Image Retrieval System-An Integrated Approach

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Abstract. With the development of multimedia technology, the usage of large image database becomes possible and is rapidly increasing. These can be used for the purpose of retrieving files, which works on the mechanism of image search. Different databases are available on different websites like Instagram, Facebook, Twitter, Flickr, and Picasa. This paper shows the advantage of content-based image retrieval system, as well as its key technologies. Comparing to the shortcoming, only certain feature are used in the traditional system. This paper presents a review on different techniques of image retrieval techniques which are based on color, texture and shape of images. It also focuses on the feature extraction and representation, several commonly used algorithms and different methods used for matching of images.

Keywords — Content Based Image Retrieval, color, texture, shape.

1. Introduction

These days an innovation on image recovery is generally used in numerous zones which represent feasible solution for recovering the comparative image from an image collection. A large number of digital images can be found these days in the fields of medicine, education, sciences, industry etc with the advancement in the internet. The meaning of content defines the analysis of complete data present in an image instead of metadata, for example, keyword labels or image-related information. It is important to efficiently accumulate and retrieve images for different applications like fashion design, crime prevention, medicine, architecture etc. The images are filed by their visual features like colour, texture and shape.
Various CBIR frameworks have been developed, yet the issue of recovering images based on their pixel content stays unsolved, to a greater extent. CBIR is utilized for programmed ordering and recovery of image depending on the substance of the image known as highlights. The accessibility of image capturing gadgets, for example, digital camera, picture scanners, the size of digital picture variety is rising rapidly. It is important to accumulate and recover picture for various application, for example, style structure, crime prevention, medication, engineering. CBIR is image having rich substance. In CBIR framework image preparing strategies are utilized and concentrate visual highlights, for example, shading, surface and shape from images. The framework utilizes a query model to change over the picture into a portrayal of a query, in light of highlights extracted from the input picture.

2. Types of image Retrieval System

Currently image retrieval systems can be categorized as Text-Based Image Retrieval (TBIR), Content-Based Image Retrieval (CBIR) and Semantic Based Image Retrieval (SBIR). The brief explanation of different types of image retrieval systems is as given below as shown in Fig.1 [3]

![Figure 1Classification of Image Retrieval System](image)

2.1 **TBIR-Text Based Image Retrieval**

In this type, the images are annotated by text firstly and then complete retrieval is done by text-based database management systems. For this purpose text based tags, keywords, or descriptions are used. The user makes written or numeric query to retrieve the image which satisfies the criteria based on tags. This type of framework is known as Text Based Image Retrieval framework [3]

2.2 **CBIR-Content based Image Retrieval**

It is also recognized as a question about the content of image. It was introduced in the early 1980s. All the experiments are performed into automatic retrieval of images in content on the basis of image retrieval from the database which are totally based on the features present in it. The principle objective
is to find the related images based on their feature. To achieve this, the substance ought to be at first be delineated in a profitable manner and, the content should be initially defined in an efficient manner. When the query image is applied in the system, it will produce all the different features of that image. After that, comparison will be done between the features and different pictures in the database and finally results will be shown to the user.

2.3 **SBIR-Semantic Based Image Retrieval**

CBIR’s intensification is the gap that extends between high-level and low-level image features. There always exists a phenomenon of human perception. Semantic image retrieval programs are divided into two categories i.e. building stage and query stage. In building stage, the significant and interesting patterns/ regions/objects based on the parallel properties of the visual features are extracted by low level features are recognized in semantic-based image retrieval systems. In query stage, in order to get the semantic features, images can be queried based on the high-level idea or a textual query.

3. *Publically Available Dataset*

There are various datasets available on which the content based retrieval has been done. The summary of such datasets including the number of images, categories, various types, and size of images is shown in the Table 2.

**Table 1. Dataset Available**

| Sr. No. | Dataset Used | Reference | No. of Images | Types of Images | No. of Categories | Size of Images |
|---------|--------------|-----------|---------------|-----------------|------------------|--------------|
| 1.      | Corel 1K     | [5], [7], [15] | 1000          | Asians, buildings, beaches, elephant, flower, dinosaur, buses, mountains, hills and floods | 10               | 256×384      |
| 2.      | Corel 5K     | [5], [9]   | 5000          | bear, lion, fox, tiger, etc., human, buildings, paintings, natural scenes, fruits, cars etc. | 50               | 192×128      |
| 3.      | Corel 10K    | [5], [9]   | 10,000        | buses, ships, texture, food, army, airplanes, furniture, oceans, cats, fishes etc. | 100              | 192×128      |
4. Literature Review

Different authors have used different techniques in image retrieval systems. The review of the work which has already been done is summarized in Table 3.

| 4. | Corel-1500 | [15] | 1500 | Butterfly, Leopard, Hibiscus, Airplanes, Kitchen, Motorbike, Fireworks, etc. | 15 | 256×384 |
| 5. | Salzburg texture (STex) | [5] | 7616 | bark, fabric, gravel, stone, wall, etc | 476 | 1024x102 |
| 6. | MIT-Vistex | [5] | 40 | Natural scenes | 40 | 512x512 |
| 7. | UFI (Unconstrained Facial Images) | [6] | 400 | Different facial expression images | 40 | 128X128 |
| 8. | ORL (Oracle Research Laboratory) | [6] | 400 | Facial images | 40 | 92x112 |
| 9. | European 1M dataset | [7] | 1081 | landmark scenes of different European cities | - | - |
| 10. | LFW(Labeled Faces in the Wild) | [7] | 13000 | Face photographs | - | - |
| 11. | Flickr Logos 27 | [7],[9] | >4000 | annotated logo dataset like Apple, BMW, Citroen, Coca Cola, DHL, FedEx etc | 27 | - |
| 12. | GHIM-10K | [9] | 10000 | sunset, ship, flower, building, car, mountains, insect, etc. | 20 | 300×400 |
| 13. | Caltech-256 | [15] | 29,780 | Butterfly, Leopard, Hibiscus, Airplanes, Kitchen, Motorbike, Fireworks, etc | 256 | 260×300 |
| Year | Author(s)       | Reference | Summary                                                                                                                                                                                                 |
|------|----------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2019 | Bhunia AK et al.| [5]       | The original feature descriptor which combines the color and texture information is presented. The inter-channel relationship between Hue (H) and Saturation (S) channels in the HSV color space has been defined for different datasets. The precision and recall values are calculated on various databases and compared with some state-of-art local patterns. |
| 2017 | Ningthoujam et al. | [6]      | A model of hybrid face recognition system based on CBIR and SVM is proposed. The feature vectors from the face image database are generated by using Gabor wavelet (GW), wavelet Transformation (WT), and Principal Component Analysis (PCA)[6]. |
| 2019 | Mudhafar et al. | [7]       | A hybrid model is designed in this research article using the Gaussian filtering technique. After pre-processing, texture and colour are extracted as sets of feature which are clustered by k-means clustering approach. A novel SVM based CNN (NSVM-CNN) was used to optimize features using the modified genetic algorithm. The performance of developed model is better in terms of precision, recall, f-measure and accuracy as compared to the Regression Vector Machine (RVM). |
| 2019 | Michal L et al. | [8]       | The concept of fuzzy logic has been implementing for the image key point extraction as descriptors and the key point of image in question is compared with the key points of the database with the Apache Hadoop software framework with HDFS. |
| 2018 | Suliang Yu et al. | [9]      | It is based on the soft hyper graph which is combined with the weighted adjacent structure to get the better performance of system in terms of its accuracy and retrieval efficiency. The combined color difference histogram with micro-structure descriptor method is used as a similarities measurement technique between the images to generate a similarity matrix. |
| Year | Authors | Reference | Summary |
|------|---------|-----------|---------|
| 2018 | Shaila, S.G. et al. | [10] | The implementation is based on the construction of histogram for human color visual perception. The true color and grey color proportion are calculated using an appropriate weight function for each pixel of the image. |
| 2018 | Qili Deng et al. | [14] | The implementation is based on the two different steps named as the embedding step and the aggregation step. The concept of multi-level-image representation is used by authors which helps to improve the performance of model and it is also applied on the large scale Alibaba Dataset but the simulation complexity is more due to small feature sets. |
| 2018 | SafiaJaben et al. | [15] | Authors proposed the speeded-up robust features (SURF) and fast retina keypoint (FREAK) feature descriptors for a CBIR technique[15].Both descriptors are combined and the issues are resolved.But in future, the problem of incorporating spatial information could be solved using the concept of the deep learning. |
| 2018 | Chen et al. | [16] | A common bitmap scheme was proposed and then converted into two colour quantizers. The colour histogram feature (CHF) and the bit pattern histogram feature (BHF) are extracted from the image to determine the similarity between a query and dataset images for retrieval of the desired image. Results of this work leads to improvement in performance but precision rate of large dataset is low. |
| 2014 | Bhute M et al | [17] | Edge detection technique is used for the extraction of images. Signal processing and image compression are the different techniques which are used in this algorithm. |
| 2012 | Chadha et al. | [18] | The comparison of different content based image retrieval is presented in this paper. The system finds the relevant images from the large database and unique descriptors are assigned for the trained images. Several feature extraction technique are used for detection of features. |
| 2008 | Deselaers et al. | [19] | The experiment is performed on an expansive number of various image descriptors. Comparative analysis of different descriptors proves that color histogram performs well from all other |
A powerful technique for image retrieval i.e. a relevance feedback framework is presented. It gives full impact on the low-level feature of the images. But this technique did not ensure the requirement of the images in the semantic content.

This paper provides a hybrid image restoration system that gives the user the flexibility to use the low-level and the high level features. The algorithm is used for semantic collections with correct answer in an image area. The system developed a framework where users wanted to practice according to the semantic concept.

### 5. Present State of Art

After the analysis of above existing work, comparison of previous work on the basis of parameters and techniques used is made which is summarized in Table 4. Different authors has used different types of database set along with the various techniques to provide better results in terms of precision, recall and F-measure value.

| Author                  | Technique Used                               | Database Used   | Performance Metrics |
|-------------------------|---------------------------------------------|-----------------|---------------------|
| Bhunia Ayan Kumar et al. [5] | Diagonally Symmetric Local Binary Co-occurrence Pattern | HSV(Corel 1K)   | Precision 79.52 Recall 51.78 Accuracy - F-Measure - |
|                         |                                             | HSV(Corel 5K)   | Precision 64.16 Recall 32.36 Accuracy - F-Measure - |
|                         |                                             | HSV(Corel 10K)  | Precision 53.70 Recall 24.49 Accuracy - F-Measure - |
| Ningthoujam Sunita Devi and K. | A hybrid model of face recognition using PCA, UFI | UFI(PCA)        | Precision 0.82 Recall 0.9 Accuracy - F-Measure 0.8 |
|                         |                                             | UFI(WT)         | Precision 0.73 Recall 0.81 Accuracy - F-Measure 0.77 |
| Hemachandra n [6] | WT and GW features | UFI(GW) | 0.60 | 0.7 | - | 0.70 |
|-------------------|---------------------|--------|------|----|---|------|
|                   | ORL(PCA)            | 0.91   | 0.71 | -  | - | 0.83 |
|                   | ORL(WT)             | 0.83   | 0.91 | -  | - | 0.87 |
|                   | ORL(GW)             | 0.70   | 0.8  | -  | - | 0.80 |
| Mudhafar Jalil Jassim Ghrabat et al. [7] | A novel SVM based CNN (NSVM-CNN)-Support Vector Machine-Convolutional Neural Network | European 1M dataset | 89 | 98.7 | 96.77 | - |
|                   | Corel 1K            | 98     | 98   | 96 | - | - |
|                   | LFW(Label ed Faces in the Wild) | 99 | 100 | 97.14 | - |
|                   | Flickr 27           | 83.78  | 99.69 | 92.72 | - |
| Suliang Yu et al. [9] | Different descriptors like CDH, MSD and SSH are used for different data sets. | Corel-5K (CDH) | 0.58 | 0.062 | - | 0.3 |
|                   | Corel-10K (MSD)     | 0.59   | 0.062 | -  | - | 0.3 |
|                   | Flicker (SSH)       | 0.62   | 0.075 | -  | - | 0.10 |
| SG Shaila, A Vadivel [10] | Smooth Weighted Color Histogram | Corel Benchmark | 0.79 | 0.1  | -  | 0.19 |
| Safia Jabeen et al. [15] | SURF-FREAK feature descriptors | Corel-1500 | 83.20 | 16.64 | - | - |
|                   | Caltech-256         | 38.98  | 7.796 | -  | - | - |
6. Conclusion

In this study, different approaches of content based image retrieval are studied and analysed. Content based image retrieval system is promising and the work done by the researchers in this field is praiseworthy but still there is significant scope for future research. Most of the work has been already done on different feature extraction approach like speeded-up robust features (SURF), Color Histogram Feature (CHF) and the Bit Pattern Histogram Feature (BHF) but these are not up to acceptance in large database scenario. Improvement in techniques can be made by applying some preprocessing methods on the input image. So, the use of preprocessing techniques in the methodology will lead to retrieval of images in an accurate manner.

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