

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

## A Study on Low Level Features and High Level Features in CBIR

Rohini Goyenka<sup>1</sup>, D.B.Kshirsagar<sup>2</sup>

P.G. Student, Department of Computer Engineering, SRES Engineering College, Kopergaon, Maharashtra, India<sup>1</sup>

H.O.D, Department of Computer Engineering, SRES Engineering College, Kopergaon, Maharashtra, India<sup>2</sup>

**ABSTRACT:** Content Based Image Retrieval System retrieves images using color, texture and shape properties of the image. Using precision and recall assessment is done on these features for performance measures. In CBIR digital images are stored in large databases. CBIR focuses on Features extraction and its demonstration from huge databases. The image retrieval is fascinating and fastest developing practice in all arenas. It is effective and well-organized method for retrieving the image. In CBIR system the images are stored in the form of low level visual information due to this the direct connection with high level semantic is absent. To bridge the gap between high-level and low-level semantics several methodologies has developed. For the retrieval of image, firstly extracts the features of stored images then all extracted features will goes for the training. After the completion of pre-process, it'll compare with the query image. The need to improve the precision of image retrieval systems and reduce the semantic gap is high in view of the growing need for image retrieval.

**KEYWORDS:** CBIR Systems, CBIR with Relevance Feedback,, Low Level Features, High Level Features.

### I. INTRODUCTION

Multimedia database system is a very active research field in recent years, with the driving forces being:

1. The day-by- day growth of multimedia information as the data source;
2. The fast enlargement of the World Wide Web as the consumer market;
3. The fast growth in the computer hardware industry as the technical support.

Still research CBIR systems that can support fast and efficient indexing, browsing, and retrieval are still in short supply.. There are many challenging research sub-areas, among which content-based image retrieval (CBIR) has been very active since early 90's . However, despite the advances in both the feature selection techniques and matching and retrieval techniques, the current CBIR systems still have a. major difficulty that it has yet to overcome, i.e., how do we relate the low-level features to the high level semantics? From our extensive experiments on CBIR systems using features like colour, texture, shape, spatial layout, etc., and relevance feedback from the user, we still found out that the low-level contents cannot always describe the high level semantic concepts in the user's mind. This is one of the major burdens for a CBIR system to be implemented in practical image retrieval applications. To overcome this burden, on the one hand, one can go along the direction of searching for more low-level features that can improve the performance of the current content-based retrieval schemes.

With the advancement of devices for image acquisition, the digital image information is additionally increasing oftentimes. Therefore, to access any explicit image from this large pool of image information, it becomes necessary for user to own an economical image retrieval tool that is correct and processes pictures in less time. Seeing this issue, CBIR is introduced.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

The working of CBIR framework shown in Figure 1 is as follows:

1. Image Acquisition: Image is created using digital devices and image database is created
2. Image Pre-processing: image pre-processing is step requires enhancement, noise removal, segmentation etc. Images stored into databases are processed before the retrieval process to enhance the image quality for retrieving the most similar images in less time.
3. Feature Extraction: in feature extraction image feature such as colour, shape, texture, spatial layout are extracted from images. Those extracted features are stored into database called as features vector database. Image features are classified into two
  1. Low-level features
  2. High-level features.

The feature vector database is used to compare the features of query image with features of database image.

Similarity Matching: these similarity matching techniques and algorithms used for comparing the similarity between the features of query image with features stored in feature vector database.

5. Output/Retrieved Images: after similarity matching is performed, the most similar images are given as output.
6. User Interaction/Feedback: here user can participate in retrieval system. He/she just needs to select the most similar or appropriate image as feedback to system. Based on the query image, again features are calculated and compared to the image features stored into database and updated output is given to users. The images that users select are the relevant or positive images and the others are irrelevant or negative images.

Currently research is focused on how to minimize the semantic gap and lot of work is going on.

Section:

2. What is semantic gap?
3. Low-level features and high level semantics
4. Literature survey
5. Performance feature

Semantic gap:

High-level features are keywords, text, visual features etc. By which image is interpreted and similar images are retrieved from a number of images. But automatic systems only extract low-level features like colour, shape, texture, spatial location etc. from the image. So there is no direct link or bridge between high-level features and low-level features which are extracted. It is quite difficult to relate to the high-level semantics of humans mind. Semantics of images are broadly divided into two levels,

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

1. Local semantic level
2. Global semantic level

Local semantic level:

Local semantic features tell about the existence of independent objects or combination of objects in an image. So the queries can be formed using single object “retrieve images with mountain” or combination of objects like “retrieve images with mountains, rivers and trees”.

Global semantic level:

It describes or defines about the image or topic of the image. So the queries can be based on particular topic for example

“retrieve images of flood”. The objects in the images are examined by the global semantic feature and how this objects are related to each other spatially. To make the CBIR queries more clear, they are categorized into three levels.

Level1:

is based on low-level features like colour/shape, texture/spatial location, images are retrieve so queries formed will be based on particular thing. For example “foundimages like this”.

Level2: to find images containing particular objects. For example images having bike in it.

Level3- in this level images having some

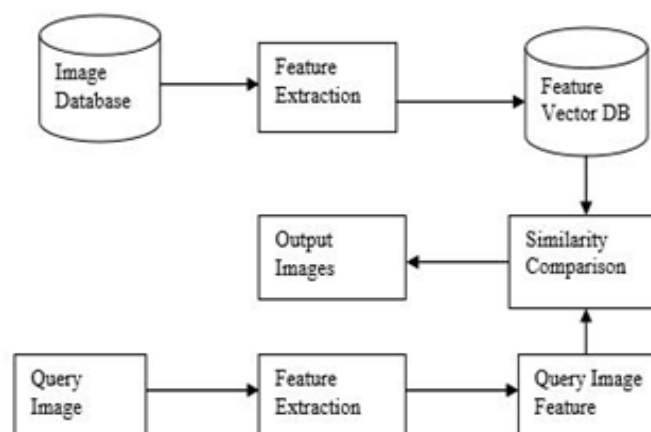


Figure 1. Block Diagram of CBIR

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

2. Semantic Gap Accuracy in CBIR is dependent on the subject on whom CBIR is working and the user perspective. According to humans, HL features (concepts) are keywords, text, visual features etc. by which they interpret images and find similarity between numbers of images. But automatic systems only extract LL features like colour, shape, texture, spatial location etc. from the image. So if we try to see in a broader view, there's no direct bridge between high level features by which human understand and low level features which are extracted. Many experiments and studies have been done in CBIR but LL features obtained were unable to relate to the HL semantics of human's mind [4, 5]. In Ref [6], the semantics of images are broadly divided into two levels:

1. Local Semantic Level: Local semantic features say about the existence of independent objects or combination of objects in an image. For this purpose, queries formed can be like

„Retrieve images with mountains“ (single object) or „Retrieve images with mountains, rivers and trees“ (combination of objects).

2. Thematic or Global Semantic Level: Thematic semantic features refer to the definition/description about the image or topic of the image. It sees the image with a global perspective.

Queries formed could be on a particular topic like „Retrieve images of flood“. The thematic feature examines all image's objects and how they are related spatially to each other. In Ref [3], the CBIR queries are categorized into three levels for better understanding:

1. Level 1: Retrieve images based on the LL features like colour/shape/texture/spatial location. Typical query would be “found images like this”. Here, “this” would be a particular thing.

2. Level 2: Retrieve images having a particular object in it like finding images having bike in it. 3. Level 3: Retrieve images having some higher level logical reasoning or some significance about particular objects which are taken as a query. Typical query would be like retrieving images of riots which has information like an angry crowd of people.

To extract the visual features is the foundation of any content-based image retrieval technique. This feature may include both

1. Text based feature that is keyword annotations.
2. Visual features that are colour, texture, shape etc.

The visual features can further classified as the low-level features and high level features

## II LOW-LEVEL FEATURES

Colour:

The response of the human visual system to light and the interaction of light with objects. It is most widely and commonly used low-level features, as it is more to extract from the image.

Colour space:

To represent a image in digital world, number of colour spaces are used for the better understanding of human visual system, not only implementation of CBIR.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

RGB:

RGB is the most commonly used colour spaces. There are number of colour spaces used. The RGB stands for red-green-blue. Additive primary colours of light red, green, blue are also included in this colour space. This colour is mixed in any combination to produce or create any colour in the visible spectrum.

Objective to use this features are:

1. To filter out unwanted images with large distance at first stage.
2. Use a small number of data to represent the features vector.
3. RGB is perceptually non-uniform and device independent

Grey level co-occurrence matrix:

Gray Level Co-occurrence Matrices (GLCM) is a popular representation for the texture in images. They contain a count of the number of times a given feature (*e.g.*, a given gray level) occurs in a particular spatial relation to another given feature. GLCM, one of the most known texture analysis methods, estimate image properties related to second-order statistics. We used GLCM techniques for texture description in experiments with 14 statistical features extracted from them. The process involved is follows:

1. Compute co-occurrence matrices for the images in the database and also the query image. Four matrices will be generated for each image [17].
2. Build up a 4×4 features form the previous co-occurrence matrices as shown in Table 2

Colour histogram:

In colour histogram, bins are formed and colour distribution is carried using a set of bins. But sometimes the results generated by the CBIR system based on colour features shows a distortion. To improve the technique of colour histogram features are classified into

1. Global colour extraction
2. Local colour extraction

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

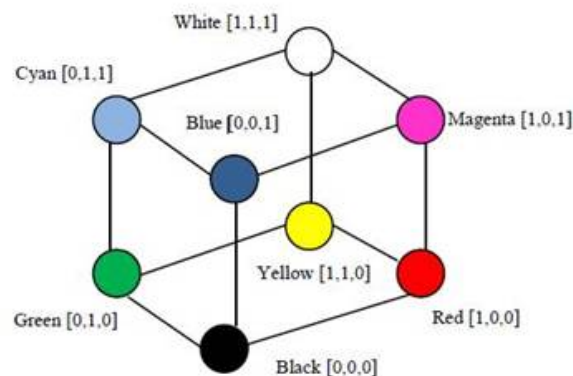


Fig.3 RGB Color Space.

## Colour histogram:

In colour histogram, bins are formed and colour distribution is carried using a set of bins. But sometimes the results generated by the CBIR system based on colour features shows a distortion. To improve the technique of colour histogram features are classified into

1. Global colour extraction
2. Local colour extraction

## Geometric moments:

An image moment is a certain particular weighted average of the image pixel's intensities, or a function of such moments normally chosen to have some attractive properties. Properties of image like area, its centroid, and information about its orientation can be search through image moment. Geometric moment use only one value for feature vector. However performance is not scaled i.e if image size becomes relatively large, it takes more amount of time to compute feature vector

## Colour moments:

To eliminate the quantization problem of colour histogram, colour moments are used. Distribution of colours is carried out by its moments and most information is focused on low moments like the first moment(mean), the second moment (variance), the third moment (skewness) are taken as feature vectors. The central idea behind colour moment is that the distribution of colour in an image can be interpreted as probability distribution

## Texture:

The visual pattern and the occurrence of this visual pattern in an image having the properties of uniformity. Texture properties are defined for a region in an image or sub-image. Texture patterns have some basic properties

# International Journal of Innovative Research in Science, Engineering and Technology

*(An ISO 3297: 2007 Certified Organization)*

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

1. structure
2. specification

Structure:

Patterns may be thought as a set of macroscopic regions. And its structure is set by a group of repetitive patterns that have little primitives or parts organized per a special rule referred to as placement rule.

The six visual texture properties were

1. Contrast
2. Coarseness
3. Directionality
4. Regularity
5. Line likeness
6. Roughness

Coarseness:

The texture pattern examines whether or not a pattern is a coarse or fine. The pattern of enormous size in small range is the coarse texture pattern.

Contrast:

The difference between the intensity values of pixels which are adjacent in an image are the contrast values. The image may be of high contrast or low contrast. A high contrast image has contrast values greater than texture primitives and low contrast image has contrast values less than texture primitives

Directionality:

Directionality is a global property of the specific area of the image. It also tells about the shape as well as about the inclination of the texture patterns.

Line Likeness:

Line Likeness tells about texture primitives“shape”. Sometimes the texture primitives cannot be classified using directionality. Using line likeness feature it is decided whether texture primitive is a straight line or a sort of wave.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

Regularity:

Texture patterns are sometimes uniformly organized and sometimes they are randomly organized. Regularity tells about the organization of the texture patterns.

Shape

Shape is one of the important basic visual features that are used to give data about image content. While evaluating shapes within the image, an illustration of an object or shape is done using either shape boundary. For accurate retrieving of images, it is required that shape descriptors find similar shapes from the pool of images effectively. Shape descriptors are categorized into two types:

1. Contour based methods and
2. Region based methods

## III. SEMANTIC TEMPLATE

The major link or bridge between the high level semantic concepts and low level visual features or it can be a set of mapping between high level semantic concepts and low level visual features. Semantic template is an important as it understood the content of images which user entered as a query. Also it increases the performance level of retrieving images.

Extracting semantic features:

Low level features are not sufficient to describe an image if the content of image is blurred, complex, and abstract. In this case, the abstract characteristics can be better described by high level semantics. Three extraction methods for extracting semantic features.

1. Semantic feature can be extracted based on image processing and domain knowledge. The 3 basic processes are
  - i. image segmentation
  - ii. object recognition
  - iii. analysis of the object relation
2. Through tags manual or human interaction, the semantics of images can be obtained.
3. Using file name, URL images near the text or metadata information, semantics can be extracted.

A. Semantic extraction based on knowledge.

The main aim is to provide necessary knowledge and information in advance. It is divided into following methods, 1. Semantic extraction based on object recognition:

For object detection, and object recognition, this method uses the traditional concept of computer vision.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

It goes through 3 main processes

- Image segmentation
- Object recognition
- Analysis of the spatial relationship of objects

2. Extraction of scene and behavioural semantics:

With the help of semantic- level knowledge of concept, abstract scene and behaviour semantics can be extracted on the basis of object recognition and spatial relations. When there is a problem of image recognition, some other techniques and methods are used to obtain semantics of scene images. These methods usually bypass the process of image recognition.

3. Extraction of emotional semantics:

The emotional semantics are the highest level and most

important of image semantics. The semantic must involve feeling and expression of the people psychological, cognitive and aesthetic and other factors in the extraction of visual features closely related to emotion present in image.

B. Semantic extraction based on manual interaction:

All the time we cannot dependant fully on computers, to access the semantics of images effectively. To overcome this situation, we can add human involvement into retrieval system in order to get better and improved results. The system should correct the semantic description of the image database. This method involves in the pre-image processing and feedback learning.

Just using a manual mark, image pre-processes is carry out. User feedback plays important role in semantic extraction. The user feedback plays two roles

1. Based on retrieval results, capture the intention or needs of users by examining the user operations.
2. The other is to establish and modify the relationship between high-level semantics and low level features of the image.

C. Semantic extraction based on external information

In this method information may be a file, name, URL, text near the image or metadata. Semantics are extracted using this relevant external information. In this method manual indexing is the most common. The benefits of this method is its easy process in machine, expression of information is spontaneous and can describe high-level concepts.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

High-level semantics:

In programming, the meaning and format of syntaxes written in program code defines the semantics. In image processing field, the user level perspective is considered. Semantics depicts about the interpretation of images.

In CBIR low-level features does not satisfy user's perspective and his critical thinking properly. This is called semantic gap.

## IV. CONCLUSION

This paper gives a complete summary about CBIR system, image retrieval, semantic gap, Low Level features and High Level semantics. CBIR is still not perfect technique as well as it needs more improvements for better retrieval results. "Semantic Gap" is the main issue and reduction of semantic gap is the challenge for researchers. As there is no proper technique available which reduces semantic gap fully, future research directions are suggested. Various semantic feature extraction methods and techniques for reducing semantic gap are discussed in this paper. There are three traditional methods to extract the image semantic feature. Firstly, semantic feature can be extracted based on image processing and domain knowledge which contains three key processes that are image segmentation, object recognition, and object relation analysis, Secondly, we can get image semantics from manual labels or human interaction. Thirdly, we can extract semantics from external information such as file name, URL, text near the image or metadata information.

## REFERENCES

- 1]. Rui, Y., T. S. Huang, M. Ortega, and S. Mehrotra, 1998, "Relevance Feedback: A Power Tool in Interactive Content Based Image Retrieval", IEEE Tran on Circuits and Systems for Video Technology, Vol 8, No. 5, Sept., 644-655.
- 2]. Y.Liu, D.Zhang, G.Lu, and W.-Y. Ma, "A survey of content-based image retrieval with high-level semantics", Pattern Recognition, vol. 40, no. 1, (2007), pp.262-282.
- 3]. X.S. Zhou and T. S. Huang, "CBIR: from low-level features to high-level semantics", In Electronic Imaging, International Society for Optics and Photonics, (2000), pp. 426-431.
- 4]. Aman Saini, Sonit Singh, "Evaluation of CBIR System by Using Low Level Features of an Image", International Journal of Science, Engineering and Technology Research (IJSETR) Volume 5, Issue 6, June 2016. ISSN: 2278 -7798
- 5]. Ying Liu, Dengsheng Zhang, Guojun Lu, Wei-Ying Ma (2006) *A survey of content-based image retrieval with high-level semantics* Pattern Recognition 40 (2007) 262 – 282.
- 6]. Yong Rui, Thomas S. Huang and Shih-Fu Chang (1999) *Image Retrieval: Current Techniques, Promising Directions, and Open Issues* Journal of Visual Communication and Image Representation 10, 39–62.
- 7]. Harpreet Kaur, Kiran Jyoti, "Survey of Techniques of High Level Semantic Based Image Retrieval", International Journal of Research in Computer and Communication technology, IJRCCT, ISSN 2278-5841, Vol 2, Issue 1, January 2013.
- 8]. Tamane, Sharvari, "Content Based Image retrieval Using High level semantic features", Proceedings of the 2nd National Conference, 2008.
- 9]. Liu, Ying, Zhang, Dengsheng, Lu, Guojun, and Ma, Wei-Ying, "A survey of content-based image retrieval with high-level semantics", Pattern Recognition 40, 262 – 282, 2009.
- 10]. Zhou, Xiang Sean, and Huang, Thomas S., "CBIR: From Low-Level Features to High-Level Semantics", Beckman Institute for Advanced Science and Technology University of Illinois at Urbana Champaign, Urbana, IL 61801.
- 11]. Jiang, Wei, Chan, Kap Luk, Li, Mingjing, and Zhang, Hongjaing, "Mapping Low-Level Features to High-Level Semantic Concepts in Region-Based Image Retrieval", IEEE, Computer Society Conference on Computer Vision and Pattern Recognition, 2005
- 12]. HuMin, and Shuangyuan, Yang, "Overview of content-based image retrieval with high-level semantics", IEEE, 3rd International Conference on Advanced Computer Theory and Engineering (ICACTE), 2010.
- 13]. Anuja Khodaskar, Dr. S.A. Ladke, "Content Based Image Retrieval with Semantic Features using Object Ontology" International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 4, June - 2012 ISSN: 2278-0181