Survey on Content Based Image Retrieval Techniques

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Abstract: Content based image retrieval (CBIR), a technique which uses visual contents to search images from the large scale image databases, is an active area of research for the past decade. It is increasingly evident that an image retrieval system has to be domain specific. Advances in the internet and digital imaging have resulted in an exponential increase in the volume of digital images. New techniques are necessary to archive and access this data as the quantity of the digitally produced images is growing. In this paper we discuss various Content based image retrieval and retrieve documents based on Mathematical Expressions. Most of the CBIR systems available in the literature extract only concise feature sets that limit the retrieval efficiency. Various Similarity measures are identified to top perform between the query image features and the database image features. Finally identified that that soft computing techniques are giving the better results.

Keywords: Image Retrieval, Shape Signature, Image Segmentation, Feature Extraction, and Evolutionary Programming.

I. INTRODUCTION

Content Based Image Retrieval (CBIR) is the process of retrieving desired images from a large collection on the basis of features (such as color, texture and shape) that can be automatically extracted from the images. Content Based Image Retrieval (CBIR) plays a significant role in the image processing field. Images relevant to a given query image are retrieved by the CBIR system utilizing either low level features (such as shape, color etc.,) or high level features (human perception). Image-based math retrieval is a new area of research which has gained importance because of the need for extracting the mathematical expressions for processing. Content-based image retrieval system is built using statistics, pattern recognition, Fuzzy logic, soft computing, computer and signal processing. The need for content-based image retrieval is increased tremendously in many application areas such as biomedicine, military, commerce, education, web image classification and searching. The best indexing technique is also required to present the results.

II. LITERATURE REVIEW

The following sections deals with brief research reviews of various Content Based Image Retrieval (CBIR) techniques and methods used to retrieve documents based on Mathematical Expressions which are found in the literature and outline the proposed approach of the present research work.

A. Review of Content Based Image Retrieval (CBIR) techniques

[Anil K. J and Aditya.V,1996][1], deals with efficient retrieval of images from large databases based on the color and shape content in images. Techniques using textual attributes for annotations are limited in their applications. Their approach relies on image features that exploit visual cues such as color and shape. Unlike previous approaches which concentrate on extracting a single concise feature, our technique combines features that represent both the color and shape in images. Experimental results on a database of 400 trademark images shows that an integrated color- and shape-based feature representation results in 99% of the images being retrieved within the top two positions and demonstrate that a combination of clustering and a branch and bound-based matching scheme aids in improving the speed of the retrievals.

[Manjunathi B.S. and Ma W.Y.1996][2], focused on the image processing aspects and in particular using texture information for browsing and retrieval of large image data. They propose the use of Gabor wavelet features for texture analysis and provide a comprehensive experimental evaluation and comparisons with other multiresolution texture features using the Brodatz texture database indicate that the Gabor features provide the best pattern retrieval accuracy.

[Mohamed A.M, Krishnamachari.S, and Nicholas J.M,1998][3], presented scalable algorithms for image retrieval based on color. Their solution for scalability is to cluster the images in the database into groups of images with similar color content. At search time the query image is first compared with the pre-computed clusters, and only the closest set of clusters is further examined by comparing the query image to the images in that set. This obviates the need to compare the query image with every image in the database, thus making the search scalable to large databases. They used the hierarchical clustering and the K-means clustering techniques. Performances of these two clustering algorithms are compared when three similarity measures, the histogram intersection measure, the L1, and the L2 measures, are used for image retrieval and evaluations shows that the hierarchical clustering algorithm outperforms the K-means clustering algorithm for all similarity measures.

[Zhang J., L. Fuzong, and Zhang. B,1999][4], proposed the analysis of color features in HSV space, anew dividing method to quantize the color space into 36 non-uniform bins is first introduced in their approach. Based on this quantization method and a color-spatial method to include several spatial features of colors in animage for retrieval. These features are area and position, which mean the zero-order and the first-order moments respectively. Experiments on an image database of 838 images shows that the algorithm performs well in precision and adaptability.

[Yong R and Thomas S.H, and Shih F.C,1999][5], provides a comprehensive survey of the technical achievements in the research area of image retrieval, especially content-based image retrieval, an area that has been so active and prosperous in the past few years. The survey tells aspects of image feature representation and extraction, multidimensional indexing, and
system design, three of the fundamental bases of content-based image retrieval.

[Simone S, and Ramesh J, 1999][6], developed a similarity measure based on fuzzy logic, that exhibits several features that match experimental findings in humans. The model is dubbed Fuzzy Feature Contrast (FFC) and is an extension to a more general domain of the Feature Contrast model. They how the FFC model can be used to model similarity assessment from fuzzy judgment of properties, and address the use of fuzzy measures to deal with dependencies among the properties.

[GunhanP, Yunju B, and Heung K.L, 2002][7], proposed a ranking algorithm using dynamic clustering for content-based image retrieval (CBIR). They utilize similarity relationship of retrieved results via dynamic clustering. In the first step images are retrieved using visual feature such as color histogram, etc. Next, the retrieved images are analyzed using a HACM (Hierarchical Agglomerative Clustering Method) and the ranking of results is adjusted according to distance from a cluster representative to a query. According to experiments, the proposed method achieves more than 10% improvements of retrieval effectiveness in ANMRR (Average Normalized Modified Retrieval Rank) performance measure.

[James C. F, Chapin A.C, and Worthy N. M, 2003][8], presented an example of “multiple viewpoint” approach, multiple image channels, and discuss its advantages for an image-seeking user. The approach has also been shown to dramatically improve retrieval effectiveness in content-based image retrieval systems.

[Minaaksi B and M. K. Kundu, 2003][9], presented a robust technique for Content Based Image Retrieval (CBIR) using fuzzy edge map of an image. Fuzzy compactness vector is computed from fuzzy edge map threshold at different levels of the unsegmented image, which also incorporates gray level contrast information embedded in the edges. The resemblance of two images is defined as the similarity between the computed feature vectors.

[Thomas M.L, Mark O. G, Christian T, Benedikt F, Daniel K, Michael K, Henning S, and Berthold B.W, 2003][10], developed Picture archiving and communication systems (PACS) aim to efficiently provide the radiologists with all images in a suitable quality for diagnosis. The textual descriptions insufficiently describe the great variety of details in medical images, content-based image retrieval (CBIR) is expected to have a strong impact when integrated into PACS. Integrating CBIR and PACS, a special focus is put on (i) location and access transparency for data, methods, and experiments, (ii) replication transparency for methods in development, (iii) concurrency transparency for job processing and feature extraction, (iv) system transparency at method implementation time, and (v) job distribution transparency when issuing a query. Transparent integration will have a certain impact on diagnostic quality supporting both evidence-based medicine and case-based reasoning.

[Hwei J.L, Yang T. K, Shwu H, and Chia J.W , 2004][11], developed an efficient and robust shape-based image retrieval system. They use the Prompt edge detection method to detect edge points, which is compared with the Sobel edge detection method and also introduce a shape representation method, the low-to-high sequence (LHS), which is invariant to translation, rotation, and scale problems. The results of proposed method show a superior matching ratio even in the presence of a modest level of deformation.

[Kfaq A.P, and Sumari, 2004][12], tells Automated image retrieval from large databases using content-based image retrieval (CBIR) is in great demand nowadays as many areas such as medical and journalism rely on CBIR systems to perform their job. The most CBIR systems uses features, color and texture seems. Texture information can also be extracted after being decomposed using Wavelet transform. They present techniques used to extract color and texture information from images using wavelet transform.

[Wang X and Xie K , 2004][13], presented a Content-Based Image Retrieval (CBIR) system - Average Area Histogram (AAH) based on the area features of the regions formed by the pixels of each color, which retains the advantages of the conventional histogram. A key issue in CBIR is to develop a proper weight assignment method for combining various image features in retrieval. The Analytic Hierarchy Process (AHP) method is imported into this system for assessing the importance of various image features. The experimental results demonstrate the feasibility and efficiency of proposed scheme.

[Christopher C.Y, 2004][14], investigated two approaches, query by example and image browsing map. Activities to support the information seeking behavior are analyzed. The performance of these approaches is measured by a user evaluation. It is found that the image browsing map provides more functionalities and capabilities to support the features of information seeking behavior and produces better performance in searching images.

[Marzieh M, Mei C.A, Anton S.P, 2004][15], presented a short review of the existing research works and challenges in patent image retrieval domain. From the review, the image feature extraction step is found to be an important step to match the query and database images successfully. In order to improve the current feature extraction step in image patent retrieval, they proposed a patent image retrieval approach based on Affine-SIFT technique. Comparison discussions between the existing feature extraction techniques are done to assess the potential of this proposed approach.

[Iskandar D. N. F. A, Thom A, and Tahaghghi S. M, M, 2004][16], explore the use of image regions as query examples and compare the retrieval effectiveness of using whole images, singleregions, and multiple regions as examples. They also compare two approaches for combining shape features: an equal weight linear combination, and classification using machine learning algorithms and show that using image regions as query examples leads to higher effectiveness than using whole images, and that an equal weight linear combination of shape features is simpler and at least as effective as using a machine learning algorithm.

[Kailing K, Hans-Peter K, and Stefan S, 2004][17], described two models for image representation which integrate structural features and content features in a tree or a graph structure. The effectiveness of two approaches is evaluated with real world data, using clustering as means for evaluation. Furthermore,
show that combining those two models can further enhance the retrieval accuracy.

[Ksantini R, Ziou D, Colin B, and Dubeau F, 2004][18], tells probabilistic approaches have proven to be an effective solution to this CBIR problem. They use a Bayesian logistic regression model, in order to compute the weights of a pseudo-metric to improve its discriminatory capacity and then to increase image retrieval accuracy. The Bayesian logistic regression model was shown to be a significantly better tool than the classical logistic regression one to improve the retrieval performance. The retrieval method is fast and is based on feature selection.

[Thomas M.L, Mark O.G, Christian T, Benedikt F, Klaus S, Daniel K, Hermann N, Michael K, Henning S, and Berthold B.W, 2004][20], objective of this work is to develop a general structure for semantic image analysis that is suitable for content-based image retrieval in medical applications and an architecture for its efficient implementation. Stepwise content analysis of medical images results in six layers of information modeling (raw data layer, registered data layer, feature layer, scheme layer, object layer, knowledge layer). The multilayer processing is implemented using a distributed system designed with only three core elements: central database, scheduler balances, and web server. The feature transformations in all semantic layers are based on the same implemented mechanism, this is sufficient to validate the overall system concept. The leaving-one out experiments were distributed by the scheduler and controlled via corresponding job lists. The experiments have shown that the IRMA framework offers transparency regarding the viewpoint of a distributed system and the user, such as location and access transparency, replication transparency, concurrency transparency, system transparency, and job distribution transparency when issuing a query. The proposed architecture is suitable for content-based image retrieval in medical applications. It improves current picture archiving and communication systems that still rely on alphanumerical descriptions, which are insufficient for image retrieval of high recall and precision.

[Yi T and William L.G, 2005][21], presented a novel method based on feature point histogram indexing for object shape representation in image databases. In this scheme, the feature point histogram is obtained by discretizing the angles produced by the Delaunay triangulation of a set of unique feature points which characterize object shape in the context, and then counting the number of times each discrete angle occurs in the resulted triangulation. The proposed shape representation technique is translation, scale, and rotation independent. The various experiments concluded that the Euclidean distance performs very well as the similarity measure function in combination with the feature point histogram computed by counting the two largest angles of each individual Delaunay triangle.

[Thomas M.L, Mark O.G, Thomas D, Keysers D, 2005][22]. Categorization of medical images means selecting the appropriate class for a given image out of a set of pre-defined categories. This is an important step for data mining and content-based image retrieval (CBIR). So far, published approaches are capable to distinguish up to 10 categories. They evaluate automatic categorization into more than 80 categories describing the imaging modality and direction as well as the body part and biological system examined. Based on 6231 reference images from hospital routine, 85.5% correctness is obtained combining global texture features with scaled images. With a frequency of 97.7%, the correct class is within the best ten matches which is sufficient for medical CBIR applications.

[Yixin C, J.Z. Wang, and Robert K, 2005][23], introduced a new technique, cluster-based retrieval of images by unsupervised learning (CLUE), for improving user interaction with image retrieval systems by fully exploiting the similarity information. CLUE retrieves image clusters by applying a graph-theoretic clustering algorithm to a collection of images in the vicinity of the query. Clustering in CLUE is dynamic. CLUE can be combined with any real-valued symmetric similarity measure. Thus, it may be embedded in many current CBIR systems, including relevance feedback systems. The performance of an experimental image retrieval system using CLUE is evaluated on a database of around 60,000 images from COREL. Empirical results demonstrate improved performance compared with a CBIR system using the same image similarity measure. The results on images returned by Google’s Image Search reveal the potential of applying CLUE to real-world image data and integrating CLUE as a part of the interface for keyword-based image retrieval systems.

[Long R.L, Sameer K.A, and George R.T, 2005][24], focused on Image informatics at the Communications Engineering Branch of the Lister Hill National Center for Biomedical Communications (LHNBC), an R&D division of the National Library of Medicine (NLM), includes document and biomedical images. In both domains, research into computer-assisted methods for information extraction, and the implementation of prototype systems incorporating such methods, is central to our mission. Current document image research focuses on extracting bibliographic data from scanned journal articles. Current biomedical imaging work focuses on content-based image retrieval (CBIR) and related problems in segmentation, indexing, and classifying collections of images of the spine and of the uterine cervix.

[Filip F, Alexandra R, Abdelaziz B.J, Nicolas D, and Stefan J.D, 2005][25], concerned with the automatic indexing of medical images for image retrieval purposes inside a large online health-catalogue and presenta rule-based medical-image modality categorization approach. The modality information is important for the indexing of medical images present in on-line health documents (thus, mainly in JPEG format). The system performances were tested on a medical image database, containing six medical modalities: angiography, ultrasonography, magnetic resonance imaging, standard radiography, computer tomography, and scintigraphy. The high precision rate of categorization system (~90%), proves that textual annotations present in medical images are very reliable indicators of the medical modality.

[Peter G.B. E, Christine J. S, and Paul H. L, 2005][26], described the real challenge of semantic image retrieval. Consideration is given to the plurality of types of still image, a taxonomy for which is presented a framework within which to show examples of real ‘semantic’ requests and the textual metadata by which such requests might be addressed. The specificity of subject indexing and underpinning domain knowledge which is necessary in order to assist in the
realization of semantic content is noted. The potential for that semantic content to be represented and recovered using CBIR techniques is discussed.

[ReddyP.V.N and SatyaPrasadK, 2006][27], proposed a retrieval method which combines color and texture feature. According to the characteristic of the image texture, represent the information of texture by Multi Wavelet transform. They choose the color correlogram in RGB color space as the color feature. The experimental results show that this method is more efficient than the traditional CBIR method based on the single visual feature and other methods combining color and texture.

[Keh-Shih C, Hong-Long T, Sharon C, Jay W and Tzong-Jer C, 2006][28], presented a fuzzy c-means (FCM) algorithm that incorporates spatial information into the membership function for clustering. The spatial function is the summation of the membership function in the neighborhood of each pixel under consideration. The advantages of the new method are it yields regions more homogeneous than those of other methods, reduces the spurious blobs, removes noisy spots, and less sensitive to noise than other techniques.

[HiremathP.S, Shivashankar S, and Jagadeesh P, 2006][29], described an algorithm for texture feature extraction using wavelet decomposed coefficients of an image and its complement. Four different approaches to color texture analysis are tested on the classification of images from the VisTex database. The first method employs multispectral approach, in which texture features are extracted from each channel of the RGB color space. The second method uses HSV color space in which texture features are extracted from the luminance channel V and color features from the chromaticity channels H and S. The third method uses YCbCr color space, in which texture features are extracted from the luminance channel Y and color features from the chromaticity channels Cb and Cr. The last one uses gray scale texture features computed for a color image. The classification results show that the multispectral method gives the best percentage of 97.87%. Experiments are carried out on Wang’s dataset using JSEG for segmentation.

[M.Ozden, E.Polat, 2007][30], described a new color image segmentation method based on low-level features including color, texture, and spatial information. The mean-shift algorithm with color and spatial information in color image segmentation is in general successful, however, in some cases, the color and spatial information are not sufficient for superior segmentation. The proposed method addresses problem and employs texture descriptors as an additional feature. The method uses wavelet frames that provide translation invariant texture analysis. The method integrates additional texture feature to the color and spatial space of standard mean-shift segmentation algorithm. The new algorithm with high dimensional extended feature space provides better results than standard mean-shift segmentation algorithm as shown in experimental results.

[Ze-Nian Li 2007][31], presented two methods for a better content-based image retrieval (CBIR) namely, the use of recognition kernel and locales. Features of model objects are extracted at levels that are most appropriate to yield only the necessary yet sufficient details, together they form the kernel. Instead of relying on image segmentation, a method of feature localization based on locales is developed. It is shown that the deployment of the recognition kernel and locales in a pyramidal (multi resolution) framework delivers good retrieval results.

[Ying J., Dengsheng Z., Guojun J., Wei-Y, M , 2007][32], focus on reducing the ‘semantic gap’ between the visual features and the richness of human semantics and attempts to provide a comprehensive survey of the recent technical achievements in high-level semantic-based image retrieval. They identify five major categories of the state-of-the-art techniques in narrowing down the ‘semantic gap’: using object ontology to define high-level concepts, using machine learning methods to associate low-level features with query concepts, using relevance feedback to learn users’ intention, generating semantic template to support high-level image retrieval, fusing the evidences from HTML text and the visual content of images for WWW image retrieval.

[Hiremath P.S and Jagadeesh P, 2007][33], presented a novel framework for combining color, texture, and shape information, and achieve higher retrieval efficiency using image and its complement. The image and its complement are partitioned into non-overlapping tiles of equal size. The features drawn from conditional co-occurrence histograms between the image tiles and corresponding complement tiles, in RGB color space, serve as local descriptors of color and texture. This local information is captured for two resolutions and two grid layouts that provide different details of the same image. An integrated matching scheme, based on most similar highest priority (MSHP) principle and the adjacency matrix of a bipartite graph formed using the tiles of query and target image, is provided for matching the images. Shape information is captured in terms of edge images computed using Gradient Vector Flow fields. Invariant moments are then used to record the shape features. The combination of the color and texture features between image and its complement in conjunction with the shape features provide a robust feature set for image retrieval.

[SrinivasaraoCh, kumar S.S, and Chatterji B.N, 2007][34], proposed Content Based Image Retrieval (CBIR) system using Contourlet Transform (CT) based features with high retrieval rate and less computational complexity. Unique properties of CT like directionality and anisotropy made it a powerful tool for feature extraction of images in the database. The distance measures viz., Manhattan distance and Euclidean distance are used as similarity measures in the proposed CBIR system. Superiority of Manhattan distance is observed over Euclidean distance in terms of average retrieval rate.

[Mei-Ju S.U, Chen H.S, Yang C.Y, Chen S.J, Chen R, Lee W.J, ChengP.H, Yip P.K,LiuH.M, LaiF.P, and DanielR, 2007][35], developed prototyping system for Content-Based Image Retrieval (CBIR) with EMR because it is a neurological disease usually with a long histopathology, and presents itself with a variety of abnormalities in brain images such as those obtained through CT, MRI or Positron Emission Tomography (PET). The image database, in conjunction with clinical information, can be crucial in the care of dementia patients. Moreover, treatments for dementia patients usually involve intensive collaboration among neurologists, radiologists and other clinical specialties. The implementation of this study, an intelligent medical image retrieval system coupled with the EMR system, is expected to enhance the early diagnosis and
monitoring of disease progressions in both Dementia and other chronic pathologies.

[Christopher F.B., 2007][36], described Image-driven data mining methods for image content segmentation, classification, and attribution, where each pixel location of an image-under-analysis is the center point of a pixel-block query that returns an estimated class label. Feature attribute estimates may also be mined when sufficient attribute strata exist in the data warehouse. Novel methods are presented for pixel-block mining, pattern similarity scoring, class label assignments, and attribute mining. These methods are based on a direct sum tree structure called aσ-tree that is utilized with near-neighbor similarity scoring. The σ-tree structure provides a solution to the challenge of high computation/memory costs of pixel-block similarity searching and integrated into warehouse subsystems that provide referential capability into feature attribute data, resulting in a foundation for data mining called Source Optimized, Labeled, Digital Expanded Representations (SOLDIER).

[Md. Mahmudur R, Bipin C.D, and Bhattacharya P., 2007][37], presented a content-based image retrieval framework for diverse collections of medical images of different modalities, anatomical regions, acquisition views, and biological systems. For the image representation, the probabilistic output from multi-class support vector machines (SVMs) with low-level features as inputs are represented as a vector of confidence or membership scores of pre-defined image categories. The outputs are combined for feature-level fusion and retrieval based on the combination rules that are derived by Bayes’ theorem and also propose an adaptive similarity fusion approach based on a linear combination of individual feature level similarities. The performances of the classification and retrieval algorithms are evaluated both in terms of error rate and precision–recall.

[Peng X, King L, 2007][38], deals the Biased Minimax Probability Machine (BMPM) constructs a classifier for the imbalanced learning tasks and provides a worst-case bound on the probability of misclassification of future data points based on reliable estimates of means and covariance matrices of the classes from the training data samples, and achieves promising performance. They develop a novel yet critical extension training algorithm for BMPM that is based on Second-Order Cone Programming (SOCP) and apply the biased classification model to medical diagnosis problems to demonstrate its usefulness. By removing some crucial assumptions in the original solution to this model, make the new method more accurate and robust.

[Carneiro G, Chan A.B, Moreno P.J, and Vasconcelos N., 2007][40], proposed a probabilistic formulation for semantic image annotation and retrieval. Annotation and retrieval are posed as classification problems where each class is defined as the group of database images labeled with a common semantic label and by establishing this one-to-one correspondence between semantic labels and semantic classes, a minimum probability of error annotation and retrieval are feasible with algorithms that are conceptually simple, computationally efficient, and do not require prior semantic segmentation of training images. The supervised formulation is shown to achieve higher accuracy than various previously published methods at a fraction of their computational cost. Finally, the proposed method is shown to be fairly robust to parameter tuning.

[Mark O.G, Christian T, Fischer B, and Deserno T.M., 2008][41], aims at a fair comparison of state-of-the-art algorithms for medical content-based image retrieval (CBIR) and contribution of this work is twofold: at first, a logical decomposition of the CBIR task is presented, and key elements to support the relevant steps are identified: implementation of algorithms for feature extraction, feature comparison, and classifier combination, visualization of extracted features and retrieval results, generic evaluation of retrieval algorithms, and optimization of the parameters for the retrieval algorithms and their combination. Data structures and tools to address these key elements are integrated into an existing framework for image retrieval in medical applications (IRMA). Secondly, baseline results for the CLEF annotation tasks 2005–2007 are provided applying the IRMA framework, where global features and corresponding distance measures are combined within a nearest neighbor approach. Using identical classifier parameters and combination weights for each year shows that the task difficulty decreases over the years. The declining rank of the baseline submission also indicates the overall advances in CBIR concepts.

[Chan-Fong W and Chi-Man P., 2008][42], presented a new framework for effective content-based image retrieval (CBIR) based on rectangular segmentation. In image segmentation, speed is more important than accuracy in CBIR, new rectangular approximate image segmentation is proposed to solve the problem and also develop a significance function to reflect the importance of different position in image, and improve the segmentation and retrieval performance. Finally, present a similarity measure between images with multi-objects.

[Hiremath P.S and Jagadeesh P., 2008][43], tells Salient points are locations in an image where there is a significant variation with respect to a chosen image feature and presents a method for salient points determination based on color saliency. The color and texture information around these points of interest serve as the local descriptors of the image. In addition, the shape information is captured in terms of edge images computed using Gradient Vector Flow fields. Invariant moments are then used to record the shape features. The combination of the local color, texture and the global shape features provide a robust feature set for image retrieval.

[Arti K, Deekshatulu B.L, Madhavilatha M, Zakira F, and Sandhya Kumari V., 2008][44], presented a new approach for global feature extraction using an emerging technique known as
Independent Component Analysis (ICA). A comparative study is done between ICA feature vectors and Gabor feature vectors for 180 different texture and natural images in a database. Result analysis show that extracting color and texture information by ICA provides significantly improved results in terms of retrieval accuracy, computational complexity and storage space of feature vectors as compared to Gabor approaches.

[Ritendra D, Dhiraj, Joshi, Jiali, and James S.Z.W, 2008][47], survey almost 300 key theoretical and empirical contributions in the current decade related to image retrieval and automatic image annotation, and in the process discuss the spawning of related subfields and also discuss significant challenges involved in the adaptation of existing image retrieval techniques to build systems that can be useful in the real world. In retrospect of what has been achieved so far, conjecture what the future may hold for image retrieval research.

[Liana S, Dan B, Anca I, Andrei P, 2008][48], presented an e-learning platform (TESYS) that enhances the possibilities of the traditional medical teaching. It allows students to use modern tools for information access and continuously testing their knowledge. Although medical learning cannot replace direct transfer of knowledge performed during hospital practice hours, when the teacher presents to students different medical cases with all complementary, the e-learning solution can offer significant advantages. It can be said that the hybrid learning is the best solution for the medical teaching. The second element of originality is the content-based visual query that uses characteristics that were automatically extracted from medical images. It can be used both in the training process and e-testing process.

[Z.G. Fan, J.Li, B.Wu, and Y. Wu, 2008][49], presented local patterns constrained image histograms (LPCIH) for efficient image retrieval. Extracting information through combining local texture patterns with global image histograms, LPCIH is an effective image feature representation method with a flexible image segmentation process. This kind of feature representation is robust and invariant for several image transforms, such as rotation, scaling and damaging. LPCIH method is efficient for several difficult image retrieval tasks, such as rotated and damaged gray image retrieval. Because many traditional image retrieval methods are not suitable for the difficult gray image retrieval tasks, LPCIH is valuable for many real-world applications of image retrieval.

[Nandagopalan S, Adiga B.S and Deepak N, 2009][50], presented a novel approach for generalized image retrieval based on semantic contents. A combination of three feature extraction methods namely color, texture, and edge histogram descriptor. There is a provision to add new features in future for better retrieval efficiency. Any combination of these methods, which is more appropriate for the application, can be used for retrieval. This is provided through User Interface (UI) in the form of relevance feedback. For color the histogram of images are computed, for texture co-occurrence matrix based entropy, energy, etc, are calculated and for edge density it is Edge Histogram Descriptor (EHD) that is found. For retrieval of images, a novel idea is developed based on greedy strategy to reduce the computational complexity. The entire system was developed using A Forge.

[SHANMUGAM T.N and RAJENDRAN P, 2009][51], address the specific aspect of inferring an enhanced approach for content-based video retrieval from a collection of videos. Specifically, present a video data model that supports the integrated utilization of various approaches. To begin with, the system splits the video into a sequence of elementary shots and extracts a small number of representative frames from each shot and subsequently calculates frame descriptors depending on the Motion, Edge, Color and Texture features. The video shots are segmented using 2-D correlation coefficient technique. The motion, edge histogram, color histogram and texture features of the elementary video shots are extracted by employing Fast Fourier transform and L2 norm distance function. Statistical approach, HSV color space conversion and Gabor wavelets using Fast Fourier transform respectively. The elementary video shots’ features, extracted using the above approaches, are stored in feature library. On the basis of a query clip, the videos are retrieved in our system. The color, edge, texture and motion features are extracted for a query video clip and evaluated against the features in the feature library. With the help of Kullback-Leibler distance similarity measure the comparison is carried out. Later, similar videos are retrieved from the collection of videos on the basis of the calculated Kullback-Leibler distance.

[Sastry C.S, Saurabh J and Ashish M, 2009][52], presented the $l^1$-norm minimization technique as a similarity metric is used in image retrieval. It is demonstrated through simulation results that the $l^1$-norm minimization technique provides a promising alternative to existing similarity metrics. In particular, the cases where the $l^1$-norm minimization technique works better than the Euclidean distance metric are singled out.

[Hong L and Xiaohong Y, 2009][53], presented an application of k-means clustering algorithm to image retrieval system. Combining the low-level visual features and high-level concepts, the proposed approach fully explores the similarities among images in database, using such clustering algorithm and optimizes the relevance results from traditional image retrieval system by firstly clustering the similar images in the images database to improve the efficiency of images retrieval system. The results of experiments on the testing images show that the proposed approach can greatly improve the efficiency and performances of image retrieval, as well as the convergence to user’s retrieval concept.

[Suhasini P.S, RamaKrishna K and Murali KrishnaI.V, 2009][54], performed color extraction and comparison using the three color histograms, conventional color histogram (CCH), invariant color histogram (ICH) and fuzzy color histogram (FCH). The conventional color histogram (CCH) of an image indicates the frequency of occurrence of every color in an image. The appealing aspect of the CCH is its simplicity and ease of computation. There are however, several difficulties associated with the CCH. The first of these is the high dimensionality of the CCH, even after drastic quantization of the color space. Another downside of the CCH is that it does not take into consideration color similarity across different bins and cannot handle rotation and translation. To address the problem of rotation and translation an invariant color histograms (ICH) based on the color gradients is used and to address the problem of spatial relationship fuzzy linking color histogram (FCH) is used.
[ArunK.S, HemaP.M, 2009][55], focuses on the problem of texture and shape feature extraction. A novel approach by successfully combining rotation invariant contourlet transform and Fourier descriptors is proposed. Rotation invariant contourlet transform is used for texture feature extraction and Fourier descriptor extracts shape features. The retrieval performance of this method is tested using a large medical image database and measured using precision used as performance measurement.

[Preeti A, Sardana H.K, and Gagandeep J, 2009][56], disseminate the knowledge of the CBIR approach to the applications of medical image retrieval and to attract greater interest from various research communities to rapidly advance research in this field. The semantic gap divides the high-level scene analysis of humans from the low-level pixel analysis of computers. They suggest a more systematic and comprehensive view on the concept of gaps in Content based medical image retrieval (CBMIR) research. Also, several research directions for improving the retrieval quality based on the experiences from other closely related research fields and possible clinical benefits from the use of content-based access methods are described as well as promising fields of applications.

[Braveen M, Dhavachelvan P, 2009][57], deals an assessment methodology for CBIR systems with the help of a set of distance metrics. This quantitative evaluation scheme consists of statistical models that provide an insight in assessing the capability of different CBIR systems. This model also serves as a reference for selecting particular CBIR system for any particular application domain.

[Matan P and Michael E, 2009][58], considers denoising of image sequences that are corrupted by zero-mean additive white Gaussian noise. Relative to single image denoising techniques, denoising of sequences aims to also utilize the temporal dimension. This assists in getting both faster algorithms and better output quality. They focus on utilizing sparse and redundant representations for image sequence denoising. In the single image setting, the K-SVD algorithm is used to train a sparsifying dictionary for the corrupted image. The generalization of the above algorithm by offering several extensions: the atoms used are 3-D; the dictionary is propagated from one frame to the next, reducing the number of required iterations; and averaging is done on patches in both spatial and temporal neighboring locations.

[Fernández J, Guerrero R, Miranda Nand Piccoli F, 2009][59], described human visual system and its importance. At early stages, a human visual system is involved in identifying objects (the “what” system) and in locating them (the “where” system). The two systems can be simulated by looking for visual cues such as color, shape, depth, and motion. The combined cues lead to a unique image visual content representation. The most common image representation is a feature vector, where each vector component represents an image feature. They proposed a parallel feature vector construction following the precepts stated by the “what” and “where” system and by using high performance computing. The problem enables the application of multiple levels of parallelism and different paradigms combination. Finally some preliminary results are given.

[Cho-Chun C, Guan-Ju P, and Wen-Liang H, 2009][60], proposed a novel weighting method, which takes account of the pixel connectivity, to solve the problem and derive the effect of the quantization error of a subband on the reconstruction error of a group of pictures and employ the proposed method on a 2-D structure with different temporal filters, namely the 5-3 filter and the 9-7 filter. Experiments on various coding parameters and sequences show that the proposed approach improves the bit-allocation performance over that obtained by using the weightings derived without considering the pixel connectivity in the MCTF process.

[Balamurugan V and Anandhakumar P, 2009][61], introduced neuro-fuzzy based clustering approach for content based image retrieval using 2D-wavelet transform (2D-DWT). Most of the imageretrieval systems are still incapable of providing retrieval results with high retrieval accuracy and less computational complexity. To address this problem, they developed neural network fuzzy logic based approach for content-based image retrieval using 2D-wavelet transform. The system performance improved by the learning and searching capability of the neural network combined with the fuzzy interpretation. This overcomes the vagueness and inconsistency due to human subjectivity. Multiresolution analysis using 2D-DWT can decompose the image into components at different scales, so that the coarse scale components carry the global approximation information while the finer scale components contain the detailed information.

[Yao-Hong T, 2009][62], described salient points are frequently used to represent local properties of the image in content-based image retrieval and present a reduction algorithm that extracts the local most salient points such that they not only give a satisfying representation of an image, but also make the image retrieval process efficient. This algorithm recursively reduces the continuous point set by their corresponding saliency values under a top-down approach. The resulting salient points are evaluated with an image retrieval system using Hausdorff distance.

[Ying L, Xin C, Chengui Z, and Alan S, 2009][63], proposed a semantic clustering scheme to achieve these two goals. By performing clustering before image retrieval, the search space can be significantly reduced. The proposed method is based on (1) it is region based, meaning that image subregions, instead of the whole image, are grouped into. The semantic similarities among image regions are collected over the user query and feedback history; (2) the clustering scheme is dynamic in the sense that it can evolve to include more new semantic categories. Ideally, one cluster approximates one semantic concept or a small set of closely related semantic concepts, based on which the “semantic gap” in the retrieval is reduced.

[Gnaneswara R, VijayaKumar V, and Krishna V, 2009][64], developed a new technique based on wavelet transformations by which a feature vector of size ten, characterizing texture feature of the images is constructed. The method derives feature vector(10 signatures) for each image characterizing the texture feature of sub image from only three iterations of wavelet transforms. A clustering method ROCK is modified and used to cluster the group of images based on feature vectors of sub images of database by considering the minimum Euclidean distance. This modified ROCK is used to minimize searching
process. The experiments are conducted on a variety of garment images and successful matching results are obtained.

[Jalil A, Salman Q, Muhammad I, Sarfraz A, and Naeem A.K., 2010][65], focus on the Content Based image retrieval with specific domain of Text Based image retrieval (TBIR) system. This is an application of computer vision meant to explain image retrieval problem. In large databases, to find the required image by applying some query on the basis of content based shapes, textures colors etc and find the required data or image. If the ability to estimate or examine the image Content does not exist, in that case search must depend upon metadata like caption or keywords. If the query doesn’t match the required contents then it is implemented on some other feature of images to retrieve from the database.

[Julia E.E. de Oliveira, Alexei M.C.M, Guillermo C.C., Ana P.B.L, Thomas M.D, Arnaldo de, 2010][66], presented a content-based image retrieval system designed to retrieve mammographies from large medical image database. The system is developed based on breast density, according to the four categories defined by the American College of Radiology, and is integrated to the database of the Image Retrieval in Medical Applications (IRMA) project, that provides images with classification ground truth. Two-dimensional principal component analysis is used in breast density texture characterization, in order to effectively represent texture and allow for dimensionality reduction. A support vector machine is used to perform the retrieval process. Average precision rates are in the range from 83% to 97% considering a data set of 5024 images. The results indicate the potential of the system as the first stage of a computer-aided diagnosis framework.

[Miguel A.H, Francesc J.F and Salvador M.P, 2010][67], aim to provide a means to find pictures in large repositories without using any other information except its contents usually as low level descriptors. Since these descriptors do not exactly match the high level semantics of the image, assessing perceptual similarity between two pictures using only their feature vectors is not an easy task. In fact, the ability of a system to induce high level semantic concepts from the feature vector of an image is one of the aspects which most influences its performance. They describe a CBIR algorithm which combines relevance feedback, evolutionary computation concepts and ad-hoc strategies in an attempt to fill the existing gap between the high level semantic content of the images and the information provided by the low level descriptors.

[Daekeun y, Sameer A, Dina D.F, MdMahmudur R, Venu G, George R.T, 2010][68], goal is to automatically annotate images extracted from scientific publications with respect to their usefulness for clinical decision support and instructional purposes, and project the annotations onto images stored in databases by linking images through content-based image similarity. They often use text labels and pointers overlaid on figures and illustrations in the articles to highlight regions of interest (ROI). These annotations are then referenced in the caption text or figure citations in the article text. In previous research we have developed two methods (a heuristic and dynamic time warping-based methods) for localizing and recognizing such pointers on biomedical images. They add robustness to our previous efforts by using a machine learning based approach to localizing and recognizing the pointers.

Identifying these can assist in extracting relevant image content at regions within the image that are likely to be highly relevant to the discussion in the article text. Image regions can then be annotated using biomedical concepts from extracted snippets of text pertaining to images in scientific biomedical articles that are identified using National Library of Medicine’s Unified Medical Language System (UMLS) Metathesaurus. The resulting regional annotation and extracted image content are then used as indices for biomedical article retrieval using the multimodal features and region-based content-based image retrieval (CBIR) techniques. The hypothesis that such an approach would improve biomedical document retrieval is validated through experiments on an expert-marked biomedical article dataset.

[Srinivasarao Ch., Srinivas Kuman S and Chandra Mohan B, 2010][69], tells Content Based Image Retrieval (CBIR) systems based on shape using invariant image moments, viz., Moment Invariants (MI) and Zernike Moments (ZM) are available in the literature. MI and ZM are good at representing the shape features of an image. However, non-orthogonality of MI and poor reconstruction of ZM restrict their application in CBIR. Therefore, an efficient and orthogonal moment based CBIR system is needed. Legendre Moments (LM) are orthogonal, computationally faster, and can represent image shape features compactly. CBIR system using Exact Legendre Moments (ELM) for grayscale images is proposed in this work. Superiority of the proposed CBIR system is observed over other moment based methods, viz., MI and ZM in terms of retrieval efficiency and retrieval time. Further, the classification efficiency is improved by employing Support Vector Machine (SVM) classifier. Improved retrieval results are obtained over existing CBIR algorithm based on Stacked Euler Vector (SERVE) combined with Modified Moment Invariants (MMI).

[Uday P.S, Sanjeev J, and Gulfishan F.A, 2010][70], in this proposed method feature are extracted after applying Phong shading on input image. Phong shading, flattering out the dull surfaces of the image the features are extracted using color, texture & edge density methods. Feature extracted values are used to find the similarity between input query image and the database image. It can be measured by the Euclidean distance formula. The experimental result shows that the proposed approach has a better retrieval results with Phong shading.

[Murthy V.S.V.S, Vamsidhar E, Sugurup Kumar J.N.V.R, and Sankararao P, 2010][71], presented an image retrieval system that takes an image as the input query and retrieves images based on image content. The unique aspect of the system is the utilization of hierarchical and k-means clustering techniques. The proposed procedure consists of two stages. First, here we are going to filter most of the images in the hierarchical clustering and then apply the clustered images to KMeans, so that we can get better favored image results.

[Aliaa A.Y, Darwish A.A and Mohamed R.A, 2010][72], developed a new approach to image retrieval based on color, texture, and shape by using pyramid structure wavelet. The major advantage of such an approach is that little human intervention is required. However, most of these systems only allow a user to query using a complete image with multiple regions and are unable to retrieve similar looking images based on a single region. Experimental results of the query system on different test image databases are given. They introduces a
comparative study between color, texture, shape and the pyramid structure wavelet technique and generates the receiving operating characteristic curve (ROC) to assess the results.

[Kondekar V.H, Kolkure V.S and Kore S.N, 2010][73] described the research on different feature extraction and matching techniques in designing a Content Based Image Retrieval (CBIR) system. Due to the enormous increase in image database sizes, as well as its vast deployment in various applications, the need for CBIR development arose. Firstly, outlines adescription of the primitive feature extractiontechniques like: texture, colour, and shape. Once these features are extracted and used as the basis for similarity check between images, the various matching techniques are discussed.

[Devis T, Gustavo C.V, Giona M and Mikhail K, 2010][74], proposed to classify the images and simultaneously to learn the relevant features in such high-dimensional scenes. The proposed method is based on the automatic optimization of a linear combination of kernels dedicated to different meaningful sets of features. Such sets can be groups of bands, contextual or textural features, or bandacquired by different sensors. The combination of kernels is optimized through gradient descent on the support vector machine objective function. Even though the combination is linear, the ranked relevance takes into account the intrinsic nonlinearity of the data through kernels. Since a naive selection of the free parameters of the multiple-kernel method is computationally demanding and they propose an efficient model selection procedure based on the kernel alignment. The result is a weight for each kernel where both relevant and meaningless images automatically emerge after training the model. Experiments carried out in multi- and hyperspectral, contextual, and multisource remote sensing data classification confirm the capability of the method in ranking the relevant features and show the computational efficiency of the proposed strategy.

[Volkun U and dhsan O.B, Cekmece B, and Dstanbul,2010][75]. the goal of this study is to make a fine distinction against the gene expressions in the microarray image processing. For this reason, two clustering methods have been experimented and compared. In this study specifically investigated the segmentation step of the microarray image. Other than the segmentation methods used in commercial packages used the clustering techniques and applied fuzzy c-means and k-means methods and observed the results.

[Rajshree S.D, Rajnish C and Joy B, 2010][76], described the features of fourtechniques Color Histogram, Color moment, Texture, and Edge Histogram Descriptor. The nature of the Image is basically based on the Human Perception of the Image. TheMachine interpretation of the Image is based on the Contours and surfaces of the Images. The study of the Image Mining is a very challenging task because it involves the Pattern Recognition which is a very important tool for the Machine Vision system. A combination of four feature extraction methods namely color Histogram, Color Moment, Texture, and Edge Histogram Descriptor. There is a provision to add new features in future for better retrieval efficiency. The combination of the four techniques are used and the Euclidian distances are calculated of the every features are added and the averages are made. The user interface is provided by the Matlab. The image properties analyzed in this work are by using computer vision and image processing algorithms. For color the histogram of images are computed, for texture cooccurrence matrix based entropy, energy, etc, are calculated and for edge density it is Edge Histogram Descriptor (EHD) that is found. For retrieval of images, the averages of the four techniques are made and the resultant Image is retrieved.

[Awais A, Muhammad N, Sajid A, Tamleek A, and Muhammad A, 2010][77], tells human psychology and perception and cultural diversity also have their share for the design of a good and efficient image recognition and retrieval system. A new object based search technique is presented where object in the image are identified on the basis of their geometrical shapes and other features like color and texture where object-co-relation augments this search process. To be more focused on objects identification; simple images are selected for the work to reduce the role of segmentation in overall process however same technique can also be applied for other images.

[Jun Z and Lei Y, 2010][78], discussed about Feature aggregation technique in content based image retrieval (CBIR) systems that employs multiple visual features to characterize image content and its disadvantages. They propose a new feature aggregation scheme, series feature aggregation (SFA). SFA selects relevant images using visual features one by one in series from the images highly ranked by the previous visual feature. The irrelevant images will be effectively filtered out by individual visual features in each stage, and the remaining images are collectively described by all visual features. Experiments, conducted with IAPR TC-12 benchmark image collection (ImageCLEF2006) that contains over 20,000 photographic images and defined queries, have shown that the proposed SFA can outperform conventional parallel feature aggregation schemes.

[Stefanos V, Symeon P, Anastasia M, Panagiotis S, Emanuelle Pand Ioannis K, 2010][79], discussed the potential benefits, the requirements and the challenges involved in patent image retrieval and subsequently and propose a framework that encompasses advanced image analysis and indexing techniques to address the need for content-based patent image search and retrieval. The framework involves the application of document image pre-processing, image feature and textual metadata extraction in order to support effectively content-based image retrieval in the patent domain. To evaluate the capabilities they implemented a patent image search engine. Results based on a series of interaction modes, comparison with existing systems and a quantitative evaluation of our engine provide evidence that image processing and indexing technologies are currently sufficiently mature to be integrated in real-world patent retrieval applications.

[Gwéno’le Q, Mathieu L, Guy C, B’eatrice C and Christian R, 2010][80], proposed a Content-Based Image Retrieval method for diagnosis aid in medical fields. In the system, images are indexed in a generic fashion, without extracting domain-specific features: a signature is built for each image from its wavelet transform. These image signatures characterize the distribution of wavelet coefficients in each subband of the decomposition. A distance measure is then defined to compare two image signatures and thus retrieve the most similar images.
in a database when a query image is submitted by a physician. To retrieve relevant images from a medical database, the signatures and the distance measure must be related to the medical interpretation of images. As a consequence, they introduce several degrees of freedom in the system so that it can be tuned to any pathology and image modality. In particular, they propose to adapt the wavelet basis, within the lifting scheme framework, and to use a custom decomposition scheme. Weights are also introduced between subbands. All these parameters are tuned by an optimization procedure, using the medical grading of each image in the database to define a performance measure. The system is assessed on two medical image databases: one for diabetic retinopathy follow up and one for screening mammography, as well as a general purpose database.

[Keong Y, Zhen T, Jiying Z, Yanling B, and Qingshan Y,2011][81], provide an efficient approach to develop the archives of large brain CT medical data. Medical images are securely acquired along with relevant diagnosis reports and then cleansed, validated and enhanced. Then some sophisticated image processing algorithms including image normalization and registration are applied to make sure that only corresponding anatomy regions could be compared in image matching. A vector of features is extracted by non-negative tensor factorization and associated with each image, which is essential for the content-based image retrieval. Their experiments prove the efficiency and promising prospect of this database building method for computer-aided diagnosis system.

[Gwénolé Q, Mathieu L, Guy C and Béatrice C, 2011][82], Presented A novel content-based heterogeneous informationretrieval framework, particularly well suited to browse medical databases and support new generation computer aided diagnosis(CAdx) systems. It was designed to retrieve possibly incomplete documents, consisting of several images and semantic information, from a database; more complex data types such as videos can also be included in the framework. The proposed retrieval method relies on image processing, inorder to characterize each individual image in a document by their digital content, and information fusion. Once the available images in a query document are characterized, a degree of match, between the query document and each reference document stored in the database, is defined for each attribute. A Bayesian network is used to recover missing information if need be. Finally, two novel information fusion methods are proposed to combine these degrees of match, in order to rank the reference documents by decreasing relevance for the query. In the first method, the degrees of match are fused by the Bayesian network itself. In the second method, they are fused by the Dezert–Smarandache theory: the second approach lets us model our confidence in each source of information and take it into account in the fusion process for a betterretrieval performance. The proposed methods were applied to twoheterogeneous medical databases, a diabetic retinopathy database and a mammography screening database, for computer aided diagnosis.

[Nguyen D.T, Tahir R, Young-Koo L, Sungyoung L, and Tae-Seong K, 2011][83], focus on a specific domain of CBIR that involves the development of a content-based facial image retrieval system based on the constrained independent component analysis (cICA). Originating from independent component analysis (ICA), cICA is a source separation technique that uses priori constraints to extract desired independent components (ICs) from data. By providing query images as the constraints to the cICA, the ICs that share similar probabilistic features with the queries from the database can be extracted. Then, these extracted ICs are used to evaluate the rank of each image according to the query. In addition to a single image-based query, a compound query with multiple query images can be used to search for images with compounding feature content.

[Samuel R.B, Massimo R, and Marcello P, 2011][84], proposed a novel approach to content-based image retrieval with relevance feedback, which is based on the random walker algorithm introduced in the context of interactive image segmentation. The idea is to treat the relevant and non-relevant images labeled by the user at every feedback round as “seed” nodes for the random walker problem. The ranking score for each unlabeled image is computed as the probability that a random walker starting from that image will reach a relevant seed before encountering a non-relevant one. The method is easy to implement, parameter free and scales well to large datasets. Extensive experiments on different real datasets with several image similarity measures show the superiority of method over different recent approaches.

[Kerstin B, Michael B, Marcel F.J, and Nicolai P, 2011][86], investigate the extraction of effective color features for a content-based image retrieval (CBIR) application in dermatology. Effectiveness is measured by the rate of correct retrieval of images from four color classes of skin lesions. They employ and compare two different methods to learn favorable feature representations for this special application: limited rank matrix learning vector quantization (LiRaM LVQ) and a Large Margin Nearest Neighbor (LMNN) approach. They achieved significant improvements in every examined color space. LiRaM LVQ and the computationally more expensive LMNN give comparable results for large values of the method parameter k of LMNN (kZ25) while LiRaM LVQ outperforms LMNN for smaller values of k.

[Adrien D, Samuel D, Ivan E and Henning M, 2011][87], proposed mobile access to peer-reviewed medical information based on textual search and content-based visual image retrieval. Web-based interfaces designed for limited screen space were developed to query via webservices a medical information retrieval engine optimizing the amount of data to be transferred in wireless form. Visual and textual retrieval engines with state of the art performance were integrated. Results obtained show a good usability of the software. Future use in clinical environments has the potential of increasing the quality of patient care through bedside access to the medical literature in context.

[Sreedhar J, ViswanadhaRaju S, Vinayababu A, 2011][88], investigated image retrieval based on image content, Content Based Image Retrieval (CBIR) and proposed a framework to characterize the image content and similarity between the images. Due to the enormous increase in image database sizes, the need for the development of CBIR systems arose. Firstly, outlines feature extraction methods for color and texture. The extracted features for each image in the database used as the basis for similarity between the images. They built user interface based on Java, in which users can easily select query image and
view top ten retrieved images based on decreasing order and extended the approach to subimage retrieval also. Results report that HSV based color features and contrast based texture features outperform than RGB based features and results reported in the paper are convincing.

[Vagelis H, Yuheng H, and Panagiotis G.I, 2011][89], presented an algorithm that return the top results for a query, ranked according to an IR (information retrieval) style ranking function, while operating on top of a source with a Boolean query interface with no ranking capabilities (or a ranking capability of no interest to the end user). The algorithms generate a series of conjunctive queries that return only documents that are candidates for being highly ranked according to a relevance metric. The approach can also be applied to other settings where the ranking is monotonic on a set of factors (query keywords in IR) and the source query interface is a Boolean expression of these factors. The comprehensive experimental evaluation on the PubMed database and a TREC data set show that we achieve order of magnitude improvement compared to the current baseline approaches.

[Sankha A, Ajantha D, and Bernhard T, 2012][90], introduced a framework and a service model improving the understanding of domain requirements acquisition for IT-service systems development. The service model fills the gap in domain specific requirements elicitation through its base in the classical rhetorical frame introduced by Hermogoras of Temnosan through the interpretation of the domain in terms of service offerings. The model is validated by a real-life situation - to establish an ophthalmologic Disease Diagnosis Decision Support Network (DDDSN) for age-related macular degeneration (ARMD) [91].

[Nidhi S, Kanchan S, and Ashok K.S,2012][91], addressed the problem of content based image retrieval in dynamic environment. It is not feasible for systems that analyze images in real-time where the images are stored or added on an ongoing basis. They propose a framework which is able to select the most appropriate features to analyze newly received images thereby improving the retrieval accuracy and efficiency. The algorithm comprises of designing feature vectors after segmentation which will be used in similarity comparison between query image and database images. The framework is trained and tested for different images in the database.

[Ray-J C, Shu-Yu L, Jan-Ming H, Chi-Wen F and Yu-Chun W,2012][92], proposed a novel system architecture for CBIR system which combines techniques include content-based image and color analysis, as well as data mining techniques. To their best knowledge, this is the first time to propose segmentation and grid module, feature extraction module, K-means and k-nearest neighbor clustering algorithms and bring in the neighborhood module to build the CBIR system. Concept of neighborhood color analysis module which also recognizes the side of every grids of image is first contributed. The results show the CBIR systems performs well in the training and it also indicates there contains many interested issue to be optimized in the query stage of image retrieval.

[Pathjea P.S, Waoo A.A and Maurya J.P, 2012][93], proposed a approach we use neural network based pattern learning to achieve effective classification and with neural network we use decision tree algorithm tomeak less complex mining of images.

[FanidF.Y, and Balafar M.A,2012][94], describes Content Based Image Retrieval (CBIR) systems retrieve brain images from that database which are similar to the query image. CBIR is the application of computer vision. Instead of text based searching, CBIR efficiently retrieves images that are visually similar to query image. In CBIR query is given in the form of image. They aims to provide an efficient medical image data Retrieval in Diagnosis Brain Disease.

[Dumitru D.B, Cristian G.M, Liana S, Marius B,2012][95], presented a system used in the medical domain for three distinct tasks: image annotation, semantic based image retrieval and content based image retrieval. An original image segmentation algorithm based on a hexagonal structure was used to perform the segmentation of medical images. Image’s regions are described using a vocabulary of blobs generated from image features using the K-means clustering algorithm. The annotation and semantic based retrieval task is evaluated for two annotation models: Cross Media Relevance Model and Continuous space Relevance Model. Semantic based image retrieval is performed using the methods provided by the annotation models. The ontology used by the annotation process was created in an original manner starting from the information content provided by the Medical Subject Headings (MeSH).

[Latika P, Manisha S and Kamal M,2012][96], discussed various methodologies used in the research area of Content Based Image Retrieval techniques using Relevance Feedback. The comparison and analysis of these methods is done. Relevance feedback techniques were incorporated into Content-based image retrieval for obtaining more precise results and covers various relevance feedback techniques for Content Based Image Retrieval systems.

[Ashish O and Manpreet S,2012][97], designed a Content Based Image Retrieval System for Medical Databases (CBIR-MD) based on various techniques like Fourier descriptor, Euclidean distance, Haar Wavelet transformation, Canberra distance and analyzed its performance on Endoscopy, Dental and Skull images.

[Shadma P, Shweta Y, and Neelu C,2012][98], introduced the problems and challenges concerned with the design and the creation of CBIR systems, which is based on a free hand sketch (Sketch based image retrieval – SBIR). With the help of the existing methods, revealed that the proposed algorithm is better than the existing algorithms, which can handle the information gap between asketch and a colored image. Overall, the results show that the sketch based system allows users an intuitive access to search tools.

[Manimala S and Hemachandran K, 2012][99], presents the content based image retrieval, using features like texture and color, called WBCHIR (Wavelet Based Color Histogram Image Retrieval). The texture and color features are extracted through wavelet transformation and color histogram and the combination of these features is robust to scaling and translation of objects in an image. The proposed system has demonstrated a promising and faster retrieval method on a WANG imagen database containing 1000 general-purpose color images.
[Kashif I, Michael O.O and Anne J, 2012][100], discuss a new content-based image retrieval approach for biometric security, which is based on colour, texture and shape features and controlled by fuzzy heuristics. The proposed approach is based on the three well-known algorithms: colour histogram, texture and moment invariants. The use of these three algorithms ensures that the proposed image retrieval approach produces results which are highly relevant to the content of an image query, by taking into account the three distinct features of the image and similarity metrics based on Euclidean measure. Colour histogram is used to extract the colour features of an image. Gabor filter is used to extract the texture features and the moment invariant is used to extract the shape features of an image. The evaluation of the proposed approach is carried out using the standard precision and recall measures, and the results are compared with the well-known existing approaches.

[Mangijao S.S, and Hemachandran K,2012][101], proposed a content-based image retrieval method which combines color and texture features. To improve the discriminating power of color indexing techniques, encode a minimal amount of spatial information in the color index. As its color features, an image is divided horizontally into three equal non-overlapping regions. From each region in the image, extract the first three moments of the color distribution, from each color channel and store them in the index i.e., for a HSV color space, store 27 floating point numbers per image. As its texture feature, Gabor texture descriptors are adopted. The assignment of weights to each feature respectively and calculate the similarity with combined features of color and texture using Canberra distance as similarity measure.

[Petra W, Benedikt F, Rolf W.G, and Thomas M.D,2012][102], described Content-based image retrieval (CBIR) offers approved benefits for computer-aided diagnosis (CAD), but is still not well established in radiological routine yet. An essential factor is the integration gap between CBIR systems and clinical information systems. The international initiative Integrating the Healthcare Enterprise (IHE) aims at improving interoperability of medical computer systems. They took into account deficiencies in IHE compliance of current picture archiving and communication systems (PACS), and developed an intermediate integration scheme based on the IHE post-processing workflow integration profile (PWF) adapted to CBIR in CAD. The Image Retrieval in Medical Applications (IRMA) framework was used to apply our integration scheme exemplarily, resulting in the application called IRMAcon. The novel IRMAcon scheme provides a generic, convenient and reliable integration of CBIR systems into clinical systems and workflows. Based on the IHE PWF and designed to grow at a pace with the IHE compliance of the particular PACS, it provides sustainability and fosters CBIR in CAD.

[Ching Y.Y, Kim M.C, and Nasrul H.M and Ismail A, 2012][104], deals the survey of image processing algorithms that have been developed for detection of masses and segmentation techniques. 35 students from university campus participated in the Development of Biomedical Image Processing Software Package for New Learners Survey to investigate the use of software package in processing and editing image. Composed of 19 questions, the survey built a comprehensive picture of the software package, programming language, workflow of the tool and captured the attitudes of the respondents. The result of this study shows that MATLAB is among the famous software package; Microsoft Photo Editor is the second popular software for images editing process. The result is expected to be beneficial and able to assist users on effective image processing and analysis in a newly develop software package.

[Deying F, Jie Y, and Congxin L,2013][106], proposed an efficient indexing method for content-based image retrieval and introduces the ordered quantization to increase the distinction among the quantized feature descriptors. Thus, the feature point correspondences can be determined by the quantized feature descriptors, and they are used to measure the similarity between query image and database image. To implement the above scheme efficiently, a multi dimensional inverted index is proposed to compute the number of feature point correspondences, and then approximate RANSAC is investigated to estimate the spatial correspondences of feature points between query image and candidate images returned from the multi-dimensional inverted index.

[Sukhada A,2013][107], proposed Content-based image retrieval (CBIR) framework for diverse collection of medical images of different imaging modalities, anatomic regions with different orientations and biological systems. Organization of images in such a database (DB) is well defined with predefined semantic categories; hence, it can be useful for category-specific searching. The proposed framework consists of machine learning methods for image pre-filtering, similarity matching using statistical distance measures, and a relevance feedback (RF) scheme. In this framework, the probabilistic outputs of a multiclass support vector machine (SVM) classifier as category prediction of query and database images are exploited at first to filter out irrelevant images, thereby reducing the search space for similarity matching. A query-specific adaptive linear combination of similarity matching approach is proposed by relying on the image classification and feedback information from users. These images constitute an important source of anatomical and functional information for the diagnosis of diseases, medical research, and education. Effectively and efficiently searching in these large image collections poses significant technical challenges as the characteristics of the biomedical images differ significantly from other general purpose images.

[RameshKumar A and Saravanan D,2013][108], describe the Content-based image retrieval (CBIR) scheme which searches the most-similar images of a query image that involves in comparing the feature vectors of all the images in the database with that of the query image using some pre-selected similarity measure, and then sorting of the results. On querying an image, a reduced set of candidate images which have the same Grid Code as that of the query image is obtained. The color histogram for an image is constructed by quantizing the colors within the image and counting the number of pixels of each color. The feature vector of an image can be derived from the histograms of its color components and finally can set the number of bins in the color histogram to obtain the feature vector of desired size. Thus the grid code of an image is obtained through the quantization of the feature vector derived from the histogram of the desired color component of the image. In order to have similar features of the images the grid code must be same for all Images in the grid.
[Arvind N, 2013][109], finds various methods for implementation of CBIR which uses low-level image features like color, texture and shape. They proposed Global image properties based CBIR using a feed-forward backpropagation neural network. At first, the neural network is trained about the features of images in the database. The image features considered here are color histogram as color descriptor, GLCM (gray level co-occurrence matrix) as texture descriptor and edge histogram as edge descriptor. The training is carried out using backpropagation algorithm. This trained when presented with a query image retrieves and displays the images which are relevant and similar to query from the database. The results show a considerable improvement in terms of precision and recall of image retrieval.

[Guang-Hai L and Jing-Yu Y, 2013][110], presented a novel image feature representation method, namely color difference histograms (CDH), for image retrieval. The unique characteristic of CDHs is that they count the perceptually uniform color difference between two points under different backgrounds with regard to colors and edge orientations in color space. This method pays more attention to color, edge orientation and perceptually uniform color differences, and encodes color, orientation and perceptually uniform color difference via feature representation in a similar manner to the human visual system. The method can be considered as a novel visual attribute descriptor combining edge orientation, color and perceptually uniform color difference, as well as taking the spatial layout into account without any image segmentation, learning processes or clustering implementation. Experimental results demonstrate that it is much more efficient than the existing image feature descriptors that were originally developed for content-based image retrieval, such as MPEG-7 edge histogram descriptors, color autocorrelograms and multi-texton histograms.

[Meenachi S.S and Srinivasagan K.G, 2013][111] proposed a novel method, Navigation Pattern-based RelevanceFeedback (NPRF), to achieve the high efficiency and effectiveness of CBIR in coping with the large-scale image data. In terms of efficiency, the iterations of feedback are reduced substantially by using the navigation patterns discovered from the user query log. In terms of effectiveness, proposed search algorithm NPRF Search makes use of the discovered navigation patterns and three kinds of query refinement strategies, Query Point Movement (QPM), Query Reweighting (QR), and Query Expansion (QEX), to converge the search space toward the user’s intention effectively. By using NPRF method, high quality of image retrieval on RF can be achieved in a small number of feedbacks. The experimental results reveal that NPRF outperforms other existing methods significantly in terms of precision, coverage, and number of feedbacks.

[Joyjit P, Himadri N.M, and Arun K.M, 2013][113], designed for automatic measurements of orthopedic parameters, and allows the possibility of human intervention in case the parameters have not been detected properly. The segment of the application is Hip Arthroplasty.

[Karthikeyan T, Manikanthaprabhu P and Nithya S, 2014][114], made a survey about text and content based image retrieval system. Image retrieval is performed by matching the features of a query image with those in the image database. It can be classified as text-based and content-based. The text-based Image retrieval applies traditional text retrieval techniques to image annotations. The content-based Image retrieval apply image processing techniques to first extract image features and then retrieve relevant images based on the match of these features. Feature extraction is the process of extracting image features to a distinguishable extent to extract the image content by using colors, textures or shapes based. Similarity measures are used to determine how similar ordissimilar in the given query image and the image database collections.

[Noor H.L, Shaheen M, and Kuldeep S, 2014][115], discussed about Agriculture sector which provides gainful employment and livelihood for majority of the population of India and contributes significantly to the National Income. Farmers are unable to cope up with the problems that arise due to agricultural plant diseases and they depend on Agriculture Plant Biologists to address these problems. They proposed a system based on Content Based Image Retrieval for diagnosing the agricultural plant diseases. MPEG-7 CLD (Color layout descriptor) has been used to create the image descriptors and MPEG-7 CLD distance measure is used to compare the images.

[Santhosh P.M, Valentina E.B, Zachariah K.P and Philip S, 2014][116], proposed Polar Raster Edge Sampling Signature (PRESS) algorithm using this shape features are extracted from the database images and the same are polar raster scanned into specified intervals in both radius and angle. Counts of edge points lying in these bins are stored in the feature library. When a query image passed on to the system, the features are extracted in the similar fashion. Subsequently, similarity measure is performed between the query image features and the database image features based on Euclidean Distance similarity measure and the database images that are relevant to the given query image are retrieved. This technique preserves rotation and scale invariance. It is evaluated by querying different images. The retrieval efficiency is also evaluated by determining precision-recall values for the retrieval results.

[Dos-Santos M, 2014][117], presented a system called CaseServer, it supports radiology teaching and research practices. The initial intention was to create an electronic and MIRC-compliant infrastructure to provide integrated and context-based access to all relevant patient data at the time of image interpretation. A successful implementation has integrated information collected from various sources. Furthermore, the application of role-based coupled with context-based principles to acquisition, organization, control, dissemination and use of clinical cases in teaching and research has brought out a multipurpose infrastructure which promotes and makes feasible the usage of clinical cases within academic and research communities.

[Anna S.V and Vinod Kumar S, 2015][118], deals with the retrieval of images into three basic categories of color called RGB. After retrieving the image with their component transformation can be applied. The HOG method is used to retrieve the feature of image vectors and others. The HOG method is fully analyzed and proves its accuracy and efficiency of image retrieval with reduced number of steps.

[André M, Flávio M, and João M, 2015][119], proposed a medical information retrieval system with support for multimodal medical case-based retrieval. The system supports
medical information discovery by providing multimodal search, through a novel data fusion algorithm, and term suggestions from a medical thesaurus. Our search system compared favorably to other systems in 2013 ImageCLEFMedical.

[Goncharov A and Melnichenko A, 2016][120], investigated two approaches to content based image retrieval and their application to near duplicate detection in image collections. The first approach was proposed by C.E. Jacobs et al. It involves wavelet transformation of source image to extract features. The second approach is based on so called matrix of brightness variations which uses signs of partial derivatives of image brightness as features. Both approaches use some kind of pseudometric as similarity measure.

B. Review of techniques to retrieve documents based on Mathematical Expressions

[Utpal G and Chaudhuri B.B, 2004][19], aims at automatic understanding of online handwritten mathematical expressions (MEs) written on an electronic tablet. The proposed technique involves two major stages: symbol recognition and structural analysis. Combination of two different classifiers have been used to achieve high accuracy for the recognition of symbols. A context-free grammar has been designed to convert the input expressions into their corresponding TEX strings which are subsequently converted into MathML format. Contextual information has been used to correct several structure interpretation errors. A new method for evaluating performance of the proposed system has been formulated. Experiments on a dataset of considerable size strongly support the feasibility of the proposed system.

[Jozef M and Leo G, 2008][45], addressed the issues and present a new technique how to search for mathematical formulae in real-world mathematical documents, but still offering an extensible level of mathematical awareness. It exploits the advantages of full text search engine and stores each formula not only once but in several generalised representations. Because it is designed as an extension, any full text search engine can adopt it. Based on the proposed theory they developed EgoMath — new mathematical search engine. Experiments with EgoMath over two document sets, containing semantic information, showed that this technique can be used to buildfully-fledged mathematical search engine.

[Josef B.B, Alan P.S and Volker S, 2008][46], presented a procedure that extracts mathematical symbols from PDF documents by examining both the original PDF file and a rasterised version. This provides more precise information than is available either directly from the PDF file or by traditional character recognition techniques. The data can then be used to improve mathematical parsing methods that transform the mathematics into richer formats such as MathML.

[Shinpei Y, Fumihiro F, Qinzheng Z, Keiichiro Sand Masayuki O, 2011][85], describes embedding a mathematical formula recognition module into the OCR system OCRopusaiming at developing a OCR system for scientific and technical documents which include mathematical formulas. OCRopus is open source OCR system emphasizing modularity, easy extensibility, and reuse. This system has several basic components such as preprocessing, layout analysis, and text line recognition, so it is a challenging project to embed the mathematical formula recognition module into the OCRopus system. They developed the math OCR module, then report how to embed our module into the OCRopus system in order to realize automatic OCR which can deal with wide variety of documents including mathematical formulas.

[Xiaoyan L, Liangcai G, Zhi T, Xuan Hand Xiaofan L, 2012][103], presented a performance evaluation system for mathematical formula identification. First, a ground-truth dataset is constructed to facilitate the performance comparison of different mathematical formula identification algorithms. Statistics analysis of the dataset shows the diversities of the dataset to reflect the real-world documents. Second, a performance evaluation metric for mathematical formula identification is proposed, including the error type definitions and the scenario-adjustable scoring. The proposed metric enables in-depth analysis of mathematical formula identification systems in different scenarios. Finally, based on the proposed evaluation metric, a tool is developed to automatically evaluate mathematical formula identification results.

[Wei-Ta C and Fan L, 2013][112], presented mathematical formula detection in heterogeneous document images that may contain figures, tables, text, and math formulas. They adopt the method originally proposed for sign detection in natural images to detect non-homogeneous regions and accordingly achieve text line detection and segmentation. Novel features based on centroid fluctuation information of non-homogeneous regions are proposed to more appropriately characterize both displayed formulas and embedded formulas.

III. PROBLEM IDENTIFICATION AND PROPOSED APPROACH

Studies on references from literature revealed that there are number of challenges in providing Heuristic techniques for Content Based Image Retrieval (CBIR) and soft computing techniques to retrieve documents based on Mathematical Expressions. Although many researchers, over the years have suggested various approaches to resolve them, still there are requirements for invention and improvements.

Content based image retrieval (CBIR), is a critical technique which uses visual contents to search images from the large scale image databases, is an active area of research for the past decade. CBIR system extracts the images that are appropriate to the specified query image based on the image content. Only concise feature sets that limit the retrieval efficiency is been extracted by a majority of the CBIR systems. In response to industry demand (Medical Sector), a myriad of CBIR techniques have been proposed during the last three decades.
Existing isolated formulas identification approaches are rule-based and machine learning-based. Since the isolated formulas exhibit distinct geometric layout features, it is relative easier to identify them. In contrast, the embedded formula identification is more challenging, because the embedded formulas are generally short expressions, which are difficult to discriminate from ordinary text. Consequently, the lower accuracy is expected for embedded formula identification compared with isolated formula identification.

In this context, the present thesis work takes the following approach for effective Content based image retrieval using heuristic technique and retrieval of documents based on Mathematical Expressions with the application of soft computing strategies.

1. To apply Improved HillClimbing based segmentation technique for Content based image retrieval System which uses Modified Fuzzy C-Means algorithm for better segmentation.
2. Apply Evolutionary Programming (EP) for retrieval of documents based on Mathematical Expressions in order to obtain optimized results.

As the efficacy of the techniques is always crucial in any study and in order to assess the suitability of these proposed techniques in the thesis, from a diverse selection, their performance and relative merits are compared in each chapter, with several existing models in the literature by conducting the experiments on the image database contained 10000 images stored in the JPEG format using MATLAB.

**CONCLUSION**

In this paper we briefly present the various Content Based Image Retrieval (CBIR) techniques and methods used to retrieve documents based on Mathematical Expressions which are found in the literature and outline the proposed approach of the present research work. Finally identified that that soft computing techniques are giving the better results.

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