CHAPTER 2

LITERATURE REVIEW

Content-based image retrieval has been a vigorous area of research for at least the last two decades. The abundance of publications within this period reflects diversity among the proposed solutions and the application domains. CBIR has been most successful in non medical domains, among which some with relevance to medical domain have been taken for literature review in this work.

The Image Retrieval for Medical applications (IRMA) project1 undertaken at the Aachen University of technology (Thies et al 2005, Lehmann et al 2004) aims to provide visually rich image management through CBIR techniques applied to medical images using intensity distribution and texture measures taken globally over the entire image. This approach permits queries on a heterogeneous image collection and helps to identify images that are similar with respect to global features. The IRMA system lacks the ability for finding particular pathology that may be localized in particular regions within the image.


The Image Map (Petrakis et al 2002) is one of the existing medical image retrieval that considers how to handle multiple organs of human body.
However, it works based on spatial similarity. Consequently, a problem caused by user is likely to occur and therefore, the retrieved image will represent an unexpected organ.

The Automatic Search and Selection Engine with Retrieval Tools (ASSERT) (Chi-Ren Shyu et al 1999) A physician-in-the-Loop content-based retrieval system for HRCT image databases which is implemented to show a human-in-the-loop approach in which the human delineates the pathology bearing regions(PBR) and a set of anatomical landmarks in the image when the image is entered into the database.

Texture Classification via Patch-Based sparse texton learning (Jin Xie, Lei Zhang, Jane You & David Zhang 2010). In this method, the author proposed a novel texture classification using patch-based sparse texton learning. The texton dictionary is learned by sparse representation technique and then SR coefficients are used for feature description. The histogram of the SR coefficients is constructed for texture classification. The classification accuracy and size of texton dictionary is considered as the drawback and it is a general purpose system and is not too specific to medical domain.

Content-Based Retrieval and Classification of Ultrasound Medical Images of Ovarian Cysts (Abu Sayeed Md. Sohail et al 2010). In this work, authors presented a combined method of content-based retrieval and classification of ultrasound medical images. Combination of histogram moments and Gray Level Co-Occurrence Matrix (GLCM) based statistical texture descriptors has been proposed with features for retrieving and classifying ultrasound images. To retrieve images, relevance between the query image and the target images has been measured using a similarity model based on Gower’s similarity coefficient. For image classification, Fuzzy $k$-Nearest Neighbour ($k$-NN) classification technique has been applied.
However this method gives more accurate and efficient result, but it has its own characteristics for classifying and retrieval of the images.

**Content-Based Image Retrieval Incorporating the AHP Method** (Xiaoling Wang, xie kanglin 2011). In Content-Based Image Retrieval Incorporating the AHP Method, the authors presented an algorithm called Average Area Histogram (AAH). It is based on the area features of the regions formed by the pixels of each color, which retains the advantages of the conventional histogram. The Analytic Hierarchy Process (AHP) method is imported into this system for assessing the importance of various image features. The drawback is study of new image content features such as the spatial information in retrieval and novel application of AHP in image retrieval which looks difficult for users to retrieve the desired images.

**Evaluation axes for medical image retrieval systems: the image CLEF experience** (Henning Muller et al 2005). In Evaluation Axes for Medical Image Retrieval Systems—the Image CLEF method, the author proposed an Image CLEF evaluation campaign that develops the various axes that can be taken in to account for medical image retrieval system evaluation. First, the axes are developed based on current challenges and experiences from image CLEF. Then, the resources developed for image CLEF are listed and finally, the application of the axes is explained to show the bases of the imageCLEFmed evaluation campaign. This method will only concentrate on the medical retrieval tasks and it does not favor the non medical tasks that are considered as the main drawback.

The **CasImage system** (CasImage Website March 2011) is another type of CBIR that combines different images like MRI scan, CT and radiograph images. This was developed by the Radiology Department of the Geneva University Hospital, Switzerland. This provides a huge database of images and allows the user to use them along with the feature files database.
This is actually an extension of the Picture Archiving and Communication System (PACS).

**MIRAGE: An E-repository of Medical Images for Learning Biomedical Informatics** (Xiaohong Gao, Yu Qian 2012). The authors proposed an E-repository for medical images that offers great facilities to learn about the biomedical informatics to its users. The facilities of domain-based, atlas-based, and content-based retrieval (CBIR) techniques are implemented in order to search the images in this developed repository. The uniqueness of the system is, CBIR system for 3D is developed and coupled with 3D visualization that has been used for educational material and as a tele-education in future.

**Computer-aided diagnostics for screening mammography using content-based image Retrieval** (Thomas et al 2012). In this paper, the authors proposed a computer-aided diagnostics tool for screening the mammography using content based image retrieval technique. The main objective of the system is to provide an efficient image retrieval tool for screening the mammography using content-based image retrieval system. In this system, the authors mainly concentrated on classification technique using Support Vector Machine (SVM) for doubtful tissue pattern extraction in an image. Based on that, the retrieval of the system implemented using content-based image retrieval technique for detecting the mammography of the image.

**Content-based binary image retrieval using the adaptive hierarchical density histogram** (Panagiotis Sidiropoulos et al 2011). In this paper, the authors proposed a scheme for binary image retrieval. With this scheme, the authors have utilized black and white binary represented values as image feature and it is named as adaptive hierarchical density histogram that develops the allocation of the image points on a two-dimensional area. This technique uses the assessment of point density histograms of image
regions that are computed by a pyramidal grid that is repeatedly simplified through the calculation of image geometric centroids. This extracted descriptor includes both global and local possessions that can be used in different types of binary image databases for the retrieval of images.

**Improving the ranking quality of medical image retrieval using a genetic feature selection method** (Sérgio Francisco da Silva et al 2011). In this paper, the authors proposed a method for improving the ranking quality for medical image retrieval using genetic feature selection method. With this system, the authors have used single-valued genetic functions for evaluating the rankings to extend a group of feature selection methods based on the genetic algorithm approach to improve the precision of content-based image retrieval systems.

**RTL: Reduced Texture spectrum with Lag value Based Image Retrieval for Medical Images** (Vijaya Kumar et al 2009). This method proposes a novel scheme based on Texture Unit. The proposed scheme reduces texture unit values from 0 to 6561 to 0 to 255 based on Lag values. The Similarity measures are extracted on both schemes and a good comparison is made. The experimental results on MRI images indicate reliability, feasibility and efficacy of the proposed method.

**CBMIR: Theory, Gaps and Future Directions** (Preeti Aggarwal et al 2009). The main purpose of this method is to 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. This method suggest a more systematic and comprehensive view on the concept of gaps in CBMIR research. Also, several research directions for improving the retrieval quality based on the experiences from other closely related research fields are
given. Possible clinical benefits from the use of content-based access methods are described for promising applications.

**Edge texture based CBIR using row mean of transformed column gradient image** (Kekre et al 2010). Texture refers to the various patterns in an image. Textures are found in almost everything captured in an image. The various textural features serve as a crucial discriminating factor in CBIR and therefore are extensively used. The authors in this work discuss an image retrieval method based on edge texture. Here the edge textures are captured using four gradient operators and seven image transforms, concentrating particularly on the edge textures.

**Application of Edge Histogram Descriptor and Region Shape Descriptor to MRIs** (Katarina Trojacanec et al 2009). Shape representation refers to the objects within an image. The shape could be either region based or boundary based. The boundary based representation concentrates only on the outer boundary area of the object, whereas the region based representation continues to a particular region. The authors in this work discuss the use of both EHD and region shape descriptors standardized by MPEG-7 standard to MRI. However since the MRI images have specific characteristics, additional image processing techniques have to be used.

**Hierarchical annotation of medical images** (Ivica Dimitrovski et al 2008). The CBIR systems for most medical purposes retrieve the anatomical structure of the query image. Some systems go beyond this and retrieve images that feature abnormalities or tumors within that anatomical structure. The authors in this work describes a fully annotated images using shape feature extraction using EHD and hierarchal multi-label classification. Here the features are extracted using a technique called local distribution of edges. It achieves classification of images according to IRMA code which is
organized hierarchically. The edge histogram provides a robust feature for radiological images.

**BRISC - An Open Source Pulmonary Nodule Image Retrieval Framework** (Lam et al 2007) devises a system called BRISC wherein the system provides similar nodal images stored in the Lung Image Database Consortium. The system can be used for both commercial and for research purposes and is available publicly through open source.

**A CBIR method for extracting similar MRI images** (Prashanth Ingole et al 2007). A novel CBIR method for extracting similar MRI images provides a new framework with a combination of segmented centroid compilation based fuzzy feature matching approach for CBIR. It employs in two stages, the first being the graph matching technique followed by the UFM technique using the fuzzy set theory. This work gives an average precision and recall and faster MRI image retrieval.

**Image Retrieval based on Color and Texture Features of the Image Sub blocks** (Kavitha et al 2011). In this method the author proposed the image retrieval system based on color and texture feature. An image is partitioned into sub blocks; color of each sub block is taking out by measuring the HSV color space into non-equal interval. The drawback of the system is the HSV color space. This method will concentrate only on the color images it does not favor for the specific medical domain. Because in specialized fields, namely in medical domain the absolute color and grey level features are very limited.

**Using Texture-based Symbolic Features for Medical Image Representation** (Filip Florea et al 2006). In this method the author presents medical image categorization approach in the context of CISMef Health Catalogue-capability to create queries by giving the image associated
keywords to retrieve the health resources. This uses texture and high order statistical movements feature this can be improved by adding other features and classifiers to improve the results.

**Content Based Image retrieval based on pyramid Structure Wavelet** (Aliaa, Youssif et al 2010). In this method the author proposed the result of image retrieval by using color, shape and texture and combination between them by using Receiver-operating characteristic curve (ROC). The hybrid technique is used with ROC technique to give best results. In hybrid technique it compares HSV query with HSV database images and it provides sorted list with sorted images and their differences. The major drawback is that it takes the longer time for calculation and comparison with other technique.

**Multi Feature Content Based Image Retrieval** (Rajshree, Dubey et al 2010). The authors have used different types of features in this work which includes Color Histogram, Color moment, Texture, and Edge Histogram Descriptor. The Images are used basically based on the human Perception of the Image. The Machine 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. Combinations of four feature extraction methods (such as Color Histogram, Color moment, Texture, and Edge Histogram Descriptor) have been used to retrieval of the images. Additional provision also included to add new features in future to improve retrieval efficiency. The authors have used combination of these four techniques for calculating Euclidian distances for every feature of the database images and the average values are also calculated. Using computer vision and image processing algorithms, the image properties are analyzed. For color, histograms of color images are also computed, for texture, co-
occurrence matrix based entropy, energy, etc, are calculated and for edge density, Edge Histogram Descriptor (EHD) that is found. Based on the computed averages of four techniques, the resultant Images are retrieved.

**Tumor Detection in Mammography Images using Vector Quantization Technique** (Kekre et al 2009). X-ray mammography is the most common investigation technique used by radiologists in the screening, and diagnosis of breast cancer. The ability to improve diagnostic information from medical images can be enhanced by designing computer processing algorithms. This work proposed an algorithm to detect cancer in mammogram breast cancer images. In this work authors have proposed segmentation using vector quantization technique with Linde Buzo and Gray (LBG) for segmentation of mammography images. Initially a codebook of size 128 was generated for mammography images. These code vectors were further clustered in 8 clusters using same LBG algorithm. These 8 images were displayed as a result. This approach does not lead to over segmentation or under segmentation. For the comparison purpose the system displays results of GLCM and watershed segmentation along with this method.

**The medGIFT retrieval system** (Wei, Li & Wilson 2006). The medGIFT retrieval system extracts global and regional color and texture features, including 166 colors in the HSV color space and Gabor filter responses in four directions each at three different scales; Combinations of textual labels and visual features are used for medical image retrieval.

**NHANES II (The Second National Health and Nutrition Examination Survey)** (Wei, Li & Wilson 2006). This system contains the Active Contour Segmentation (ACS) tool, which allows the users to create a template by marking points around the vertebra. If the segmentation of a template is accepted, the ACS tool will estimate the location of the next vertebra, place the template on the image, and then segment it; in data
representation, a polygon approximation process is applied for eliminating insignificant shape features and reducing the number of data points. The data obtained in the polygon approximation process represent the shape of vertebra. Then, the approximated curve of vertebra is converted to tangent space for similarity measurement.

**Image texture classification using a manifold-distance-based evolutionary clustering method** (Maoguo Gong et al 2008). In this method, the author proposed unsupervised image classification based on texture features using a manifold evolutionary clustering (MEC). In MEC, each individual is a sequence of integers representing the cluster representatives and based on the manifold-distance-based dissimilarity measure, each datum is assigned to its respective cluster representative in order to extract the texture features.

**A new K-View algorithm for texture image classification using rotation-invariant feature** (Liu, Dai, Song et al 2009). In this method, texture image classification is done using rotation-invariant features. This algorithm randomly selects k views of the view set from each sample sub-image as the characteristic view set. This is more robust and accurate compared with the results of the existing K-View algorithm.

**A Context Model for Content Based Medical Image Retrieval** (Patrick Brezillon & Daniel Racoceanu 2007). This work discusses about limitation of Content based search: Semantic Gap. It proposes a context model for Content Based Medical Image Retrieval to overcome this limitation. The author addresses the management of user’s query by initially defining the contextual terms relevant to the current context. Next, is to understand the meaning and the interference rules of the contextual elements. Thus creating a conceptualized situation.
Content-Based Image Retrieval in Radiology: Current Status and Future Directions. (Ceyhun Burak Akgül et al 2010). The author proposes to use the CBIR techniques for the retrieval of Radiology Images. It points out the opportunity and challenges for CBIR in medical domain. The subtle difference between the images in CBIR is irrelevant but is important in CBMIR for the purpose of diagnosis. It describes the various Image Descriptors and Similarity Measures used in CBIR. The author suggests the use of relevance feedback loop to overcome Semantic Gap in medical CBIR. It provides the guidelines for deploying CBIR in radiology.

A Survey On: Content Based Image Retrieval Systems Using Clustering Techniques for Large Data sets (Monika Jain & Singh 2011). In this work, authors have proposed the high-dimensionality of large data-set and how this can be used to improve the performance of CBIR by the use of clustering. It describes various clustering techniques and also the pros and cons of each technique. Also the author proposes a HDK algorithm that uses hierarchical Clustering method and Divide and Conquer K-means. This improves the efficiency and accuracy of the K-Means. HDK algorithm can be used in various applications.

Relevance Feedback in Content Based Image Retrieval- A Review (Pushpa Patil & Manesh Kokare 2011). This work discus the various approach for Relevance Feedback methods such as short and long-term learning. Relevance Feedback Method is used to close the semantic gap between low level features and high level concepts. It points out various limitations of relevance feedback such as the difficulty in extracting high level features, less number of feedback samples, time consumption etc.,

Image-Based Informatics for Preclinical Biomedical Research: (Kenneth Tobin, Deniz Aykac & Priya Govindasamy et al 2006). This work proposes the use of CBMIR to index and manage large libraries of micro
images. It Segments a specific organ by probabilistic shape and analysis models. It creates a model based on the points selected by the user during the training. The author also describes 3D Segmentation techniques based on volume. It compares the various results achieved by CT, PET, and SPECT imaging modalities.

**A CBIR System for Human Brain Magnetic Resonance Image Indexing:** (Mina Rafi Nazari & Emad Fatemizadeh 2010). Content-based image retrieval (CBIR) is becoming an important field with the advance of multimedia and imaging technology still more and more. It builds use of image features, such as color, shape and texture, to index images with minimal human interference. Among many retrieval features related with CBIR, texture retrieval is one of the most powerful. Content-based image retrieval can also be used to locate medical images in large databases. In this work, the authors proposed a content-based approach to medical image retrieval. A case study, which describes the methodology of a CBIR system for retrieving digital human brain MRI database based on texture feature for retrieval. This research intends to propagate the knowledge of the CBIR approach to the applications of medical image management and to differentiate between the normal and abnormal medical images based on features. The main indices are finding Normal, Abnormal and clustering the abnormal images to detect two certain abnormalities: Multiple Sclerosis and Tumoral images to classify the database. A classification with a success of 95% has been obtained by this method. But still there is a numerous challenges to improve the result.

**A Universal Model for Content-Based Image Retrieval:** (Nandagopalan et al 2008). In this work a novel approach for generalized image retrieval based on semantic contents is presented. A combination of three feature extraction methods namely color, texture, and edge histogram
descriptor. This approach facilitates to add new features in future for better retrieval efficiency. Any combination of these methods, which is more suitable for the application, can be used for retrieval. This is provided through User Interface (UI) in the form of relevance feedback. The image properties analyzed in this work are by using computer vision and image processing algorithms. For color, the color histogram of images is computed, for texture gray level cooccurrence matrix based entropy, energy, etc, are calculated and for edge density, Edge Histogram Descriptor (EHD) has been used to detect edge information of the image. For retrieval of images, an idea is developed based on greedy strategy to reduce the computational complexity.

A Survey On: Content Based Image Retrieval Systems: (Nidhi Singhai & Shishir Shandilya 2010). As the network and development of multimedia technologies are becoming more popular, users are not satisfied with the traditional information retrieval techniques. So nowadays the content based image retrieval is becoming a source of exact and fast retrieval. In this article, authors have discussed, analyzed and compared the various techniques of content based image retrieval. It also discussed various features like neuro fuzzy technique, color histogram, texture and edge density for accurate and effective Content Based Image Retrieval System.

Content Base Image Retrieval Using Phong Shading: (Uday Pratap Singh et al 2010). The digital image data is rapidly increasing in day to day activities of today’s world in terms of quantity and heterogeneity. The conventional information retrieval techniques do not meet the user’s demand, so there is a need to develop an efficient system for content based image retrieval. Content based image retrieval refers to retrieval of images from database based on its visual features like color, texture etc. In this work features are extracted after applying Phong shading on input image. Phong shading means smoothing 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 data base image. Similarity of the images can be computed by using the Euclidean distance formula for retrieval of the images.

Content Based Image Retrieval for Medical Images Techniques and Storage Methods- A Review: (Wanjale, Tejas Borawake, Shashideep Chaudhari 2010). In the medical field, more number of digital images are produced in day to day activities and used for diagnostics and therapy. Content based medical image retrieval system usually developed for supporting clinical decision making has been proposed that would be used for easy management of clinical data. It would be used in scenarios such as the integration of content-based retrieval methods into Picture Archiving and Communication Systems (PACS). This article presents an overview of the existing literature in the field of content based medical image data retrieval and on the technologies used in this field. New research directions are being outlined that can prove to be useful. This article also identifies some of the problems in the field of medical domain.

Discriminating Cystic and Non Cystic Mass using GLCM and GLRLM-based Texture Features: (Hari Wibawanto et al 2010). In this work, research has been conducted to identify cystic mass and non-cystic mass in ultrasound images. Here each image was transformed into a grey-level run-length matrix and a grey level co-occurrence matrix. There were 11 features extracted from grey-level run-length matrix and 8 features extracted from grey-level co-occurrence matrix, so that totally 19 features have been extracted. The ability of features in distinguishing cystic mass and non-cystic mass images was determined by discriminant analysis using statistical software package SPSS version 11.5. With this system, authors proves that the 19 features extracted from grey level run-length matrix and grey-level co-
occurrence matrix could distinguish cystic masses from non-cystic mass with better accuracy rate for different pixels of images. Further analysis carried out by involving only 12 of the 19 features extracted, which consists of 5 features extracted from GLCM matrix and 7 features extracted from GLRL matrix. The 12 selected features are: Energy, Inertia, Entropy, Maxprob, Inverse, SRE, LRE, GLN, RLN, LGRE, HGRE, and SRLGE. Discriminant analysis with the 12 features has been conducted as predictors can distinguish cystic mass image and non-cystic mass with a great level of accuracy for different image sizes. Further analysis showing that area under the Receiver Operating Curve was providing better result as good or very good. Based on that data, it concluded that texture analysis based on GLCM and GLRLM could distinguish cystic mass image and non-cystic mass image with considerably good result.

**Interfacing Global and Local CBIR Systems for Medical Image Retrieval** (Antani et al 2007). Modern picture archiving and communication systems are limited in managing large and varied image collections in today’s scenario, because there is no enough content-based image retrieval (CBIR) methods available. Here the authors have proposed an XML-based data and resource exchange framework using open standards and software to enable specialized CBIR systems to act as geographically distributed toolkits. This approach enables communication and collaboration between two or more geographically separated paired systems with different architectures developed on different platforms for specialized image modalities and characteristics. This provides the user with a greater functionality operating within a familiar Web browser interface, making the combined system portable and independent of location and underlying user operating systems.

**Experiments with Content-Based Image Retrieval for Medical Images:** (Gongzhu Hu & Xiaohui Huang 2008). In this work, authors
introduced a scheme for image retrieval and classification using low-level image features. This scheme is based on selection of important features in the high dimension feature space and the parameter of k-NN algorithm. It also combines non-image features (patient records) and image features to improve the precision of the results. For testing, authors have collected both the patient data and images from a clinical trail studying aloe (disambiguation) in treating the side effects due to radiation on oral cancer patients at Mid-Michigan Medical Center. For implementation, a Matlab image engine is used for image feature retrieval, and principal component analysis is applied to reduce the feature space for optimizing the performance.

**Medical Image Retrieval and the medGIFT project:** (Henning Muller et al 2005). The medGIFT project used in this work includes several axes around the retrieval of medical images from a variety of databases and image types as well as for several applications. The authors have used a framework based on open source image retrieval tool GIFT (GNU Image Finding Tool) and add tools of this work to create a system tailored for the domain-specific needs in medical image retrieval. These tools comprise the preprocessing of images, extraction of the object or segmentation in specialized fields such as lung image retrieval. The grouping and integration of GIFT with tools for text retrieval such as Lucene and EasyIR are other applications. Strength of GIFT is the establishment of an infrastructure for image retrieval evaluation. The ImageCLEFmed standard is a result of this project and the result does not only help locally but is also accessible for many research groups from remote.

**Learning with Unlabeled Data and Its Application to Image Retrieval:** (Zhi-Hua Zhou 2006). In machine learning or data mining applications, most of the researchers have used unlabeled training examples. But labeled examples are quite expensive to obtain because labeling the
examples need human effort. So, working with unlabeled data has attracted for most of the researchers during the recent years. In this work, author shows that how labeled techniques can be helpful in a difficult task, content-based image retrieval, for improving the retrieval performance by using images existing in the database.

**Enhancing Relevance Feedback in Image Retrieval Using Unlabeled Data:** (Zhi-Hua Zhou 2006). Relevance feedback is an effective scheme to fulfilling the gap between high-level semantics and low-level features in content-based image retrieval. Previous methods rely on labeled images provided by the user, but this work tries to improve the performance of relevance feedback by utilizing unlabeled images existing in the database. Also, this work combines the merits of semi-supervised learning and active learning into the relevance feedback process.

**Symmetrical Color-Spatial Feature for Medical Image Retrieval:** (QU Jing-yi & SHI Hao-shan 2006). Color is the one of the most common feature used in content-based image retrieval (CBIR) systems. By combining the traditional color histogram with spatial information will increase the accuracy of color features. Main one advantage of the color feature is that it is independent to the distortion of an image. By introducing the spatial information, this advantage will disappear. In this work, authors proposed a new symmetrical color-spatial method based on square loop for improving the retrieval result.

**Medical Image Retrieval Using Texture, Locality and Colour:** (Peter Howarth et al 2005). In this article, authors describe experiment for the Image CLEF medical retrieval task. This work focused on the initial visual search. A content-based approach was followed. It has used texture, localization and colour features that have been proven by previous experiments. Medical images normally have a formulaic composition for each
modality and anatomic region. So authors have chosen exclusive features that perform well in this domain. Tiling a Gabor texture feature have used to add localization information and that have been proved to particularly effectiveness of the image. The distances from each feature were combined together with equal weighting. This smoothed the performance across the queries.

**IPAL Knowledge-based Medical Image Retrieval in ImageCLEFmed 2006:** (Caroline Lacoste et al 2006). This paper presents the contribution of IPAL group on the CLEF 2006 medical retrieval task (i.e. ImageCLEFmed). The core objective of this work is to integrate medical knowledge in the retrieval system within a multimodal combined framework. For text, this knowledge is in the Unified Medical Language System (UMLS) sources. For images, this knowledge is in semantic features that are learned from examples within structured learning framework. Based on the previous works, the authors proposed a method to represent both image and text using UMLS concepts. The use of UMLS concepts are that allows the system to use at a higher semantic level and to regulate the semantic index of medical data, aid the communication between visual and textual indexing and retrieval. The results obtained in this work shows better in terms of potential of conceptual indexing, fusion framework and especially when using a semantic dimension filtering in ImageCLEFmed 2006.

**A Context Model for Content Based Medical Image Retrieval:** (Patrick Brezillon & Daniel Racoceanu 2007). In this paper, the authors have pointed out various types of context in CBIR. Therefore, if one wishes to use context in efficient, it previously need to be identify and model it correctly. This paper shows how it can be possible to improve the different steps in the CBIR processing. It has illustrated on two steps, namely the user’s query management and the medical image domain knowledge-related semantic
indexing. In order to bridging the gap between semantic and domain knowledge, authors have utilized various methods and tools from artificial intelligence to implement these steps.

**Texture-based Medical Image Indexing and Retrieval on Grids:** (Johan Montagnat 2007). In this research work, the authors are addressing the problem of content-based medical image retrieval in large databases. Hence the authors have utilized grids to tackle the computational requirement of this problem. Also various strategies have developed to optimize the load distribution over the very large scale EGEE grid infrastructure by considering its properties and load. To identify relevant images, several methods also have been investigated by the authors. Texture features extracted using Gabor filters which shows to be an efficient and relevant one of indexing medical databases. The texture features could be correlated to image modality, tissues, and subtle changes such as myocardium tissues variation during the cardiac cycle.

**Image Classification for Digital Archive Management:** (Cheng-Hung Li, Chih-Yi Chiu & Hsiang-An Wang 2005). In recent years, the volume of digital images has grown rapidly due to its improvement in development of various tools and systems for producing and distributing the images. For managing those images in digital archive system, an efficient mechanism needed. In this paper, authors proposed an image classification technique for fulfilling this need. This technique can be used to annotate and verify image classes when collecting images. This technique segments each image into non-overlapping blocks from which color and texture features can be extracted. Then authors have applied Support Vector Machine (SVM) classifiers to train and classify the images.

**Automatic Pavement Crack Detection Using Texture and Shape Descriptors:** (Yong et al 2010). In this work, authors have proposed a novel
automatic pavement crack detection approach based on texture analysis and shape descriptors. Here, the pavement surface is considered as a texture surface, and distresses are defined as in homogeneities occurring in the texture surface. The authors have used six texture features and two translation-invariant shape descriptors as distinguish features against irregular texture and uneven illumination. Also the system uses SVM classifier for classification of sub-images as crack or non-crack. At last, final results were obtained after post-processing, which includes segmentation, fake-crack eliminating, and crack-measuring methods.

**Evaluation of Content Based Image Retrieval Systems Based on Color Feature:** (Braveen & Dhavachelvan 2009). In this paper, authors dealt an assessment methodology for CBIR systems by using a set of distance metrics. This quantitative metrics evaluation scheme consists of statistical models that offer 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.

**Content Based Image Retrieval using Contourlet Transform:** (Srinivasarao et al 2007). In this paper, authors have proposed Contourlet Transform based content based image retrieval system with less computational complexity and high retrieval efficiency. For feature extraction, directionality and anisotropy properties have been extracted for constructing image feature database. Also the result outcome compared with Gabor-Zernike features based CBIR system in terms of computational complexity and retrieval efficiency. For image retrieval, Manhattan and Euclidean distance similarity measures were used.

**Comparative Analysis of Image Retrieval Approaches:** (Zare et al 2008). This work expose the content based image retrieval (CBIR) system based on the low level features such as color, shape, spatial and
texture analysis. It observes the limitation of conventional image retrieval approaches. In CBIR, though there are lots of approaches already have been developed, still there are numerous challenges for researchers due to the lack of human perception ability in image retrieval methods and its use of low level features for image retrieval. This limitation of CBIR system is analyzed by comparing it to semantic based image retrieval where low level features are integrated with high level semantic features.

**Computer-Aided Diagnosis in Mammography Using Content-Based Image Retrieval Approaches: Current Status and Future Perspectives:** (Bin Zheng et al 2009). In this article, authors have identified and discussed different types of approaches for CBIR-based CAD methods and performance assessment of these methods by presenting and comparing a number of approaches commonly used in previous studies. CBIR-based CAD schemes have potential to provide radiologists with ‘visual aid’ and increase their confidence in accepting CAD-cued results in the decision making. The CAD performance and reliability depends on a number of factors including the optimization of lesion segmentation, feature selection, reference database size, computational efficiency, and relationship between the clinical relevance and visual similarity of the CAD results. Although preliminary studies have suggested that using CBIR-based CAD schemes might improve radiologists’ performance and increase their confidence in the decision making, this technology is still in the early development stage. Much research work is needed before the CBIR-based CAD schemes can be accepted in the clinical practice.

**Metric Indexing for Content-Based Medical Image Retrieval:** (Niño Edwin et al 2008). In this paper, authors have proposed a scheme called metric indexing for fast content-based image retrieval system in an image database. It avoids calculating the distance from the query to all the images in
the database. The authors have tested this method on a pathology image collection and comparing its performance against sequential scanning indexing. Though this method outperforms good result, the computational complexity for indexing the data is high.

Review of Content Based Image Retrieval Systems of Medical Domain: (Sanghavi et al 2012). CBIR is the major topic of research in medical domain due to its growth in large medical image databases. CBIR technique efficiently retrieves images that are visually similar to query image than text based searching and retrieval. It allows the retrieval of similar images based on features directly extracted from the input image. This article focused on recent advances in CBIR systems in medical domain. It also focuses on the various feature extraction techniques and algorithms implemented for CBIR systems in different cases of medical domain.

Content-Based Image Retrieval - Approaches and Trends of the New Age: (Datta et al 2005). In this manuscript, authors discussed various key contributions of image retrieval and automated image annotation by providing across 120 references. Also authors have discussed several key challenges concerned in the modification of existing image retrieval techniques to build useful systems that can handle real-world data.

Overview of the ImageCLEF 2012 medical image retrieval and classification tasks: (Henning Müller, Alba García Seco de Herrera, Jayashree Kalpathy-Cramer et al 2012). The 9th edition of the ImageCLEF medical image retrieval and classification tasks was conducted in 2012. A division of the open access collection of PubMed central database was used which consist of about 300'000 images. There were three subtasks: modality classification, image-based and case-based retrieval. A new hierarchy for article figures was created for the modality classification task. The modality detection could be one of the most important filters to limit the search and
focus the results sets. The goal of the image-based and the case-based retrieval tasks were similar, but the image-based retrieval task is the classic medical retrieval task with which textual queries only have been used to retrieve the images. Whereas in case-based retrieval a case description, with patient demographics, limited symptoms and test results including imaging studies, is provided. The goal is to retrieve cases including images that might best suit the provided case description.

**BUAA AUDR at ImageCLEF 2012 Medical Retrieval Task:**
(Wei Song, Danchen Zhang & Junwu Luo 2012). This paper presents the participation of the BUAA AUDR group at ImageCLEF 2012 at the Medical Image classification and Retrieval task. In this work, authors performed two subtasks: modality classification and ad-hoc image-based retrieval. The authors concentrated on mono-modal visual-based image classifier. For that, LibSVM tool was used to train the classifier and edge histogram feature was used to represent images. To improve the performance of the retrieval system with huge size of training sets, authors have explored a combined approach that allows combining modality prediction with so called MeSH was used as source of query expansion.

**LABERINTO at ImageCLEF 2012 Medical Image Retrieval Task:**
(Mariano Crespo et al 2012). This paper shows that the experimentation and the results obtained for LABERINTO research group at the ImageCLEF 2012 medical task. In this work authors mainly focused on image retrieval based on textual information related to the image. This group has been worked with query expansion using the hierarchical structure of the MeSH descriptors. With that, they have achieved a significant improvement in image retrieval systems. In this work, their main goal is to improve the results obtained in the previous one by adding a relevance factor to the query terms. In addition, authors have developed a new strategy by combining the
expansion strategy based on the hierarchical MeSH structure with another expansion strategy called MMTx program where the query terms are expanded.

**Content-based image retrieval in medical applications for picture archiving and communication systems** (Thomas Lehman et al 2003). In this work, authors have used Picture archiving and communication systems (PACS) in order to provide the medical physicians with appropriate quality images for diagnosis. Current standard for digital imaging and communication in medicine (DICOM) encompasses alphanumerical descriptions, patient descriptions, and technical parameters only. This is the only information that has been used to retrieve similar images from PACS. Content-based image retrieval (CBIR) plays a pivotal role in retrieving images from archives that has a strong impact when integrated into PACS due to insufficient descriptions of textual representation in medical images. Even though, there is lot of limitations in existing approaches of CBIR in terms of modality, organ, or diagnostic study, there is a need to overcome such limitations in this domain. In this study, the authors have presented implementation of general approach to content-based image retrieval in medical applications (IRMA) and they discussed its integration into PACS environments. Normally, PACS includes DICOM image server and several DICOM workstations that are used by physicians for retrieving the images and findings the reports. With the DICOM image server, all the basic IRMA components such as relational database, scheduler, and web server have been installed and the IRMA codes also running on distributed machines (example physicians’ workstations). These workstations also host the web-based front-ends of IRMA applications. By Integrating CBIR with PACS, the authors have focused the following issues

1. Location and access transparency for data, methods and experiments
2. Replication transparency for methods in development
3. Concurrency transparency for job processing and feature extraction
4. System transparency at method implementation time
5. 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.

**Application of Hierarchical and K-means techniques in content based image retrieval** (Murthy et al 2010). Content based Image retrieval emerged as an alternative approach to automated text based image retrieval systems. It has played an important role in image retrieval applications. In the last decade especially last five years, there is a huge growth in the collection of varied image databases in the web. To search and retrieve these images is very difficult and tedious process. In order to fulfill this, Content based Image retrieval has played an important role. It is an approach for search and retrieving similar images in semantically from an image database based on automatically-derived image features. In this article authors have proposed an image retrieval system that accepts images as input query and groups all the images in the database based on their similarity. This helps the user to keep a faster track of his required images, after which users can opt to retrieve images from the group that would be closest to visual interpretation. The unique aspect of the system is the utilization of hierarchical and k-means clustering techniques. Also this proposed system consists of two stages. They are hierarchical clustering technique is used for grouping similar images and the image groups are applied to the K-Means.

**Task-Oriented Medical Image Retrieval** (Horsthemke, Raicu & Furst et al 2007). Most of the clinical tasks have performed based on the
proper interpretation of medical images. In this article, authors present CBIR approaches for two clinical tasks and discussed their specific challenges. They are

1. The CBIR system retrieves anatomical regions in Computed Tomography (CT) studies of the chest and abdomen. The system can be used to provide context-sensitive tools for computer-aided diagnosis.

2. CBIR system retrieves pathologies specific to an anatomical structure, such as nodules present in the CT studies of the lung. This system can be used directly as a computer-aided diagnosis system for case-based and evidence-based medicine.

Both systems are estimated using texture image features and several similarity measures.

**Content Based Image Retrieval System for Medical Databases (CBIR-MD)** - Lucratively tested on Endoscopy, Dental and Skull Images (Ashish Oberoi & Manpreet Singh 2012). More quantities of digital images are produced in medical field in day to day activities and used for diagnostics and therapy. This fast growth of digital medical images requires efficient Content-based image retrieval system for retrieving medical images that are visually similar to query image. Such system offers a big help to physicians in clinical care and research. In this aspect, the authors proposed 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.
**Multilevel Feature Extraction and X-ray Image Classification** (Mueen, Sapiyan Baba & Zainuddin et al 2007). Due to huge development of digital medical image database, the need of content-based image retrieval tools also increased. Classification of images is an important step of content-based image retrieval (CBIR). In this study, authors proposed a new image classification method by using multi-level image features and state-of-the-art machine learning method, Support Vector Machine (SVM). In medical image classification, most of the previous works have been proposed by combining different global features or local features as independently. But in this work authors proposed new image classification method that extracted three levels of features global, local and pixel and combine them together in one big feature vector. In this method, authors have achieved 89% of classification recognition rate and also large dimensional feature vector is reduced by Principal Component Analysis (PCA).This classification recognition rate compared with two other classifiers such as K-Nearest Neighbor (K-NN) and Support Vector Machine (SVM). By this comparison, Performance of the system has been verified that proposed method improves the quality of image classification.

**Medical X-ray Image Classification Using Gabor-Based CS-Local Binary Patterns** (Fatemeh Ghofrani, Mohammad Sadegh Helfroush et al 2012). Normally medical x-ray images have wide-ranging of intensity values and texture characteristics of medical x-ray images are very similar. Feature extraction based on characteristic of these images and providing such features is a difficult task. To provide such features, most of the researchers have focused on feature extraction schemes for this type of images. In this article, authors have proposed a new set of features that are extracted from transform domain. This method includes three stages.

1. Extraction of edge and shape information from original images
2. Obtaining local features by partitioning each image into 25 overlapping sub images

3. Computing Gabor transform of each subimage to extract centre symmetric local binary patterns.

To evaluate proposed scheme for radiography image classification, authors have utilized two various SVM classifiers. This proposed scheme is implemented on a subset of IRMA dataset from 15 different categories.

A New Approach for Clustering of X-ray Images (Chhanda Ray, Krishnendu Sasmal et al 2010). Automation of medical images classification is very essential to structuring of medical image database and for searching and retrieval of biomedical images. Medical image databases are a key component in future diagnosis and preventive medicine. In this paper, authors proposed an approach for efficient clustering of x-ray images based on various levels of image features. In this work, for each x-ray image, global, local and pixel level features are extracted first. Then a new approach called “combination of k-means and hierarchical clustering techniques” has been applied to classify x-ray images.

Automated X-Ray Image Annotation Single versus Ensemble of Support Vector Machines (Devrim Unay, Octavian Soldea et al 2010). The growth of medical imaging technology has been increased due to its advances and that the number of digital images requires to be acquired, analyzed, classified, stored and retrieved in medical centers. This creates a great interest among researchers in medical image classification and retrieval. There are so many systems have been developed earlier, however still there is lack in implementing such systems in real time environment that needs to be complete. By considering these requirements, authors summarized the various technical details of their experiments for the Image CLEF 2009 medical
image annotation challenge. Also authors considered two important classification schemes.

1. Direct (It employs a single SVM to automatically annotate X-ray images)

2. Ensemble (It employs local binary patterns as image descriptors)

These two proposed ensemble schemes divide the classification task into sub-problems. The first one utilized SVMs trained on IRMA sub-codes and the second one is learns from subgroups of data defined by frequency of classes.

**DCT-DST Plane sectorization of Row wise Transformed color Images in CBIR** (Kekre & Dhirendra Mishra et al 2010). In this article, authors have dealt with a new idea of sectoring of DCT-DST plane of row wise transformed images and feature vector generation with and without augmentation of zeroth column component of DCT transformed image and the last column component of DST transformed image. Two similarity measures have been used such as sum of absolute difference and Euclidean distance and results of these measures are compared. Also, authors analyzed and observed cross over point performance of overall average of precision and recall for different sector sizes. These tests were applied in the Wang image database containing 1055 images with consisting of 12 different classes. DCT/DST plane has been divided into 4, 8, 12 and 16 sectors.

**Content Based Image Retrieval Using Exact Legendre Moments and Support Vector Machine** (Srinivasa Rao et al 2010). There are many techniques are available to extract shapes for Content Based Image Retrieval (CBIR) systems. Such as invariant image moments, Moment Invariants (MI) and Zernike Moments (ZM). Among which MI and ZM are
good techniques for representing the shape features of an image. However, non-orthogonality of MI and poor reconstruction of ZM restrict their application in CBIR. Hence, there is a need of an efficient and orthogonal moment based system for Content Based Image Retrieval (CBIR). To alternate this authors proposed a system for CBIR using Legendre Moments (LM). It is orthogonal, computationally faster, and can represent image shape features compactly. Also, authors have used Exact Legendre Moments (ELM) for gray scale images in order to propose CBIR system in this work. Results were compared with other moment based methods, viz., MI and ZM in terms of retrieval efficiency and retrieval time. Further for improving classification of images Support Vector Machine (SVM) classifier has been used.

**Combining similarity measures in content-based image retrieval** (Miguel Arevalillo-Herráez, Juan Domingo et al 2008). The main objective of the content based image retrieval (CBIR) systems is to provide a system with which users allows to retrieve images from large image databases. In a CBIR system, normally images are represented by set of low level descriptors from which similarity measures or distance functions are used to retrieve various queries. In recent Literature, most of the works have dealt with combination of distances or scores from different and independent representations in order to make high level semantics from the low level descriptors of the images. Selecting the best technique to combine these results needs a careful analysis and, in most cases, the use of ad-hoc strategies. With this aspect authors have proposed a method to combine a given set of dissimilarity functions. For each similarity function, a probability distribution is constructed.

**Image Searching Using Heuristic Method for Image Retrieval System** (Yeni Herdiyeni & Fitria Yuningsih 2009). Heuristic algorithm techniques have been used as solutions for efficient searching process in
Content Based Image Retrieval System. It is used in structural database which is built in indexing phase. The structure is graph-formed and also known as landscape. Each node represents an image and each edge is labeled with similarity value as nearest prediction between connected nodes. In this work, authors have used combination of three image features such as color, shape, and texture for calculating similarity values. For retrieving, the heuristic searching algorithm such as Breadth-First Search mechanism has been used in order to provide an efficient retrieval tool with best performance.

Exploring the Semantic Gap in Content-Based Image Retrieval: with application to Lung CT (Omar Karam, Ahmad Hamad & Mahmoud Attia 2005). Visual features are played an important role in content based image retrieval systems (CBIR). Though there is sufficient retrieval quality and convenient automatic extraction of visual features systems existed, there is still a semantic gap between the low-level visual features (textures, colors) automatically extracted and the high-level concepts that users normally search for (tumors, abnormal tissues). This Semantic gap is an open challenging problem that was addressed in many researches. It has different definitions and different proposed solutions. Hence, there is a need to develop effective solutions in the field of content based image retrieval systems (CBIR). With this aspect, authors have investigates the existing semantic gaps and their effects on content based image retrieval systems (CBIR). Based on their investigation, authors proposed a new idea to represent the images by visual features at different levels of details and monitor the retrieval accuracy obtained at every level. Through which authors have explored the semantic gap in content based image retrieval. Also this method has been applied in Lung CT applications.

Content Based Image Retrieval using Texture, Color and Shape for Image Analysis (Amanbir Sandhu, Aarti Kochhar 2012). Content- Based
Image Retrieval (CBIR) or QBIR is the important field of research. Content Based Image retrieval has gained much popularity in the past Content-based image retrieval (CBIR). It has also helped users to retrieve relevant images based on their contents. It represents low level features like texture, color and shape. In this article, authors compare the several feature extraction techniques such as GLCM, Histogram and shape properties over color, texture and shape. By implementing this work authors have analyzed and offered best solution to the Content- Based Image Retrieval applications.

**Content Based Image Retrieval using Color and Texture** (Manimala Singha and K. Hemachandran 2012). The increased demand of content based image retrieval technique can be found in many different domains such as Data Mining, Education, Medical Imaging, Crime Prevention, Weather forecasting, Remote Sensing and Management of Earth Resources. In this paper authors presented a content based image retrieval system 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 been applied in WANG image database containing 1000 general-purpose color images.

**Query-by-Sketch Image Retrieval Using Edge Relation Histogram** (Yoshiki Kumagai, Toru Arikawa, Gosuke Ohashi 2011). Feature extraction method has been played an important role in Query-by-sketch image retrieval system, because the retrieval result depends on image feature. In this work, authors have proposed a query-by-sketch image retrieval system using Edge Relation Histogram (ERH) as global and local feature. ERH focuses on the relation among edge pixels, and ERH is shift-, scale-, rotation-
and symmetry-invariant feature. Also authors have applied this system in Corel Photo Gallery database in order to test the system.

**Efficient Image Mining using Multi Feature Content Based Image Retrieval System** (Rajshree Dubey, Rajnish Choubey, Sanjeev Dubey 2011). There are numbers of methods existing for Image Mining Techniques. In this work authors have used two techniques such as Color Histogram and Edge Histogram Descriptor. The input image used in this system is based on the Human Perception of the Image. In order to process, Contours and surfaces of the Images have been used for Machine interpretation. Combination of above two feature extraction methods is used to implementing this system. For retrieval, the Euclidian distances are calculated. Matlab based user interface is also provided.

**Combining Feature Methods for Content-Based Classification of Mammogram Images** (Chiapas, Viriri, Tapamo 2013). Mammography is one of the successful ways for early detection of breast cancer. Because studies of this field shows that early detection allows for a better prognosis. It mostly involves manual reading of mammograms, a process that is difficult and error-prone also. In this work authors have discussed a classification model for mammograms based on micro classification characteristics in order aid radiologists to make quick and accurate diagnostic decisions. With this system, images are pre-processed by Gaussian smoothing and median filtering with \(5\times5\) and \(3\times3\) kernels respectively. Gabor and Haralick features are used to compute similarity measurements.

**A Combined Color, Texture and Edge Features Based Approach for Identification and Classification of Indian Medicinal Plants** (Basavaraj Anami, Suvarna Nandyal & Govardhan 2010). In this work, authors have proposed an approach for identifying and classifying of images of medicinal plants such as herbs, shrubs and trees based on color and texture
feature using SVM and neural network classifier. The medicinal systems such as Ayurveda medicine that requires identification of medicinal plants and it is considered as an important activity in the preparation of herbal medicines. Hence, technology in automatic identification and classification of medicinal plants has become essential. In this work, authors have considered images of plant species belonging to different classes such as Papaya, Neem, Tulasi, Aloe and Garlic. With this work, authors have used edge and color descriptors for detecting edges of the images. Also the rotation invariant texture descriptors namely, directional difference and the gradient histogram are used for extracting texture pattern of the images. These features have been applied for 900 images of medicinal plants and used to train and test the image samples of three classes with SVM and radial basis exact fit neural network (RBENN).

Medical Image Retrieval using Multiple Features (Jyothi, Madhavee Latha & Reddy 2010). The growth of digital images in medical domain has been increased more and more in day to day activities of human life. The retrieval of such images from huge volume of repositories is plays an important role in content based image retrieval. For efficient image retrieval, the medical image should be processed systematically in order to extract and represent as feature vector for each of the images stored in medical repository as well as input query image. There are two important issues in Content Based Image Retrieval.

1. Visual feature Representation
2. Similarity measurements

In this article, authors proposed a method in which both Intensity and spatial relationship of images have been considered. This work consists of multiple feature vectors that include color, texture and shape features. For color feature representation, cumulative histogram of color features has been
exploited. For texture feature representation, gray level co-occurrence matrix (GLCM) algorithm used. For shape feature representation, the edge information of images extracted and their histogram of the edge directions are computed to represent the shape feature. For retrieval, Euclidean distance similarity measures have been computed between repository images and input query image of the user.

**Edges Extraction Method based on Fractal and Wavelet** (Qingsheng Zhu, Yanxia Wang & Huijun Liu 2010). In this work, authors present a method for edge extraction of the images by combining fractal with wavelet. With this method, fractal dimension values of R, G, and B components of every pixel in image have been computed. Then, by using normalized fractal dimension values of color images are synthesized. By using wavelet transform, histogram of synthetic images is decomposed to determine the threshold of extraction edges. At the same time, threshold values of edges have been improved based on segmentation on wavelet transform (AEEM-Automatic Extraction Edges Method—which determines automatically the threshold values of edges).

**Multiresolution Gray-Scale and Rotation Invariant Texture Classification with Local Binary Patterns.** (Timo Ojala, Matti Pietikäinen & Topi Mäenpää 2002). In this article, authors present an efficient method for image classification using multiresolution approach. This approach applied to gray-scale, rotation invariant texture classification based on local binary patterns and nonparametric discrimination of sample and prototype distributions. It is based on recognizing certain local binary patterns, termed ‘uniform’, are fundamental properties of local image texture and their occurrence histogram is proven to be a very powerful texture feature. In this work, authors have derived a generalized approach to gray-scale and rotation invariant operator presentation that allows for detecting the ‘uniform’ patterns
for any quantization of the angular space and for any spatial resolution and presents a method for combining multiple operators for multiresolution analysis

**Image Feature Extraction Techniques and Their Applications for CBIR and Biometrics Systems** (Ryszard Chora 2007). In this article authors presents various image feature extraction techniques and their applications for retrieval of biometric images. The visual features used in retrieval system are shape, color and texture that are extracted to characterize images. These features are represented using one or more feature descriptors. For retrieval, features and descriptors of the query images are compared to the images in the database in order to ranking and indexing the images according to its distance to the query. Also authors discussed how these methods applied in biometric application systems.

**Recognition of isolated handwritten Kannada vowels** (Sangame, Ramteke, Rajkumar Benne 2009). In this work, authors dealt with recognition of unconstrained handwritten Kannada vowels based on unconstrained handwritten Kannada vowels. This system extracts Invariant moments feature from region of images. Also Euclidian distance criterion and K-NN classifier is used to classify the handwritten Kannada vowels. The uniqueness of this system is independent of size, slant, orientation, and translation in handwritten characters.

**Object Detection using Geometric Invariant Moment** (Mohamed Rizon, Haniza Yazid, Puteh Saad et al 2006). Geometric moment invariant generates a set of feature vectors that are invariant to shifting, scaling and rotation of the images. This technique is widely used to extract the global features for pattern recognition. In this work, authors proposed moment invariant for identifying the object from the image using the first invariant moments.