES DEVELOPED IN CONTENT BASED IMAGE RETRIEVAL SYSTEM

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ABSTRACT

Multimedia content analysis is applied in different real-world computer vision applications, and digital images constitute a major part of multimedia data. In last few years, the complexity of multimedia contents, especially the images, has grown exponentially, and on daily basis, more than millions of images are uploaded at different archives such as Twitter, Facebook, and Instagram. To search for a relevant image from an archive is a challenging research problem for computer vision research community. The content based image retrieval aims to find the similar images from a large scale dataset against a query image. Generally, the similarity between the representative features of the query image and dataset images is used to rank the images for retrieval. In early days, various hand designed feature descriptors have been investigated based on the visual cues such as color, texture, shape, etc. that represent the images. This paper attempts to provide a comprehensive survey of the techniques developed content based image retrieval. This paper also analyzed the main aspects of various image retrieval and image representation models from low-level feature extraction to recent semantic deep-learning approaches. The important concepts and major research studies based on CBIR and image representation are discussed in detail, and future research directions are concluded to inspire further research in this area.

Keywords: Content Based Image Retrieval, Semantic Gap, Machine Learning, Deep Learning,

INTRODUCTION

Due to recent development in technology, the increased use of digital computers, multimedia, and storage systems over recent years has result in large image and multimedia content repositories. This huge amount of multimedia data is being used in many fields like medical treatment, satellite data, electronic games, archaeology, video and still images repository, and digital forensics and surveillance systems. That rapid growing has created an ongoing demand of retrieval images systems operating on a large scale

[1]. The shared and stored multimedia data are growing, and to search or to retrieve a relevant image from an archive is a challenging research problem. The fundamental need of any image retrieval model is to search and arrange the images that are in a visual semantic relationship with the query given by the user

[2]. Content Based Image Retrieval (CBIR) is the procedure of automatically retrieving images by the extraction of their low-level visual features, like color, texture, shape properties or any other features being derived from the image itself. The performance of a CBIR system mainly depends on these selected features. Thus, it can be said that through navigation, browsing, query-by-example etc, we can calculate the similarity between the low-level image contents which can be used for the retrieval of relevant images. The most challenging issue associated with CBIR systems is reducing the semantic gap. It is the information lost by representing an image in terms of its features i.e., from high level semantics to low level features. This gap exists between the visual information captured by the imaging device and the visual information perceived by the human vision system (HVS) and it can be reduced either by embedding domain specific knowledge or by using some machine learning technique to develop intelligent systems that can be trained to act like HVS [1] [2]. The fundamental substance of CBIR is the feature extraction process. In CBIR, certain image features incorporate color, texture, and shape that can be resolved from the images. Color is considered as one of the important low-level visual features as the human eye can differentiate between visuals on the basis of color. The images of the real-world object that are taken within the range of human visual spectrum can be distinguished on the basis of differences in color. The color feature is steady and hardly gets affected by the image translation, scale, and rotation. Texture and Shape is also considered as an important low-level feature as it is helpful in identification of real-world textures, shapes and objects. General flow for content based image retrieval system is as shown in figure 1.

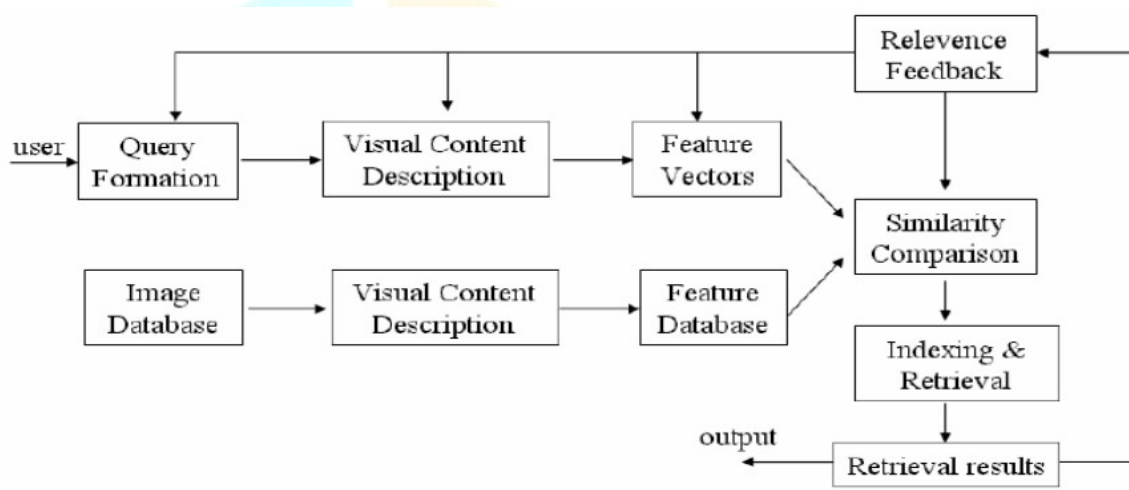


Fig 1: General Flow Diagram of Content Based Image Retrieval System

The basic need for any image retrieval system is to search and sort similar images from the archive with minimum human interaction with the machine. According to the literature, the selection of visual features for any system is dependent on the requirements of the end user. The discriminative feature representation is another main requirement for any image retrieval system. To make the feature more robust and unique in terms of representation fusion of low-level visual features, high computational cost is required to obtain more reliable results. However, the improper selection of features can decrease the performance of image retrieval model. In this paper, we aim to provide a compressive overview of the recent research trends that are challenging in the field of CBIR and feature representation and its techniques to retrieval the images.

RELATED WORK

Research work presented by various authors related to CBIR and various techniques related to feature extraction described is as given below.

A. Deep Learning Based CBIR

Sirisha Kopparthi et.al. [4] proposed experiments which are carried out in two datasets such as UC Merced Land Use Dataset. By using a pre-trained model that is trained on millions of images and is fine-tuned for the retrieval task. Pre-trained CNN models are used for generating feature descriptors of images for the retrieval process. The proposed architecture demonstrates an outstanding performance in extracting the features as well as learning features without a prior knowledge about the images. By using various performance metrics.

Ouhda Mohamed et.al. [5] presented a simple but effective deep learning framework based on Convolutional Neural Networks (CNN) and Support Vector Machine (SVM) for fast image retrieval composed of feature extraction and classification. From several extensive of empirical studies for a variety of CBIR tasks using image database, we obtain some encouraging results which reveals several important insights for improving the CBIR performance.

Heba Abdel-Nabi et.al. [6] proposed approach overcomes these difficulties with the aid of the most fast growing technology, namely Deep Learning. In addition, it explores the effects of merging the features extracted from the latter layers of the deep network to achieve better retrieval results. The experimental results demonstrate the effectiveness of the proposed scheme in terms of the number of relevant retrieved images of the query results, and the mean average precision, while keeping low computational complexity since it uses an already trained deep convolutional model called AlexNet. Thus in turn, a reduction in the complexity that combines training a deep model from the scratch has been achieved.

Ying Liu et.al. [10] proposes an image database retrieval algorithm based on the framework of transfer learning and feature fusion. Based on the fine-tuning of the pre-trained Convolutional Neural Network (CNN), the proposed algorithm first extracts the semantic features of the images. Principal Component Analysis (PCA) is then applied for dimension reduction and to reduce the computational complexity. Last, the semantic feature extracted from the CNN is fused with traditional low-level visual feature to improve the retrieval accuracy further. Experimental results demonstrated the effectiveness of the proposed method for image database retrieval.

B. Machine Learning Based CBIR

M. Alrahhah et.al. [7] proposed a new CBIR system using Local Neighbor Pattern (LNP) with supervised machine learning techniques. They evaluated the performance of this system by comparing the system with Local Tetra Pattern (LTrP) using Corel 1k, Vistex and TDF face databases. They used three types of the database (i.e color, texture and face databases) to improve the effectiveness of our system. Performance analysis shows that LNP gives better performance regarding the average recall than LBP, LDP, and LTrP. To increase the accuracy of this system they used the LNP method with machine learning techniques and performance analysis shows that local pattern with machine learning techniques improves the average accuracy.

P. Kaur et.al [8] proposed a new system in which features are extracted using Gabor filtering which are further optimized using lion optimization. In the end the classification is done using SVM for cuckoo search optimization and decision tree method for lion optimization. The proposed method is tested in terms of various parameters that show improved results are achieved using Lion optimization as compared to cuckoo search optimization.

Palepu Pavani et.al. [11] proposed an enhanced relevance-feedback method to support the user query based on the representative image selection and weight ranking of the images retrieved. The support vector machine (SVM) has been used to support the learning process to reduce the semantic gap between the user and the CBIR system. From these experiments, the proposed learning method has enabled users to improve their search results based on the performance of CBIR system. In addition, the experiments also proved that by solving the imbalance training set issue, the performance of CBIR could be improved.

Rajeev Srivastava et.al. [13] proposed a fast and effective CBIR system which uses supervised learning-based image management and retrieval techniques. It utilizes machine learning approaches as a prior step for speeding up image retrieval in the large database. For the implementation of this, first, we extract statistical moments and the orthogonal-combination of local binary

patterns (OC-LBP)-based computationally light weighted color and texture features. Further, using some ground truth annotation of images, we have trained the multi-class support vector machine (SVM) classifier. This classifier works as a manager and categorizes the remaining images into different libraries. However, at the query time, the same features are extracted and fed to the SVM classifier. SVM detects the class of query and searching is narrowed down to the corresponding library. This supervised model with weighted Euclidean Distance (ED) filters out maximum irrelevant images and speeds up the searching time. This work is evaluated and compared with the conventional model of the CBIR system on two benchmark databases, and it is found that the proposed work is significantly encouraging in terms of retrieval accuracy and response time for the same set of used features.

Praveen Yadav et.al. [15] proposed algorithms on the basis of texture, shape and color based feature extraction and matching of color and texture. They will use concept of Discrete Wavelet transform for euclidian distance and calculate clusters using modified K-Means clustering. They extract texture, shape, and color and finally measure similarity between query image and database image. Integrated approach retrieve more accurate image, reduce semantic gap between local and high level features. Modified K-Means takes less time of computation in comparison to other algorithms. It is more optimized for small as well as large database.

C.Hand Crafted Feature Based CBIR

Ibrahim Abood, Zainab et.al. [3] proposes content based image retrieval (CBIR) using four feature extraction techniques. The four techniques are colored histogram features technique, properties features technique, gray level co-occurrence matrix (GLCM) statistical features technique and hybrid technique. The features are extracted from the data base images and query (test) images in order to find the similarity measure. The similarity-based matching is very important in CBIR, so, three types of similarity measure are used, normalized Mahalanobis distance, Euclidean distance and Manhattan distance. A comparison between them has been implemented. From the results, it is concluded that, for the database images used in this work, the CBIR using hybrid technique is better for image retrieval because it has a higher match performance (100%) for each type of similarity measure so; it is the best one for image retrieval.

Deepa Dubey et.al. [9] clarifies for the most part about the determination of the picture highlights like shading, surface, and edge for the substance based picture recovery framework which utilizes the intelligent hereditary calculation. The shading highlight is extricated by utilizing mean and standard deviation, the surface element is separated by utilizing BDIP and BVLC highlight and the edge elements of a picture are removed by utilizing the watchful edge indicator. Extra to these, enhanced weights is ascertained by applying hereditary calculation on two dimensional entropy of picture. Since, Two-dimensional entropy utilizes both the dark estimation of a pixel and the nearby normal dim estimation of it, and along these lines gives better results. Here the term intuitive hereditary calculation (IGA) achieves all the more near the client's need and fulfillment of picture recovery.

Yogita D. Shinde et. al. [12] presented Self Mutated Hybrid Wavelet transform (SMHWT) which is used to form by using same component transform. In Proposed algorithm, feature extraction is done by applying sectorization on Self Mutated Hybrid Wavelet transformed images. To test the performance of the proposed method, total 1000 queries were fired on the image database containing 1000 images of 10 categories. Manhattan Distance is used for similarity measurement. Performances proposed algorithm is evaluated using average precision. Results show that the proposed Self Mutated Hybrid Wavelet Transform containing Sine transform as a component gives better performance improvement across all tried variations of SMHWTs.

Poorani M et.al. [14] proposed retrieval system uses integrated features, such as color, texture and shape. Color features are extracted using color histogram by calculating the RGB pixel count, HSV pixel count, Color Moment values. Shape features are extracted using Hu Moments and also by Edge detection by calculating Normalized rotation invariant moment values, similarly texture feature which is extracted by texture analysis method and the parameters are contrast, correlation, homogeneity, entropy and energy. The similarity measure using these integrated features can be carried out using Euclidean distance which provides high accuracy of retrieved images.

Nehal M. Varma et.al. [16] proposes a mixture of hybrid features for based image retrieval in which color features are obtained using color histogram method which will ultimately give the color gradient. The outer and inner edge would be extracted

through gabor wavelet method. The final features vector would be constructed by combining these above methods to retrieve visually similar images. The developed algorithm has been tested on wide range of datasets and the performance is recorded in terms of matching score and subjective analysis. The obtained results are competitive with respect to recently proposed methodologies.

CONCLUSION

Content based image retrieval is a technique which uses the visual contents to search images from large scale image databases. We have presented a comprehensive literature review on different techniques for CBIR and image representation. The main focus of this study is to present an overview of different techniques that are applied in different research models. After this review, it is summarized that image features representation is done by the use of low-level visual features such as color, texture, spatial layout, and shape. Due to diversity in image datasets, or nonhomogeneous image properties, they cannot be represented by using single feature representation. One of the solutions to increase the performance of CBIR and image representation is to use low-level features in fusion. The semantic gap can be reduced by using the fusion of different local features as they represent the image in the form of patches and the performance is enhanced while using the fusion of local features.

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