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Research Article

An Overview of Feature Extraction Techniques in Content-Based Image Retrieval Systems

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Abstract

The collection of images has grown rapidly and continues to increase in future due to widespread use of internet. Content based Image Retrieval (CBIR) system aims at retrieval of images of relevance to the query image input by the user from an enormous image database by low-level feature (such as color, texture and shape) extraction from the image. Some common applications of CBIR and existing commercial systems employing CBIR have been highlighted. General algorithm for explaining the working of CBIR is presented. This article presents a review on methods for low level feature extraction like extracting color, texture and edge features. CBIR still faces some challenges like judgement of human perception of visual content, less appropriate selection of similarity measure, semantic gap and other factors.

Keywords: *Content Based Image Retrieval, color histogram, color moments, texture, edge detector, query image, CBIR.*

Introduction

Rapid emergence of new Technology and advancement in scientific methods with a large dependency on internet to meet the increasing public demand for searching information of relevance from huge databases for desired application has led to the necessity for an efficient image retrieval system. Various applications such as Face recognition, Medical diagnosis, prevention of Crime, Geospatial Satellite Imaging, Fashion Designing, Architectural design and several other applications require a fast and efficient system to help in retrieval of images of relevance from a large image database containing enormous number of images. Traditional image retrieval systems like Text based image retrieval systems that require the manual annotation of images with text consumed a lot of time and proved to be practically impossible for huge databases. Employment of TBIR by commercial systems like Google for image retrieval from large databases. One of the limitations of TBIR is the variation in perception of humans for image description.

The limitations of TBIR system area unit resolved by Content based mostly Image Retrieval (CBIR) system. CBIR system aims at retrieval of pictures of connection to the question image input by the user from an enormous image info by low-level feature (such as color, texture and shape) extraction from the image.

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For extraction of desired pictures computation of similarity between question image and pictures of info is performed. alternative terms like question by Image Content (QBIC) and Content based mostly Visual data Retrieval (CBVIR) also are utilized in place of CBIR that could be a laptop vision application geared toward resolution the matter of looking digital pictures in giant databases. In 1992 T. Kato used the term content-based image retrieval to explain the experiments into retrieving the photographs mechanically from an info by exploitation color and form feature extraction. IBM developed the earliest CBIR system popularly referred to as QBIC. The various business CBIR systems are QBIC, Virage, Visual SEEK, Netra, Photobook and ease. The databases containing huge variety of pictures are medical databases used for diagnosing of a unwellness, Geographical info systems (GIS) used for remote sensing functions, picture gallery, repository catalogues, on-line searching catalogues, Industrial Imaging, AIA (Automates Imaging /Machine Vision), ASPRES (Remote sensing program), Wang information, Corel information of pictures, multimedia system and graphical pictures, Face Recognition system employed by the police personnel. Over the years, many analyses have been allotted on CBIR systems to enhance the retrieval potency, speed, accuracy and exactness values to scale back the image retrieval time and increase the effectiveness of image retrieval from vast databases. Despite of the analysis carried to this point CBIR still faces some challenges like judgement of human

perception of visual content. Gap between info extracted mechanically from visual knowledge and interpretation by the user called linguistics gap. the present CBIR systems still lack accuracy of relevant pictures because of improper choice of feature extraction strategies and similarity measuring technique. Over many years varied techniques for image retrieval are used and enforced however CBIR still suffers from challenges like linguistics gap and inconsistency in understanding the visual knowledge for various users. Jenni Kommineni *et al*. (2015) planned a technique for content primarily based image retrieval supported support vector machine classifier and also the feature extraction supported color string secret writing and string comparison. Yogita Mistry *et al*. (2017) planned a CBIR supported hybrid feature victimization varied distance live. Farsi Hassan and M. Sajad (2013) planned color and texture feature primarily based image retrieval by victimization Hadamard matrix in distinct rippling rework. A. K. Alhassan and A. A. Alfaki (2017) planned a fusion {based|based mostly|primarily primarily based} retrieval model for merging results extracted from color and texture image options based totally different fusion strategies. CombMEAN fusion approach exhibits the most effective exactness price. K. Seetharaman and S. Sathiamoorthy (2014) planned an efficient framework for color image retrieval supported Full vary Autoregressive model (FRAR) and color image retrieval victimization applied mathematics model and radial basis operate neural network. X. Y. Wang *et al*. (2013) planned a replacement content primarily based image retrieval technique victimization color and texture info. M. K. Alsamadi (2017) planned AN economical similarity live for CBIR victimization memetic rule. The results were superior to alternative CBIR in relation to exactness. H. Aboulmagd *et al*. (2009) planned the employment of formal logic to enhance CBIR. K. Iqbal *et al*. (2011) planned the CBIR approach for biometric security victimization color, Texture and form options controlled by fuzzy heuristics. B. Verma and S. Kulkarni (2004) planned a fuzzy neural approach for interpretation and fusion of color and texture options for CBIR systems. J. Yue *et al*. (2011) planned CBIR victimization color and texture amalgamate options. CBIR that mixes the colour and texture options greatly improves the performance. Color options are stable and strong and it's not sensitive to rotation translation and scale changes and also the color feature calculation is comparatively easy.

Texture is another wide used feature that has been able to capture the graininess and repetitive patterns of surfaces at intervals a picture. This paper proposes the extraction of low-level visual options by using color moment, native Binary Pattern and smart Edge Detection techniques for extracting color, texture and edge options severally. the mix of those options is employed in conjunction with Support Vector Machine to scale back the retrieval time and improve the exactness. conjointly the challenge of linguistics gap between low- and high-level options is addressed by incorporating connection Feedback.

Motivation

1) The collection of images have grown rapidly and continues to increase in future due to widespread use of internet.
2) Manual annotation is time consuming especially for large databases.
3) CBIR is an efficient method for retrieval of relevant images
4) Limitation of characters in keywords to express the visual content of image
5) CBIR is an efficient method for retrieval of relevant images as it has reduced the retrieval time

Applications of CBIR

A brief description of various applications of CBIR is given below:

Societal factors

There is no field which does not incorporate the use of images. Advancement in telecommunication industry and internet has led to an explosion of images. The Images provide information regarding geographical regions and topography by means of maps, forecasting of weather, online shopping relies on the images of the products thereby allowing the customers to go through the details of the products, advertising industry heavily depends on images as well, Art galleries incorporate the use of images that are admired by the appreciators of art work (M. Rehman and M. Iqbal., 2012).

Industrial factors

Professional such as graphic designers and illustrators require the use of images almost every day in their job. There is a wide range of professions lying between these two extremes, including medicine and law. Professionals such as librarians and museum curators need to search images for their clients. To ensure good quality production a database of images such as tools, machinery, raw material, standard shape and size and other visual parameters is required in an industry (Y. Mistry *et al*., 2017).

Crime prevention

For the identification of people the use of visual information by the policemen proves to be of utmost importance. Visual information gathered from cameras are a valuable source to provide recordings of crime scene to be used as an evidence. The images of people accused for committing a crime are digitally stored in computerized systems for keeping a record. For enforcing law images are incorporated for carrying out

face recognition, automatic fingerprint recognition system, DNA matching, shoe sole impressions, and surveillance systems. Database of objects that get stolen has also been maintained in some countries (H. Aboulmagd *et al*., 2009).

Medicine

With the objective of diagnosing health ailments and patient monitoring the medical professionals store visual information in the form of MRI scan, CT scan, X-rays, and ultrasound. These files related to individual patients must be kept confidential and are labelled with some number for giving it a unique identification. Also this stored visual information can be utilized for the purpose of research. Effective image processing systems are necessary for the correct diagnosis of lesions by the health professionals.

A CBIR system for the domain of HRCT (High-resolution Computed Tomography) images of the lung with emphysema-type diseases is shown in fig.3. The symptoms of these diseases can drastically alter the appearance of the texture of the lung (M. Iqbal and M. Sharif, 2012).

Fashion and graphic design

For professionals such as graphic, fashion and industrial designers the use of images has a great importance. Different designers resolve the problem by presenting different designs and some of them incorporate designs that are obtained from past versions of designs, graphics, sketches and images. Advancement in technology has enabled the access and storage of images electronically.

Architectural and engineering design

The internal and external view of buildings and specific architectural design is captured as photographs. For presenting the architectural designs to their clients use of photographs captured by digital cameras and digitally stored for future reference is now trending among architects. The images can be drawings, plans, machine parts, and others. The designs are commonly made using Computer Aided Design (CAD), 2-D and 3-D modelling.

Geospatial Satellite Imaging

The increase in volume of images acquired from various satellite platforms has created a necessity for an efficient image retrieval system. The use of Geospatial image retrieval system will enable the analyst to limit their search to a subset identified by the retrieval system. GeoIRIS is one such Geospatial Satellite Imagery Retrieval system.

Military

An unknown fighter aircraft is recognized by comparing its static image with those from a database of images of aircraft. This work is a research initiative involving the use of image processing techniques to detect three-dimensional (3D) aircraft object based on their 2D images, providing feedback information for strategic purposes. The phase correlation technique is found to give a better recognition result for the set of database and test images considered, compared with the invariant moments. The phase correlation method is also used in other areas such as image registration. Aircraft images used include those from Aero India 2011 held at Bangalore, India.

Image retrieval techniques

The various Techniques used for image retrieval are Text based Image Retrieval, Content Based Image Retrieval, Multimodal Fusion image retrieval, Semantic based Image Retrieval and other techniques.

Text Based Image Retrieval

Text based image retrieval is also called as description based image retrieval. Text based image retrieval is used to retrieve the XML documents containing images based on textual information for a specific multimedia query. TBIR represents the visual content of image by manually annotating keywords. The user is allowed to present his need by textual query (S. M. Mukane *et al*., 2014).

Content Based Image Retrieval

In Content based image retrieval images are retrieved by extracting the visual low level features such as color, texture and shape. Features from query image and database images are extracted and similarity between them is calculated.

Multimodal Fusion image retrieval

Multimodal Fusion image retrieval involves data fusion and machine learning algorithms. Data fusion also known as combination of evidence is a technique of merging multiple sources of evidence. By using multiple modalities we can learn the skimming effect, chorus effect and dark horse effect (Alghamdi *et al*., 2014).

Semantic based Image Retrieval

The semantic Image retrieval is the research area currently being explored by several researchers. This retrieval method is mainly focussed on reducing the semantic gap. There are two main approaches. There are two main approaches: annotating image with keywords through automatic image annotation or adopting semantic web annotations (S. K. Reddy and K. Shreedhar, 2016).

Commercial CBIR systems

Query by Image Content (QBIC)

QBIC is the earliest commercial CBIR system that was developed by IBM. The color feature used in QBIC are average(R,G,B), (Y,I,q), (L,a,b), and MTM coordinates and a k-element color histogram. Texture feature is an improved version of Tamura feature representation. Shape feature consist of shape area, circularity, eccentricity, major axis orientation and set of algebraic moment invariants (Y. Rui *et al*., 1999).

Virage

Virage is a content based Image search engine developed by Virage Inc. In addition to color, composition, texture and structure it also supports arbitrary combination of above four atomic queries. Virage is similar to QBIC in supporting visual queries based on color, composition, texture and structure. The users can adjust the weights associated with the atomic features according to thir own emphasis. Virage is similar to QBIC in supporting visual queries based on color, composition, texture and structure (Y. Rui *et al*., 1999).

Photobook

Photobook provides a set of tools for browsing and searching images developed at MIT Media Lab. Photobook consists of three sub books from which shape, texture and face features are extracted. Users can then input a query in each of the three sub books (Y. Rui *et al*., 1999).

Visual SEEK and WebSEEK

Visual SEEK is a visual feature search engine and Web SEEK is a World Wide Web oriented text/image search engine. Both developed at Columbia University. The visual features used by them are color set and wavelet transform based texture feature. Binary tree based on indexing algorithm was developed to speed up the retrieval process. VisualSEEK incorporates queries based on both visual features and and their spatial relationship. WebSEEK is a web oriented search engine It consists of image/video collecting module, subject classification and indexing module, search, browse and retrieval module (Y. Rui *et al*., 1999).

Netra

Netra is a prototype retrieval system developed in UCSB Alexandria Digital Library (ADL) project. Netra uses color, texture, shape and spatial local information in the segmented image regions to search and retrieve similar regions from database. Main research features are Gabor wavelet based texture analysis, neural-net based image thesaurus construction and edge flow based region segmentation (Y. Rui *et al*., 1999).

Working of CBIR system

CBIR performs the task of retrieving the relevant images from the image database by extracting the low level features such as color, texture and shape from the query image as well as the images from the database. CBIR involves the following steps:

Step1: Query Image is input by the user.
Step 2: The low level features such as color, texture and shape are extracted from the query image as well as database images.
Step 3: Feature vector is formed from the low level features extracted.
Step 4: The feature vectors of database images are stored in a binary file.
Step 5: The similarity between query image and database images is computed to obtain the most relevant images from the database.
Step 6: The database images are arranged in ascending order corresponding to their similarity evaluation.

Query techniques

The query input by a user can be of the form query by example, query by Sketch, Query by group example, Relevance Feedback
The different types of queries are:

Query by example

User gives example of image in query by example to facilitate the system for the retrieval process. Features from the example image are extracted by the system. The images that are most similar to the query image are searched in the image database. In web browsing engines, categories are provided by the user such as object description in the required spatial order. The disadvantage of query by image technique is that the result is computed on the basis of first set of images. Searching for a set of initial images must have one positive image can be challenging.

Query by Sketch

User sketches the image with characteristics of features of query image with a graphic user interface tool. Sketched outlines of image have to be normalized for reducing the negative details of query object before comparing it to images in the database.

Query by group example

It permits the user to give group image examples of query to the system. The system will search for exact or approximate images relevant to group image examples of query. Here, we can specify the target images more accurately with different image example in group.

Relevance Feedback

In relevance feedback a searching interface animatedly changes the weights of content based visual features in query image based on use feedback of relevant retrieved images.

Feature extraction techniques

Color

1. Conventional color histogram (CCH)
2. Color Moments
3. Color Auto Correlogram
4. Dominant Color Descriptor (DCD)

Texture

1. Tamura Texture Features
2. Steerable Pyramid
3. Gabor filter
4. Grey Level Co-occurrence Matrix
5. Wavelet Transform

Edge

1. Sobel
2. Robert
3. Prewitt
4. Canny edge detection
5. Second order edge detector

Low level features

Color

Color is the most prominent and important feature of an image. Color feature is a dominant descriptor due to its reduced computational complexity, and invariant behaviour to changes in rotation, translation and scale and viewing angle. Color Histogram is the most commonly used color feature extraction technique. But color histogram method does not provide spatial information and give the same histogram representations for entirely different images (K. Jenni *et al*., 2015). Color space represents the range of colors and is used for color feature extraction. RGB is a three dimensional color space that consist of red, green and blue as primary colors. HSV color space where H represents hue, V represents value or greyscale image intensity and S represents saturation. Other color spaces are CIE L*a*b*, CIE L*u*v*. Other color feature extraction techniques are color Correlogram, Dominant Color Descriptor, Color moments, and Color Co-occurance matrix.

Color Feature Extraction Techniques

Color Histogram

The most commonly used technique for color feature extraction is Color Histogram. Color histograms are computationally efficient. They are insensitive to rotation and translation changes (M. Patel *et al*., 2016). HSV histogram computation is carried out in three steps namely conversion of color space, quantization and computation of histogram. The main drawback of color histogram technique is the inability to provide spatial information. Also there are increased chances of two completely different images having the same histogram representation due to same distribution of color. Color histogram gives the color pixel probability in an image. Bar graph representation is used for color histogram computation. The bins are represented along x-axis whereas the y-axis represents the number of pixels that belong to a particular bin (S. D. Ruikar and S. R. Kabade, 2016).

Color auto-correlogram

Unlike color histogram Color auto-correlogram provides spatial information combined with color histogram. It represents the variation of color with respect to distance (Y. Mistry *et al*., 2017). The autocorrelation of colors in spatial plane is given. One of the disadvantages of color auto-correlogram is slow speed of computation as it requires the evaluation of all neighbouring pixels (Y. Mistry *et al*., 2017).

Color moments

Color moments computation is performed by using probability distribution technique. Mean, median, skewness and variance are computed. 9 moments are used to characterize an image.

Dominant color descriptor

It describes the dominant color in some specific portion of an image. The retrieval of images from the database is carried out by using a particular color or a group of color values. It is more advantageous compared to histogram techniques (M. Patel *et al*., 2016).

Texture

Texture feature gives a description about the structural arrangement of surface geometry. Texture describes properties such as coarseness, contrast, regularity, smoothness, directionality. Texture feature provides spatial information unlike color. Texture description can be given in terms of some approaches i.e. statistical, approach in which statistical properties of surface image are used to categorize texture with the help of gray scale. Here Co- occurrence matrix and wavelet transformation is used. The structural approach uses texel or texture elements. Spectral techniques such as Fourier spectrum is used to explain the global periodicity of surface. Various texture feature extraction techniques are Tamura texture feature, Steerable Pyramid, Wavelet Transform, Gabor

wavelet Transform, Local binary pattern, Curvelet Transform.

Texture feature extraction techniques

Tamura texture feature

Six textual features namely coarseness, contrast, directionality, line-likeness, regularity and roughness are used by Tamura feature. The contrast describes the range of grey levels with polarization of black and white distribution. The angle and magnitude are counted at each pixel (M. Patel *et al*., 2016).

Steerable Pyramid

The steerable pyramid extracts texture feature by dividing image into a set of sub bands. The image is divided into a set of un-decimated directional sub-bands and one decimated lowpass sub-bands (M. Saad, 2008).

Gabor wavelet transform

Gabor wavelet transform is an efficient method in both spatial and frequency domains. The local spatial frequencies are measured using multi resolution and multi orientation properties. For a given image I (x,y) with size M times N its discrete Gabor wavelet transform is given by (Y. Mistry *et al*., 2017),

$$Gmn(x,y)=\sum s \sum t\, I(x-s, y-t)\Psi^{*}mn(s,t) \quad (1.1)$$

s and t are mask size variables,

$$\Psi mn\,(x,y) = a^{-m}\,\Psi(\bar{x},\bar{y}) \quad (1.2)$$

Grey level Co-Occurrence matrix

Grey Level Co-Occurrence matrix is computed by using conditional probability density function. 14 features proposed by Haralick are used for extracting features. These features are contrast, correlation, Inverse Variance, Inverse difference moment, sum Average, Entropy Difference Variance, Mean of Correlation, Energy, and Entropy, Contrast, Correlation and Homogeneity features.

Wavelet Transform

The multi resolution approach is used by wavelet transform for texture analysis and classification. An image in wavelet transform is decomposed using shifted and dilated functions. A 2-D discrete wavelet transform is obtained by applying filter bank to each column of image and to each row of the resultant coefficient [S. D. Ruikar and R. S. Kabade, 2016].

Shape

Shape represents the contour of an object. Shape enables the object to look different from its surroundings. The representation of the outer boundary of shape is called as boundary-based shape representation and in region based shape representation the entire shape region is used. Boundary based shape feature extraction techniques are Fourier descriptors, polygonal model, splines, polygonal, boundary partitioning, higher order constructs and curvature model. Region based feature extraction techniques are Fourier descriptors, Blum's skeletons, implicit polynomials and super quadrics. Canny edge detection, moment invariants and Fourier descriptors are most popular shape feature extraction techniques.

Edge feature extraction techniques

Sobel operator

The Sobel operator incorporates the convolution of image with filter in horizontal and vertical direction. Simplified computation is a merit of using Sobel operator. Approximations of derivatives are computed by convolving two kernels of the form of 3x3 matrix with the image. Let Gx and Gy represent two images comprising of horizontal and vertical derivatives.

Table1. Sobel operator

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

One kernel is the perpendicularly rotated version of the other. Different computations of the gradient component can be extracted by separately applying kernels to the input image in each orientation. One of the drawbacks of Sobel edge detector is the reliance of the pixel grid location of the response to step edge over with of the pixels.

Robert Operator

The Robert Cross operator presents a computationally faster, easier, 2-D spatial measurement on an image. The input to the operator is greyscale image. Regions of high spatial frequency corresponding to edges are highlighted. The absolute magnitude of spatial gradient for input image is represented by pixel values at that point. Two 2x2 convolution kernels are employed by the operator. One kernel is the perpendicularly rotated version of the other.

Table 2. Robert operator

+1	0		**0**	**+1**	
0	-1		**-1**	**0**	
Gx			**Gy**		

Prewitt Technique

The horizontal and vertical edges in an image can be detected using the Prewitt operator.

Table 3. Prewitt operator

-1	0	+1		+1	0	-1		
-1	0	+1		+1	0	-1		
-1	0	+1		+1	0	-1		
Gx				**Gy**				

Kernel Gx is used for computing the vertical component and the Gy is used for computing the horizontal component of the edge. The gradient intensity in current pixel is given by $|Gx|+|Gy|$.

Canny edge detector

A multi stage algorithm is employed for wide range edge detection in images. Edge detection is perfect, clear response and good image localization is achieved.

Second Order Edge detector

The second order edge detector is also called as Laplacian filter and it incorporates the use of threshold.

Similarity measurement

The similarity between the features of query image and database images is computed by various metrics such as Euclidean distance City block distance, Minkowski distance and Mahalanobis distance (Y. Mistry *et al*., 2017). Recently researchers have used various algorithms for similarity measurement such as memetic algorithms that have proved to be more efficient in computing similarity than the conventional similarity evaluation methods.

Euclidean distance: It is the most widely used method for similarity measurement. It measures the distance between two vectors by:

$$D_E=\sqrt{\sum_{i=1}^{n}(I_i - D_i)^2} \quad (1.8)$$

Manhattan distance: It is computed as:

$$D_C=\sum_{i=1}^{n}|I_i - D_i| \quad (1.9)$$

Minkowski distance: The generalized form is given as:

$$D_M=[\sum_{i=0}^{n}(|I_i - D_i|)]^{\frac{1}{p}} \quad (1.10)$$

Mahalanobis distance: This distance metric is computed as:

$$D_{Mh}=\sqrt{\vec{x} - \vec{\mu}} \quad (1.11)$$

The performance of a retrieval system is evaluated based on several criteria. Some of the commonly used performance measures are average precision, average recall, average retrieval rate and Average Normalized modified Retrieval Rate (ANMRR). All these parameters are computed using precision and recall values computed for each query image. The precision of the retrieval is defined as the fraction of the retrieved images that are indeed relevant for the query.

Some studies of interest

A CBIR system supported Color strings comparison was projected. information was classified exploitation Support Vector Machine Classifier so as to get totally different categories. options of the question image and for all pictures within the such category label are extracted exploitation color string cryptography and comparison methodology. information classification improves the performance and color string cryptography provides higher results (K. Jenni *et al*., 2015). A hybrid feature primarily based economical CBIR system was projected exploitation varied distance metrics. abstraction domain options like color machine - correlogram, color moments, HSV bar graph options and frequency domain options like moments exploitation SWT and physicist ripple rework were used. The exactness was improved by exploitation binarized applied mathematics image options, Color and Edge radial asymmetry descriptor options. WANG information containing a thousand pictures was used. Similarity activity was done exploitation geometer distance, block distance, Minkowski distance and Malabonis distance. High exactness was achieved by exploitation BSIF and CEDD descriptor (Y. Mistry *et al*., 2017). Content primarily based image retrieval approach for biometric security exploitation color, texture and form options controlled by fuzzy heuristics was projected. Color bar graph was wont to extract color options, physicist ripple was wont to extract texture options and moment invariant was wont to extract form options that created results that are extremely relevant to question. The projected approach shows higher results as compared to existing

strategies. F. Hassan and M. Sajad (2013) projected a fusion retrieval model for merging results extracted from color and texture image options based totally different fusion strategies. CombMEAN fusion approach exhibits the most effective exactness price (I. J. Sumana *et al*., 2008). a replacement and effective framework for color retrieval exploitation Full vary Autoregressive (FRAR) Model was projected. theorem Approach (BA) estimates the parameters of FRAR. The feature vector information is characterized exploitation the Radial Basis perform neural network (RBFNN). The improved EHD and compact MTs yield higher results compared to it of MPEG-7s EHD, HTD and standard MTs (K. Seetharaman and S. Sathiamoorthy, 2014). a replacement content primarily based image retrieval technique was projected exploitation color and texture info (X. Y. Wang *et al*., 2013). A novel similarity analysis employing a meta-heuristic formula referred to as a memetic formula (genetic formula with nice deluge) is achieved between the options of the ki and also the options of the information pictures. This work projected an efficient CBIR system exploitation MA to retrieve pictures from databases. Then, exploitation the MA primarily based similarity measure; pictures that ar relevant to the ki were retrieved with efficiency. Corel image information was used. it's robust capability to discriminate color, form and color, texture options. The results outperformed alternative CBIR systems in terms of exactness and recall wherever average exactness and recall rates were zero.882 and 0.7002 severally (M. K. Alsmadi, 2017). the employment of symbolic logic to boost CBIR was projected (H. Aboulmagd, 2009). The CBIR approach for biometric security exploitation color, Texture and form options controlled by fuzzy heuristic was projected (K. Iqbal *et al*., 2011). A fuzzy neural approach for interpretation and fusion of color and texture options for CBIR systems was projected (B. Verma and S. Kulkarni, 2004). A CBIR system exploitation color and texture united options was developed during which color options were extracted exploitation color bar graph and texture options were extracted exploitation co-occurrence matrix to make feature vectors. The characteristics of world color bar graph, native color bar graph and texture options was compared and analyzed. additionally, a CBIR system exploitation color and texture united options by constructing feature vectors was designed. Experiments showed that retrieval by united feature shows higher retrieval results (J. Yue *et al*., 2011). The summary of varied techniques used for extracting low level options i.e. color and Texture was given. Color feature extraction techniques ar Color bar graph, color Correlogram, color co-occurance matrix and Dominant Color descriptor. Texture feature extraction techniques ar Tamura texture feature, dirigible pyramid, ripple rework, physicist ripple rework. A comparative analysis of color and texture feature extraction techniques with their benefits and drawbacks was given (M. Patel *et al*., 2016). Genetic formula may be a powerful tool used for optimisation. The degradation in performance thanks to random behaviour and problem in dashing the machine method the disadvantage that Genetic formula suffers from. Genetic formula relies on the biological process theory of survival of the fittest (K. F. Man *et al*., 1996). a replacement analysis of similarity exploitation metaheuristic formula is conducted between question image and information image options. The addition of GA and ILS formula has raised the standard of answer via increase in fitness perform. The exactness and recall rates were zero.8883 and 0.7125 (K. M. Alsmadi, 2017). A CBIR system supported Interactive Genetic formula was projected to extend the accuracy of image retrieval. The retrieval method was split into 2 stages. within the question stage, the question options were extracted and also the similarity between the question image and information image options was evaluated. within the evolution stage, the foremost relevant pictures were retrieved exploitation Interactive Genetic formula. The projected system incorporates user directed CBIR that uses Interactive Genetic formula to seek out the foremost relevant pictures to the user. Ig provides AN interactive mechanism to effectively capture the user's intention (V. M. Dass *et al*., 2014). a visible objects categoryification supported generating straightforward fuzzy classifiers exploitation native image options to tell apart between one known class and alternative categories was given. Despite simplicity, it outperformed the bag-of-features methodology in terms of accuracy and speed. Learning and classification is extremely quick. the strategy is correct in terms of visual object classification (M. Korytkwoski *et al*., 2016). Research on Content based image retrieval in the past has focussed on low level feature extraction such as color, texture and shape. Extensive experiments on CBIR systems demonstrate that low-level image features cannot always describe high-level semantic concepts in the users mind. The low level features do not involve the human perception. Aim of research is to reduce the semantic gap between low and high level features. The low level features (color, texture and shape) were extracted and Relevance feedback and adaptive clustering were applied thus, reducing the gap between low and high level features. Also The various approaches used for (S. A. Dar and Z. G. Khaki, 2013). A fusion based retrieval model for merging results taken from color and texture image features based different fusion methods was proposed. The color feature was extracted by using Color moment method. Texture feature was extracted by applying Gabor wavelet transform. Precision values were calculated. Wang database was used. Results proved that CombMEAN fusion approach had the highest precision value (A. K. Alhassan and A. A. Alfaki, 2017). A new CBIR procedure developed in a non-supervised fashion, clustering the local achieved descriptors and classifying them with the use of K-means algorithm supported by genetic algorithm was used. The improvement in performance using

LabVIEW brings more training and recovering velocity. This improvement outperforms implementation with MatLab. The results are very promising reaching upto 90% recall for natural scene classification (Y. P. Pimentel *et al*., 2014). Image segmentation is the classification of an image into different groups. K-means clustering algorithm is an unsupervised algorithm used to segment the required are from the background. Subtractive clustering was used to generate the initial centres and these centres were used in k-means algorithm for segmentation of image. Median filter was applied to segmented image to remove any unwanted region from the image. A small value of RMSE and large value of PSNR which ensure good quality image segmentation (N. Dhanachandra *et al*., 2015).

CBIR system in which image retrieval is carried out by extracting the low level features such as color, texture and shape was implemented. CBIR system was implemented using MATLAB software. Experiments show that color feature extraction is not very efficient. Image retrieval using co-occurrence matrix gives good results for images that contain structures. Wavelet packet decomposition provides better results compared to co-occurrence matrix. Boundary scanning technique provides good results for images with objects of specific shape. Optimum weights for features are decided empirically (S. D. Ruikar and R. S. Kabade, 2016). The improvement in the precision of CBIR system using Binary Search Algorithm was proposed. Gravitational search algorithm was compared with genetic algorithm and particle swarm optimization in feature selection. Comparative studies show that BGSA exhibits higher precision compared to BPSO and GA (E. Rashedi and N. Hossein, 2012). A content based image retrieval system was proposed in which the color feature was extracted using Color Moment (CM) and texture feature was extracted using Local Binary Pattern (LBP) technique. Both the color and Texture feature are combined to form a single feature vector. The similarity between the features of query image and database image is computed using Euclidean distance. Here, LBP was used on natural images to extract texture feature (R. Choudhary *et al*., 2014). Research on multi-scale analysis especially the curvelet transform enabled more accurate texture feature extraction. Curvelet was originally proposed for image denoising and has shown a promising performance. The discrete curvelet transform was applied on images for texture retrieval and low order statistics was computed from transformed images. Results show that Curvelet transform outperforms Gabor texture feature extraction (J. Sumana *et al*., 2008). An adaptive retrieval approach based on relevance feedback was proposed that bridges the gap between low level and high level features by using user's feedback not only to assign proper weights to the user but also to enable dynamically selection within a large collection of parameters. The feature adaptation is based on hierarchical approach. The weights are then adjusted based on retrieved relevant and irrelevant images without further user feedback. The new relevance feedback approach with feature adaptation shows a significant improvement in retrieval accuracy compared to the standard RF approaches (A. Grigorova and De G. B. F., Natale, 2007). Research has been carried out for the retrieval of incomplete and distorted queries. The query images in which some information is missing, presence of undesirable objects, blurring, noise due to disturbance at the time of image acquisition are called incomplete or distorted mages. HSV color space is used to extract color feature, Moment Invariant and Fourier descriptor is used to extract shape features. The results exhibit an increase in retrieval accuracy by fusing color and shape features giving a precision of 79.87 % (B. K. Singh *et al*., 2011). Content based image retrieval by based on Color Edge detection and discrete wavelet transform was used. This method combines both color and edge features. The wavelet transform was used for reducing the size of feature vectors and for preserving the details of the content. Experimental results exhibit the robustness to alteration of image by intensity variations, sharpness variations, cropping, shifting and rotation (S. Aggarwal *et al*., 2014). The relevant database images are selected using color moments. Texture and edge features extracted using LBP and Canny edge detection from images selected from first stage. Average precision measured on Wang's corel-5K and Corel-10K databases is 11.8%-22.315%, 8.025%-18.935% and 10.755%-32.221% (L. K. Pavithra and T. S. Sharmila, 2017).

A comparative survey has been presented on various edge detection techniques such as Sobel, Prewitt, Canny, Robert's cross, Laplacian and EMT (S. Asha and R. R. Khanna, 2014). Optimized color and texture features used. A uniform partitioning scheme on HSV color space to extract DCD features is used. Texture feature extraction using wavelet and curvelet. Particle Swarm Optimization is used to combine color and texture feature. Average precision is improved from 67.85% to 71.05% for DCD, 58.9% to 65.43% for wavelet, 53.18 to 56% for curvelet. Average precision of 76.5% is achieved using proposed method (S. Fadeil, R. Amirffattahi and M. R. Ahmadzadeh, 2018). LBP, Multivariate LBP, LBP Variance, Center Symmetric LBP are examined. K classification is used for extracting facial features. Databases used were FRGC Version 2, CMU-PIE, JAFFE-female were used. The CS-LBP showed recognition rate of 87% compared to 80% for CMU-PIE, 82% for FRGC Version (K. A. Meen and A. Suruliandi, 2011).

Color feature was extracted by color moments, texture feature was extracted by wavelet and shape feature was extracted by using Edge Histogram. The classification of image into different groups is performed by incorporating SVM classifier and the computation of similarity is carried out within the same class. The combination of color, texture and shape feature exhibits higher values of average precision compared to individual features (A K Naveen

and N. K. Narayanan, 2016). In this paper, the key challenge of Semantic gap between low level features and user's perception of retrieved images has been discussed. A brief literature survey regarding the research and innovation for solving this challenge has been presented. The authors have suggested the fuzzy logic approach to overcome the semantic gap (A. Khodaskar and S. Ladhake, 2014). The low level features such as color, texture and shape were extracted with the help of SIFT method. Bacteria foraging optimization algorithm (BFOA) was implemented to overcome the limitations imposed by SIFT. Deep Neural Network is used for similarity evaluation. Accuracy is greatly enhanced by the proposed work (A. Ali and S. Sharma, 2017). Color and shape features were extracted. Color Histogram and Canny Edge detection were used for color and shape feature extraction respectively. Euclidean distance metric was employed for similarity calculation.

With 400 trademark images retrieval accuracy on color basis is better than shape and the combination of both provides more accurate results (A. K. Jain and A. Vailaya, 1955). The low level features are transformed to high level features by using Latent Semantic Analysis is used for Content Based Image Retrieval. Database of 50 images were taken. Both the results were compared with and without LSA. Results were better but not much (R. Zhao and W. I. Grosky, 2000). Color feature using Histogram ato obtain matched images. Color coherence vectors of matched images refine results. Shape feature extraction based on automatic segmentation process. Euclidean distance for similarity. Average precision has increased from 44% to 72% (R. Chaudhari and A. M. Patil, 2012). System was designed to use for the medical applications. HBIRS was designed which is the combination of TBIRS & CBIRS. In HBIRS, both text and content increase the retrieval efficiency. TBIR complements weakness in CBIR and is an essential component for the development of HBIRS (L. C. Siong *et al*., 2015). High accuracy, invariance to changes in illumination and ease of computation are the features that make Local Binary pattern a very efficient texture feature extraction technique. The Color Coherence Vector Helps to achieve higer a=ccuracy when employed in Intensity Histogram (A. O. Vatamanu and M. Ionescu, 2013). Support Vector Machine is used for relevance feedback and the image feature dimensions are decreased by means of feature selection. Color moment technique is used for extracting color feature, Wavelet Transform is employed for texture feature extraction and edge features are extracted using edge histogram (A. Marakakis 2009]. A content Based image retrieval system using Support vector machine-based Relevance Feedback that incorporates not only positive but also negative feedbacks for retrieving images is proposed. SVM learns the information regarding the positive and negative examples and the desired weights are automatically updated for images that are positive and relevant. Results show better performance (P. Hong *et al*., 2000).

Challenges faced by the current CBIR system

The current CBIR systems are still lack in accuracy of relevant image due to the improper selection of feature extraction methods and similarity measurement. Single feature extraction does not provide good performance in comparison to combined features i.e. a combination of color, texture and edge. Gap between information extracted automatically from the visual data and interpretation by the user which is known as Semantic gap. Subjectivity of human perception of visual content.

Conclusion

Content based Image Retrieval (CBIR) system aims at retrieval of images of relevance to the query image input by the user from an enormous image database by low-level feature (such as color, texture and shape) extraction from the image. CBIR has proved to be of great help in applications such as Face recognition, Medical diagnosis, prevention of Crime, Geospatial Satellite Imaging and several other applications that require a fast and efficient retrieval system for relevant image extraction from enormous image databases**.**

Conventional color histogram, Color Moments, Color Auto Correlogram, Dominant Color Descriptor are the color feature extraction techniques. Tamura Texture Features, Steerable Pyramid, Gabor filter, Grey Level Co-occurrence Matrix and Wavelet Transform are some popular texture extraction techniques. Sobel, Robert, Prewitt, Canny edge detection, second order edge detector are the edge extraction techniques. CBIR still faces some challenges like judgement of human perception of visual content, less appropriate selection of similarity measure, semantic gap and other factors.

References

Aboulmagd, H., El-Gayar, N. and Onsi, H., 2009. A new approach in content-based image retrieval using fuzzy. *Telecommunication Systems*, *40*(1-2), p.55.

Agarwal, S., Verma, A.K. and Dixit, N., 2014, February. Content based image retrieval using color edge detection and discrete wavelet transform. In *2014 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT)* (pp. 368-372). IEEE.

Alghamdi, R.A., Taileb, M. and Ameen, M., 2014, April. A new multimodal fusion method based on association rules mining for image retrieval. In *MELECON 2014-2014 17th IEEE Mediterranean Electrotechnical Conference* (pp. 493-499). IEEE.

Alhassan, A.K. and Alfaki, A.A., 2017, January. Color and texture fusion-based method for content-based Image Retrieval. In *2017 International Conference on Communication, Control, Computing and Electronics Engineering (ICCCCEE)* (pp. 1-6). IEEE

Ali, A. and Sharma, S., 2017, June. Content based image retrieval using feature extraction with machine learning. In *2017 International Conference on Intelligent Computing and Control Systems (ICICCS)* (pp. 1048-1053). IEEE.

Alsmadi, M.K., 2018. Query-sensitive similarity measure for content-based image retrieval using meta-heuristic

algorithm. *Journal of King Saud University-Computer and Information Sciences*, *30*(3), pp.373-381.

Alsmadi, M.K., 2017. An efficient similarity measure for content based image retrieval using memetic algorithm. *Egyptian journal of basic and applied sciences*, *4*(2), pp.112-122.

Asha, S. and Kanna, R.R., 2014. A Survey on Content Based Image Retrieval Based On Edge Detection. *International Journal of Computer Science and Information Technologies*, *5*(6), pp.8272-8275.

Singh, B.K., Thoke, A.S., Verma, K. and Chandrakar, A., 2011. Image information retrieval from incomplete queries using color and shape.

Chaudhari, R. and Patil, A.M., 2012. Content based image retrieval using color and shape features. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, *1*(5), pp.386-392

Choudhary, R., Raina, N., Chaudhary, N., Chauhan, R. and Goudar, R.H., 2014, September. An integrated approach to content based image retrieval. In *2014 International Conference on Advances in Computing, Communications and Informatics (ICACCI)* (pp. 2404-2410). IEEE.

Eakins, J. and Graham, M., 1999. Content-based image retrieval.

Dass, M.V., Ali, M.M. and Ali, M.R., 2014, March. Image retrieval using interactive genetic algorithm. In *2014 International Conference on Computational Science and Computational Intelligence* (Vol. 1, pp. 215-220). IEEE.

Dhanachandra, N., Manglem, K. and Chanu, Y.J., 2015. Image segmentation using K-means clustering algorithm and subtractive clustering algorithm. *Procedia Computer Science*, *54*, pp.764-771.

Fadaei, S., Amirfattahi, R. and Ahmadzadeh, M.R., 2016. New content-based image retrieval system based on optimised integration of DCD, wavelet and curvelet features. *IET Image Processing*, *11*(2), pp.89-98.

Farsi, H. and Mohamadzadeh, S., 2013. Colour and texture feature-based image retrieval by using hadamard matrix in discrete wavelet transform. *IET Image Processing*, *7*(3), pp.212-218.

Grigorova, A., De Natale, F.G., Dagli, C. and Huang, T.S., 2007. Content-based image retrieval by feature adaptation and relevance feedback. *IEEE transactions on multimedia*, *9*(6), pp.1183-1192.

Hong, P., Tian, Q. and Huang, T.S., 2000, September. Incorporate support vector machines to content-based image retrieval with relevance feedback. In *Proceedings 2000 International Conference on Image Processing (Cat. No. 00CH37101)* (Vol. 3, pp. 750-753). IEEE.

Iqbal, K., Odetayo, M.O. and James, A., 2012. Content-based image retrieval approach for biometric security using colour, texture and shape features controlled by fuzzy heuristics. *Journal of Computer and System Sciences*, *78*(4), pp.1258-1277.

Kak, A. and Pavlopoulou, C., 2002, June. Content-based image retrieval from large medical databases. In *Proceedings. First International Symposium on 3D Data Processing Visualization and Transmission* (pp. 138-147). IEEE.

Jain, A.K. and Vailaya, A., 1996. Image retrieval using color and shape. *Pattern recognition*, *29*(8), pp.1233-1244.

Kommineni Jenni, Satria Mandala, Mohd Shahrizal Sunar, Content Based Image Retrieval Using Colour Strings Comparison, Procedia Computer Science, Volume 50, 2015, Pages 374-379, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2015.04.032.

Khodaskar, A. and Ladhake, S., 2014, June. Content based image retrieval using quantitative semantic features. In *International Conference on Human Interface and the Management of Information* (pp. 439-448). Springer, Cham.

Korytkowski, M., Rutkowski, L. and Scherer, R., 2016. Fast image classification by boosting fuzzy classifiers. *Information Sciences*, *327*, pp.175-182.

Patel, J.M. and Gamit, N.C., 2016, March. A review on feature extraction techniques in content based image retrieval. In *2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)* (pp. 2259-2263). IEEE.

Man, K.F., Tang, K.S. and Kwong, S., 1996. Genetic algorithms: concepts and applications [in engineering design]. *IEEE transactions on Industrial Electronics*, *43*(5), pp.519-534.

Marakakis, A., Galatsanos, N., Likas, A. and Stafylopatis, A., 2009, September. Relevance feedback for content-based image retrieval using support vector machines and feature selection. In *International Conference on Artificial Neural Networks* (pp. 942-951). Springer, Berlin, Heidelberg.

Meena, K. and Suruliandi, A., 2011, June. Local binary patterns and its variants for face recognition. In *2011 International Conference on Recent Trends in Information Technology (ICRTIT)* (pp. 782-786). IEEE.

Mistry, Y., Ingole, D.T. and Ingole, M.D., 2018. Content based image retrieval using hybrid features and various distance metric. *Journal of Electrical Systems and Information Technology*, *5*(3), pp.874-888.

Mukane, S.M., Gengaje, S.R. and Bormane, D.S., 2014. A novel scale and rotation invariant texture image retrieval method using fuzzy logic classifier. *Computers & Electrical Engineering*, *40*(8), pp.154-162.

Naveena, A.K. and Narayanan, N.K., 2016, September. Image retrieval using combination of color, texture and shape descriptor. In *2016 International Conference on Next Generation Intelligent Systems (ICNGIS)* (pp. 1-5). IEEE.

Pavithra, L.K. and Sharmila, T.S., 2018. An efficient framework for image retrieval using color, texture and edge features. *Computers & Electrical Engineering*, *70*, pp.580-593.

Pérez-Pimentel, Y., Osuna-Galan, I., Villegas-Cortez, J. and Avilés-Cruz, C., 2014, November. A genetic algorithm applied to content-based image retrieval for natural scenes classification. In *2014 13th Mexican International Conference on Artificial Intelligence* (pp. 155-161). IEEE.

Rashedi, E. and Nezamabadi-pour, H., 2012, May. Improving the precision of CBIR systems by feature selection using binary gravitational search algorithm. In *The 16th CSI International Symposium on Artificial Intelligence and Signal Processing (AISP 2012)* (pp. 039-042). IEEE.

Dureja, A. and Pahwa, P., 2018. Image retrieval techniques: a survey. *International Journal of Engineering & Technology*, *7*(1.2), pp.215-219.

Rehman, M., Iqbal, M., Sharif, M. and Raza, M., 2012. Content based image retrieval: survey. *World Applied Sciences Journal*, *19*(3), pp.404-412.

Rui, Y., Huang, T.S. and Chang, S.F., 1999. Image retrieval: Current techniques, promising directions, and open issues. *Journal of visual communication and image representation*, *10*(1), pp.39-62.

Ruikar, S.D. and Kabade, R.S., 2016, March. Content based image retrieval by combining feature vector. In *2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)* (pp. 1517-1523). IEEE.

Saad, M., 2008. Low-level color and texture feature extraction for content-based image retrieval. *Final Project Report, EE K*, *381*, pp.20-28.

Seetharaman, K. and Sathiamoorthy, S., 2014. Color image retrieval using statistical model and radial basis function neural network. *Egyptian Informatics Journal*, *15*(1), pp.59-68.

Siong L. C., Zaki W. M. D. W., A. Hussain, H. A. Hamid, and H. A. Hamid, "Image Retrieval System for Medical Applications," pp. 73–77, 2015.

Sumana, I.J., Islam, M.M., Zhang, D. and Lu, G., 2008, October. Content based image retrieval using curvelet transform. In *2008 IEEE 10th workshop on multimedia signal processing* (pp. 11-16). IEEE.

Vatamanu, O.A., Frandes, M., Ionescu, M. and Apostol, S., 2013, November. Content-based image retrieval using local binary pattern, intensity histogram and color coherence vector. In *2013 E-Health and Bioengineering Conference (EHB)* (pp. 1-6). IEEE.

Verma, B. and Kulkarni, S., 2004. A fuzzy-neural approach for interpretation and fusion of colour and texture features for CBIR systems. *Applied Soft Computing*, *5*(1), pp.119-130.

Wang, X.Y., Yang, H.Y. and Li, D.M., 2013. A new content-based image retrieval technique using color and texture information. *Computers & Electrical Engineering*, *39*(3), pp.746-761.

Yue, J., Li, Z., Liu, L. and Fu, Z., 2011. Content-based image retrieval using color and texture fused features. *Mathematical and Computer Modelling*, *54*(3-4), pp.1121-1127.

Zhao, R. and Grosky, W.I., 2000, July. From features to semantics: Some preliminary results. In *2000 IEEE International Conference on Multimedia and Expo. ICME2000. Proceedings. Latest Advances in the Fast Changing World of Multimedia (Cat. No. 00TH8532)* (Vol. 2, pp. 679-682). IEEE.