Content Based Image Retrieval (CBIR) Using Novel Gaussian Fuzzy Feed Forward-Neural Network

A Thesis submitted to Gujarat Technological University

For the award of

Doctor of Philosophy

in

Computer Engineering

by

Maniar Swity M.
Enrollment No. 129990907008

Under supervision of

Dr. Jagdish S. Shah

GUJARAT TECHNOLOGICAL UNIVERSITY
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ABSTRACT

This thesis presents research work related to Content Based Image Retrieval with focus on medical images. This is an extension to search based on text query wherein images are applied as text query. This works extends to image based query.

This study handles the problem related to the difficulty of handling high level image content from low level image features. Retrieval method based on relevance feedback require human interaction.

The proposed approach uses fusion of texture and shape features. Texture features used were mean, variance, standard deviation, contrast, energy etc. whereas shape features used are area, perimeter, circularity, aspect ratio etc. Euclidean and Manhattan distance were used to extract relevant images from database. Successively artificial neural network was applied for image classification.

The proposed approach with composite features was experimentally compared with existing approach on dataset of 250 images and was found effective and superior for medical classification.

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Table of Content

List of Abbreviations

CBIR : Content Based Image Retrieval

MCBIR : Medical Content Based Image Retrieval

MRI : Magnetic Resonance Imaging

CT: Computed Tomography

PET : Position Emission Tomography

PACS : Picture Archiving and Communication System

QBIC : Query By Image Content

FIRE : Flexible Image Retrieval Engine

RF: Relevance Feedback

ANN : Artificial Neural Network

IR : Information Retrieval

CART : Classification and Regression Tree

DTCWT : Dual-tree Complex Wavelet Transform

DWF : Discrete Wavelet Frame

GLH : Gray Level Histogram

MARS : Multimedia Analysis and Retrieval Systems

PicSOM : Picture & Self-organizing Map

MPEG-7 : Moving Pictures Expert Group Multimedia Content Description Interface

IRMA : Image Retrieval for Medical applications

SPIRS : Spine Pathology and Image Retrieval System

ASSERT : Automatic Search and Selection Engine with Retrieval Tools

PBR : Pathology Bearing Regions

MIRAGE : Middlesex Image Repository with a CBIR Archiving Environment

GIFT: GNU Image Finding Tool

QBE : Query-by-Example

HUG :University Hospital in Geneva

KNN : K Nearest Neighbors

SOM : Self-Organizing Map

MLP : Multilayer Perceptron

RBF : Radial Basis Function

DT: Decision Tree

ML : Machine Learning

MBM : Multifractional Brownian motion

GLCM : Gray Level Co-occurrence Metrics

DCT : Discrete Cosine Transform

FD: Fourier Descriptors

DFT: Discrete Fourier Transform

EMR : Electronic Medical Record

EHR : Electronic Health Record

PDF : Probability Distribution Function.

TP : True positive

TN: True negative

FP : False Positive

FN : False Negative

MATLAB : MATrix LABoratory

GUI : Graphical User Interface

EMD : Earth Mover Distance

ED : Eucludian Distance

MD : Manhattan Distance

LBP : Local Binary Pattern

HRCT : High Resoultion Computed Tomography

CMY : Cyan Magenta and Yellow

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Chapter – 1 Introduction

CHAPTER - 1
Introduction

1.1 Introduction

The amount of image data that has to be maintain, searched, retrieved, and stored produces constantly in lot many areas of engineering and research. The search for images in general used search engine like Bingo, Yahoo, and Google, the search for image we give text which retrieves similar images based on text that we give for the image. In text or keyword oriented retrieval technology, to give a text of image with water lilies so it can search, match and retrieve the image of lilies only and give a more detail of image with text lilies flowers in pond that is find an image that as per the user want. So user has to give all explanation of image in the text or keyword based retrieval.

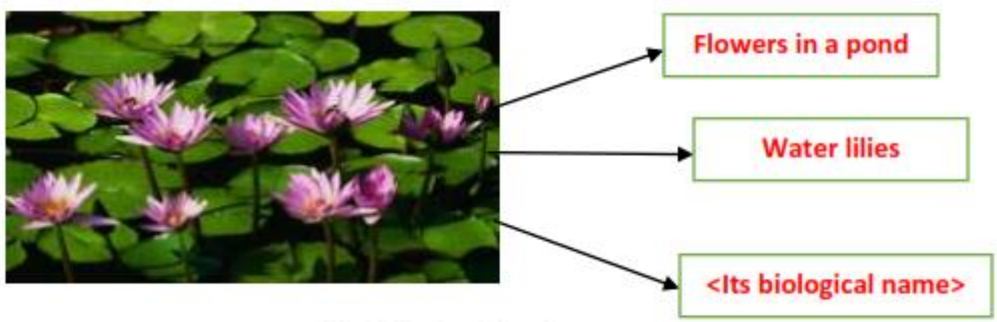


Fig. no. 1.1 Text Based System

There are drawback of text oriented method that are given as follow. The one difficult thing for image explanation has huge sizes of database cannot retrieve in text or keyword oriented method and language should be known to retrieve an image given by operator. The second difficult thing is operator point of view that is find a problem like subjectivity of user need and more concern need on the end user. Third one difficult thing is more clarity needs to sharp queries that cannot be possible at all into the different features of images to find.

1.1.1 Content Based Image Retrieval (CBIR)

CBIR system searches based on query by image not by text so the retrieval images based on the content of image. The Example of CBIR given in below figure no. 1.2

Fig.1.2 CBIR examples

CBIR then has been used as an alternative to text based image retrieval. The user interface is very important since it represents the primary means of interaction. A non user friendly interface is frequently cited as one on the reason for a lack of CBIR application in clinical usage [2] [3]. Both [2] and [3] auspicate an increase of effort in usability studies of CBIR interfaces. The interface should allow and support many techniques for query submission

- Query by example
- Query by sketch
- Query by region,
- Query by pattern,
- Query by composition of pre-defined regions of interest,
- Query by text or a composition of query by text
- Query by image,
- Query refinement, relevance feedback [4] [5] and so on [1].

A CBIR system uses pictorial contents of the images given in the terms of low level features like color, texture, shape and spatial positions to present the images in the databases. The system finds similar images when a sample image or sketch is presented as input to the system. Querying in this method removes the requirements of relating the visual content of images in words and is near to human needs of visual data.

In a typical CBIR system (Figure 1.3), image low level features like color, texture, shape and spatial locations are represented in the form of a multidimensional feature vector. The feature vectors of images in the database form a feature database. The retrieval process is initiated when a user query the system using an example image or sketch of the object. The query image is converted into the internal representation of feature vector using the same feature extraction routine that was used for building the feature database. The similarity measure is employed to calculate the distance among the feature vectors of query image and for the target images in the feature database. Finally, the retrieval is performed using an indexing scheme which facilitates the efficient searching of the image database.

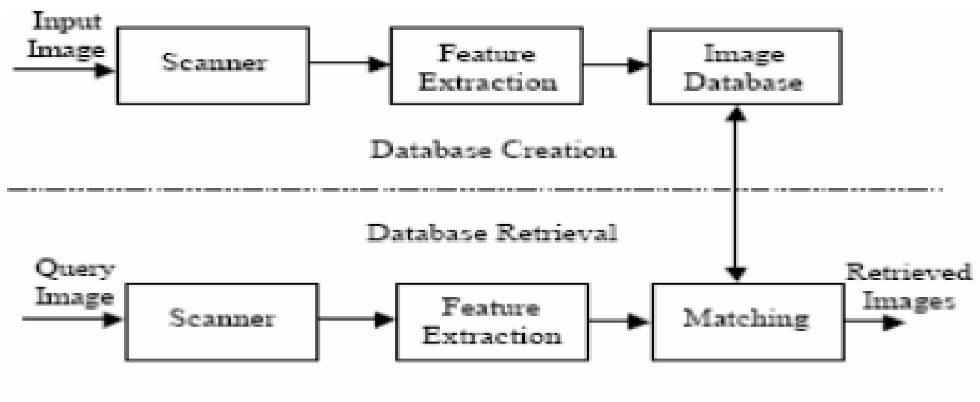


Fig no. 1.3 CBIR system

A. Feature Extraction

Feature extraction is a need of information shrinks. The input to the different technique are big for user and it is believed to be disreputably unneeded (more data, but not more information) then the input information can change into a compact version with different number of features (also called features vector). Storing the input data into the other format of features is called features extraction. The numbers of techniques for feature extraction are given below.

Earlier established CBIR systems categorized images by global features like shape, texture and color histogram, parameters, though, to capture the relevant information for medical images, the systems using global image features are failed. Thus, the global image features such as color, texture, shape, etc. cannot effectively characterize the content of the medical images. In medical images, the clinically useful information is mostly highly localized in small areas of the images, that is, the ratio of pathology bearing pixels to the rest of the images is small.

Normally content based image retrieval were used image features as per below:

- **Color:** In stock photography (large, varied databases for being used by artists, advertisers and journalists), color has been the most effective feature and almost all systems employ colors. Although most of the images are in the red, green, blue (RGB) color space, this space is only rarely used for indexing and querying as it does not correspond well to the human color perception. Much effort has also been spent on creating color spaces that are optimal with respect to lighting conditions or that are invariant to shades and other influences such as viewing position [84, 85]. This allows identifying the colors even under varying conditions but on the other hand information about the absolute colors is lost. Thus, color features are not used for medical image retrieval;

- **Texture:** Texture is the very useful features for the image. The matching for image is more difficult than color feature. It is described by the location delivery of gray value in a neighbor**.** Performance of image retrieval can calculated based on texture features with different methods but the main method of color base CBIR. The researches in texture based features have higher variety than color base features due to the inaccurate understanding and definition of texture.

  Texture is the essential things for faces that terms as graphical patterns and covers important information for the physical plan to the slides of object and its connection given by nearby surroundings area. Many type of texture images have founded in computer field and design identification.

  It is a feature for in describing more meaning for image retrieval resolution. It is generally used in image retrieval and matching systems consist of ethereal feature, for instance features gained using various transform. [29]. Texture features means spatial group of pixel values of an image and used in transform area study by tools such as Gabor, wavelets, or Stockwell , Fourier transform, or Stockwell filters. In the medical images, the details within an image structure are get with the help of texture features they can reflect;

- **Shape:** In shape-based techniques, shape feature has wide-ranging of feature sets normally include edges, corners, and visual cues such as curve, contour, chain codes and curvature scale space. Like shape, colour, and texture are not universal feature for the image. In the texture and color, distance calculation done if a query image has a specific texture or color. Shape feature are of two different category [29].

I. Boundary based.

Boundary based shape representation uses the outer boundary of the image. Using its external features we can describing the region. The object boundary given with pixel continuity. Boundary is a sequence of pixels, to compare two shapes by using the fourier descriptor feature that work on boundary. In general term, the shape is collection of N pixels with series.

II. Region based.

Region based shape feature uses the full shape of image by giving the region using its internal appearances. In the region covered some number of the pixels. Query to the database using shape features can permit physicians to find mal formations that otherwise may be missed. To find a shape, where a higher level change in the gray level intensities in between, we must found where the edges.

1.1.2 Medical Content Based Image Retrieval(MCBIR)

An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images. CBIR refers to techniques that retrieve images based on their content, as opposed to based on metadata. CBIR methods are usually developed for specific features of images, so that those methods are not readily applicable across different kinds of medical images. Various category of medical images are endoscopy, Magnetic Resonance Imaging (MRI), X-ray, Computed Tomography (CT) scan, Position Emission Tomography(PET) scan are developed in various medical center as well as in various health centers [6]. A huge volume of medical images are daily generated in medical centers by several equipment such as CT, MR, X-ray, among others. With the advent and introduction of picture archiving and communication system (PACS) in medical environment and stored in image data base. In the medical field, CBIR is used to aid radiologist to retrieve of images with similar contents.

When radiologists analyze new cases in the clinical routine, they can be motivated to search for similar past cases in a historic database that could have had similar known anomalies. In fact, retrieving similar images have potential to help the specialists to interpret medical images, providing new insights and contributions to the current case. Also, differential diagnosis techniques may help to increase (or decrease) the certainty degree of the professionals about their previous diagnosis hypothesis [8]. The automatically retrieval of similar images has been studied by many researchers [9][10], culminating (among others) in the current components/methods of the Medical Content- Based Image Retrieval systems [11]. MCBIR-based tools retrieve images that are similar to the given query image instead of using traditional data (i.e. text or numerical attributes related to the image). MCBIR systems retrieve the most similar images regarding to a given query image based on comparisons of features [7]. Usually, those systems are supported by operations involving similarity-based searches, represented in metric spaces [12].

Medical content based image retrieval has more useful to especially in education, research, education astronomy and medical diagonsis fields. Medical content-based image retrieval is the useful to computer technology to the issue of digital image search in big databases. MCBIR helps to retrieve the images from the databases. Medical images are purpose to highly different and collected of variety in structures [11]. So there is a require for feature calculation, similarity calculation and categorization of images for simple and proficient retrieval. MCBIR is a regular retrieval of images normally depends on various exacting properties like shape and texture.

A. History

IBM was the first, who take an initiative by proposing query-by image content (QBIC). QBIC developed at the IBM Almaden Research Center is an open framework and development technology [13]. Unlike keywords-based system, visual features for contents-based system are extracted from the image itself. CBIR can be categorized based on the type of features used for retrieval which could be either low level or high level features. At early years, low level features include color, texture, shape and spatial relations were used [14].

Current trials for medical image retrieval were ASSERT (Automatic Search and Selection Engine with Retrieval Tools) system for more determination computed tomography (CT) images of the lung. Image retrieval for medical applications (IRMA) system for the classification of images into viewpoints, modalities and anatomical areas. Flexible image retrieval engine (FIRE) system handles different kinds of non-medical data like photographic databases and medical data as well as.

1.1.3 Relevance Feedback(RF) approach of CBIR

The main reason of CBIR created for relevance feedback is on retrieval process, permitting users to evaluate and mark the retrieval outcomes of content based image retrieval, find out which are not relevant results and which are releted to the query image, then feedback the related info that the users mark to the system as training samples for instruct next image retrieval and learning, So made the results more as per the requirements of users. A wider application of relevance feedback method changes the query vector on the one hand, using feedback information to change the weight of each feature vector in the formula, highlighting the more important vector of the query.

In CBIR based systems use the low level image features as color, shape and texture are extracted for matching. Extracted feature are characterized by feature vectors in place of lot many of keywords. Though, big issue in CBIR is the semantic gap between the low level features and high level concepts. To decrease the gap in between the low level features and high level concepts.

Despite such endeavors, there is still a “big gap” between the low-level similarity measure and the human perception of image similarity [23]. In order to bridge this semantic gap, one should incorporate the human knowledge into the image retrieval system. One approach which is widely used for this purpose during the last half a decade is relevance feedback (RF) [23]-[25]. In RF, a user submits his/her perceptual judgments on the first round retrieval results to the CBIR system so that the system can retrieve more relevant images on the next round. RF is also used for medical image retrieval [26].

Relevance Feedback (RF) was presented into CBIR [16,17]. Currently, many investigators start to give the RF as a classification problem. Where a user is gives true and/or false samples, and the systems study the samples to distinct all data into matching and non matching types. Many machine learning algorithm given to the RF like, decision tree [18], Naïve Bayesian [19], [20], Neural Network [21], support vector machine [22] and lot many.

The other issue in CBIR systems is multi dimensional indexing. In CBIR systems, the image features has more numeric data so it has the high dimensional data. So to manage these type of data with general type of database systems are more difficult, the reason behind these are systems planned for text data and small dimensional numerical data. Due to this reason investigators have created systems for indexing with high dimensional data in CBIR systems

The problem is difficult due to the difference between the user idea of the image to search and the computer representation of the same image. In the search identify gaps that are grouped in four categories:

- Content gaps. In this category the semantic gap, that is, the difference between low level features and abstract user representation, is considered the most important.
- Feature Gaps are due to both the difficulties in extracting low level features and the in adequacies of the chosen numerical features to characterize the image content.
- Performance Gaps: refer to the lack of formal CBIR performance evaluation and its benefit in health care.
- Usability gaps: refer to the ease of use of the system. In this category are framed the query, feedback and refinement gaps.

1.1.4 Classification Algorithm

In a CBIR system, to work on content-based queries, the retrieval system must be given with the current image type prior to any processing. Hence, the classification of medical images into different imaging category is necessary to do proper retrieval. A successful categorization and indexing of images based on category, body part, orientation, etc. will greatly imporves the performance of CBIR systems by filtering out the images of irrelevant classes and reducing the search space. So, image classification is an important stage in a CBIR system.

Another method to utilize human knowledge in CBIR systems is to use predefined classes and to use classification methods. Dissimilarity-based classification [27], [28] is a type of classification in which images are identified by feature vectors, and each element denotes the distance from a predefined class representative. This type of identification of images can be used as the underlying low-level feature extraction in image retrieval systems, but it restricts the definition of images to the predefined classes and can limit the accuracy of the final image retrieval system.

Image classification is a pattern recognition problem that involves three steps, feature extraction, feature selection and discrimination (the training of a classifier with extracted features). The term feature selection refers to algorithms that select the best subset of the input feature set. Methods that create new features based on transformations or combinations of the original feature set are called feature extraction algorithms. Often feature extraction precedes feature selection; first, features are extracted from image and then some of the extracted features with low discrimination ability are discarded.

To do classification on retrieval result various algorithm like Naïve Bayes classifier, Support Vector machine, Decision Tree, Neural Network based classifier have been used. To do classification on retrieval result classification algorithms Artificial Neural Network (ANN) give good result compare to others. Neural Network classifiers have been finding extensive use in the areas of image classification according to imaging modalities, body part, normal and abnormal.

Artificial neural network models have been studied for many years in the hope of achieving human-like performance in several fields such as speech and image understanding. The networks are composed of many nonlinear computational elements operating in parallel and arranged in patterns of biological neural networks.

A neural network is same as biological human brain system which includes the collection of neurons and it is also considered as the border line between approximation algorithm and artificial intelligence. It learns through training resemble structured biological neuron networks and hence it is known as a nonlinear predictive model. The neuron networks work for the applications which include pattern detection, making prediction and learn from the past such as biological systems. The artificial neuron networks are nothing but the computer programs which enables the computer to learn like human being but it cannot mimic the human brain completely, but having some lacking or limitations.

An input layer, a hidden layer and an output layer are three layer in the architecture of the neural network. The number of elements existing in one transaction in the database is equal to the no of nodes in the input layer. While the output layer was consisting of one node. The main architectures of artificial neural networks, seeing the neuron position, and how they are inter connected with each other and how their layers are composed, can be given as follows: (i) single-layer feed forward network, (ii) multilayer feed forward networks

1.2 Application

Recently, there are lot many of digital image on the Internet, mobile and in the other library. The internet has given easy access of information sharing, searching, and managing. Internet users use the internet for information transfer or sharing. In general the collecting information done with the help of World Wide Web (WWW). As every day increase in size of the web, plentiful information given a hetero genius of this information makes standard information retrieval techniques unproductive. To managing, matching for the search, and retrieving information as per user want become a thoughtful task.

Today's high speed networks has increasingly become a common phenomenon among the users for information sharing and accessing. Due to the advance in technology, all the various types of information available in the internet. The big challenges in technology to provide effective methods for storage, searching, managing of such different types of information from the networks and databases. Advancements in the digital photography technology, enables the big storage size and high speed networks, collecting and storing more quantities of with good quality images has become possible.

Digital images searching with more number of image that is the applications in area of medicine, medical and for the scientific images, at exhibition hall and arcades, military and security purposes, and personal photo albums etc. With the help of this sort of information like establishing and managing, searching for more volumes of images in databases, users may have problems, as the recent marketable database systems are planned for textual data, it is not suitable and well-matched for digital images. Due to this reason we require the system that find an efficient method for the image retrieval. In order to the different category type of images we need, investigators have try to expanding the recent information retrieval (IR) technology that are used in keyword or text retrieval to the field of the image retrieval [15].

A wide range of possible applications for CBIR technology has been identified. Potentially fruitful areas include:

- Crime prevention

- The military
- Intellectual property Architectural and engineering design
- Fashion and interior design
- Journalism and advertising
- Medical diagnosis
- Geographical information and remote sensing systems
- Cultural heritage
- Education and training
- Home entertainment
- Web searching.

Closer examination of many of these areas reveals that, while research groups are developing prototype systems, and practitioners are experimenting with the technology, few examples of fully- operational CBIR systems can yet be found. A search of public-domain sources, including the trade and scientific literature and the Web, suggests that the current state of play in each of these areas at the end of 1998 is as follows:

1.2.1 Crime prevention

Law enforcement agencies typically maintain large archives of visual evidence, including past suspects' facial photographs (generally known as mugshots), fingerprints, type treads and shoeprints. Whenever a thoughtful crime is accepted, they can compare proof from the act of the crime for its match to records in their archives. Strictly speaking, this is an example of identity rather than similarity matching, though since all such images vary naturally over time, the distinction is of little practical significance. Of more relevance is the distinction between systems designed for verifying the identity of a known individual (requiring matching against only a single stored record), and those capable of searching an entire database to find the closest matching records

1.2.2 The military

Military applications of different technology are possibly the best-developed, though least publicized. Recognition of rival aircraft from radar displays, finding of objects from satellite images, and providing the direction of systems for cruise missiles are known examples though these almost certainly represent only the tip of the iceberg. Many of the investigation techniques used in crime anticipation could also be useful to the military field.

1.2.3 Architectural and engineering design

Architectural and engineering design give a no of collective features the use of 2-D and 3-D models to represent design objects, the requirement to imagine designs for the help of non-technical clients, and the necessity to work within constraints, often financial. Such constraints mean that the designer needs to be known of earlier designs, mostly if these can be changed to the problem at hand. Hence the capability to search design records for earlier examples which are in some way similar, or meet criteria, can be valuable.

1.2.4 Fashion and interior design

Similarities can also be seen in the design process in other areas, including fashion and interior design. Here again, the designer has to work inside some constraints, such as choice of materials. The capacity to search a group of fabrics to find a combination of colour or texture is progressively being accepted as an aid to the design method.

So far, little systematic development activity has been reported in this area. Attempts have been made to use general purpose CBIR packages for specific tasks such as colour matching of items from electronic versions of mail order catalogues, and identifying textile samples bearing a desired pattern, but no commercial use appears to be made of this at present.

1.2.5 Journalism and advertising

This application area is probably one of the prime users of CBIR technology at present though not in the form originally envisaged. In the early years of CBIR development, hopes were high that the technology would provide efficient and effective retrieval of still images from photo libraries, eliminating or at least substantially reducing the need for manual keyword indexing. Disillusionment set in as the realization spread that the CBIR techniques under development were of little use for retrieval by semantic content. Stock shot agencies now seem likely to base their retrieval systems on manual key wording for many years to come, though a few are experimenting with the use of CBIR software as adjuncts to keyword indexing.

1.2.6. Medical diagnosis

When radiologists analyze new cases in the clinical routine, they can be motivated to search for similar past cases in a historic database that could have had similar known anomalies. In fact, retrieving similar images have potential to help the specialists to interpret medical images, providing new insights and contributions to the current case. Also, differential diagnosis techniques may help to increase (or decrease) the certainty degree of the professionals about their previous diagnosis hypothesis [8]. The automatically retrieval of similar images has been studied by many researchers [9][10], culminating (among others) in the current components/methods of the Medical Content- Based Image Retrieval (MCBIR) systems

1.3 Motivation

The work aimed towards various issues in dealing with the requirements of Image Processing based on CBIR data. The major focus of the work will be towards retrieval of Image. The commonly used Text Based Image Retrieval (TBIR) system is Google Images. The text based systems are fast as the string matching is computationally less time consuming process. However, it is sometimes difficult to express the whole visual content of images in words and TBIR may end up in producing irrelevant results. In addition annotation of images is not always correct and consumes a lot of time. For finding the alternative way of searching and overcoming the limitations imposed by TBIR systems more intuitive and user friendly CBIR were develop

Some drawback of text-based method that is given below.

- Problem of image annotation
  - Big size of databases
  - Valid only for one language with image retrieval this limitation should not exist
- Problem of user perception
  - Subjectivity of user need
  - Too much description need by end-user
- Problem of deeper needs by user
  - Queries that cannot be defined at all, but need into the different features of images.

CBIR system searches based on query by image not by text so the retrieval images based on the content of image.

The image is probably one of the most important tools in medicine since it provides a method for diagnosis, monitoring drug treatment responses and disease management of patients with the advantage of being a very fast non-invasive procedure, having very few side effects and with an excellent cost-effect relationship. Hard-copy image formats, i.e., analog screen films, were the initial support for medical images but they are becoming rarer. Maintenance, storage room and the amount of material to display images in this format contributed for its disuse. Nowadays digital images, the soft-copy format, lack the previous mentioned problems while offering the possibility of text annotations in metadata format

With the increase of data storage capacity and the development of digital imaging devices, to increase efficiency and produce more accurate information, a steady growth of the number of medical images produced can be easily inferred. A good example of this trend is the Radiology Department of the hospital of any where, alone, produced from 12.000 medical images a day in 2002 to 50.000 medical images a day in 2007. The main contributions for these numbers are video frames from cardiac catheterizations and endoscopies. Aside the obvious usefulness of medical images, patient diagnosis and treatment, this huge amount of data also provides an excellent resource for researchers in the medical field.

1.4 Objectives

The main objective of the proposed work on the Image Processing issues with CBIR. The research work is to test CBIR system with medical image and to get maximum retrieves images from medical datasets with the help of texture and shape feature. Then do the classification with neural network so image can be classified into relevant and no relevant image and if there is relevant image then classified into normal and abnormal image. To address this broad objective, we identify the following steps for CBIR system:

- Collect the medical images with x-ray image , magnetic resonance image (MRI), computed Tomography(CT) scan image and Extract features
- Create a database of medical images which stores various features can be calculated for the database image.
- Select query image and based on various features of database images retrieve the best matching from database.

- Apply neural network for classification of abnormal and normal images and identified semantics for image

1.5 Original Contribution by the Thesis

The entire work in this thesis, as well as the original work of thesis is, with the copyright and the research papers as the back bone. The proposed framework and the algorithms have been visualized as a collection of various modules, each of which with relevant publications. The details of the papers are given in paper publication section:

Paper Presented / Published: Total 5 papers in national/international journals/conferences (one paper is published in IEEE Explorer conferences)

In our work, we have made progress in the area of testing with CBIR system for database of medical. We have developed different techniques for solving the previously listed problems and implemented software prototypes to prove the applicability of our concepts.

To solve the first issue where human is in interaction in between the system for retrieving the related image. In this method based on human input it is search again and retrieve the related image again. It is nothing but iterative search. So the research work run on texture and shape feature iterative search. The CBIR system is do iterative search with composite feature and get the maximum retrieval without human interaction.

To solve the second issue where semantic gap is there in between low level feature and high level concept. The CBIR system is work on two low level feature (texture and shape) reach to high level semantics with the help of neural network like normal or abnormal image.

1.6 Limitation

In this research the following things have been considered/included as the limitation.

1) The research work can included 6 category of human organ image
2) The research work can included different category of organ scan image with x-ray, CT scan, MRI scan.
3) The research work can tested with 300 database image with 12 features

4) The research work if proper retrieval is founded with composite then classify into two category only.

5) The research work can be included with gray scale medical image

1.7 Work Plan

- Work Package 1 – Prescribed course work and literature / material gathering along with the Course Work.
- Work Package 2 – Experiments CBIR in Matlab with different features technique
- Work Package 3 – Improvement/Changes in CBIR with classification to achieve set objectives.
- Work Package 4 – Writing the thesis.

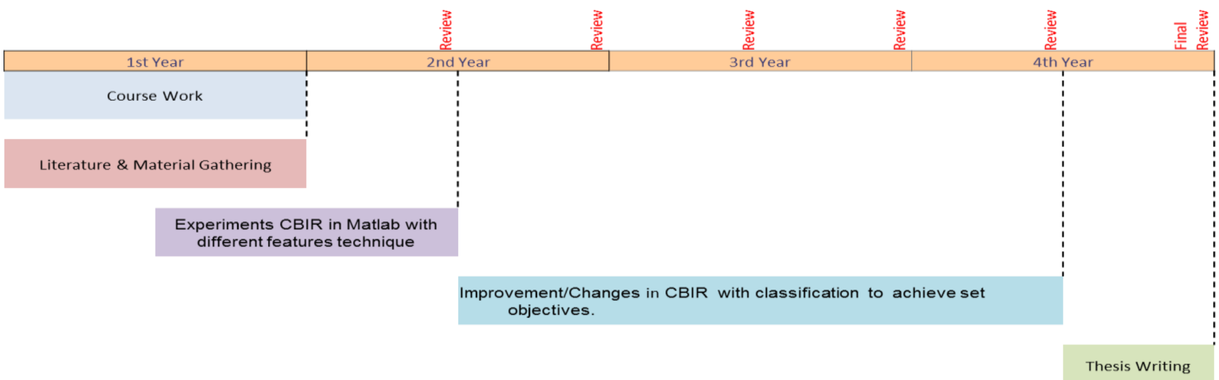


Fig. no.1.4 Work plan

1.8 Structure of thesis

Chapter 1 gives a brief description of the research work. It includes background and motivation for present work. The boundary conditions are represented along with the predefined constraints for present work. It also covers the research objectives and original contribution by the thesis.

Chapter 2 covers the Literature review related to present work and research gap identified after rigorous literature survey. The Research methodology employed with different way in review that are discussed in details in this chapter. The different way like paper review then study of existing system and classification algorithm review.

Chapter 3 presents the review of the research work comparison done with paper review with system review and classification review. The comparison of review help to identify the research gap. Then study various research gap available in the system. Identify and study that research gap with various technique. The study say that relevance feed back and high level semantics kind of research problem discussed in detail in this chapter.

Chapter 4 covers the discussion and solution of a technical problem identified from Chapter 3. For the solution of research problem research work design the proposed system with various step. The first step image collection, second step select query image and preprocessing of image, third step feature extraction, fourth step retrieval result with parameter calculation, fifth step classification on retrieval result that classify the image. This are all step discussed more in this chapter in detail.

Chapter 5 cover the implementation of proposed system with result discussion. The implementation with various step that are implemented in MATLAB software. The system implementation with matlab discussed with two type of image that are brain and heart image. That implementation is given with texture, shape and composite features. The implementation for classification using neural network also given. Results are get with all features and classification.

Chapter 6 describes the experimental results with parameterized comparisons. This chapter also concludes the research with objectives achieved with justification, conclusions of the work, and scope of future enhancements possible in this research.

Chapter - 2 Literature Review

CHAPTER - 2

Literature Review

This chapter provides a detailed description of the background theory used in the rest of this thesis. For the sake of conciseness and to avoid trivial discussions, we do not aim to present a detailed description of the background theory. Instead, we provide a brief introduction aimed at highlighting the basic concepts and definitions that contribute to the understanding of this thesis. The basic concepts and definitions are used in subsequent chapters of this thesis.

The main parts of the chapter two are concise as follows. In the first phase, we have give brief survey of CBIR with different researcher paper. In this second phase we have discussed in existing content based image retrieval systems are where to useful and its current study of system. In this third phase we have provide the survey of various classification Algorithm. Finally this all phase help in design the proposed system for research work.

2.1 Research paper Review (First phase)

Many researchers have given their significant contribution in the field of testing CBIR application. In this section we are going to discuss their work.

M. Flickner, H. Sawhney, W. Niblack [42] [43] who take an initiative by proposing query-by image content (QBIC). QBIC developed at the IBM Almaden Research Center is an open framework and development technology. Query can be images, user created sketches or a selection of color and texture patterns.

J. R. Smith, S. F. Chang [44] Use content-based & spatial image query (provides feature comparison & spatial query for unstructured color images). VisualSEEk: A Completely Computerized Content Based Image Retreival for the Query.

J. Laaksonen, M. Koskel [45] PicSOM: CBIR For Self Organization Map (SOM). Similarity scoring method using tree structured SOM.

Jagdeesh pujari, Pushpalatha S.N., Padmashree D. Desai [46] Content-based Image Retrieval using Color and Shape Descriptors. Color and Shape features are used. Features are extracted using Lab & HSV Color space (L – lightness, a&b – color components)

Hamid Zoyaki, Bahri abdelkhalak [47] Color information of the pixel and its position is combined to extract features Signature of image is built by classifying their pixels and its spatial information using Kd-tree Method of similarity measure used is EMD (Earth Mover Distance) distance. Indexing and Content-based Image Retrieval used.

Chen Feng,Yu Song-nain [48] Content-based Image Retrieval by DTCWT (Dual-tree Complex Wavelet Transform) Detects key points using DTCWT to make feature vectors Feature vectors are scale, translation and rotation invariant Comparison is done using Euclidean Distance.

Jan-Ming Ho, Shu-Yu Lin, Chi-Wen Fann, Yu-Chuum Wang Ray-I Chang [49] A Novel Content-based Image Retrieval System using K-means with feature extraction. K-means clustering (non-hierarchical) is used for clustering the data before feature extraction Feature extraction is done using Color and Contrast Context Histogram.

Nishant Shrivastava, Vipin Tyagi [50] Multistage CBIR Images are retrieved in stages: Color, Texture and Shape Three layer feed forward architecture is used Improved accuracy as the search is narrowed down at each stage.

HerbertChuctaya,ChristianPortugal [52] M- CBIR: A medical content-based image retrieval system using metric data-structures This model is compose methodologies: features extraction techniques and metric data Structures. Medical studies was used to compare the robustness of the features extraction techniques with texture Evaluate the performance of the system through different Extractors.

Megha. P. Arakeri, G. Ram Mohana Reddy [51] Medical Image Retrieval System for diagnosis of Brain Tumor Based on Classification and Content Similarity. Set of rotation invariant shape and texture features are used to discriminate between brain tumors at each level. The proposed approach with combine texture and shape gives promising retrieval results by improving precision, recall and retrieval time.

Wan Siti Halimatul Munirah Wan Ahmad and Mohammad Faizal Ahmad Fauzi [53] Comparison of Different Feature Extraction Technique in Content-Based Image Retrieval for CT Brain Images. The best texture extraction technique is Discrete Wavelet Frame (DWF) for intensity is Gray Level Histogram (GLH) and for shape feature is Fourier Descriptor. For the combination of techniques, DWF and FD combination gives the most excellent result

N. Kumaran, Dr. R. Bhavani [54] Query can be medical images, user-constructed features based on shape and texture patterns Then experiment result done CBIR System with Texture and Shape.

Amitkumar Rohit, Nehal Chitaliya [55] Images are retrieved in stages: Texture and Shape.It also classify the image with various classifier like ANN, SVM, and other classifier.

V. Amsaveni, Noorul Islam, N. Albert Singh, [56] Detection of Brain Tumor using Neural Network. The extraction of texture features in the detected tumor has been achieved by using Gabor filter. These features are used to train and classify the brain tumor employing Artificial Neural Network classifier

Deshpande et al [30] provides data mining approach which is used to identify the image content present in the association rules. The association rule algorithm helps to detect the regular item set with the help of some iterative methods. This algorithm helps to minimize the number of scans in Apriori algorithm. It is very essential to advance the image quality and make the extraction phase as simple and reliable.

Li-Hong Juang et al [31] focused on tracking tumor objects of (MRI) brain images by using K-means algorithm. The process which is also useful for detecting exact lesion objects in images. The main purpose of this algorithm is to resolve the MRI image by changing the gray-level image into colour image.

S.L.A. Lee et al [32] concentrated on lung nodule detection which is used to spot the lung abnormalities in CT lung images with the help of Random forest algorithm. This algorithm provides hybrid random forest based nodule classification. It is also used to detect 32 patients with 5721 images. The accuracy in proposed system is noted as 97.11 whereas in the developed system the high receiver operator characteristic is given 97.86% accuracy.

Mahnaz Etehad Tavakol et al [33] provide the high infrared cameras to diagnose the vascular changes of breasts by using the ada boost algorithm. The algorithm is used to classify the invisible images into benign, malignant and normal. In this system the accuracy of 83% is given which gives better performance than the proposed system of 66%.

Ming-Yih Lee et al [34] proposed an entropy based feature extraction and some other protocols for the breast cancer diagnosis using decision tree algorithm. The Morphological operations used in this system to detect the unified abnormal regions. This method gives 86% accuracy which is better than the proposed system of 59%.

Ye Chen et al [35] focused on the detection of brain structural changes from the Magnetic resonance images which helps to aid the treatment of neurological diseases with the help of Support Vector Machine algorithm. In addition the algorithm which helps to analyze the MR images from the various datasets. The accuracy range between 70% and 87% are noted.

Wen-Jie Wu et al [36] suggested both the classification accuracy and the optimal classification model which helps to detect the ultrasound breast tumor images by using genetic algorithm. The algorithm is to calculate the near optimal parameters to differentiate the tumor as benign or malignant. The accuracy of proposed system is 95% which is improved better in the developing system by reducing the biopsies of benign lesions.

Daniel J. Evers et al [37] has given the study to evaluate whether the optimal spectroscopy improve the accuracy of transthoracic lung biopsies using Classification and regression tree (CART) algorithm. Based on the derived parameter the algorithm classifies the type of tissue present in the system. The overall accuracy is 91% sensitivity.

Min-Chun Yang et al [38] enhance the naïve bayes classification algorithm by separating the ultra sound images pixel- by-pixel then the image measured by gray scale is converted to binary image which is then evaluated by two-phase criteria. So, the detection sensitivity can be further developed.

Shengjun Zhou et al [39] suggested that in the medical applications the images are segmented. To manage the segmentation, fuzzy c-means clustering do the classification of pixels into some divisions. Then the algorithm assigns the membership values for those pixels to form the centroid.

Ravi Babu et al. [40] focused to determine the image classification rate for the purpose of digital image classification. The K-Nearest neighbor algorithm uses the leaming technique to find out the classification time of those images. The lazy based and instance based are the two leaming techniques. To compare the curves the algorithm is used which based on some comparison. Finally the nearest neighbor classifiers used to measure the distance of the two curves [41].

2.2 Existing System Review (Second Phase)

2.2.1 Study of Existing General CBIR System

A study of the existing CBIR systems has been discussed in the following part.

A. Query by Image Content system (QBIC)

QBIC - Query by Image Content system, made by IBM, which use color percentage, color layout, and textures as a feature and makes image content similarity comparisons for the different type's images based on content or feature of image. The query can be given in the form of drawing or be the sample images, user created sketches or given texture and color patterns [QBIC, on line]. The IBM created QBIC methodology to manage the different type of media like image, photo type of product for matching and retrieve of query that are similar types of images.

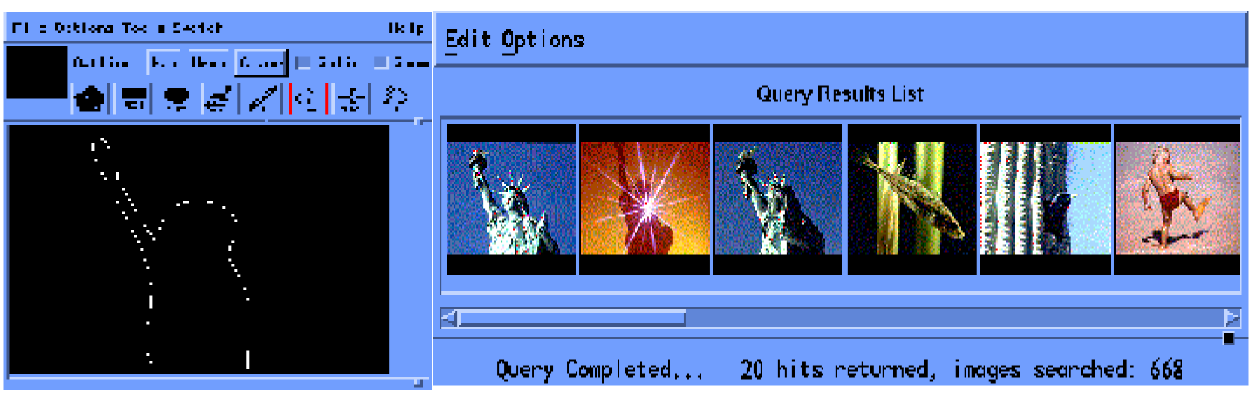


Fig no 2.1 QBIC System

B. VisualSEEK

VisualSEEk - a search engine that is developed by smith in Columbia university in 1996 for the image matching with different feature like color region for their color, sizes and their location information and try to retrieve the similar image as per the query. [VisualSEEk]. Massachus. Institute of Tech. – MIT develope the Phtotobook for image matching and retrieval for on image contents with color, shape and texture features are used and matching done with different distance formula like wavelet tree distance, Euclidean distance, histogram, manhattan distance, divergence, and lot many other distances. Photobook use unique feature for the interactive learning agent, like FourEyes for combining & selecting models for the Photobook.

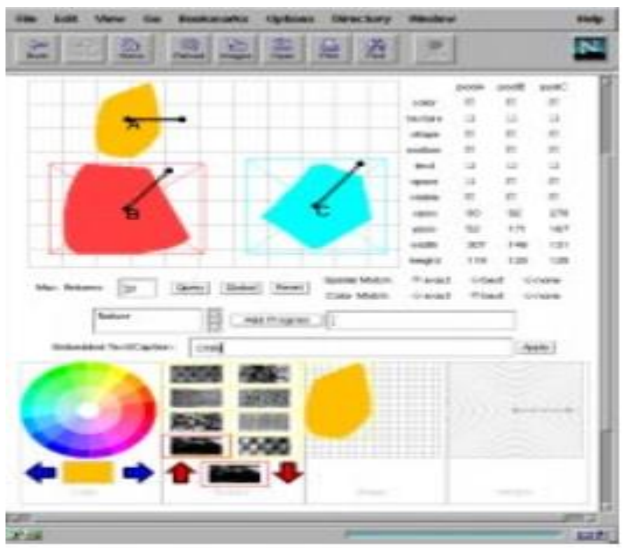


Fig no 2.2VisualSEEK System

C. Multimedia Analysis and Retrieval Systems (MARS)

MARS - Multimedia Analysis and Retrieval Systems [MARS] and FIRE- Flexible Image Retrieval Engine [Fire] uses the relevance feed back approach for the user query result refinements and get the maximum matching of the image. In this system use the color features and spatial location information as a part of color feature, Gabor filter as a part of texture feature and Fourier descriptor and its spatial location information as a part of shape feature for the matching and try to find similar images are retrieved images. In 1997 the Netra system use the Fourier descriptor for the shape features of segmented image regions of image. The color code book covers the 256 color and color feature give the efficient indexing so the retrieval can be done faster. In 2000 Ma give the NeTra has been created with incorporated for the image segmentation.

Fig no 2.3. MARS System

D. Picture & Self-organizing Map (PicSOM)

PicSOM (Picture & Self-organizing Map) was created by Laaksonen in 1999 with tree structured Self Organizating Methodology, that use the image scoring method for similar image matching and retrieving. In 2002 Laaksonen give implementation of content based image retrieval technique with per formation comparison with system Enhancement, Evaluation, Development with different algorithm that use in PICSOM with MPEG-7 (Moving Pictures Expert Group Multimedia Content Description Interface). PICSOM result of precision can be improved with the help of relevance feedback. SIMPLIcity (Semantics sensitive Integrated Matching for Picture Libraries) solved the issue related to segmented images that are set of region with improper and try to give proper methodology for that issue. The segmented images are collection different regions of image. These regions, can be given by number of objects their in the image, by their colors region, by the shapes region, or by the textures region and locations. For the good retrieval performance with precision and recall the image search is done deeply by applying image semantic sensitive categorization for image [Wang, 2001].

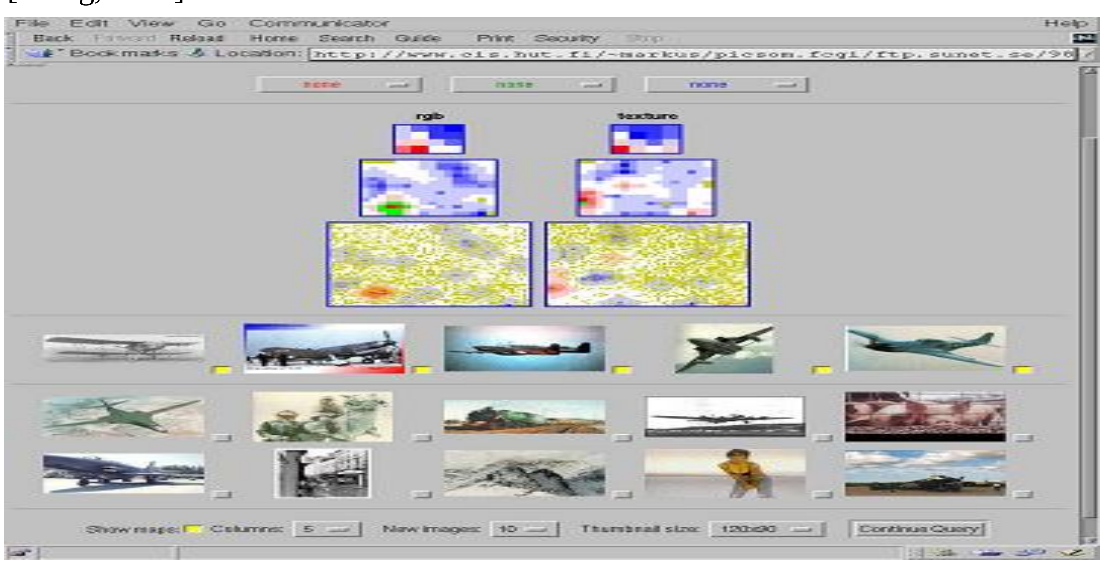


Fig no. 2.4. PICSOM System

2.2.2 Study of Existing Medical CBIR System

Various medical images are essential for surgical development, medical education, and patient analysis. In different medical centers hundreds of images are to be maintaining every month and year. For images classification, index and retrieval in physically with different method is very difficult and timing requirement more because those medical images are different from people to people [5]. In this section, we have studied number of presented technique related to medical image searching technology in content-based image retrieval.

A. Image Retrieval for Medical applications (IRMA)

The Image Retrieval for Medical applications (IRMA) systems developed at the Aachen University of technology to give generally the more image maintain throughout CBIR methods helpful to medical images with the help of intensity division and texture technique in use worldwide for the complete image. This method allows queries on a different category of image group and use to recognize images that are related with value to global features. The IRMA system lacks the capacity for searching exacting pathology that may be restricted in exacting portions through the image. IRMA system show as per below in figure no. 2.5 [51].

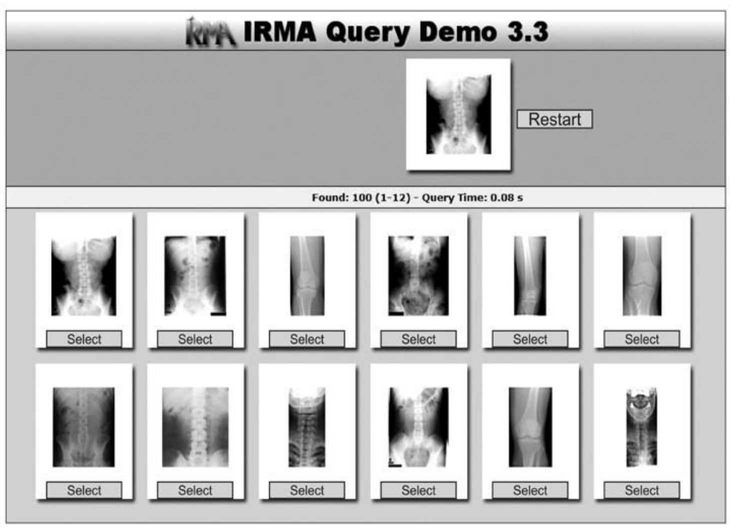


Fig.no. 2.5.IRMA System

B. Spine Pathology and Image Retrieval System (SPIRS)

The Spine Pathology and Image Retrieval System (SPIRS) systems developed at U.S. National Library of Medicine useful to restricted vertebral shape-based CBIR technique for pathologically reactive retrieval of normalized spine x-rays and related people metadata that taken from the second

U.S. National Health and Nutrition Examination Survey [51]. In the SPIRS system, the images are stored and maintained must be homogeneous. SPIRSsystem show as per below in fig. 2.6.

Fig.no. 2.6 SPIRS system

C. Automatic Search and Selection Engine with Retrieval Tools (ASSERT)

The Automatic Search and Selection Engine with Retrieval Tools (ASSERT) A radiologist give the feedback in medical content-based retrieval system for HRCT (High Resolution Computed Tomography) image databases which is developed for radiologist give the feedback method in which the radiologist define the pathology bearing regions (PBR) and a set of anatomical indicator in the image when the image are stored into the database [29, 58]. ASSERT system show as per below in fig. 2.7.

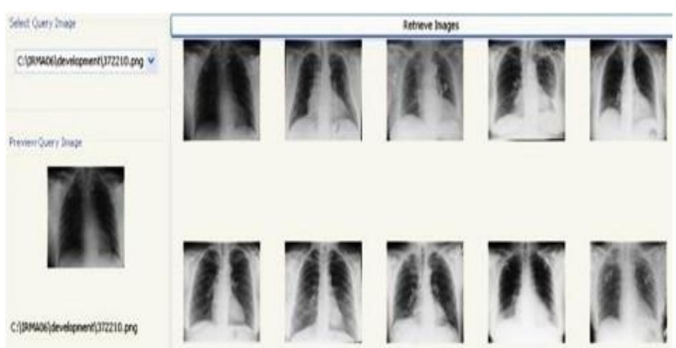


Fig.no. 2.7 ASSERT system

D. Middlesex Image Repository with a CBIR Archiving Environment (MIRAGE)

MIRAGE (Middlesex Image Repository with a CBIR Archiving Environment). Developed with the open source GNU Image Finding Tool (GIFT), the online system helpful to the Query-by-Example (QBE) idea joined with human-relevance feedback deal with these retrieved images most highly look like a query image in look [58].This system has give e-leaning environment for all the students those studied in masters and has recently collected over 100,000 medical images of various types of 2D and 3D. MIRAGE system show as per below in fig. 2.8. [57].

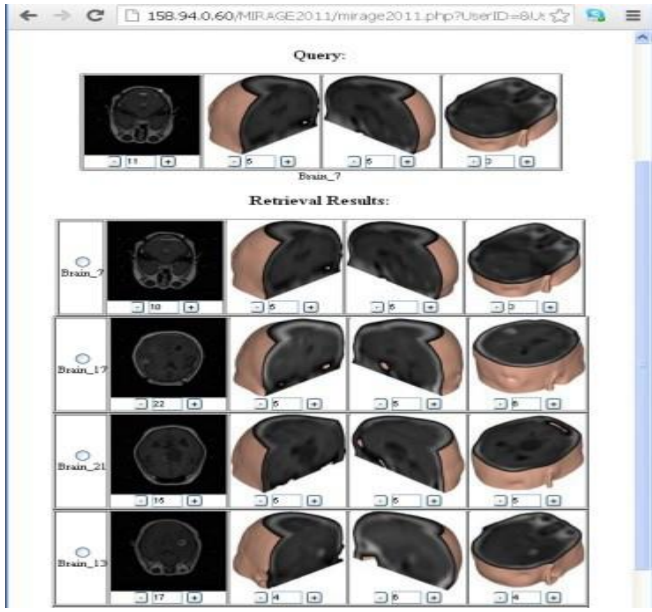


Fig. no. 2.8 MIRAGE System

E. 3D PET/CT

3D PET/CT gives actual understanding for complete body FDG (FluoroDeoxyGlucose) oncology educations and actual period communication by CT, PET and stuck volumes. The system helps medical professional too precisely and professionally mixture CT and PET learning to mix functional and useful images for characterization and rapid injury analysis. 3D permits you to for analysis tools and progressive picturing requirement based on the daily base (Figure 2.9) [51].

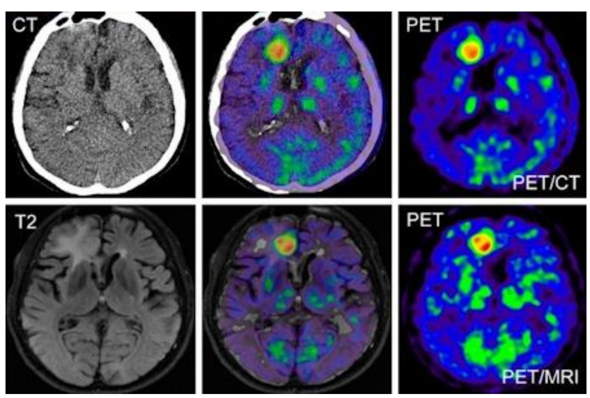


Fig.no. 2.9. The 3D PET/CT image retrieval system

F. MedGIFT (GnuImage Finding Tool)

Uni. Hospital in Geneva (HUG) developed MedGIFT for Grid organization for medical image applications. The GIFT (GnuImage Finding Tool) software uses MedGIFT is a module for studying medical images. The medGIFT retrieval system calculate global and region based color and texture features, 166 colors in the HSV color space, and Gabor filter replies in four directions with three different scales [29].

2.3 Classification Algorithm (Third phase)

This research work gives a survey on several techniques in image mining which was already proposed method they are Neural Network, CART, Naive Bayes, KNN and Decision Tree. This research work provides best method in medical image classification based on the classification accuracy, processing time and error rates.

2.3.1. K Nearest Neighbors (KNN)

K nearest neighbors is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure (e.g., distance functions). KNN has been used in statistical [66] estimation and pattern recognition already in the beginning of 1970s as a non-parametric technique.

The k-Nearest Neighbors algorithm can work for regression and classification [59] in pattern recognition. In classification or regression the input is supplied as the k neighboring training samples given to attribute space, while the amount produced be determined by on either k-NN works for regression or classification:

• The voting of neighbors play an important role for classification of an object. Here k is the number of nearest neighbor. For example if k=1, means the entity is allocated to a single closest neighbor.
• With respect to the property value (i.e. an average value of k nearest neighbors) of the object, k-NN performs the regression.

Among all the machine learning algorithms k-NN is the easy and simplest one. In k-NN the function value is approximated and calculated locally with different computation for the classification. Thus it is lazy learner of can also be said instance-based learner. In k-NN, the nearer neighbors play important role for contribution than far objects for computing the weight in both cases like classification and regression. The weight is given by 1/d where d is distance to the neighbor. This value can be plays a role to classify the object. In k-NN, no training step is required and hence it is sensitive to the local distribution of the data.

Training example has a class label and they are represented in the vector form of the feature space in multidimensional. In the training phase only the class label and the feature vector of the training objects are stored. In k-NN algorithm, k is the constant given by the user, so in the classification part test point is assigned the label that is most nearest in the training of k samples.

Euclidean distance is majorly used for continuous variables, on the other hand Hamming distance is used for text classification kind of discrete variables. Pearson and Spearman [61] used microarray has been used for finding correlation coefficients for gene expression. The performance of k-NN can be also enhanced by learning and analysis of neighborhood components. In figure 2.10 different distance equations have been given as follows:

$$\sqrt{\sum_{i=1}^{k}(\mathrm{xi}-\mathrm{yi})2} \qquad \text{Euclidean Distance}$$

$$\sum_{i=1}^{k}|xi-yi| \qquad \text{Manhattan Distance}$$

$$\left(\sum_{i=1}^{k}(|xi-yi)q\right)1/q \quad \text{Minkowski Distance}$$

Fig. no.2.10: Distance functions equations

$$D_H = \sum_{i=1}^{k}|xi-yi|$$

$$x = y \longrightarrow D = 0$$

$$x \neq y \longrightarrow D = 1$$

X	Y	Distance
Male	Male	0
Male	Female	1

Fig.no. 2.11: Hamming Distance

It should also be noted that all three distance measures are only valid for continuous variables. In the instance of categorical variables the Hamming distance as shown in figure 2.11 must be used. It also brings up the issue of standardization of the numerical variables between 0 and 1 when there is a mixture of numerical and categorical variables in the dataset.

It has been observed that if the classes of the objects distribution is skewed then k-NN has to suffer from "majority voting" drawback. That means, new sample predictions are dominated by more frequent class samples because of their large value (weight) [62]. But this classification problem can also be overcome by weighting the classification with the consideration of the distances among the test point and its k nearest neighbors. In regression problem, the class value of each k nearest points is multiplied with the inverse of the distance from the specific point to the test point. Abstraction in data representation is also the other way to overcome skew problem. K-NN can also be applied to Self-Organizing Map (SOM) without consideration of the density of node which is represented as center of the given cluster.

The data plays important role for selecting the value of k, in most cases larger k value may reduce the noise effects in classification [63]. In this case the class boundaries are less distinct. The heuristic approaches can also be applied to select the good k value. When the class label is predicted to its closest training sample, then it is called nearest neighbor algorithm.

The noise, irrelevant features or non-consistent feature scales are only responsible to degrade the overall accuracy for k-NN algorithm. In order to improve classification accuracy, many researchers contributed for scaling or selection of features. The evolutionary algorithms which optimizes the feature scaling is the well known approach [64]. The mutual information among training data and training classes is also playing good role for feature scaling. Selection of k as an odd number may avoid tied votes in can of binary classification. The well known bootstrap method also generates the practically optimal value of k [65].

2.3.2. Neural Network

Artificial neural network models have been studied for many years in the hope of achieving human-like performance in several fields such as speech and image understanding. The networks are composed of many nonlinear computational elements operating in parallel and arranged in patterns reminiscent of biological neural networks.

Computational elements or nodes are connected in several layers (input, hidden and output) via weights that are typically adapted during the training phase to achieve high performance. Instead of performing a set of instructions sequentially as in a Von Neumann computer, neural network models explore simultaneously many hypotheses using parallel networks composed of many computational elements connected by links with variable weights

An input layer, a hidden layer and an output layer are three layer in the architecture of the neural network. The number of elements existing in one transaction in the database is equal to the no of nodes in the input layer. While the output layer was consisting of one node.

The classification for the image into the different classes gives the node for the output layer. It classifies images as relevant or not relevant classes. For each training transaction the neural network receives in addition the expected output. In the training phase, the internal weights of the neural network are adjusted according to the transactions used in the learning process. This permits the changes of the weights. In the next step, to classify the new images we have to trained neural network.

The main architectures of artificial neural networks, considering the neuron disposition, as well as how they are interconnected and how its layers are composed, can be divided as follows: (i) single-layer feed forward network, (ii) multilayer feed forward networks

A. Single-Layer Feed forward Architecture

This artificial neural network has one input layer with neural layer which is also the output layer. Figure 2.12 give a simple layer feed forward network made up of n inputs and m outputs. The information passes in a single direction (thus, unidirectional), which is from the input layer to the neural layer. From Fig. 2.12, it is possible to see that in networks given to this architecture, the number of network outputs will always according with its amount of neurons. These networks are generally employed in pattern classification and linear filtering problems.

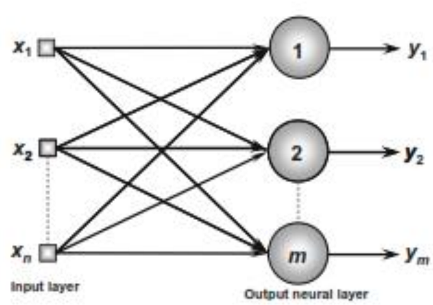


Fig.no. 2.12 Single-layer feed forward network

B. Multiple-Layer Feed forward Architectures

Differently from the first network feed forward networks with multiple layers are composed of one or more hidden neural layers (Fig. 2.13). They are created in the solution of classification problems, like those related to function estimate, pattern classification, system identification, process control, optimization, robotics, and lot many etc..

Figure 2.13 shows a feed forward network with multiple layers created of one input layer with n sample signals, two hidden neural layers consisting of n neurons respectively, and, finally, one output neural layer created of m neurons representing the respective output values of the problem being analyzed.

Among the main networks using multiple-layer feed forward architectures are the Multilayer Perceptron (MLP) and the Radial Basis Function (RBF), whose learning algorithms used in their training processes are respectively based on the useful delta rule and the competitive/delta rule. From Fig. 2.13, it is possible to understand that the volume of neurons created with the first hidden layer is generally different from the number of signals composing the input layer of the network. In fact, the number of hidden layers and their amount of neurons depend on the nature and complexity of the problem being mapped by the network, as well as the quantity and quality of the available data about the problem. Nonetheless, likewise for simple-layer feed forward networks, the amount of output signals will always coincide with the number of neurons from that respective layer.

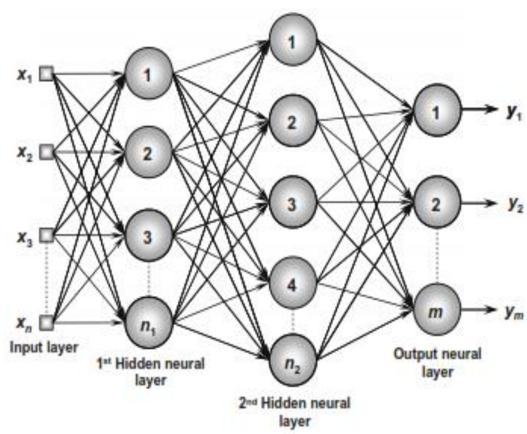


Fig. no. 2.13 Feedforward network with multiple layers

They are highly accurate predictive models which can be applied for large range of problems.

Learning

In terms of an artificial neural network, learning typically happens during a specific training phase. Training can take on many different forms, using a combination of learning paradigms, learning rules, and learning algorithms. Learning is a fundamental component to an intelligent system, although a precise definition of learning is hard to produce. Networks which are able to continue learning during production use are known as dynamical systems. Once the network has been trained, it enters a production phase where it produces results independently. A system which has distinct learning and production phases is known as a static network.

A learning can be of different type that is supervised, unsupervised and hybrid that combined the supervised and unsupervised both to the neural network. The learning method which give training numbers is for the artificial neural network. A hybrid method that mixture of unsupervised and supervised training for specific purpose in some application. For the different type of result the learning rule has the model with types of methods to train the system. The neuronal weights during the training iteration update via the learning algorithm for particularly technology. For the different learning rule use the different learning algorithm for variety of result. In general single procedures can be used via a sole learning rule. Learning algorithm and learning rule can generally be used with different type of learning method, each will give a different result.

The system becomes incapable due to the overtraining problem that created with too many training samples are given for the generalization. Overtraining can also be there when there are too many neurons in the network. The dimensionality of the input space reduce the capacity for computation. The quality and robustness of the network depend on the training to be taken with lots of input samples. The various number of training samples could give various results in neural network.

The Strengths of Neural Networks:

- High tolerance to noisy data
- Well-suited for continuous-valued inputs and outputs
- Successful on a wide array of real-world data
- Techniques exist for extraction of rules from neural networks

2.3.3 Naive Bayes

The Naive bayes algorithm is the most powerful technique. It does the testing process easily and the classification problems can be solved. It can be able to build a model fastly and giving better predictions. To find the missing data the naïve bayes algorithm plays a major role. The unseen data can be easily predicted by characterizing the problem in naïve bayes method. During the construction time and prediction time this algorithm separates the attributes value. The probability of each attributes in isolation process needs only the enough data. So, there is no need of more data collection in this algorithm. Finally, if the data has high correlated features the performance will be degraded.

Naive Bayesian classifiers are based on theorem of Bayesian and they are simple probabilistic classifiers. These classifiers use the weak (naive) dependence assumptions among the attributes/features of the data sets. Naive Bayes classifiers require the set of parameters linear in nature with variables for learning task. They are highly scalable i.e. can be further applied on increasing data set size. They use closed-form expression to train the model for likelihood as much as possible[67][68], this algorithm takes linear (O(n)) time, not the expensive loop/iterative approximation which are used by many other types of classifiers.

To construct the classifiers the Naive Bayes is a simple technique in which the models are prepared as vectors of attribute values to assign class labels to test objects/instances and the class labels are used from some finite set of labels. Naive Bayes is a set of techniques/algorithms based on common principle for training the classifiers. All naive Bayes classifiers assume the weak dependence among the feature values for the class variables. Consider one example to understand this principle, a bird may be considered to be a dove if it is grey in color, small in size, and about 100 gm in weight. Each of these features are to be considered independently to contribute that the bird is a dove by the Naive Bayes classifiers, here the any possible correlations among the color, size and weight features are considered without that they in correlation. Using this approach it is easy to build model for very large data sets. In general Naive Bayes is known for its simplicity and highly sophisticated classification.

There are numerous advantages of the Naive Bayes for which it is widely used are as below:

• It provides fast and easy prediction of test data samples. Multiple class prediction is performed very well by it.

• With minimal training data and strong assumption of independence among attributes, compared to other classifier models like logistic regression a Naive Bayes classifier performs better.

• It is performing more effectively for categorical input variables rather than to numerical variable(s). Normal distribution is assumed for numerical variable. It has the limitations as below:

• Zero Frequency problem: The model will not be able to make a prediction if categorical variable has a category, which was not observed in training data set. To resolve this problem the smoothing technique such as Laplace is used.

• In Naive Bayes probability outputs are not to be taken seriously and hence it is also known as a bad estimator.

• In Naive Bayes is also not good because of the assumption of independent predictors. In ideal situation it is not possible to have the completely independent set of predictors.

2.3.4. Decision Tree

Decision tree algorithm is one of the classifier technique which is in the form of tree structure. For classification and prediction, the powerful tools are available in this algorithm. It has four divisions such as Decision node, leaf node, edge and path. A single attribute is represented in the decision node. Leaf node defines the target attribute. Splitting of one attribute is edge and the path is a final decision. For continuous attribute this algorithm is not applicable

Due to the computational efficiency to handle the large volume of data, Decision Tree (DT) induction is the most well known Machine Learning (ML) framework. It identifies the most contributing features/attributes for the given problem and also provides interpretable results [70].

The Decision Tree is a Tree-shaped structure that represents sets of decisions. These decisions generate rules for the classification of a dataset. Each unique leaf node is dedicated to a record which is starting from the root and continuously moves toward a child node with respect to the splitting criterion. The splitting criteria evaluates a branching condition on the current node with respect to the input records. There are two stages for decision tree construction: the first stage is to build a tree and second is to prune it. In most of the algorithms the tree grows in top down way with greedy approach. It starts with the root node, followed by at each intermediate node the database records are evaluated with some splitting criterion. This procedure is applied recursively and likewise the database is partitioned/splitted. In second stage, the tree pruning is applied to reduce its size with some sophisticated way which reduces the prediction error [69].

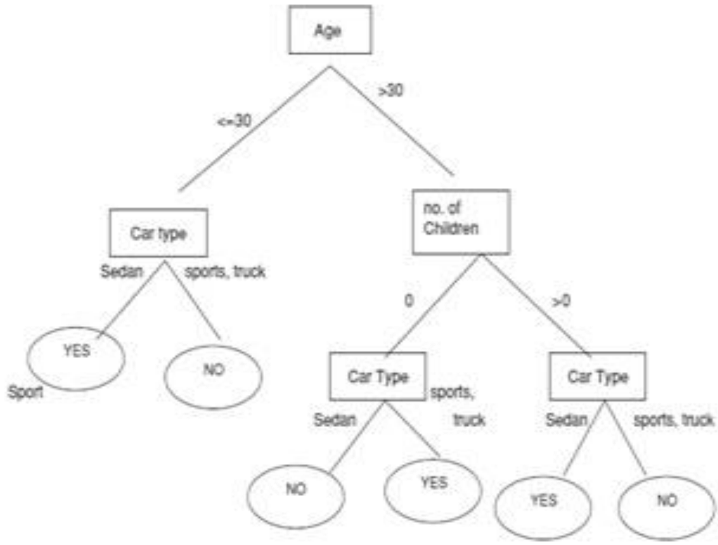


Fig.no. 2.14: Decision tree based classification for car subscription

2.3.5. CART

The classification and regression tree (CART) algorithm is mainly used for the classification of different tissues in image mining, which is on the basis of several derived parameters. The recursive partitioning method used in the CART algorithm to introduce the tree based modelling which is later converted to the statistical mainstream. To select the optimal tree value the algorithm involves the cross validation scheme from some rigorous approaches. Based on the technique called surrogate splits the algorithm automatically handles the missing values. For example the variable (x=t1) is selected then the greatest separation is produced so (x=t1) is said to be split. If this variable X it sends to which is less than t1 then the data is send to left or else it sends to right. The process is repeated for all the nodes. So that it is easy to conclude that CART algorithm uses only the binary splits.

2.3.6. K-Means

K-Means algorithm is said to be an unsupervised clustering algorithm. It works well for numerical data alone. The pixel-by-pixel image classification is possible by defining single and multiple thresholds. So that histogram statistics is used in this algorithm for the pixel based classification. The main work of this process is to check whether the histogram is bimodal or not. If it is then the gray value will be appeared otherwise the images get partitioned into several regions. The threshold of gray value can be determined using the peak values. However it converges only the local minimum values. So the algorithm involves number of clusters for the optimization [71].

2.4 Low Level Feature Extraction

The input to algorithm is so much high data and difficult to be processed so it is supposed to be repeated, then the input data will be changed into a compact set of features (also called features vector). Changing the input data into the set of features is called feature extraction. The need for the feature extraction is that if the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input. Features such as shape, texture, color, etc. are used to describe the content of the image.

Ryszard suggested the feature extraction techniques from images which are applicable in biometrics and the content based retrieval systems. The features are pixel-level features, local features and global features. Pixel-level features are calculated at each pixel such as color and location. Local features are calculated over the subdivision of image. Global features are estimated over the entire image.

2.4.1 Color Features

The color feature has widely been used in CBIR systems, because of its easy and fast computation [86]. Color is one of the visual attributes that can provide more information about the visual content of an image and the most widely used feature in CBIR [87].

Color used for pictorial content for image retrieval [82]. First color space must be defined before selecting actual color descriptors. Generally colours are given in three dimensional colour which could be RGB, HSV (Hue, Saturation, and Value). The image representation generally used with color. The representation of color done with the help of main three color like red, green, blue or mixture with three colors. In computer graphics uses generally HSV color. Here the Hue depend on the modification in camera lighting and direction. [81].

A. Color Histogram

Color Histogram is used for visulization of colour information for image if colour design is single related with the other data. Colour Histogram computes for local and global distribution of colour. Colour histogram is a method of colour information retrieval. Colour histogram has not consider the location value of pixels for the different images can have similar color [80].

The color histogram is the most traditional and the most widely used way to represent color patterns in an image [75, 76]. Many applications require methods for comparing images based on their overall appearance Color histograms are frequently used to compare images [77]. The color histogram serves as an effective representation of the color content of an image if the color pattern is unique compared with the rest of data set.

B. Color Space

Each color in the color space is a single point represented in a coordinate system. several color spaces, such as RGB, HSV, CIE *L*a*b*, and CIE *L*u*v*, have been developed for different purposes. The RGB space is a widely used color space for image display. It is composed of three color components red, green, and blue. The CIE *L*a*b* and CIE *L*u*v** spaces are device independent and considered to be perceptually uniform. They consist of a luminance or lightness component (L) and two chromatic components a and b or u and v. In HSV (or HSL, or HSB) space is widely used in computer graphics and is a more intuitive way of describing color. The three color components are hue, saturation (lightness) and value (brightness). In contrast, CMY (Cyan, Magenta, and Yellow) space is a color space primarily used for printing. The three color components are cyan, magenta, and yellow [72].

C. Color Moments

Color moments have been successfully used in many retrieval systems (like QBIC CBIR system [73, 74]). It has been shown that color distribution info is captured by the three different moments. The one order moment (μ) captures the mean color, the two order moment (s) captures the standard deviation, and the third-order moment captures the skewness (θ) of color. These three low order moments are extracted for each of the three color planes, using the following mathematical formulation [72].

$$\mu_c = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N} P_{ij}^{c}$$

$$\sigma_c = \left[\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(P_{ij}^{c}-\mu_c)^2\right]^{\frac{1}{2}}$$

$$\theta_c = \left[\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(P_{ij}^{c}-\mu_c)^3\right]^{\frac{1}{3}}$$

Color Moments effectively used in different type of retrieval systems particularly. [83]. The mean, variance, skewness, color moment have been showed the useful in visualization of color discription of images. Here skewness recovers the retrieval presentation but sometimes reductions in the performance when there are changes in section [81].

D. Color Coherence Vector

Colour histogram is similar as colour coherence vector technology but the colour histogram take the position value of intensity. The histogram is of the two type that is first coherent, if it covers to big constant colour region and second is incoherent, means it does not cover large uniform color region. It gives good outcome than color histogram when the constant color or texture part in the image [79].

E. Color Correlegram

It is predictable to describe not the colour allocations of image but similarly covers the info for location and connection of pairs of colors. Color Correlegram gives good result than color coherence vector and color histogram. It has the more computation time for the high dimensity [78].

The following fig no 2.15 and 2.17 are some practical implementation color feature example with color histogram and color zone for 6 different type of query image as shown in fig no 2.16

Fig. no. 2.16 Query Image

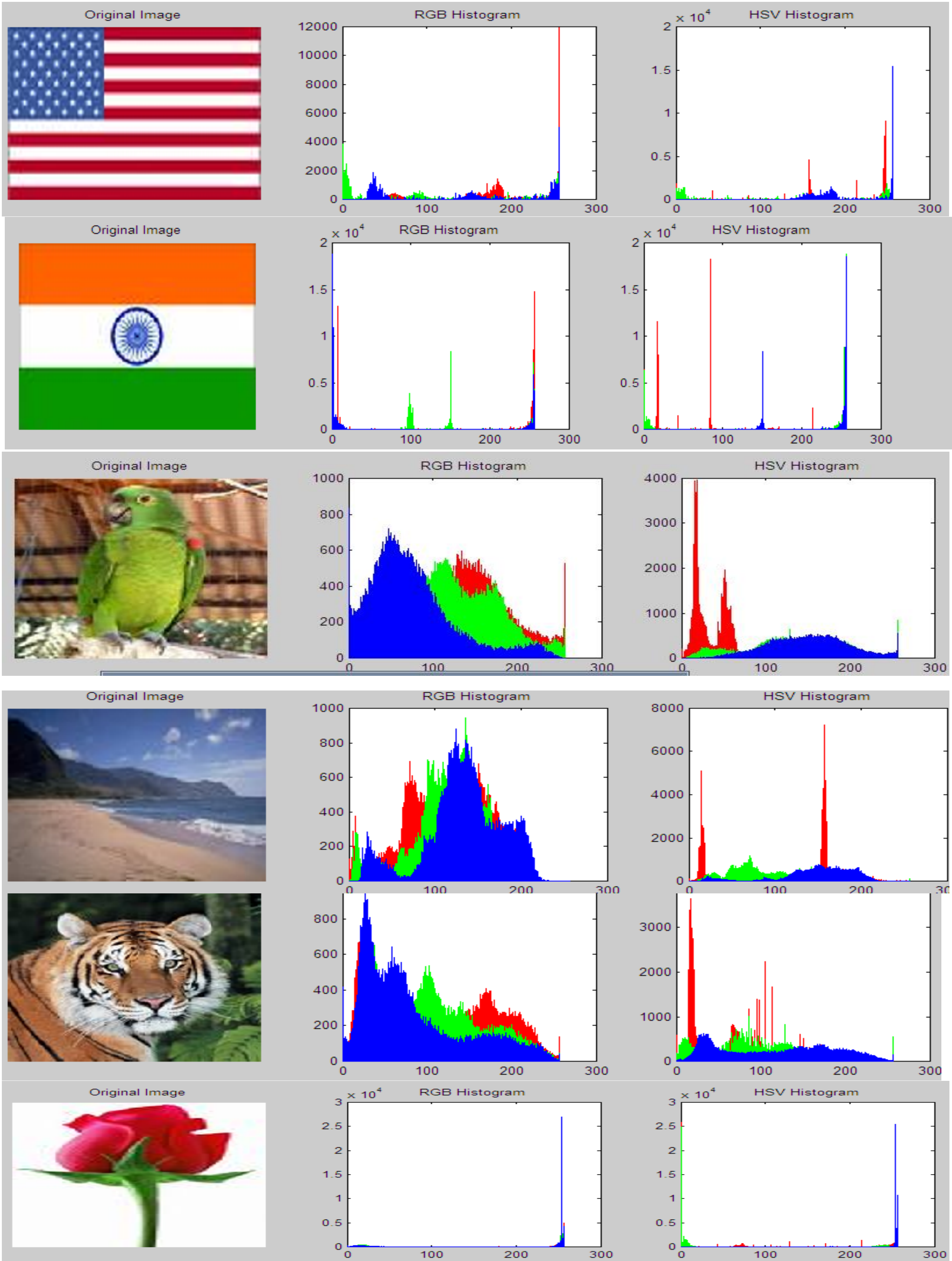


Fig. no. 2.15 Color histogram of query image

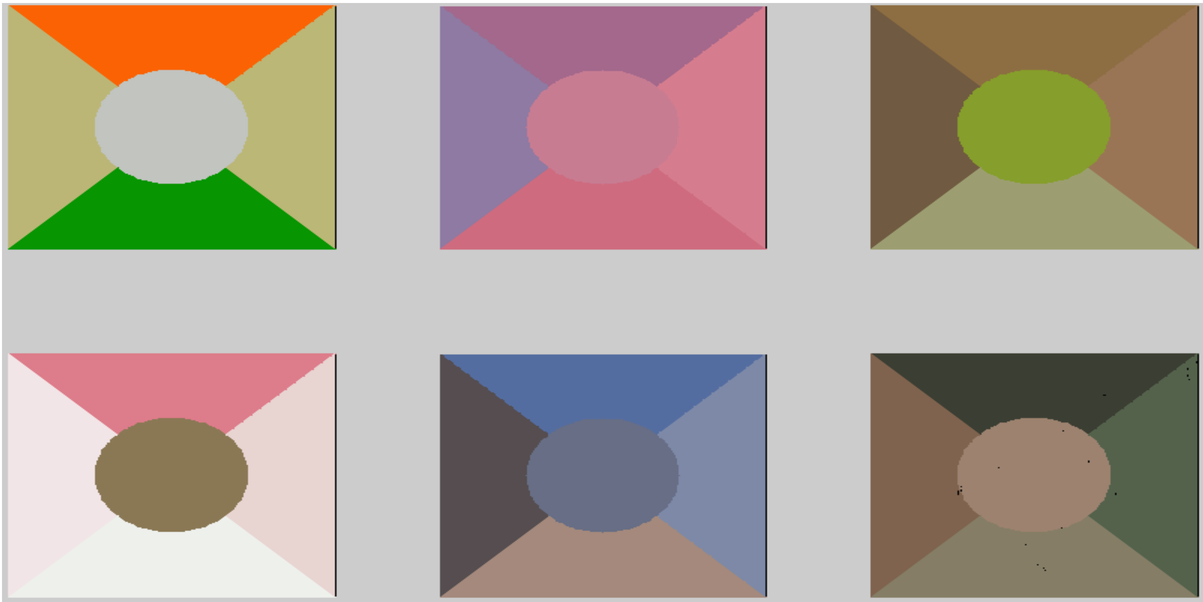


Fig. no.2.17 Color zone for image

2.4.2 Texture

Texture is the essential things for faces that terms as graphical patterns and covers important information for the physical plan to the plane and connection for the nearby environment. Different texture images can be found in computer filed.

The texture can be classified in two types of categories: (i) Structural [89] (ii) Statistical [88, 89].

1. Structural Methods: It is denote the texture by different technique and location prepare for these values [89]. So this value may be extracted for the feature extraction. The analysis is finished by calculating numbers of the values with area, intensity, orientation, and elongation once the values have been extracted, [89]. When textures are in regular or similar pattern then these methods are very useful. So it is not good for that type of images with natural images that do not have regular patterns of texture. The example of these method are different clustering and morphological methods.

2. Statistical Methods [88, 89]: Statistical methods study the location of gray values by calculating local features at each & every point in the image, and deriving a set of numbers from the local features. Statistical methods can be of different type with first-order of one pixel, second-order of two pixels and higher-order of three or more pixels statistics depending on the number of pixels that defining the local feature. By ignoring the spatial communication between image pixels the basic difference between those methods are first order data estimate properties like average and variance of specific pixel values. Where second- and higher-order statistics approximation properties of two or more pixel values happening at specific locations relative to each other.

The intention of Feature extraction is to reduce the original data set by measuring certain properties, or features, that distinguish one input pattern from another pattern [94]. The extraction of feature vector which consists of various feature components. It is produced to find the content of each image in the database with accuracy and uniqueness. Spatial gray level co-occurrence matrix estimate the image values connected by another order statics. Haarlick suggested use for GLCM (Grey Level Co-occurrence Metrics) is one of the most well known method. The wavelet based texture feature for classification is used by [98]. Multi fractional Brownian motion (MBM) algorithm is used in.

The advantage of this method is image with different resolution gives same result. Modified Haar wavelet transformation is proposed in [98]. The texture features namely Contrast, correlation Homogeneity and Energy is used in. This improves specificity and accuracy of retrieved image. Auto color correlogram and correlation in will get accuracy in less iteration. But the iteration is depending on the need of application. EI-Sayed et al. [93] has obtained the features related with MR images using discrete wavelet transformation (DWT). From the above mentioned techniques, it is clear that the extraction of appropriate features will improve the accuracy for classification and similarity matching. The generally used texture extraction methods are as given in below:

A. Gray Level Histogram (intensity)

Colour histograms are the most common way of describing low-level colour properties of images. Since medical images are only available in grayscale, a simpler histogram called gray level histogram (GLH) is used to describe intensity of gray level colour map. A GLH is presented by a set of bins where each bin represents one or more level of gray intensity. It is obtained by counting the number of pixels that fall into each bin based on their intensity. Fig. 2.18 shows an example of GLH for different images using 64 bins histogram [97].

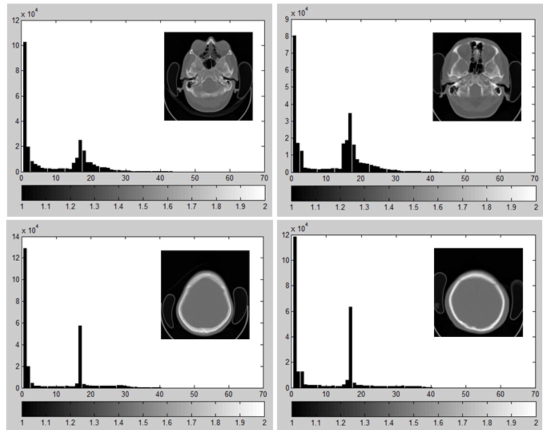


Fig.no. 2.18.   Gray level histogram with 64 bit

B. Other Feature

Mean : It is the average for the selected gray value within the image. It is the addition of the selected the pixel intensity with divided by the number of pixels.

Standard deviation: It is square of variance. Standard deviation (σ) of the gray values used to generate the mean gray value.

Entropy: Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

Contrast : Contrast is a measure of intensity or gray level variations between the reference pixel and its neighbor. Large contrast reflects large intensity:

Correlation feature shows the linear dependency of gray level values in the co-occurrence matrix:

$$Mean = \sum_{i=1}^{n}\sum_{j=1}^{m} x_y/mn \quad (1)$$

$$Variance = \frac{1}{mn}\sum_{i=1}^{n}\sum_{j=1}^{m} x_y - Mean \quad (2)$$

$$\sigma = \sqrt{Variance} \quad (3)$$

$$Correlation = \sum_{i,j}\frac{(i-\mu i)(j-\mu j)P_u}{\sigma_i\sigma_j} \quad (4)$$

$$Entropy = -\sum_i\sum_j P_d(i,j)\log P_d(i,j) \quad (5)$$

$$Contrast = \sum_i\sum_j (i-j)^2 P_d(i,j) \quad (6)$$

In Equation 1 m and n are size of image Xij. In Equation 5 and Equation 6 is the pixel at i and j position, Pd(i,j) is the probability distribution function [97].

C. Gray Level Co-occurrence Metrics (GLCM)

GLCM is the feature extraction method that useful in texture. A GLCM covers the location of pixel has related gray level value. It is a technique that calculate the relation between pixel pairs of the image [88]. In conservative GLCM has texture feature like energy, entropy, contract, correlation can be calculated. Other implementations of the GLCM, given by second order position method of the texture features, one dimensional GLCM, using the raw GLCM itself in place of the first-order statistics and given on other color space for color co occurrence matrix [88].

D. Discrete Wavelet Transform

A set of wavelet basis functions that describe multi resolution decomposition [96] process for the growth of an image. It decays image into replaced images with different scale and different resolution. It decayed the image in four substitute band LL, LH, HL, HH. It recursively divide the LL band. To solve this drawback for some textures that has most useful information present in the middle frequency channels, it decays other bands such as LH, HL or HH when required [91].

Using the pyramid-structured wavelet transform, an image is decomposed into four sub images. Due to the innate image properties that allows for most information to exist in lower sub-bands, the pyramid-structured wavelet transform is highly sufficient for lower sub-band energy calculation. This energy was calculated using the volume of the area under the three dimension DWT curve. It was found that DWT energy value is different from tumor image than non tumor images.

- **Two Dimension Discrete Wavelet Transform**

The Discrete Wavelet Transform (DWT) is used in a variety of signal processing applications, such as video compression. Internet communications compression, object recognition, and numerical analysis. This transform is discrete in time and scale. In other words, the DWT coefficients may have real (floating-point) values, but the time and scale values used to index these coefficients are integers. The wavelet transform is gaining popularity with the recent JPEG-2000 standard, which incorporates multi resolution analysis (Michael weeks (2007)). The DWT represents an image as a sum of wavelet functions, known as wavelets, with different location and scale.

The DWT represents the image data into a set of high pass (detail) and low pass (approximate) coefficients. The image is first divided into blocks of 32×32. Each block is then passed through the two filters: the first level decomposition is performed to decompose the input data into an approximation and detail coefficients. After obtaining the transformed matrix, the detail and approximate coefficients are separated as LL,HL, LH, and HH coefficients, (AmirEhsan Lashkari (2010))[98].

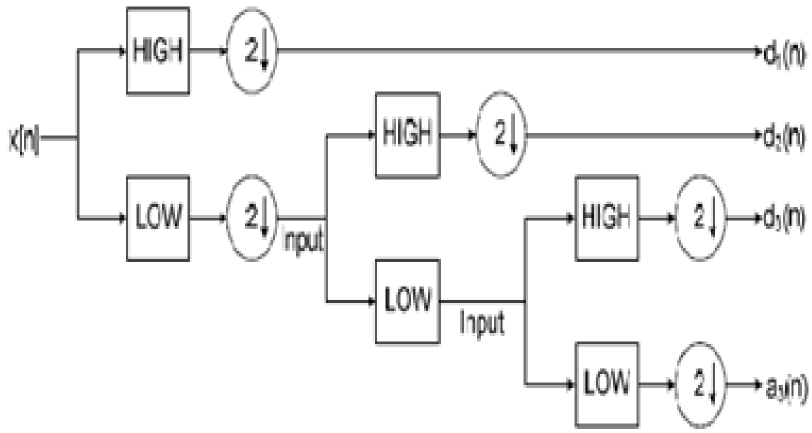


Fig.no. 2.19: Block Diagram of the 2-Level DWT Scheme

E. Discrete Cosine Transform

The discrete cosine transform (DCT) represents an image as a sum of sinusoids of varying magnitudes and frequencies. The DCT has the property that, for an image, most of the visually significant information about that image is concentrated in just a few coefficients of the DCT. For this reason, the DCT is often used in image applications. Before calculating 2-D DCT for an image, the canny edge detection algorithm was performed first. Canny algorithm used for detecting sharp changes in image brightness which correspond to discontinuities in depth, discontinuities in surface orientation, changes in material properties or variations in scene illumination. Second, the DCT for the image is calculated.

Then that image DCT result was drawn in three dimensions. After that the volume of the area under that three dimension curve was calculated. It was found that this area is different from tumor image than non tumor images. Also this area represents the quantity of difference in the image spectrum.

$$D_{DCT}(i,j) = \frac{1}{\sqrt{2N}} B(i)B(j) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} M(x,y) \cdot \cos\left[\frac{(2x+1)}{2N} i\pi\right] \cos\left[\frac{(2y+1)}{2N} j\pi\right]$$

Where x=0, 1, ….., n-1, is the list of length n

$$B(u) = \begin{cases} \frac{1}{\sqrt{2}} & if \quad u = 0 \\ 1 & if \quad u > 0 \end{cases}$$

For u= 0, 1, 2, … N-1.

DCT Attempts to decorrelate the image data after decorrelation each transform coefficient can be encoded without dropping off compression efficiency. The DCT for an N×N input sequence can be defined as: N is the size of the block that the DCT is applied on. The equation calculates one entry (i, j) of the transformed image from the pixel values of the original image matrix. M(x,y) is the original data of size x* y, (Ramandeep Kaur Grewal, and Navneet randhawa (2012))[98].

F. Gabor Transform

Gabor transform is a technique that extracts texture information from an image. The one used in this research is a two-dimensional Gabor function proposed by Manjunath and Ma [95]. Expanding the mother Gabor wavelet forms a complete but non-orthogonal basis set. The non-orthogonality implies that there will be redundant information between different resolutions in the output data. This redundancy has been reduced by [95] with the following strategy: Let *U* denote the lower and upper frequency of interest, *S* be the total number of scales, and *K* be the total number of orientations (or translations) to be computed. Then the design strategy is to ensure that the half-peak magnitude support of the filter *l* and *U* responses in the frequency spectrum touch each other as shown in Fig. 2.20

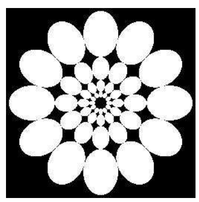


Fig.no. 2.20. Frequency spectrum of 2D Gabor transforms

In the following figure no 2.21 give practical implementation of texture feature with different transform

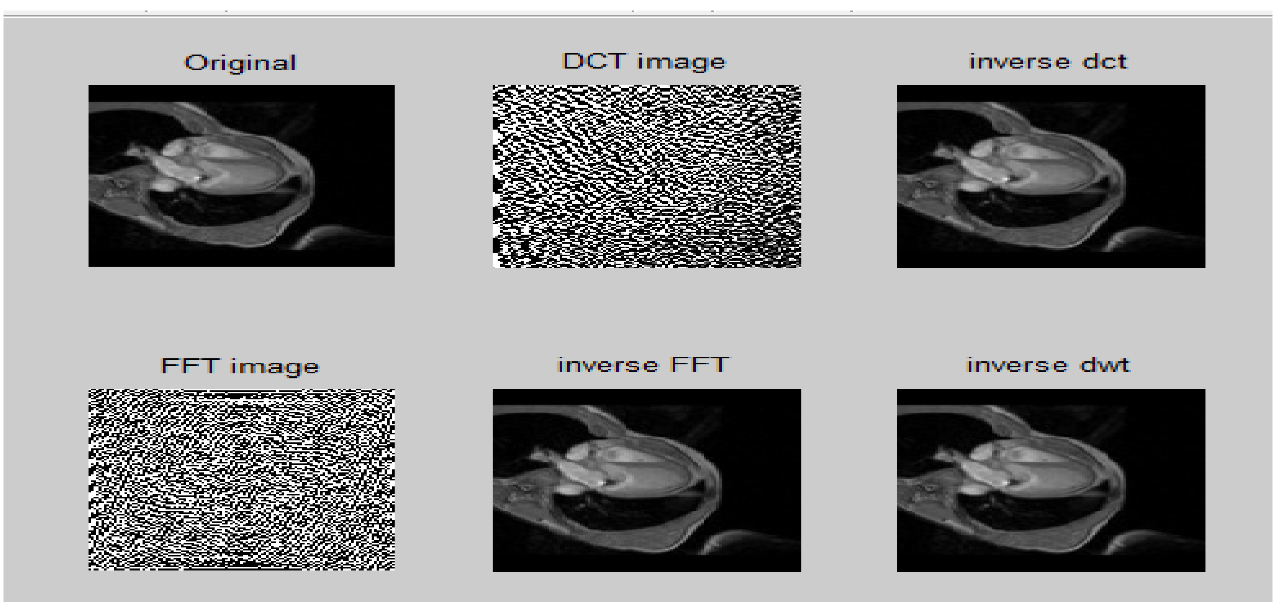


Fig. no 2.21 Texture feature with transform

2.4.3 Shape

In shape-based techniques, shape feature has broad range of feature sets normally include edges, corners, and visual cues such as contour, curve, surfaces, chain codes and curvature scale space. Like shape, colour, and texture are not universal feature for the image. In the texture and color, distance calculation done if a query image has a specific texture or color. Many of the shape feature extraction technique are as given below:

A. Other Feature

Area: Area of selection in square pixels or in calibrated square units. (e.g., mm2, µm2, etc)

Mean gray value: Ave rage gray value within the selection. This is the sum of the gray values of all the pixels in the selection divided by the number of pixels.

Standard deviation: Standard deviation of the gray values used to generate the mean gray value.

Center of mass: This is the brightness-weighted average of the x and y coordinates all pixels in the image or selection. These coordinates are the first order spatial moments.

Integrated density: The sum of the values of the pixels in the image or selection. This is equivalent to the product of Area and Mean Gray Value.

Median: The median value of the pixels in the image or selection.

Skewness: The third order moment about the mean.

Kurtosis: The fourth order moment about the mean.

Edge: Using canny edge detector, gradient, and other operators.

Circularity:

$$Circularity = 4\pi \left(\frac{Area}{Perimeter^2}\right) \tag{7}$$

Equivalence diameter (circle with same area as the region)[97]

$$Equivalence\ Diameter = \sqrt{\frac{4*Area}{\pi}} \tag{8}$$

B. Hu Moment Invariants

For this shape representation, invariant moments are based on derived by Hu [97]. Hu defined seventh moments that allows moment calculating which are invariant under translation and changes in scale and rotation. It includes skew invariant which can differentiate mirror images of otherwise undistinguishable images. The seven moments are used as features, hence making 7-dimensional feature vector.

Moment invariant is known as geometric moment. For the features extracted total seven moments used for shape feature extracted. The advantage this technique is invariant to rotation, scaling and translation. The moments are easy to calculate.

C. Fourier Descriptor

Fourier Descriptors (FDs) is a powerful feature for boundaries and objects representation. Consider an N-point digital boundary; starting from an arbitrary point (x) and following a steady counter clockwise direction along the boundary, a set of coordinate pairs can be generated. These coordinates can be expressed in a complex form such as The discrete Fourier transform (DFT) of *z(n)* gives $z(n) = x(n) + jy(n), n = 0,1,2,\ldots, N-1$

Discrete Fourier Transform of z(n)(boundary point) gives value of Fourier Descriptor. The complex coefficients *a(k)* are called the Fourier Descriptors of the boundary. 64-point Discrete Fourier Transform (DFT) is used which results on 64-dimension of feature vector. Fourier Descriptors (FDs) is a powerful feature for boundaries and objects representation [97].

$$a(k) = \sum_{n=0}^{N-1} z(n) \exp[\frac{-j2\pi kn}{N}] \ , 0 \leq k \ \leq N-1 \tag{9}$$

In the following figure no 2.22 give practical implementation of shape feature with edge detection

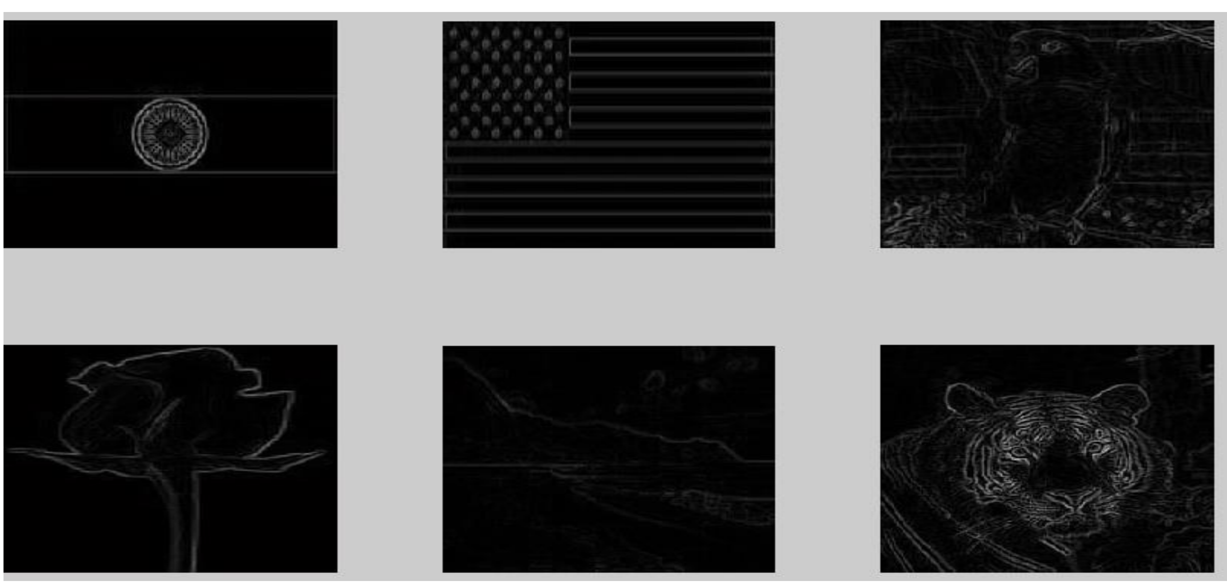


Fig. no. 2.22 Shape feature with edge detection

Chapter - 3

Comparison of system & Problem definition

CHAPTER - 3

Comparison of system and Problem definition

3.1 Comparison of Various Technique

In this section comparison done on the various type work done on Literature Review. In this section comparison done on the paper reviewed, system reviewed, classification technique reviewed and features reviewed. All the comparison given in the following section with different table.

3.1.1 Comparison by paper reviewed

In the overall comparison among different paper review with existing CBIR and medical CBIR system with different feature and classification techniques. In the table no 3.1 gives CBIR systems paper reviewed with QBIC system then VisualSeek system and PICSOM system. In the table no 3.2 gives medical cbir systems paper reviewed with color, texture and shape features. In the table no 3.2 gives classification paper reviewed with Neural Networks and other technique. Finally the all the related papers have been discussed. Out of these techniques texture and shape feature are more useful for medical image retrieval system and neural network useful for the classification, it is better than other technique.

Reference	System / Method	Comments
M. Flickner, H. Sawhney, W. Niblack [42][43]	Query by Image and Video Content: the QBIC System	Query given by the images, user created sketches or drawings or choosing the texture and color patterns
J. R. Smith, S. F. Chang [44]	VisualSEEk: A Fully Automated Content – Based Image Query System	Use content-based & spatial image query (provides feature comparison & spatial query for unstructured color images)
J. Laaksone M. Koskel Oja [45]	PicSOM: Content Based Image Retrieval for Self-Organizing Maps	Similarity scoring method using tree structured SOM

Table no 3.1 Comparison with CBIR system

Reference	System / Method	Comments
Jagdeesh pujari, Pushpalatha S.N., Padmashree D. Desai [46]	Content-based Image Retrieval using Color and Shape Descriptors	Color and Shape features are used Features are extracted using Lab & HSV Color space (L – lightness, a&b – color components)
Hamid Zoyaki Bahri abdelkhalak [47] IEEE 2010	Indexing and Content-based Image Retrieval	Color information of the pixel and its position is combined to extract features Signature of image is built by classifying their pixels and its spatial information using Kd-tree Method of similarity measure used is EMD distance
Chen Feng, Yu Song-nain [48] 2011 IEEE	Content-based Image Retrieval by DTCWT (Dual-tree Complex Wavelet Transform)	Detects key points using DTCWT to make feature vectors Feature vectors are scale, translation and rotation invariant
Jan-Ming Ho, Shu-Yu Lin, Chi-Wen Fann, Yu-Chuum Wang Ray-I Chang [49]	A Novel Content-based Image Retrieval System using K-means with feature extraction	K-means clustering (non-hierarchical) is used for clustering the data before feature extraction Feature extraction is done using Color and Contrast Context Histogram
Nishant Shrivastava, Vipin Tyagi [50] 2012 IEEE	Multi stage CBIR	Images are retrieved in stages: Color, Texture and Shape Three layer feed forward architecture is used
N. Kumaran , Dr. R. Bhavani ICETS 2014 [51]	Texture and Shape Content Based MRI Image Retrieval	Query can be medical images, user-constructed features based on shape and texture patterns

Amitkumar Rohit, Dr. Nehal Chitaliya 2014 IJEDR [52]	Content Based Brain Image Retrieval – A Retrospective	Images are retrieved in stages: Texture and Shape It also classify the image with various classifier like ANN, SVM, and other
V. Amsaveni, Noorul Islam, N. Albert Singh, 2013 IEEE [53]	Detection of Brain Tumor using Neural Network	The extraction of texture features in the detected tumor has been achieved by using Gabor filter. These features are used to train and classify the brain tumor employing Artificial Neural Network classifier
N. Kumaran , Dr. R. Bhavani ICETS 2014 [54]	Texture and Shape Content Based MRI of Brain Image Retrieval System	Query can be medical images, user-constructed features based on shape and texture patterns Then experiment result done
Amitkumar Rohit, Dr. Nehal Chitaliya 2014 IJEDR [55]	Content Based Brain Image Retrieval – A Retrospective	Images are retrieved in stages: Texture and Shape It also classify the image with various classifier like ANN, SVM, and other classifier.
V. Amsaveni, Noorul Islam, N. Albert Singh, 2013 IEEE [56]	Detection of Brain Tumor using Neural Network	The extraction of texture features in the detected tumor has been achieved by using Gabor filter. These features are used to train and classify the brain tumor employing Artificial Neural Network classifier

Table no 3.2 Comparison with MCBIR with feature and classification system

3.1.2 Comparison by CBIR System

Table 3.3 covers different image retrieval systems given for different general database. For image management generally content based image retrieval system has been used. You can compare the CBIR system with different feature and different modality of image.

In this cbir system compare with QBIC system, PICSOM system and Isearch system. This systems are compare with color, texture and shape feature. The systems are compare with different other feature like relevance feedback support or not then sketch support for the query or not like that way other features also compare. This all discussed in the following table 3.3 and 3.4.

Feature	QBIC	ISearch	PICSOM
Color	√	√	√
Color Layout	√	√	
Texture	√		√
Shape	√		√
Keywords	√		

Table no3.3 Comparison cbir system with features

Features	QBIC	ISearch	PICSOM
Number Of Reference Image	One	One	Many
Relevance Feedback	No	No	Yes
Initial Images	Random	Random And Browsing	Browsing
User Provided Reference Image	Yes	No	Yes
Sketch Support	Yes	No	No
Implementation	Both	Local	Web

Table no3.4 Comparison cbir system with other features

3.1.3 Comparison by Medical CBIR System

Table 3.5 covers different CBIR systems given for different medical database. For image management generally CBIR system has been used. You can compare the CBIR system with different feature and modality of image. This systems are compare with texture and shape feature. The systems are compare with different types of medical images. This all discussed in the following table.

Name/Feature	Imaging Modality	Domain
QBISM / Intensity	MRI / PET	Brain
FICBDS / Physiological information	Functional PET	Brain
MIMS / Ontology	All	All
MIRAGE / 3D texture	MR	Brain
Knowledge	All	All
ILive modality	All	All Organs
2D Texture	MR	Heart
3D PET / lesion	PET	Brain
Predefined semantic	CT	Brain
IRMA	MRI	Spine

Table no. 3.5 Comparison CBIR system with other features

3.1.4 Comparison of classification techniques

In the table 3.6, the overall comparison among different classification techniques such as decision tree, Naive Bayesian, K-Nearest Neighbor, Decision Tree and Neural Networks have been discussed. Out of these techniques Neural Network is easy to understand and to develop.

Decision Tree	**Naive Bayes**	**K- Nearest Neighbor**	**Neural Networks**
Easily Ob-served and develop generated rules	Fast, highly scal-able model build-ing (parallelized) and scoring	Robust to noisy training data and effective if the training data is large	High tolerance of noisy data and ability to classify patterns for untrained data

Table no 3.6 Comparison of classification algorithm

Various image datasets helps to find the classification performance of data mining algorithms. The used data sets are shown in table 3.7.

Sr. no	Algorithm	Dataset
1	ANN	Brain
2	KNN	Brain
3	CART	Lung
4	K-Means	Breast Lesion
5	Navies Bayes	Breast Lesion
6	Decision Tree	Breast

Table no 3.7 Comparison of algorithm with different dataset

This part lists out the positive and negative aspects used in various algorithms present in this following table no. 3.8 for the classification algorithm.

Sr no	Algorithm	Purpose	Limitation
1	ANN	It is used to analyze all the image from the heterogeneous dataset	It is complex to interpret and tough to learn
2	KNN	It is used to analyze the MR images from the heterogeneous dataset	Some of the features are not properly used in local image features
3	CART	This algorithm is used to enable the accurate fraction estimation of the substances	Complex classification step are followed
4	K-Means	It is used to find exact lesion objects	Parameters are not sufficient for the detection process
5	Naïve Bayes	It improves the detection sensitivity	Low scan speed
6	Decision Tree	Thermograph images was projected for the feature extraction	Credibility and sensitivity are not accurate

Table no 3.8 Classification algorithm comparison

In the table 3.9, the feature wise comparison [18][19] has been shown. The different features such as learning type, speed, accuracy, and scalability for classification techniques have been summarized more precisely.

Features	Decision Tree	Naïve Bayes	K- Nearest Neighbor	Neural Networks
Learning Type	Eager Learner	Eager Learner	Lazy Learner	Eager Learner
Speed	Fast	Fast	Slow	Fast
Accuracy	Good in many domains	Good in many domains	High Robust	Good in many domains
Scalability	Efficient for small data set	Efficient for large data set	Efficient for large data set	Efficient for large data set

Table no 3.9 Classification algorithm comparison

In this part, the comparative results and the datasets are listed for the data mining algorithms. The accuracy of various algorithms is clearly noted in this table 3.10.

Classifier	Classifier Accuracy (%)
Regression Tree	63
KNN(K Nearest Neighbor)	72
Naïve Bayes	90
Multilayer perceptions Neural Network	91

Table no 3.10 Classification Accuracy with algorithm

3.1.5 Comparison by Feature for Medical CBIR System

Table 3.11 lists various medical database with different feature proposed for several CBIR systems. For image management generally content based image retrieval system has been used. You can compare the CBIR system with different feature, different modality of image with different precision and recall. This systems are compare with texture, shape and other features. The features are compare with different types of medical images. Table 3.12 lists various image retrieval system with relevance feedback and their precision and recall. In this comparison you can see features is main part for retrieval. Compare the relevance feedback with different feature and give good precision and recall for various features. This all discussed in the following table.

Feature	Precision	Recall	Retrieval
Texture	85%	80%	70%
Shape	95%	95%	74%
Fourier descriptor	95%	90%	67%
FFT	83%	78%	72%
DCT	85%	80%	74%
DWT	90%	82%	74%

Table no 3.11 Precision and Recall for different features

S.NO	AUTHOR	YEAR	PROPOSED METHOD	RESULTS
1	Slobodan Čabarkapa et al.	2005	Relevance feedback based adaptive retrieval approach	Average Retrieval rate =89.5%
2	Quanzhong Liu et al.	2008	Real-code genetic RF	Precision=75% Recall=69%
3	Peter Auer ,Zakria Hussain et al.	2010	Implicit relevance feedback	Average precision =15.0
4	Chih-Chin Lai and Ying-Chuan Chen	2011	Interactive genetic algorithm	Precision=80.6% Recall=15.8%
5	Manish Chowdhury, Sudeb Das, and Malay Kumar Kundu	2012	Ripplet Transform & fuzzy relevance feedback	Average Precision=0.55

Table no 3.12 Precision and Recall for Relevance feedback

3.2. Problem Definition

3.2.1 General CBIR problem definition

Building any systems is required in software development life cycle with regular user feedback needed due to the development process. Google Images or Yahoo! Images has image retrieval systems that are for public usage which are based mainly on nearby area metadata not on the content. As we have to discuss them in details, the CBIR has been used with number of areas like as Medical, Astronomy, Botany, and remote sensing [108, 110]. We find the some of the problems to be critical for real world organization. With more research this area at present, there is a more possibility that image retrieval systems will vary and enlarge more [107].

Performance: Most of the present research is focused on improving performance with precision and recall in the system. The biggest problem is the excellence of retrieval and how applicable it is to the domain given by user for community.

Semantic learning: To handle the issue of semantic gap given by CBIR, to efficiently leverage semantic estimation are important direction for learning image semantics from developing retrieval mechanisms and training data

Volume of Data: The CBIR system must handle enough to handle retrieval and indexing with heavy size of database [107]. Public image databases are grow into heavy sizes.

Heterogeneity: Then the images original sources, parameters such as colour depth, quality, and are change. This changes in texture and color features method extraction. So image retrieval systems created with robustness so these changes cannot effect.

Concurrent Usage: In on line Content based image retrieval systems, have very high hardware and software need for indexing, and feature extraction etc., they enough to design so as not create any hazards for the host server resources. Instead of many of resources must be assigned.

User-interface: As discoursed earlier, a more work is required to design framework for content based image retrieval such the tool benefit get by that people are actually use[107].

Operating Speed: Implementation should ideally be done using efficient algorithms, especially for large databases. For computationally complex tasks, off-line processing and caching the results in parts is one possible way out. Time is critical in on-line systems as the response time needs to be low for good interactivity.

System Evaluation: The design of a CBIR benchmark requires careful design in order to capture the inherent subjectivity in image retrieval. Like any other software system, image retrieval systems are also required to be evaluated to test the feasibility of investing in a new version or a different product. One such proposal can be found in [75].

3.2.2 Medical CBIR problem definition

The problem challenged by CBIR systems in medical field can be accredited by mixture of many issues. Many of problems might be classified as per no of "gaps" give as below.

Semantic Gap

While Although the *semantic gap* might seem more tangible to bridge in the medical domain, there are many other gaps to fill and limitations to overcome: In this category the semantic gap, that is, the difference between low level features and abstract user representation, is considered the most important.

The critical factor in medical images, however, is the pathology the primary reason for which the image was taken. This pathology may be expressed in details within the image (e.g., shape of a vertebra or texture and color of a lesion) rather than the entire image (e.g., spine x-ray or cervicographic image). In addition, there may be multiple image modalities that provide the critical information, e.g., histology slides, photographs, etc. A CBIR system has been optimized with consider image content in context of the medical application. Too often, where the goal is to find medical images that are similar in overall appearance with help of generic image retrieval model. In adding to growing the scope of the CBIR system it is important to also consider analyzing patient histories or physician's notes for valuable information

Feature Gaps

Feature Gaps are due to both the difficulties in extracting low level features and the in adequacies of the chosen numerical features to characterize the image content. As such, the extent to which the system "knows" the image and, to a large extent the system capability the types of features, at which the features are extracted, and their use individually or in combination determines. Extracted features are used to define the image content. Medical CBIR applications are very sensitive to medical image content. So, developing toolboxes to permit user selection of features may also be very helpful in generalizing the applications and improving acceptance. It is necessary for the system to support as many types of features as possible and also capture them at several scales. [99]

The Interdisciplinary Gap

Unfortunately, the "CB" part-1 of the "CBIR" is created and used by medical professional, computer researcher, and the "IR" part-2 is used by the medical radiologist, pathologist etc.. It is a big challenge for the computer researcher to understand the medical field terminology and its meaning. On the other side, the medical radiologist and other people to know the input and output of the "CB" parts its abilities and limits is a big challenge [100].

The Performance Gap

Many media like web or personal has CBIR applications requirements on performance. Medical applications are more needed and they allow small place for failures or mistakes. As a CBIR system becomes has more semantic for the critical part of the clinical decision, it would exert more and more direct influence on the final. We hope that the radiologist or medical other people will depend more on our system as well. So naturally we need the system that leads to bigger necessity on system performance [100].

The Regulatory Gap

The clinical world is unique in yet another aspect that it is heavily guarded by government regulations. This is truer in some countries such as the United States than others. Regulatory wise, a CBIR system may deserve less scrutiny than an end to end computer aided diagnosis system [11]. But as it gets more semantic, the line may be blurred. A high regulatory burden will raise the barrier of entry; but at the same time, it also forces the existing software providers to reduce cost by building *generic* solutions that can be quickly adapted to multiple imaging modalities and application domains [100].

The Usability Gap

Usability gaps refer to the ease of use of the system. In this category are framed the query, feedback and refinement gaps. This gap is hardly talked about the development and design for CBIR systems. However, the end user of the system give more concern and the user has greatest potential for affecting the acceptance of a new technology.

The Vertical Information Gap

Doctors generally use all the information given by the patient to made up-to-date decisions. The image retrieval system require all the info of patient to funding the doctors to take judgments at the meaningful level. However, this is not possible that all data are not in electronic form; or some data may not be in structured as per the machine consumption; and finally, emerging data sources, such as genomic or proteomic data, and even with future prevalence of EMR/EHR (Electronic Medical/Health Record) give a big challenges in terms of data volume and uncertainty in relevance [100].

The Data Gap

Due to privacy, security considerations nearby the health data in over-all, medical images and related data cannot be gotten simply without careful anonymization and in many suitcases, prior agreement of the patient. This is the main reasons, in adding to the restricted quantity in the first place, that medical images appear to be always in short supply. Also, need for quality annotations by medical specialists impressively exceeds source as well, because of the high price, high subject, and fast advance of each sub-field.

3.2.3 Medical CBIR issue

Many of the main issue in the field of medical CBIR are listed as below:

- Retrieval speed – most research prototypes can handle only a few thousand images
  A reliable test-based and measurement criterion
- Incomplete query specification
- Incomplete image description
- **Gap between low level features and high-level concepts**
  - **With the help of low level feature reach to high level concepts of medical Indexing on database**
- **Human in the loop interactive systems**
- Query Engine similarity calculation
- Extraction of robust and precise visual features from medical images is a difficult problem.
- The use of CBIR in medical diagnostics is important though it is difficult to realize.

- To be used as a diagnostic tool, the CBIR systems need to prove their performance to be accepted by the clinicians.
- In medical application domain many systems have been proposed where database consists of images of various anatomical regions with variety of image modalities. Such databases are useful as a benchmark to test various approaches in a general image retrieval framework; however these approaches are not useful for diagnostics support systems where high precision is required.
- Useful semantics for medical image retrieval needs to be established.

The research work can be done on the two problems. First problem is Human in loop interactive system and second is gap between low level features and high level semantics.

To get the maximum retrieval research is work on the relevance feedback on CBIR. The idea behind relevance feedback is to take the results that are initially returned from a given query and to use information about whether or not those results are relevant to perform a new query. Here user give this feedback to the system based on the given feedback it learn the concept and retrieve the result again. To solve the issue where human interaction is done in with relevance feedback to the system.

The CBIR system is work on two low level feature (texture and shape) reach to high level semantics like normal or abnormal image.

A. Human in the Loop

The main reason of content based image retrieval created for relevance feedback is on retrieval process, permitting users to evaluate and mark the retrieval outcomes of content based image retrieval, find out which are not relevant results and which are related to the query image, then feedback the related info that the users mark to the system as training samples for instruct next image retrieval and learning, So made the results more as per the requirements of users. A wider application of relevance feedback method changes the query vector on the one hand, using feedback information to change the weight of each feature vector in the formula, highlighting the more important vector of the query.

This research tendency has been running in the development of image retrieval. For example, the QBIC group uses cooperative area segmentation. Based on the review the different texture representations, the MIT group's transfers from the automated system with Photobook to the interactive with user. [104, 105, 106].

Early literature emphasizes “fully automated systems” and tries to find a “single best feature.” We requirement to discover the interaction of a computer and a human. More running research is given to human in the loop and interactive systems [101].

In all cases human in the loop but if in the interaction human being change or their intense is wrong then system output fully changed so try to make fully automated system without human interaction.

B. High-level Concepts and Low-level Visual Features

In a general setting, however, the low-level features **does** not have a direct link to the high-level concepts. Humans tend to use high-level concepts in everyday life. In controlled applications, such as the figure print and human eyes, it is possible to relation the low level features to high level concepts [101].

While Although the *semantic gap* might seem more tangible to bridge in the medical domain, there are many other gaps to fill and limitations to overcome: In this category the semantic gap, that is, the difference between low level features and abstract user representation, is considered the most important.

It is important to consider image content in light of the context of the medical application for which a CBIR systems have been optimized. Too often, we find a generic image retrieval model where the goal is to find medical images that are similar in overall appearance. In addition, there may be multiple image modalities that provide the critical information, e.g., histology slides, photographs, etc. In addition to expanding the scope of the CBIR system it is important to also consider analyzing patient histories or physician’s notes for valuable information. This pathology may be expressed in details within the image (e.g., shape of a vertebra or texture and color of a lesion) rather than the entire image (e.g., spine x-ray or cervicographic image). The critical factor in medical images, however, is the pathology the primary reason for which the image was taken.

To go deep in this semantic gap, some on line and off line processing is needed. The off line processing can be completed by using either unsupervised or supervised learning, or the combination of the two. Neural nets and genetic algorithms are such clustering learning tools [103, 102, 105, 104].

Chapter - 4

Proposed system

CHAPTER - 4
Proposed system

4.1 Problem definition

To solve the first issue where human is in interaction in between the system for retrieving the related image. In this method based on human input system is search again and retrieve the related based on second input image again. It is called relevance feedback approach. In all cases human in the loop but if in the interaction human being change or their intense is wrong then system output fully changed so try to make fully automated system without human interaction. Fully automated system is nothing but iterative search for query image. So the research work run on texture and shape feature with iterative search. The CBIR system is do iterative search with composite feature and get the maximum retrieval without human interaction. This shown in fig. no.4.1.

To solve the second issue where semantic gap is there in between low level feature and high level concept. The CBIR system is work on two low level feature (texture and shape) reach to high level semantics with the help of neural network like normal or abnormal image.

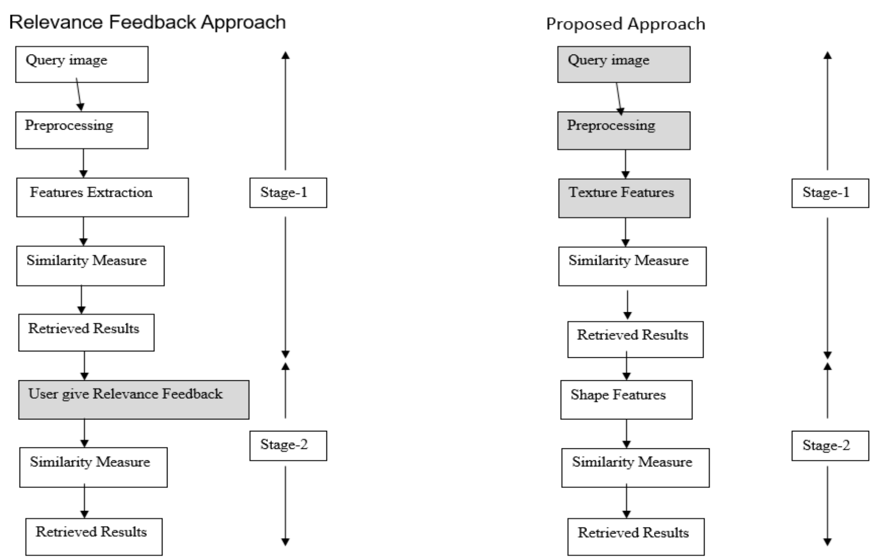


Fig no. 4.1 Comparison of Relevance feedback and proposed approach

4.2. Objectives

The main objective of the proposed work on the Image Processing issues with CBIR. The research work is to test CBIR system with medical image and to get maximum retrieves images from medical datasets with the help of texture and shape feature. To do the classification with neural network, the retrieved image can be classified into relevant and no relevant image and if there is relevant image then classified into normal and abnormal image. To address this broad objective, we identify the following steps for CBIR system:

- Collect the medical images with x-ray image , magnetic resonance image (MRI), Computed Tomography(CT) scan image
- Extract the texture and shape feature for database image.
- Create a database of medical images which stores features for Texture & Shape can be calculated for the database image.
- Select query image and calculated texture and shape feature for query image
- Calculated the different distance for the feature vectors of query image and for the result of texture and Shape features of database images. Then retrieve the best matching from database.
- Apply neural network for classification of abnormal and normal images and identified semantics for image
- If query image found in abnormal images so identified which part damage or crack
- If crack found so it is generally fractures on that part of human
- It is reach to semantic of image for human

4.3. Original Contribution by the Thesis

Figure no.2 shows an overview of the CBIR with Classification systems. The system is divide in to the two stage.

The first stage is CBIR with medical database that can be done with some steps: The first step is represented by the image acquisition with feature stored in database image followed by select query image then image enhancement with preprocessing techniques. Then calculate composite feature for query image and generate the feature vector. Find the Euclidian and Manhattan distance in between feature vector of database image and query image for similarity calculation. Then sort distance and retrieve the best related result.

The second stage is classification of retrieval result of CBIR that can be done with some steps: The first step is apply feed forward neural network for classification of relevant and no relevant image. If relevant images are retrieved then it is further classification into normal and abnormal images. All the step for the systems are cover with in detail to the further part.

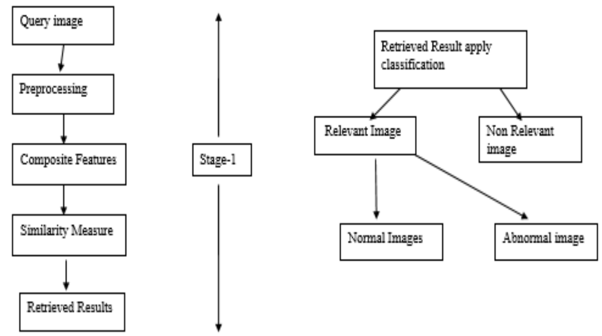


Fig.no. 4.2. CBIR with Classification Proposed System

4.4 Proposed System

In our research work made progress in the area of testing CBIR system with Medical database. We have developed different techniques for solving the previously listed problems and implemented software prototypes to prove the applicability of our concepts.

The implemented software can be work on the following step:

- Step1: Create a database of medical images with their features for Texture & Shape that can be used to search Query image.
- Step2: Select the query image.
- Step3: Extract the texture and shape feature for query image.
- Step4: Calculated the Euclidian distances for the Texture +shape feature vectors of query image and for the stored database images
- Step5: Calculated the Manhattan distance for the Texture +shape feature vectors of query image and for the stored database images.
- Step6: Apply Sorting on distance result and retrieve the best matching from database as per user want.
- Step7: The precision and recall are calculated and tabulated for performance of the system with different class of query images.
- Step8: Apply neural network for classification of image with relevant and no relevant images

- Step9:Apply neural network for classification of abnormal and normal images and identified semantics for image
- Step10: The classification Accuracy are calculated and tabulated for performance of the system with different class of query image.

4.5. Methodology of Research

The proposed system every step divide into the main four stage that is image processing, feature extraction, similarity calculation and classification. This four step cover the full detail of proposed system. The detail discussion of proposed system given below.

4.5.1 Image Processing

A. Select Query Image

Due to privacy issues and heavy bureaucratic hurdles we have access to real medical images for experimentation is a very difficult undertaking. The data collection that was used in our experiment are the medical images with x-ray image, magnetic resonance image (MRI), Computed Tomography (CT) scan image. The collection can be done from various hospital of Rajkot and collect the different types of image with existing system. This same database with collected images used in other research of classification. Then create the database with texture, shape and composite features of collected images and select the query image.

B. Preprocessing

Whenever the data to be mined in noisy, inconsistent or incomplete and to improve the effectiveness of the data mining techniques then pre-processing is always a necessity. Medical images are difficult to interpret, and a preprocessing phase of the images is necessary to improve the quality of the images and make the feature extraction phase more reliable

Image enhancement supports in quality improvement for the image with particular application [10]. In order to work with two dimensional and three dimensional image we resize the image. Histogram equalization increases the contrast range in an image by increasing the dynamic range of grey levels In order to diminish the effect of over brightness or over darkness in the images and accentuate the image features, we applied a widely used technique in image processing to improve visual appearance of images known as Histogram Equalization [10].

4.5.2 Feature Extraction

Feature extraction is a need of information shrinks. The input to the different technique are big for user and it is believed to be disreputably unneeded (more data, but not more information) then the input information can change into a compact version with different number of features (also called features vector). Storing the input data into the other format of features is called features extraction. The numbers of techniques for feature extraction are given below.

A. Texture

Texture demonstration can be of different types: structural and statistical. Statistical features can be calculated with co-occurrence matrices, principal component analysis [13]. The features like mean variance standard deviation, energy, entropy, correlation, inertia are calculated using co-occurrence matrix. Contrast is the compute of difference in the gray level for co-occurrence matrix [9].

$$Mean = \sum_{i=1}^{n} \sum_{j=1}^{m} x_y / mn \tag{1}$$

$$Variance = \frac{1}{mn} \sum_{i=1}^{n} \sum_{j=1}^{m} x_y - Mean \tag{2}$$

$$\sigma = \sqrt{Variance} \tag{3}$$

$$Correlation = \sum_{i,j} \frac{(i-\mu i)(j-\mu j)P_u}{\sigma_i \sigma_j} \tag{4}$$

$$Entropy = -\sum_i \sum_j P_d(i,j) \log P_d(i,j) \tag{5}$$

$$Contrast = \sum_i \sum_j (i-j)^2 P_d(i,j) \tag{6}$$

In Equation 1 m and n are size of image Xij. In Equation 5 and Equation 6 is the pixel at i and j position, Pd(i,j) is the probability distribution function.

B. Shape

Shape features have a significant role in primary group of medical images based on their content [2]. Features such as Area, Edge, Fourier Descriptor, Circularity, are used to retrieve medical images [14,8].

Area: Area of selection in square pixels or in calibrated square units.

Edge: Using canny edge detector, gradient, and other operators.

Fourier Descriptor: Fourier Descriptors (FDs) is a powerful feature for boundaries and objects representation.

$$a(k) = \sum_{n=0}^{N-1} z(n) \exp[\frac{-j2\pi kn}{N}] \text{ },0 \leq k \leq N-1 \tag{7}$$

Discrete Fourier Transform of z(n)(boundary point) gives value of Fourier Descriptor.

$$Circularity = 4\pi \, (\frac{Area}{Perimeter^2}) \tag{8}$$

Equivalence diameter (circle with same area as the region)

$$Equivalence\ Diameter = \sqrt{\frac{4*Area}{\pi}} \tag{9}$$

4.5.3. Similarity calculation

The Similarity matching is the process of approximating a solution, based on the computation of a similarity function between a pair of images, and the result is a set of likely values. Many Image Retrieval systems using different method based on distances (e.g, Euclidian distance(ED) and Manhattan distance (MD)) apply as a matching function. The purpose for these CBIR systems is that given a “good set” of features calculated for the images in the database, then for other images to be “similar” based on calculated features have to be nearer to equal distance.

Euclidian distance find the distance between the vectors, when it is less then vectors are aligned based on sorting but their magnitude is also same. Here we have chosen Euclidian distance and Manhattan distance as a similarity measure. Once the distance calculated then sort all the distance and retrieve the result. The direct Euclidian distance and Manhattan distance between an image S and query image T can be given as below

$$\text{ED}= \sqrt{\textstyle\sum_{i-1}^{n}}(Vsi - Vti)^2 \tag{10}$$

$$\text{MD = sum(abs(s-t))} \tag{11}$$

4.5.4. Retrieval result with Parameters

The query and database image matching is done based on Euclidean distance. Precision and recall are used as numerical evaluation parameters for the proposed CBIR techniques. The ordinary definitions of these two measures are given by following equations.

$$\text{Precision} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of images retrieved}} \tag{12}$$

$$\text{Recall} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of relevant images in database}} \tag{13}$$

The precision and recall are calculated by collecting the number of retrieved images sorted according to ascending Euclidean distances with the query image.

4.5.5. Classification Algorithm (Neural Network)

Artificial neural network models have been studied for many years in the hope of achieving human-like performance in several fields such as image understanding.

An input layer, a hidden layer and an output layer are three layer in the architecture of the neural network. The number of elements existing in one transaction in the database is equal to the no of nodes in the input layer. While the output layer was consisting of one node.

The classification for the image into the different classes gives the node for the output layer. It classifies images as relevant or not relevant classes. For each training transaction the neural network receives in addition the expected output. In the training phase, the internal weights of the neural network are adjusted according to the transactions used in the learning process. This permits the changes of the weights. In the next step, to classify the new images we have to trained neural network.

The main architectures of artificial neural networks, considering the neuron disposition, as well as how they are interconnected and how its layers are composed, can be divided as follows: (i) single-layer feed forward network, (ii) multilayer feed forward networks

A. Multiple-Layer Feed forward Architectures

Differently from the first network feed forward networks with multiple layers are composed of one or more hidden neural layers (Fig. 2.13). They are created in the solution of classification problems, like those related to function estimate, pattern classification, system identification, process control, optimization, robotics, and lot many etc..

Figure 2.13 shows a feed forward network with multiple layers created of one input layer with n sample signals, two hidden neural layers consisting of n neurons respectively, and, finally, one output neural layer created of m neurons representing the respective output values of the problem being analyzed.

Among the main networks using multiple-layer feed forward architectures are the Multilayer Perceptron (MLP) and the Radial Basis Function (RBF), whose learning algorithms used in their training processes are respectively based on the useful delta rule and the competitive/delta rule. From Fig. 2.13, it is possible to understand that the volume of neurons created with the first hidden layer is generally different from the number of signals composing the input layer of the network. In fact, the number of hidden layers and their amount of neurons depend on the nature and complexity of the problem being mapped by the network, as well as the quantity and quality of the available data about the problem. Nonetheless, likewise for simple-layer feed forward networks, the amount of output signals will always coincide with the number of neurons from that respective layer.

Neural Network Parameter

Learning Rate

Data type is Real value in between 0 to1 and typical value is 0.3

Meaning of Learning Rate. It is a parameter of training that handle the size of load and bias variations in learning with different training algorithm.

Momentum

Data type is Real value in between 0 to1 and typical value is 0.9

Meaning of Momentum simply update to the current one with increases a portion m of the earlier weight. It is a parameter that used to check the system that meeting to a local minimum. The higher value of this parameter can support to more the speediness of meeting for system. When this parameter value is more increase then generate a hazard of overshooting the least, which the system to turn into unbalanced. When this parameter value is low cannot reliable to reduce local minima, and can slowly reduce the training of the system.

Training type

Data type is Integer value in between 0 to1 and typical value is 1

Meaning of training type with 0 and 1 and 0 = train by epoch, 1 = train by minimum error

Epoch

Data type is Integer value in between 1 to ∞ and typical value is 5000000

When training by minimum error, this represents the maximum number of iterations. Meaning of Epoch is determines when training will stop once the number of iterations exceeds epochs.

Minimum Error

Data type is Real value in between 0 to 0.5 and typical value is 0.01

Meaning of Square root of the sum of squared differences between the network targets and actual outputs divided by number of patterns. Minimum mean square error of the epoch.

Transfer function

The transfer function of a neuron is chosen to have a number of properties which either enhance or simplify the network containing the neuron. Crucially, for instance, any multilayer perceptron using a *linear* transfer function has an equivalent single-layer network. A non-linear function is therefore necessary to gain the advantages of a multi-layer network.

Step function

The output y of this transfer function is binary, depending on whether the input meets a specified threshold, θ. The "signal" is sent, i.e. the output is set to one, if the activation meets the threshold. This function is used in perceptrons and often shows up in many other models. It performs a division of the space of inputs by a hyperplane. It is specially useful in the last layer of a network intended to perform binary classification of the inputs. It can be approximated from other sigmoidal functions by assigning large values to the weights.

Linear combination

In this case, the output unit is simply the weighted sum of its inputs plus a *bias* term. A number of such linear neurons perform a linear transformation of the input vector. This is usually more useful in the first layers of a network. A number of analysis tools exist based on linear models, such as harmonic analysis, and they can all be used in neural networks with this linear neuron. The bias term allows us to make affine transformations to the data.

Sigmoid

A fairly simple non-linear function, the sigmoid function such as the logistic function also has an easily calculated derivative, which can be important when calculating the weight updates in the network. It thus makes the network more easily manipulable mathematically, and was attractive to early computer scientists who needed to minimize the computational load of their simulations. It was previously commonly seen in multilayer perceptron. However, recent work has shown sigmoid neurons to be less effective than rectified linear neurons.

Based on the type of Neural networks can be classified as feed forward and feedback models. In this study we concentrate on feed forward networks with supervised learning. For the study Gaussian Fuzzy Feed Forward Neural Network architecture is given below.

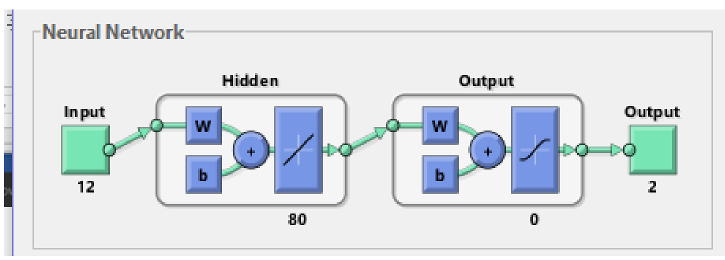


Fig.no. 4.3 Feed forward network with multiple layers

In the neural network has input it is the feature vector of images. Based on feature the network is trained and tested with given number of samples and try to get the best output with classified the image into the two classes. To the best output the transfer function is change in neural network with Gaussian fuzzy function in the layer. The first classification divide into relevant and no relevant classes. Then again the neural network is train with relevant images feature vector and test again with number of samples and get the best output with classified image into the two classes like normal and abnormal images.

B. Classification Parameter

The confusion matrix can be used to determine the performance of the system. This matrix describes all possible outcomes of a prediction results in table structure. The possible outcomes of a two class prediction be represented as True positive (TP), True negative (TN), False Positive (FP) and False

Negative (FN). The normal and abnormal images are correctly classified as True Positive and True Negative respectively. A False Positive is when the outcome is incorrectly classified as positive when it is a negative. False Positive is the False alarm in the classification process. A false negative is when the outcome is incorrectly predicted as negative when it should have been in fact positive.

In our system consider,

TP= Number of Abnormal images correctly classified

TN= Number of Normal images correctly classified

FP= Number of Normal images classified as Abnormal

FN= Number of Abnormal images classified as Normal.

- Accuracy: The fraction of test results those are correct.
  (TN+TP)/FP+TN+FN+TP

4.6. Scope of Our Work

In this research the following things have been considered/included as the scope.

1. The research work can be extended with following two step
   a. If query image found in abnormal images so identified which part damage or crack
   b. If crack found so it is generally fractures on that part of human
2. The research work can included more category of human organ image

4.7 MATLAB

4.7.1 Introduction to MATLAB

What is MATLAB?

MATLAB (“MATrix LABoratory”) is a tool for numerical computation and visualization. The basic data element is a matrix, so if you require a program that calculated array-based data it is basically fast to write and run in MATLAB (unless you have very large arrays or lots of computations, in which case you’re better off using C or Fortran).

Getting started

MATLAB is available on department machines. You can also download MATLAB for your personal machine.

Type “matlab” at the UNIX prompt to start. Open the MATLAB desktop, which covers communicating menus and windows in adding to the command window. You can start a command prompt only version of MATLAB (useful if you are logged in remotely) by typing “matlab –nodesktop”.

Using MATLAB

The easy way to learn to use MATLAB is to sit down and use it. In this theory are some examples of basic MATLAB operations, but after you have study this theory you will possibly want to study more. Check out the “Other Properties” given at the end of this theory.

The Beginning

When you start MATLAB, the command prompt
“>>” appears.

Creating matrices

The basic data component in MATLAB is a matrix. A 1x1 is matrix of the type scalar matrix in MATLAB, and a vector is a nx1 (or 1xn) matrix. For example, create a 3x3 matrix A that has 3’s row, and 3’s coloum.

```
>> A = [1 2 3; 1 2 3; 1 2 3]
```

The semicolon says that each row is ended in matrix. MATLAB gives you:

```
A =
   1   2   3
   1   2   3
   1   2   3
```

M-files and functions

All the command that you use with command prompt that all command that can be put in the m-file (“test.m”) and then run all the command at a moment and we need by typing the name of the m-file in command prompt. You can give the command descriptions to the m-file, by placing a “%” at the starting of a comment line.If you are doing a calculation of any important length in MATLAB, you will possibly want to make an m-file

m-files can be used to create user defined functions. And supposing you want to create the function “addition.” You would type an m-file called “addition.m” you create an addition function that addition the value of every number of a matrix by using fix value.

```
function s = addition(y,d)
% addition is adds d to each value in the matrix y.
s = y + d;
```

When you give a matrix y and value d to this function, the value of s = y+d is returned.

You can now call this function from the command line or in another m-file.

```
>> addition(A,1)
ans =
    2    3    4
    2    3    4
    2    3    4
```

You may catch it useful at certain point in a script to return control to the keyboard, to check variables or execute commands. Whenever the command “keyboard” is met in a script, MATLAB will return control to the keyboard. To return to the script, just type “return”. MATLAB can also prompt the user for input during a script. This is done with the “input” command:

x1 = input(‘prompt’,’s’);

The string ‘prompt’ will be showed to the user. The ‘s’ is an elective argument, used only if you want the input to be read in as a string.

4.7.2 Image Processing with MATLAB

A. Reading Images

Images are read into the MATLAB environment using function imread, whose basic syntax is

imread('filename')

Here, filename is a string has the complete name of the image file name with their extension. For example, the statement

>> f = imread('chestxray.jpg');

reads the image of the extension with JPEG file chestxray into image array f. Note we can give the string filename with the use of single quotes ('). The line is ended with the semicolon by MATLAB for separate the output. MATLAB displays on the screen the results of the operation(s) specified in that line if a semicolon is not included. MATLAB Command Window appears with the prompt symbol (>>) designates the beginning of a command line.

When, no path information is included in filename, imread reads the file from the Current Directory. The easy method to read an image from a definite directory is to consist of a full or relative path to that directory in filename. For example,

```
>> f = imread('D:\myimages\chestxray.jpg');
```

reads the image from a directory called myimages in the D: drive, whereas

```
>> f = imread('.\myimages\chestxray.jpg');
```

reads the image from the myimages subdirectory of the current working directory.

The MATLAB Desktop displays the path to the Current Directory on the toolbar, which provides an easy way to change it. Typing size at the prompt gives the row and column dimensions of an image:

```
>> size(f)
ans =
   1024   1024
```

More generally, for an array A having an arbitrary number of dimensions, a statement of the form [D1, D2,..., DK] = size(A) returns the sizes of the first K dimensions of A. This function is particularly useful in programming to determine automatically the size of a 2-D image:

```
>> [M, N] = size(f);
```

This syntax returns the number of rows (M) and columns (N) in the image.

B. Displaying Images

Images are displayed on the MATLAB desktop using function imshow, which has the basic syntax:

```
imshow(f)
```

where f is an image array. Using the syntax imshow(f, [low high]) displays as black all values less than or equal to low, and as white all values greater than or equal to high. The values in between are displayed as intermediate intensity values. Finally, the syntax

```
imshow(f, [ ])
```

sets variable low to the minimum value of array f and high to its maximum value. This form of imshow is useful for displaying images that have a low dynamic range or that have positive and negative values. The following statements read from disk an image called rose_512.tif, extract information about the image, and display it using imshow:

```
>> f = imread('rose_512.tif');
>> whos f
   Name    Size        Bytes    Class        Attributes
   f       512x512     262144   uint8 array
```

>> imshow(f)

A semicolon at the end of an imshow line has no effect, so normally one is not used. Figure 4.4 shows what the output looks like on the screen.

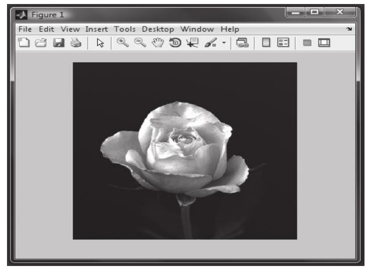


Fig no 4.4 output of rose_512.tif

C. Types of digital images – MatLab

It deals with functions that supports many file format and number of colour map for read images with different form. The matrix is either a 3D matrix of RGB values or a 2D matrix of intensity values (greyscale images) for the image file read with colour image, the medical images are colour images with RGB (Red, Green, Blue) values or grey scale images

In the Image Processing Toolbox use the image of different types are given below:

• Binary Images where every intensity can have value either 0 or 1 value or we say black or white.

• Greyscale Images. A greyscale image characterize brightness or intensity for the image pixel value. Generally the greyscale image uses the no of bits 8 for the pixels representation so the pixel values are given in range of 2^8= 256 [0…255], where 0 represent the black and 255 represent white. The pixel or intensity value is in between the 0 to 255, where k is represent bit value for the image.

• True color or RGB. In RGB each one equivalent to red, green, and blue colour of the three matrices for image. If in an RGB image every three color uses 8 bits, the pixel value for the every colour is in between 0 to 255 then the total number of bits required for each pixel is 3×8=24.

The images we see are different types like gray scale, color, binary and other lot many types. Then the conversion from one type of images to other types of images can be made easily with different function of MATLAB. The rgb2gray function transformed the color image in to the gray scale image. The im2bw function transformed the gray scale image into the black & white image. The function impixel info can be used in order to detect any pixel value.

4.7.3 Matlab with Neural Network

It is a good knowledge to learn MATLAB Neural Network Toolbox demos. When you type demo on Command line then MATLAB window for demo opens. Choose Neural Networks under Toolboxes and study the different windows.

The learning of multilayer perceptron networks has the structure as per given below:

1. To define and give the architecture of the network we choose weights, biases, activation functions and other initialize the neural network parameters for the network routines. MATLAB command for multilayer perceptron network initialization is *newff.*
2. The other parameters needed for the neural network are error goal maximum number of epoch and the training algorithm etc.
3. In MATLAB the command is *train* use to call the training algorithm.

DESIGN THE NETWORK

%First try a simple one – feedforward (multilayer perceptron) network

net=newff([0 3], [4,1], {'purelin', 'tansig'},'traingd');

Here newff defines feedforward network architecture.

The first argument [0 3] defines the range of the input and initializes the network parameters.

The second argument the structure of the network. There are three layers.

4 is the number of the nodes in the first hidden layer,

1 is the number of nodes in the output layer,

Next the activation functions in the layers are defined.

In the first hidden layer there are 5 tansig functions.

In the output layer there is 1 linear function.

'learngd' defines the basic learning scheme – gradient method

% Define learning parameters

net.trainParam.show = 100; % The result is shown at every 100th iteration (epoch) net.trainParam.lr = 0.04; % Learning rate used in some gradient schemes net.trainParam.epochs =1000; % Max number of iterations

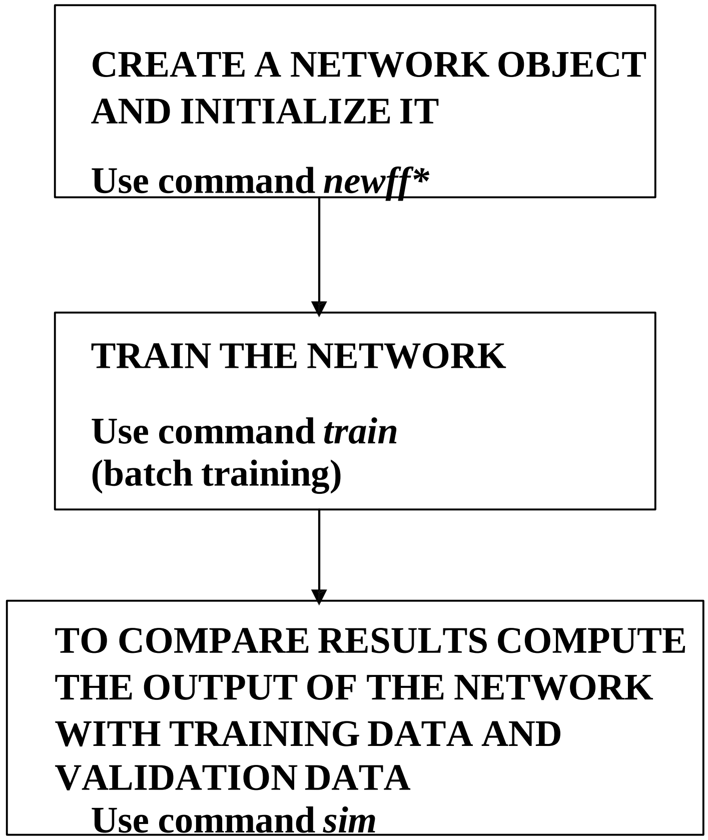
net.trainParam.goal = 1e-3; % Error tolerance; stopping criterion

%Train network

net1 = train(net, P, T); % Iterates gradient type of loop

% Simulate how good a result is achieved: Input is the same input vector P.

Output is the output of the neural network, which should be compared with output data a= sim(net1,P);[i-vii]



Chapter – 5 Implementation & Result

CHAPTER - 5

Implementation & Result

The system configuration used to run system is Windows 7 Professional service pack 1, Intel(R) Core(TM) i3-3240 CPU@ 3.40GHz running at 3.40 GHz, with 4.00 GB RAM. The software used is matlab. Matlab has tool for image processing and neural network. All measured times reported in this section are texture, shape and composite features with precision, recall and classification accuracy etc.

5.1 Work-1: Select Query image and calculate Texture and Shape Features

The proposed CBIR methods are implementing using a different types of 300 adjustable size of images through 7 categories and choose from image database. The types and partition of the medical images is shown in fig no. 5.4 and 5.5. The system developed in MATLAB 7 version using a computer with windows with higher RAM. The proposed MCBIR system develop as per below. As per the proposed system the first step to create the database of medical image with different category. To input query image system need some interface so create Graphical User Interface (GUI) for MCBIR that give in figure 5.1. As per the second step of proposed system select any query image that show in GUI that give in figure no. 5.2. The selected query image are heart and brain from database are given in figure no. 5.3. The feature for texture and shape are calculated for heart and brain query image that shown in figure no 5.7 and 5.9.

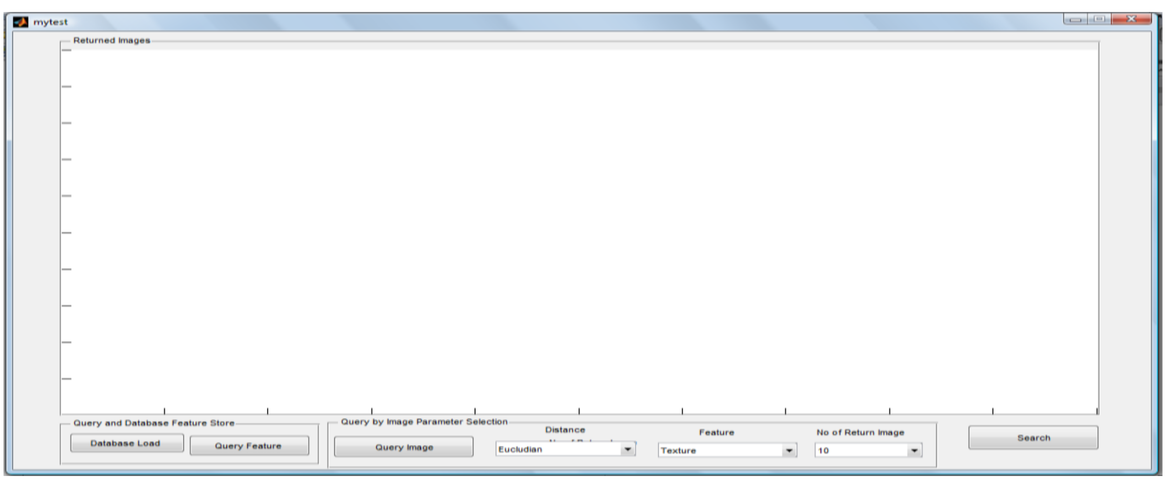


Fig. no. 5.1. GUI of MCBIR

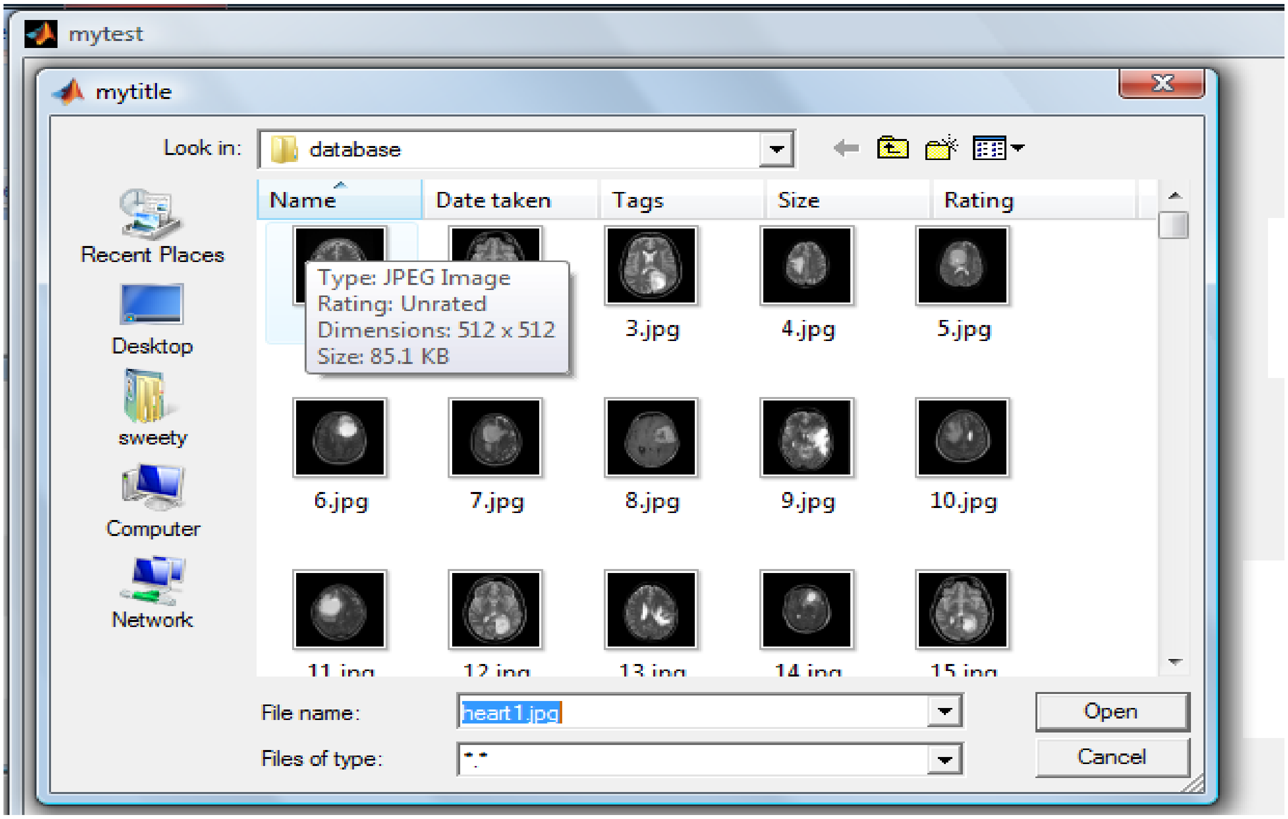


Fig. no. 5.2. Select heart query image MCBIR

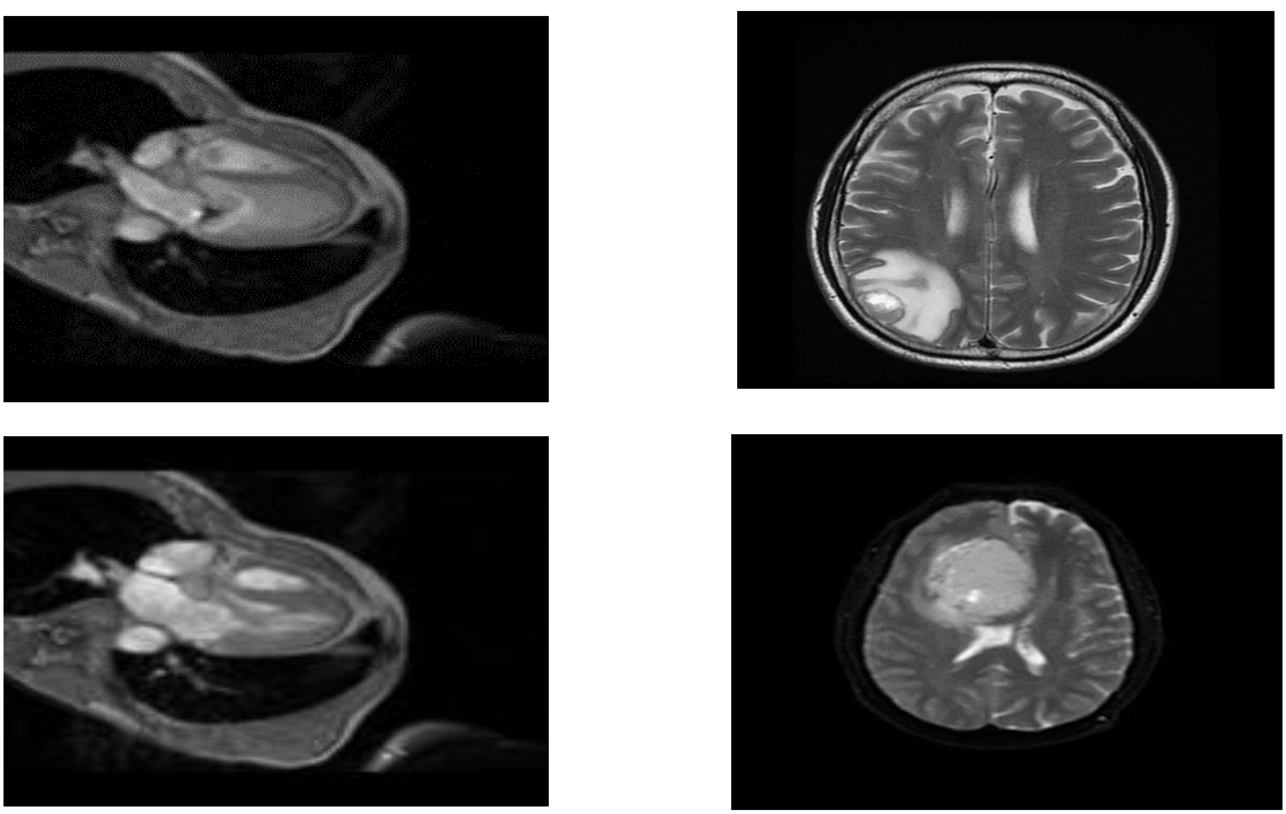
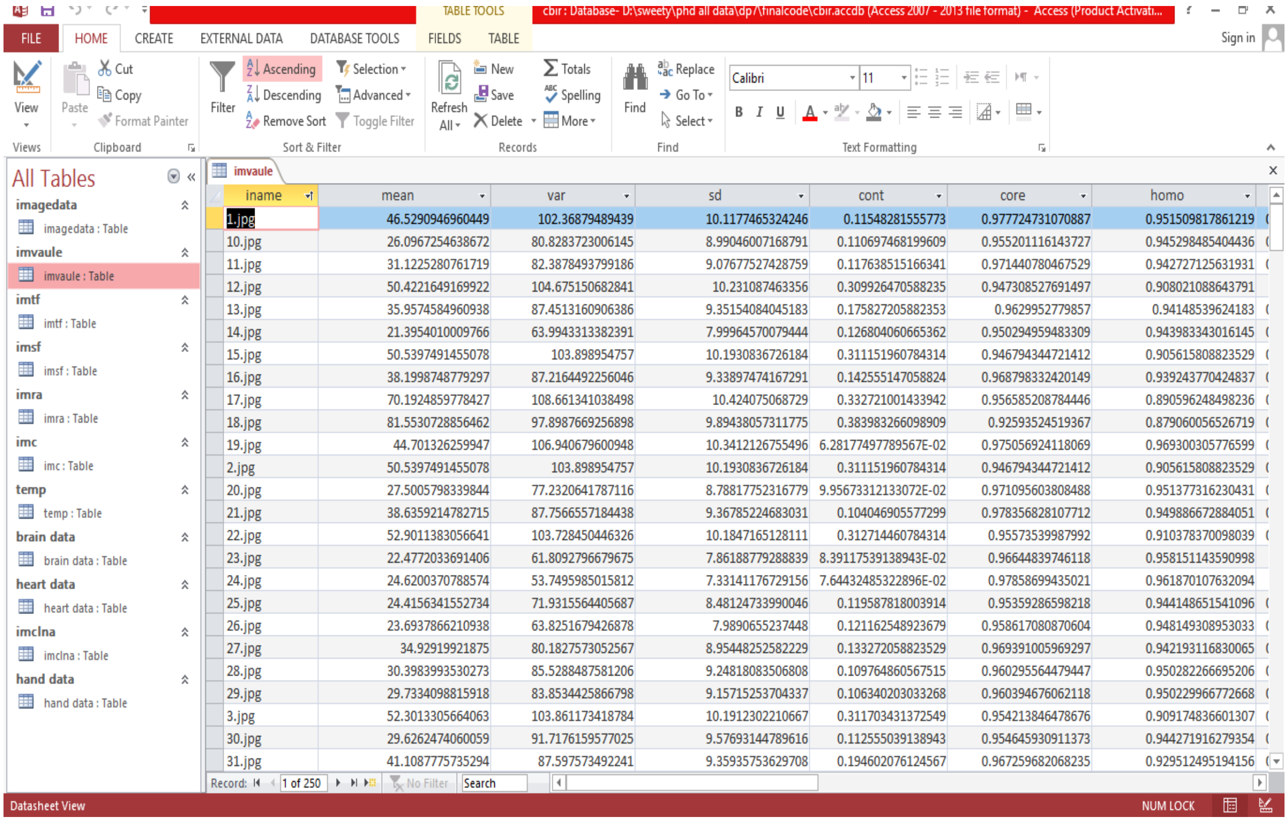


Fig. no. 5.3. Heart image with normal and Brain image with abnormal query image of MCBIR



iname	mean	var	sd	cont	core	homo
1.jpg	46.5290946960449	102.36879489439	10.1177465324246	0.11548281555773	0.977724731070887	0.951509817861219
10.jpg	26.0967254638672	80.8283723006145	8.99046007168791	0.110697468199609	0.955201116143727	0.945298485404436
11.jpg	31.1225280761719	82.3878493799186	9.07677527428759	0.117638515166341	0.971440780467529	0.942727125631931
12.jpg	50.4221649169922	104.675150682841	10.231087463356	0.309926470588235	0.947308527691497	0.908021088643791
13.jpg	35.9574584960938	87.4513160906386	9.35154084045183	0.175827205882353	0.9629952779857	0.94148539624183
14.jpg	21.3954010009766	63.9943313382391	7.99964570079444	0.126804060665362	0.950294959483309	0.943983343016145
15.jpg	50.5397491455078	103.898954757	10.1930836726184	0.311151960784314	0.946794344721412	0.905615808823529
16.jpg	38.1998748779297	87.2164492256046	9.33897474167291	0.142555147058824	0.968798332420149	0.939243770424837
17.jpg	70.1924859778427	108.661341038498	10.424075068729	0.332721001433942	0.956585208784446	0.890596248498236
18.jpg	81.5530728856462	97.8987669256898	9.89438057311775	0.383983266098909	0.92593524519367	0.879060056526719
19.jpg	44.701326259947	106.940679600948	10.3412126755496	6.28177497789567E-02	0.975056924118069	0.969300305776599
2.jpg	50.5397491455078	103.898954757	10.1930836726184	0.311151960784314	0.946794344721412	0.905615808823529
20.jpg	27.5005798339844	77.2320641787116	8.78817752316779	9.95673312133072E-02	0.971095603808488	0.951377316230431
21.jpg	38.6359214782715	87.7566557184438	9.36785224683031	0.104046905577299	0.978356828107712	0.949886672884051
22.jpg	52.9011383056641	103.728450446326	10.1847165128111	0.312714460784314	0.95573539987992	0.910378370098039
23.jpg	22.4772033691406	61.8092796679675	7.86188779288839	8.39117539138943E-02	0.96644839746118	0.958151143590998
24.jpg	24.6200370788574	53.7495985015812	7.33141176729156	7.64432485322896E-02	0.97858699435021	0.961870107632094
25.jpg	24.4156341552734	71.9315564405687	8.48124733990046	0.119587818003914	0.95359286598218	0.944148651541096
26.jpg	23.6937866210938	63.8251679426878	7.9890655237448	0.121162548923679	0.958617080870604	0.948149308953033
27.jpg	34.92919921875	80.1827573052567	8.95448252582229	0.133272058823529	0.969391005969297	0.942193116830065
28.jpg	30.3983993530273	85.5288487581206	9.24818083506808	0.109764860567515	0.960295564479447	0.950282266695206
29.jpg	29.7334098815918	83.8534425866798	9.15715253704337	0.106340203033268	0.960394676062118	0.950229966772668
3.jpg	52.3013305664063	103.861173418784	10.1912302210667	0.311703431372549	0.954213846478676	0.909174836601307
30.jpg	29.6262474060059	91.7176159577025	9.57693144789616	0.112555039138943	0.954645930911373	0.944271916279354
31.jpg	41.1087775735294	87.597573492241	9.35935753629708	0.194602076124567	0.967259682068235	0.929512495194156

Fig. no. 5.4. Database with feature calculation for MCBIR

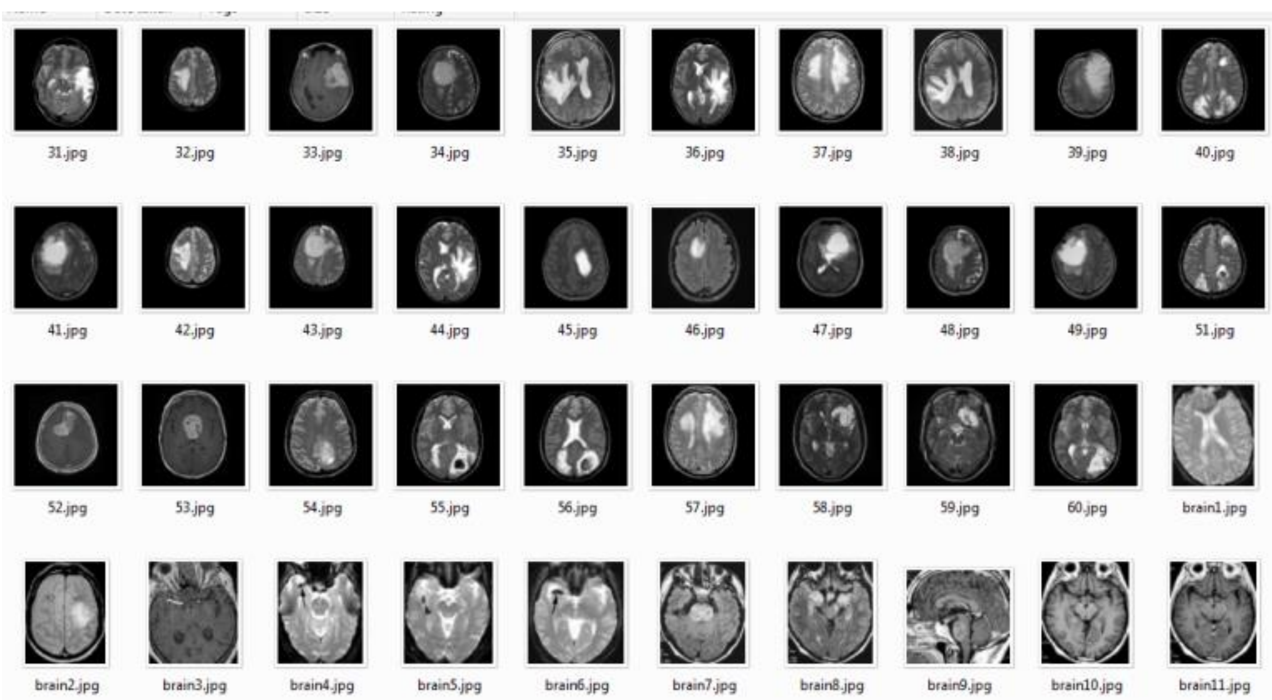


Fig. no. 5.5. Database image with different category

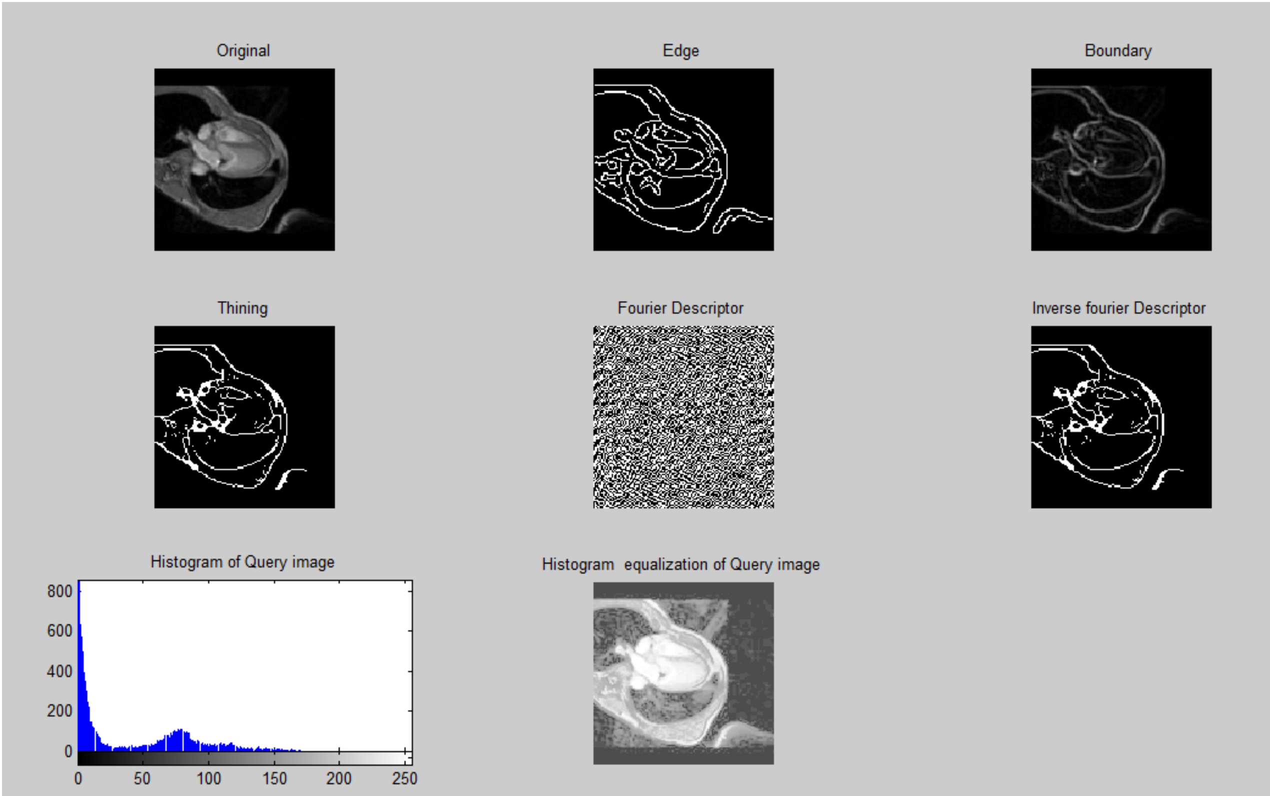


Fig. no. 5.6. Various features for heart query image of MCBIR

Command Window

```
Mean=30.317139
Variance=78.012940
Standart Deviation=8.832493
Entropy=5.197035
         Contrast: 0.1253
      Homogeneity: 0.9462

      Correlation: 0.9573
           Energy: 0.4384

Area=16384.000000
Perimeter=512.000000
Equvilance Diameter =144.469158
cirucularity=0.785000
```

Fig. no. 5.7. Texture and Shape features for heart query image of MCBIR

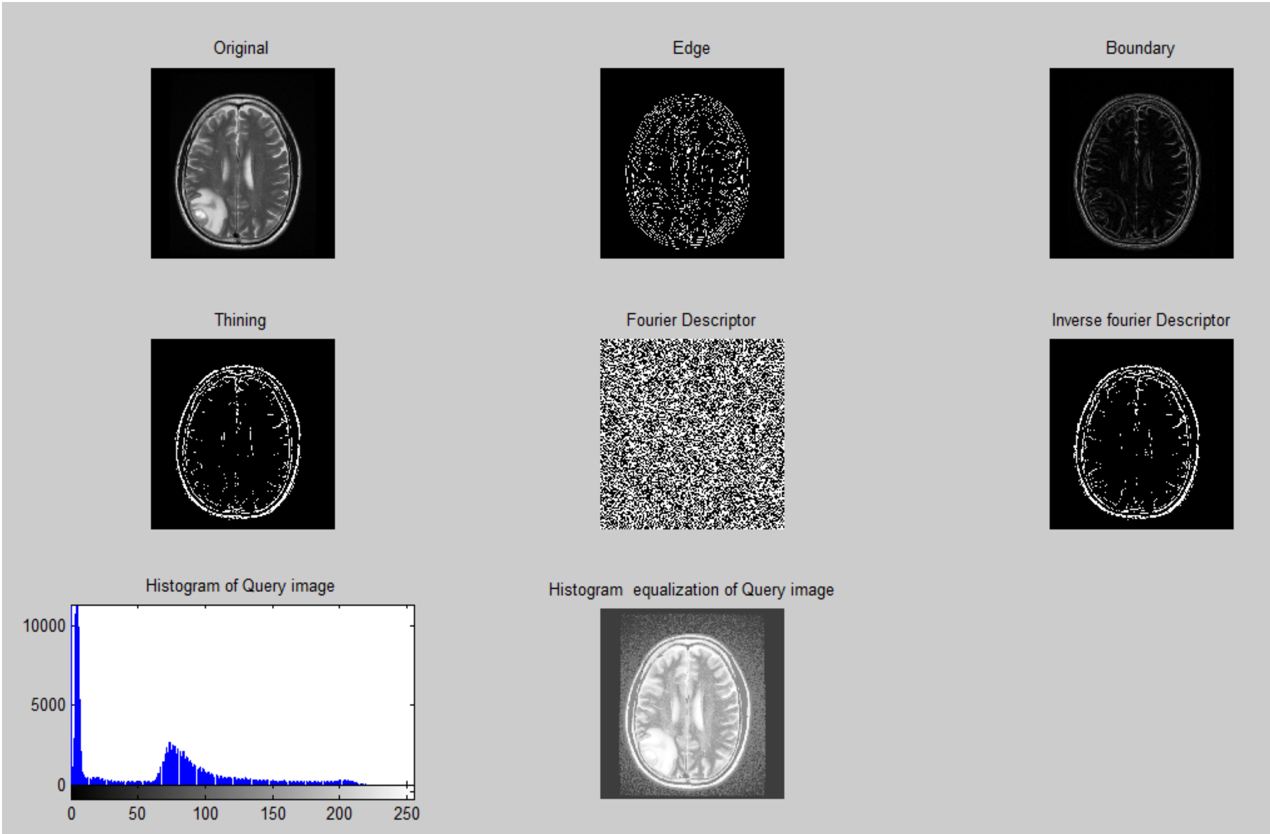


Fig. no. 5.8. Various feaures for brain query image of MCBIR

```
Mean=46.529095
Variance=102.368795
Standart Deviation=10.117747
Entropy=5.641560
       Contrast: 0.1155
    Homogeneity: 0.9515

    Correlation: 0.9777
         Energy: 0.3421

Area=262144.000000
Perimeter=2048.000000
Equvilance Diameter =577.876632
cirucularity=0.785000
```

Fig. no. 5.9. Texture and Shape feature for brain query image of MCBIR

5.2 Work-2: Precision and Recall for Texture and Shape Features

In GUI user has to select the no of images and distance formula for retrieved related images. For selected query image the texture feature are calculated that give in figure 5.8 and 5.6. In the texture feature calculate the mean, variance, standard deviation, correlation, energy, entropy, and contrast. In the texture feature the feature vector created with 7 different value. For the shape feature area, edge, Fourier descriptor, circularity, equivalence diameter are calculated. In the shape feature the feature vector created with 5 different value. So for the different category of image texture and shape feature are calculated that calculated texture and shape features are stored in database. In the GUI user has select distance method for retrieval result.

The precision and recall are calculated for all the category of image with Euclidian and Manhattan distance. For the heart and brain category the precision and recall shows in research work. In the fig no. 5.10 & 5.14 gives heart retrieval with texture features. In the fig no 5.11& 5.15 give heart retrieval with shape features. In the fig no 5.12 give brain retrieval with texture feature. In the fig no 5.13 & 5.16 give brain retrieval with shape features. As per the user selection of distance method the retrieval result can vary but it is nearer vary.

As per the selection in GUI number of images are retrieved. The system calculated the precision and recall for the texture and shape feature with different distance formula. That is given in table no 5.1&5.2 and table no 5.3&5.4 respectively. As per the table if the number of images is increase as per the category then precision and recall are decrease.

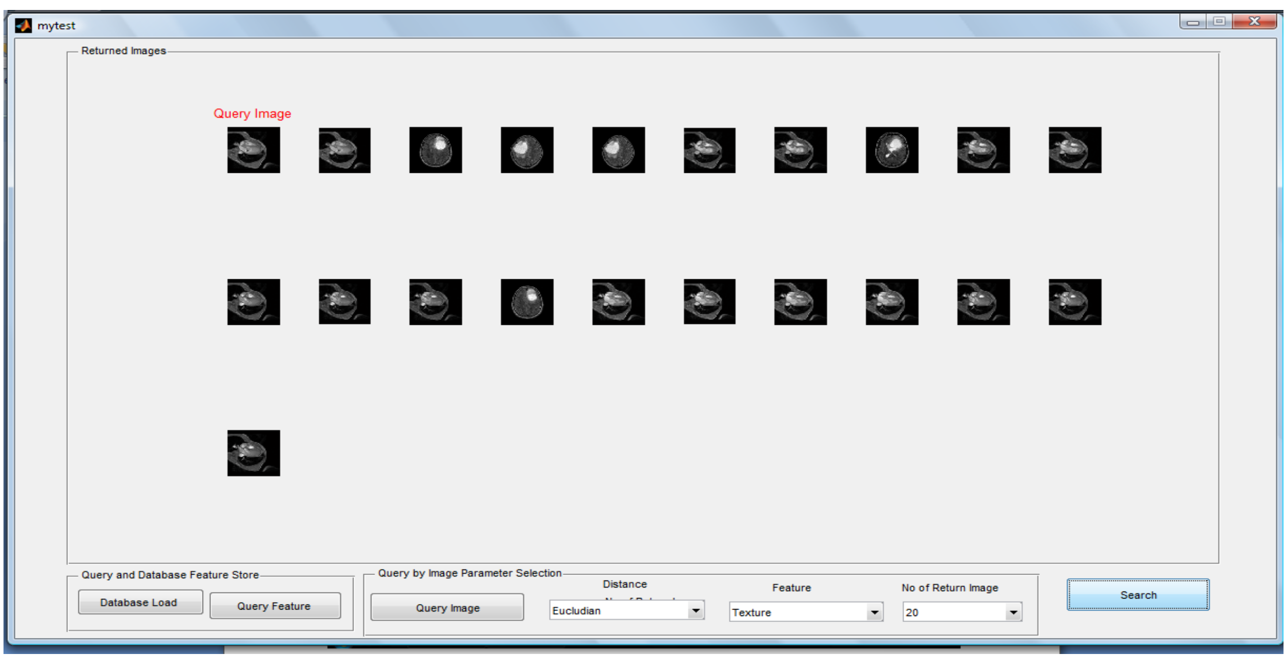


Fig. no. 5.10. Retrieval result (15) with Texture features for heart query image of MCBIR

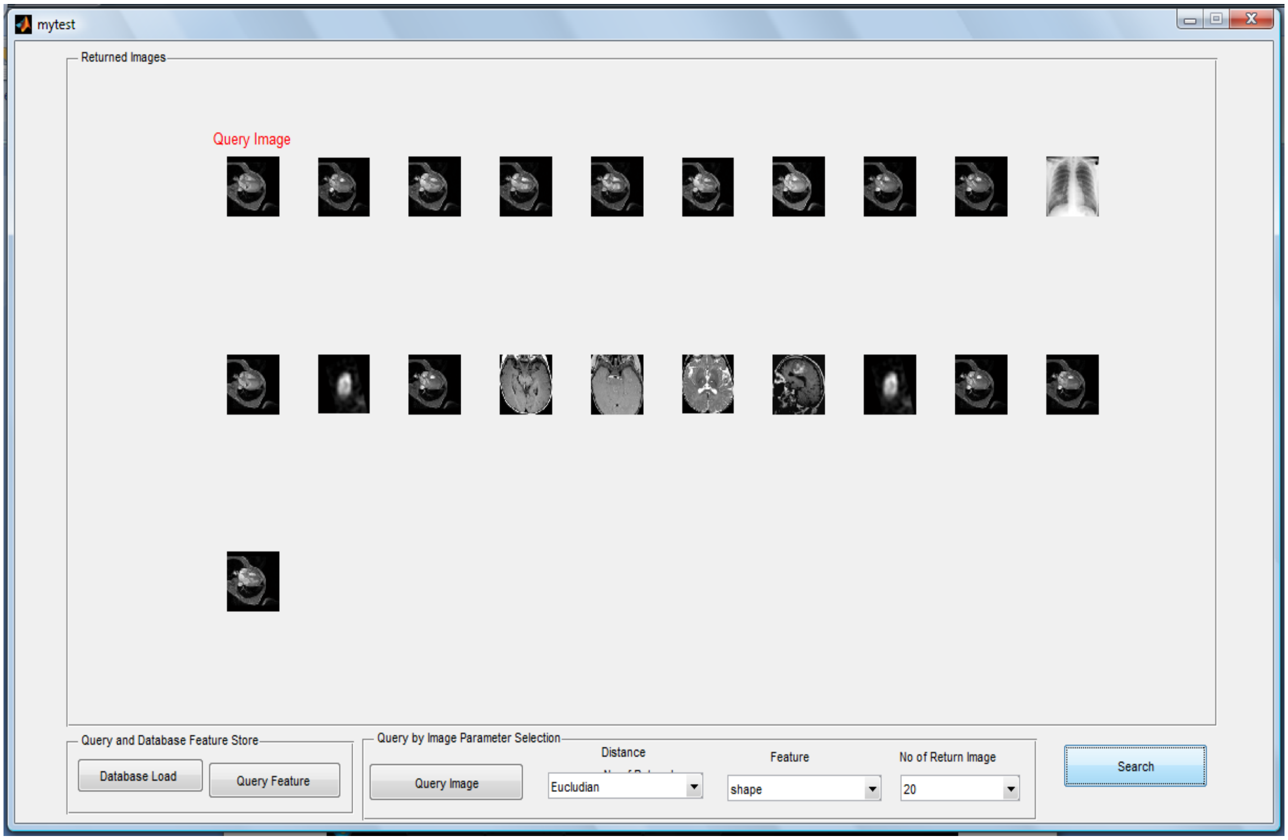


Fig. no. 5.11. Retrieval result (15) with shape features for heart query image of MCBIR

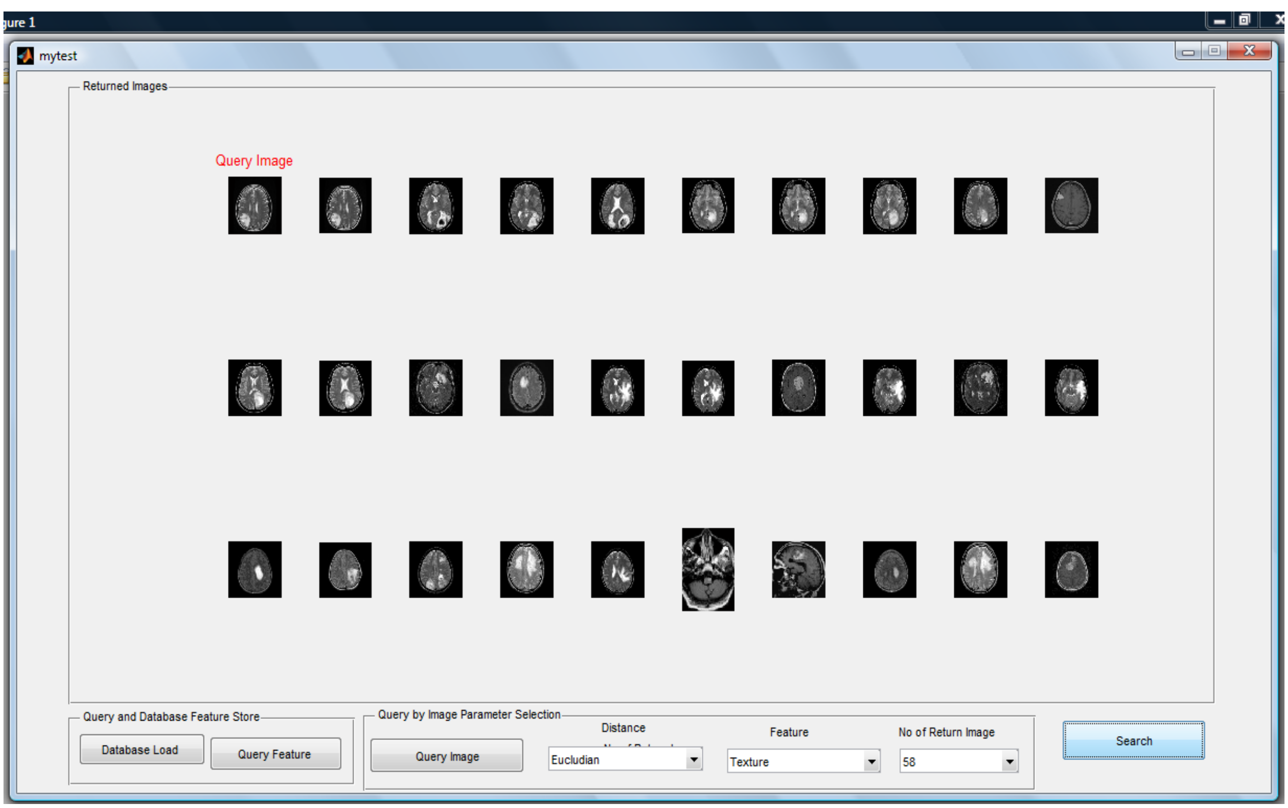
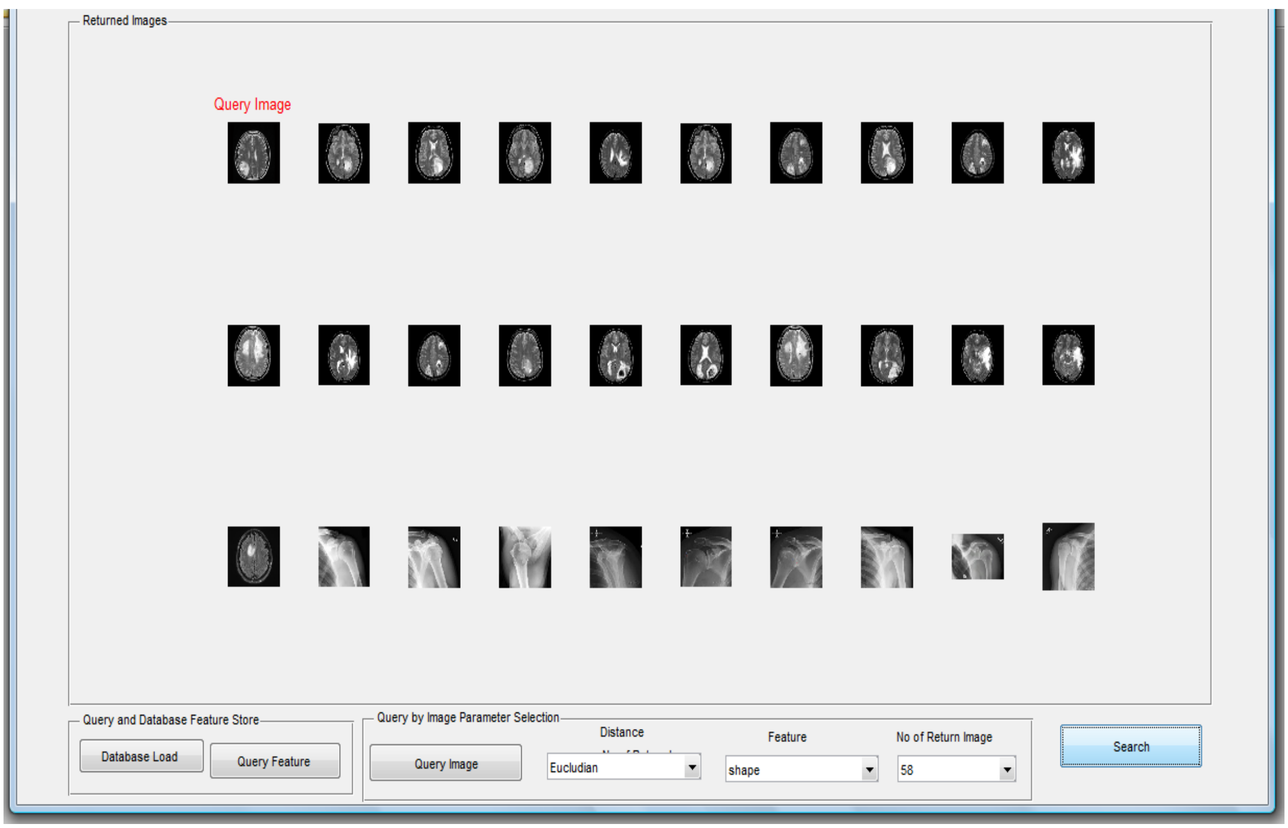


Fig. no. 5.12. Retrieval result (29) with Texture features for brain query image of MCBIR



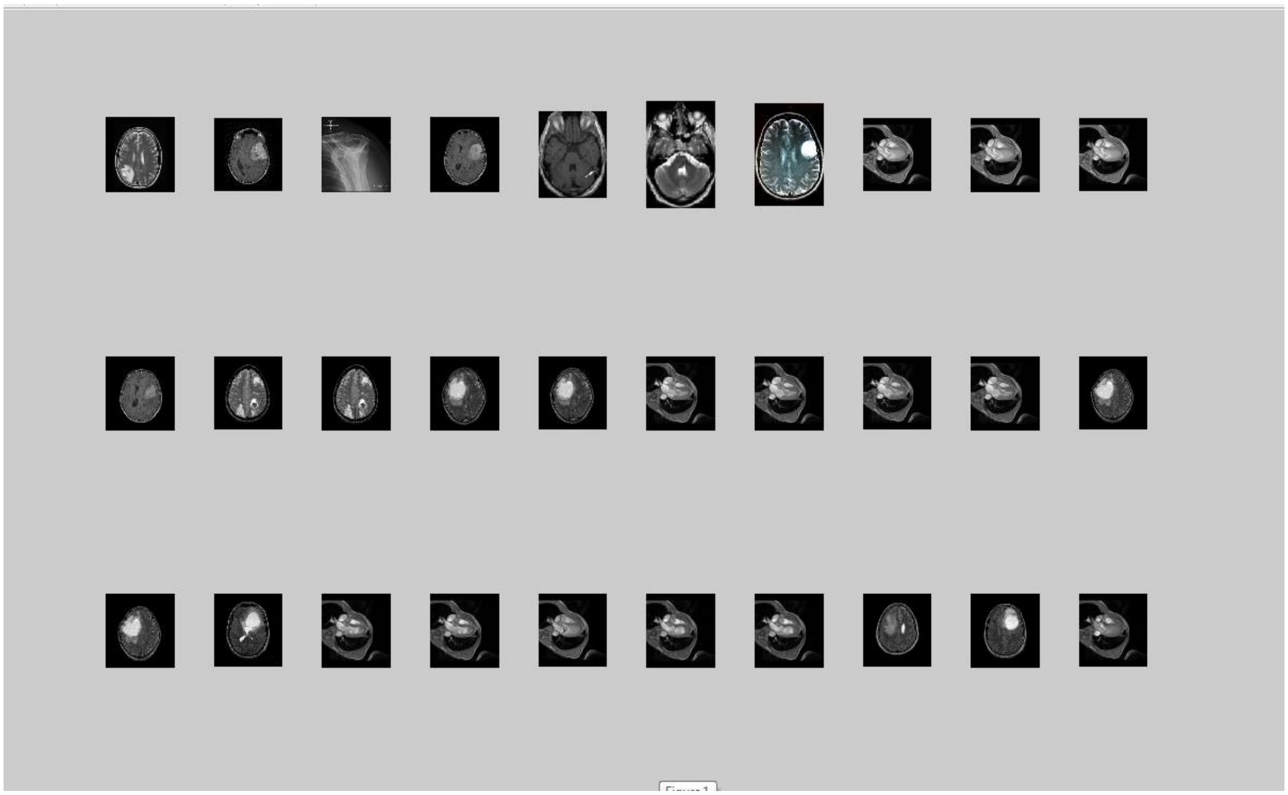


Fig. no. 5.13. Retrieval result(32) with Shape features for brain query image of MCBIR

Texture Feature	Precision with Euclidian Distance	Recall with Euclidian Distance	Precision with Manhattan Distance	Recall with Manhattan Distance
Hand	80%	80%	80%	80%
Heart	75%	75%	75%	75%
Shoulder	70%	70%	72%	72%
BrainMri	68%	68%	70%	70%
Spine	60%	60%	69%	69%
Chest	53%	53%	69%	69%
BrainCT	50%	50%	68%	68%

Table no 5.1: Precision and Recall with Texture Feature

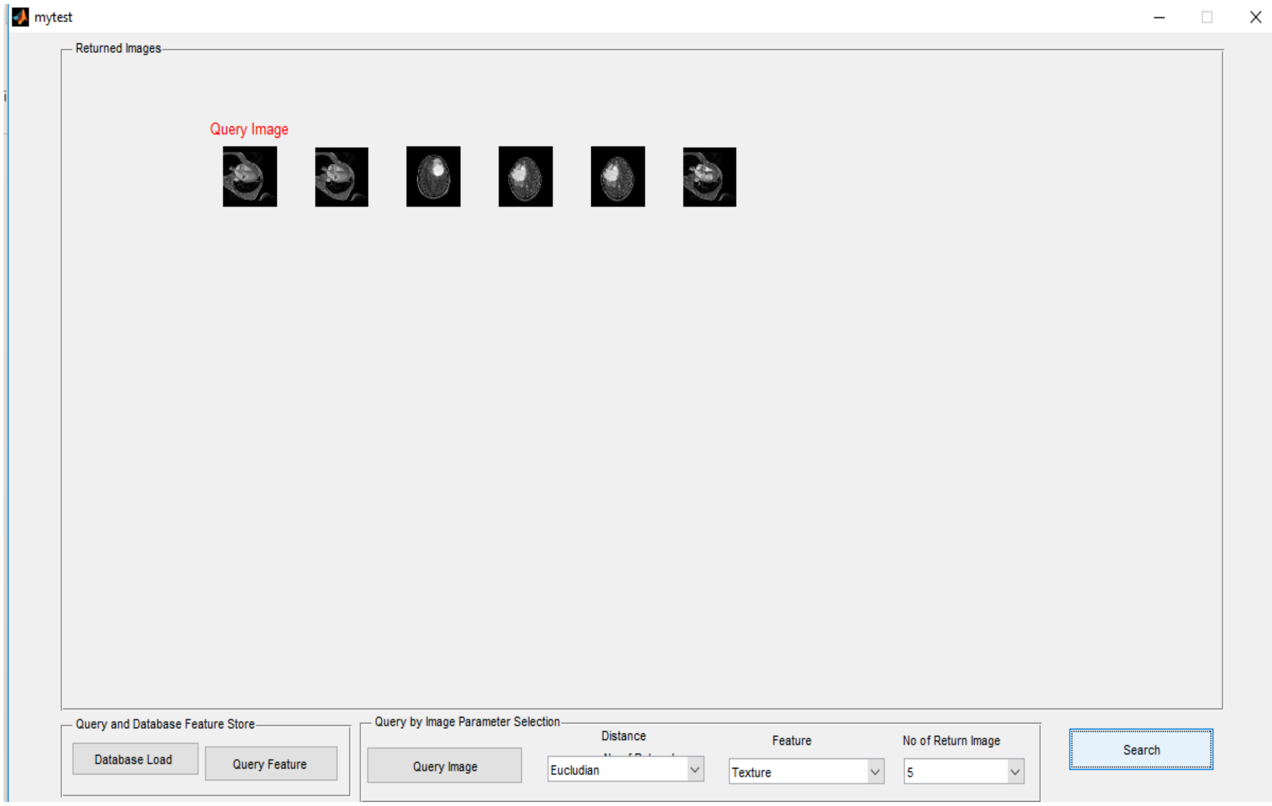


Fig. no. 5.14. Retrieval result (2) with Texture features for heart query image of MCBIR

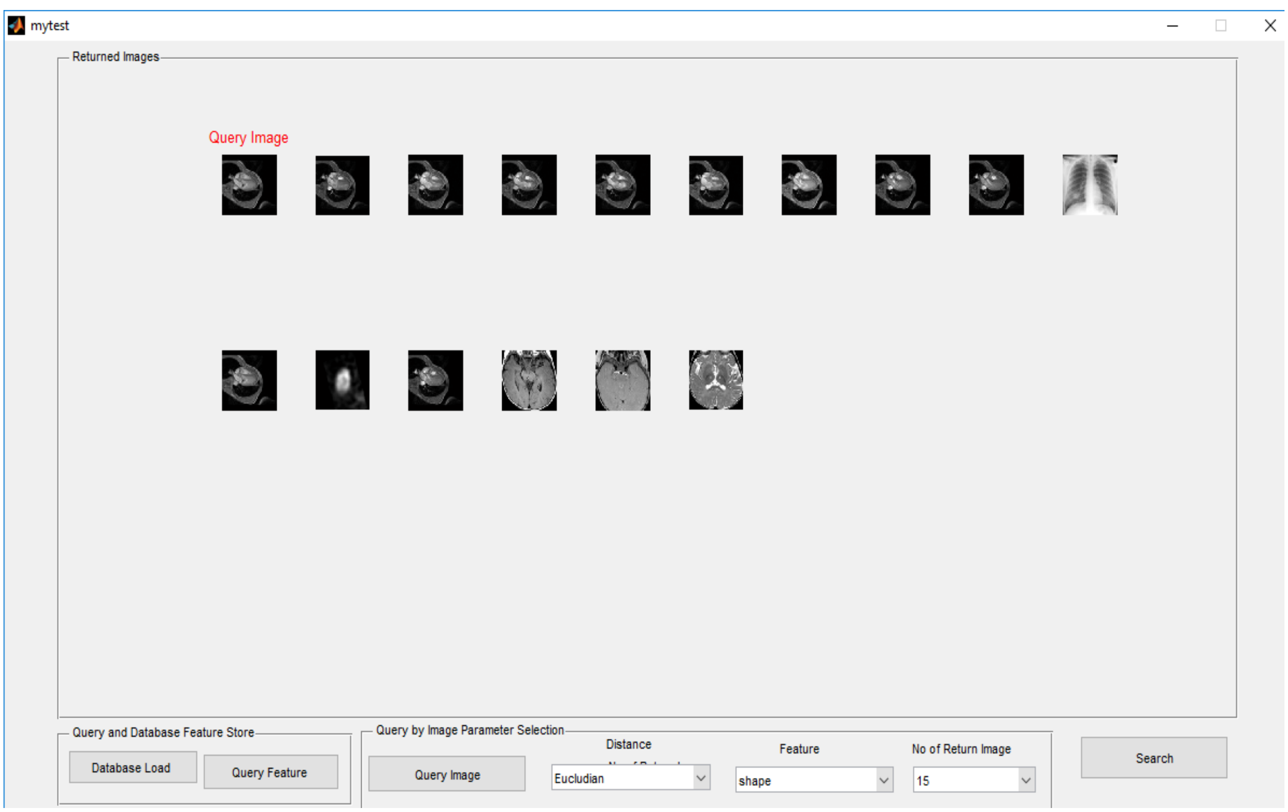


Fig. no. 5.15. Retrieval result (11) with Shape features for heart query image of MCBIR

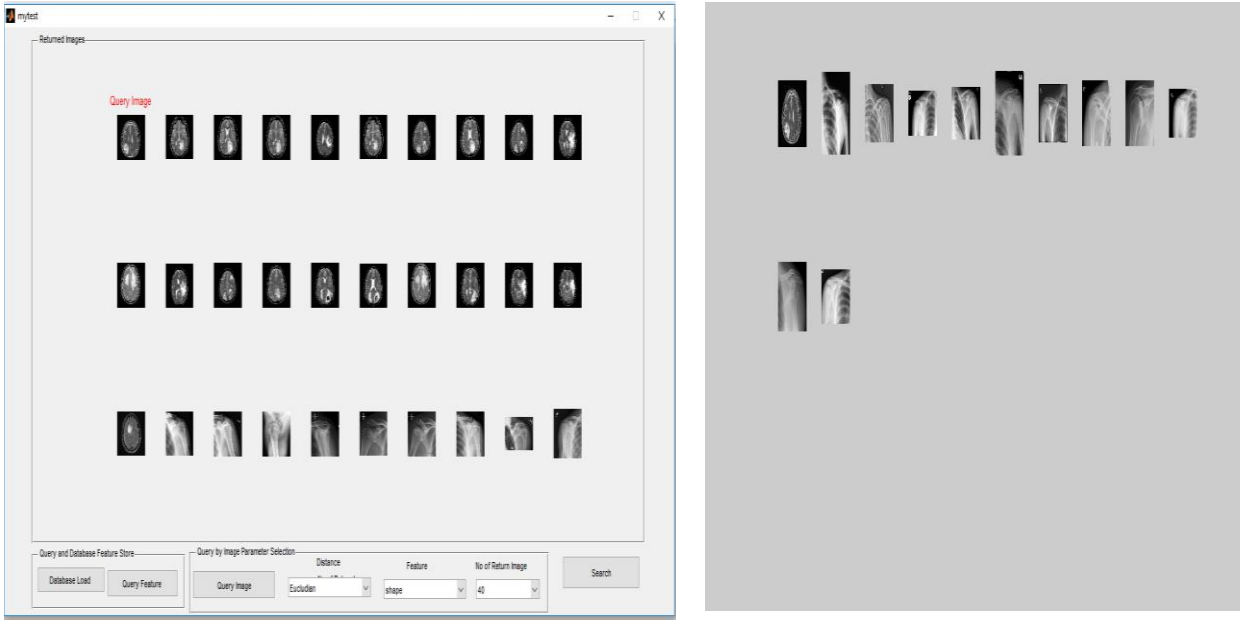


Fig. no. 5.16. Retrieval result (40) with Shape features for brain query image of MCBIR

No of Retrieval for heart and Brain(Texture)	Precision	Recall per category image in database	Recall with full database image
Heart(5)-2	40%	10%	0%
Heart(10)-6	60%	50%	2%
Heart(15)-10	66%	50%	3.3%
Heart(20)-15	75%	75%	5%
Brain(20)-7	35%	11%	0%
Brain(30)-13	43%	21%	4%
Brain(40)-18	45%	30%	6%
Brain(58)-29	50%	48%	9.6%

Table 5.2: Precision and Recall for heart and brain with Texture Feature

No of Retrieval for heart and Brain (shape)	Precision	Recall per category image in database	Recall with full database image
Heart(5)-3	60%	15%	1%
Heart(10)-7	60%	30%	2.3%
Heart(15)-10	66%	50%	3.3%
Heart(20)-15	75%	75%	5%
Brain(20)-8	40%	13%	2.6%
Brain(30)-13	43%	21%	4.3%
Brain(40)-20	50%	33%	6.6%
Brain(58)-32	55%	53%	10.66%

Table 5.3: Precision and Recall for heart and brain with Shape Feature

Shape Feature	Precision with Euclidian Distance	Recall with Euclidian Distance	Precision with Manhattan Distance	Recall with Manhattan Distance
Hand	80%	80%	80%	80%
Heart	75%	75%	75%	75%
Shoulder	73%	73%	73%	73%
BrainMri	69%	69%	76%	76%
Spine	65%	65%	70%	70%
Chest	60%	60%	65%	65%
BrainCT	55%	55%	50%	50%

Table no 5.4: Precision and Recall with Shape Feature

5.3 Work-3: Precision and Recall for the Composite feature

In GUI user has to select the no of images and distance formula for retrieved related images. For selected query image the texture feature are calculated. In the texture feature calculate the mean, variance, standard deviation, correlation, energy, entropy, and contrast. For the shape feature area, edge, Fourier descriptor, circularity, equivalence diameter are calculated. In the composite (texture + shape) feature the feature vector created with 12 different value.

The precision and recall are calculated for all the category of image with difference distance formula. For the heart and brain category the precision and recall given. In the fig no. 5.17 give heart retrieval with composite features. In the fig no 5.18 give second heart retrieval with composite features. In the fig no 5.19, 5.21 and 5.22 give brain retrieval with composite feature. In the fig no 5.20 give second brain retrieval with composite features. As per the user selection of distance method the retrieval result can vary but nearer vary.

As per the selection in GUI number of images are retrieved. The system calculated the precision and recall for the composite (texture and shape) feature. That is given in table no 5.5 & 5.6. As per the table if the number of images is increase as per the category then precision and recall are maintained with both distance formula.

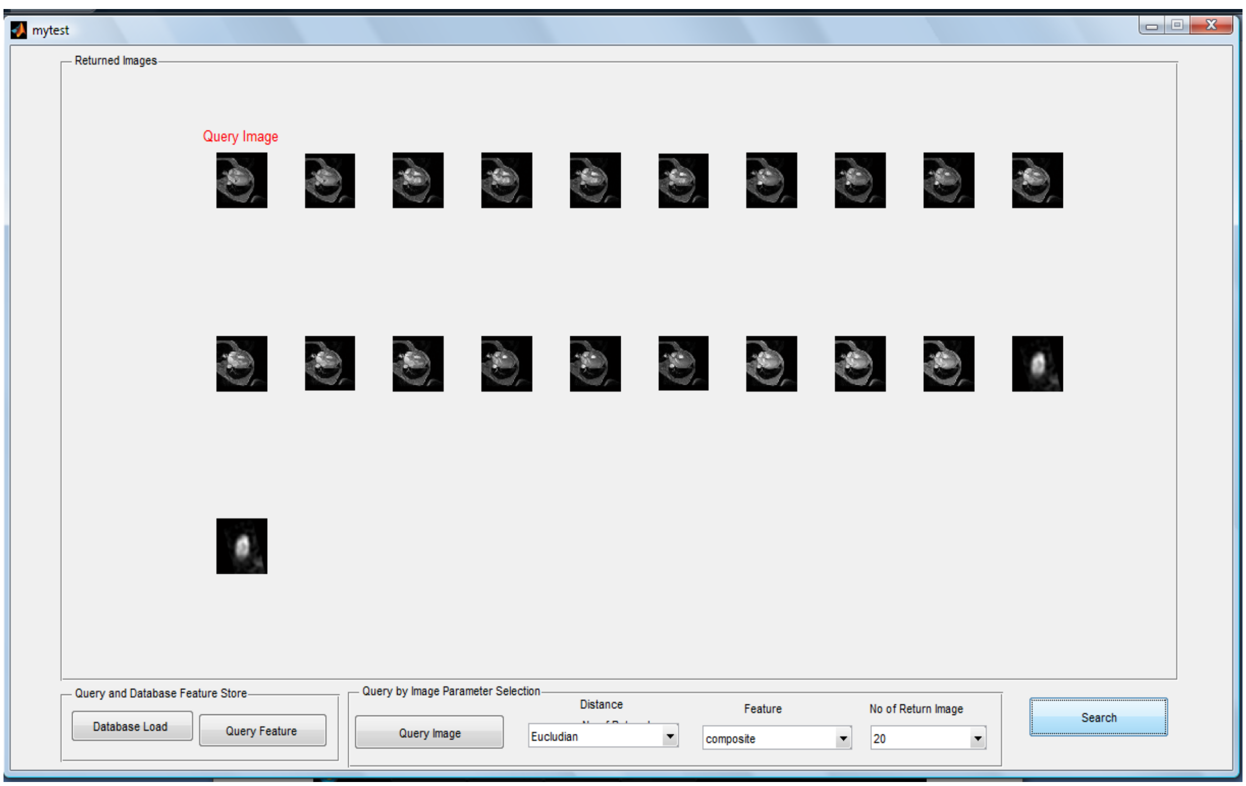


Fig. no. 5.17. Retrieval result (20) with Composite features for heart first query image of MCBIR

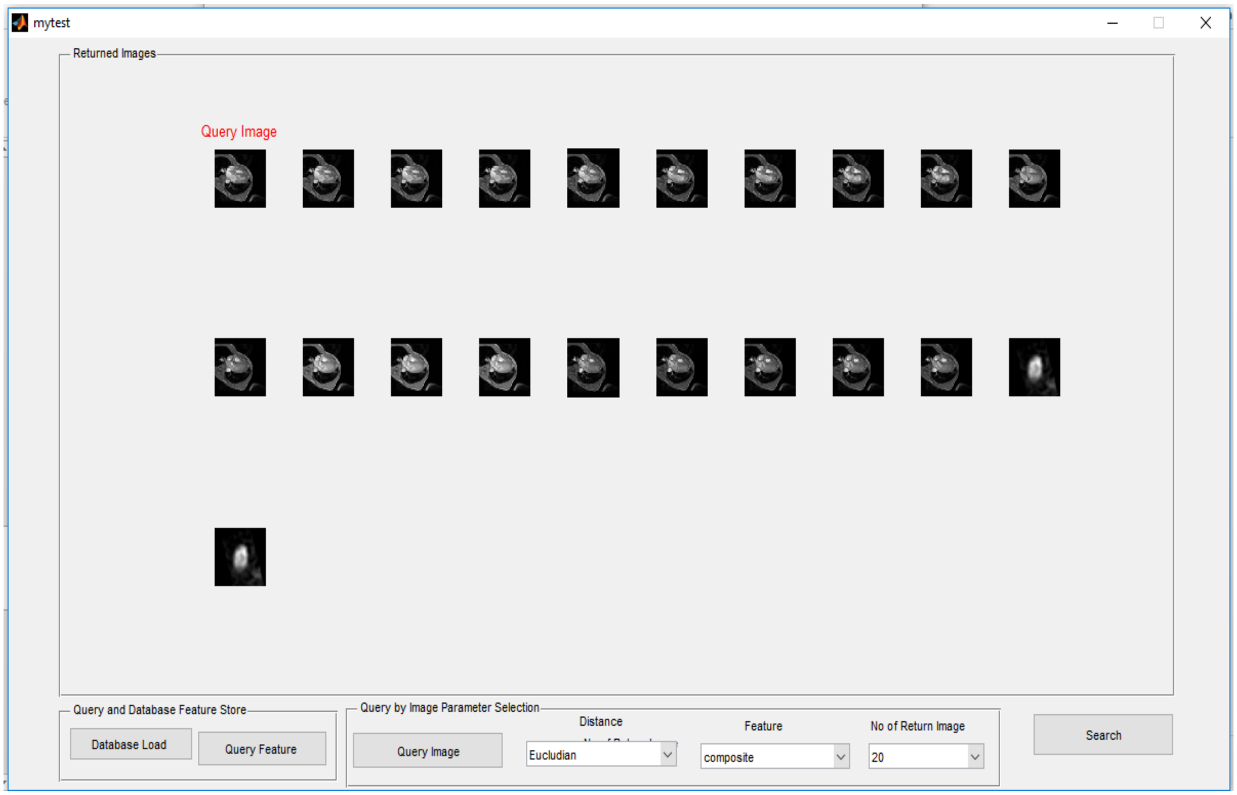


Fig. no. 5.18. Retrieval result (20) with composite features for second heart query image of MCBIR

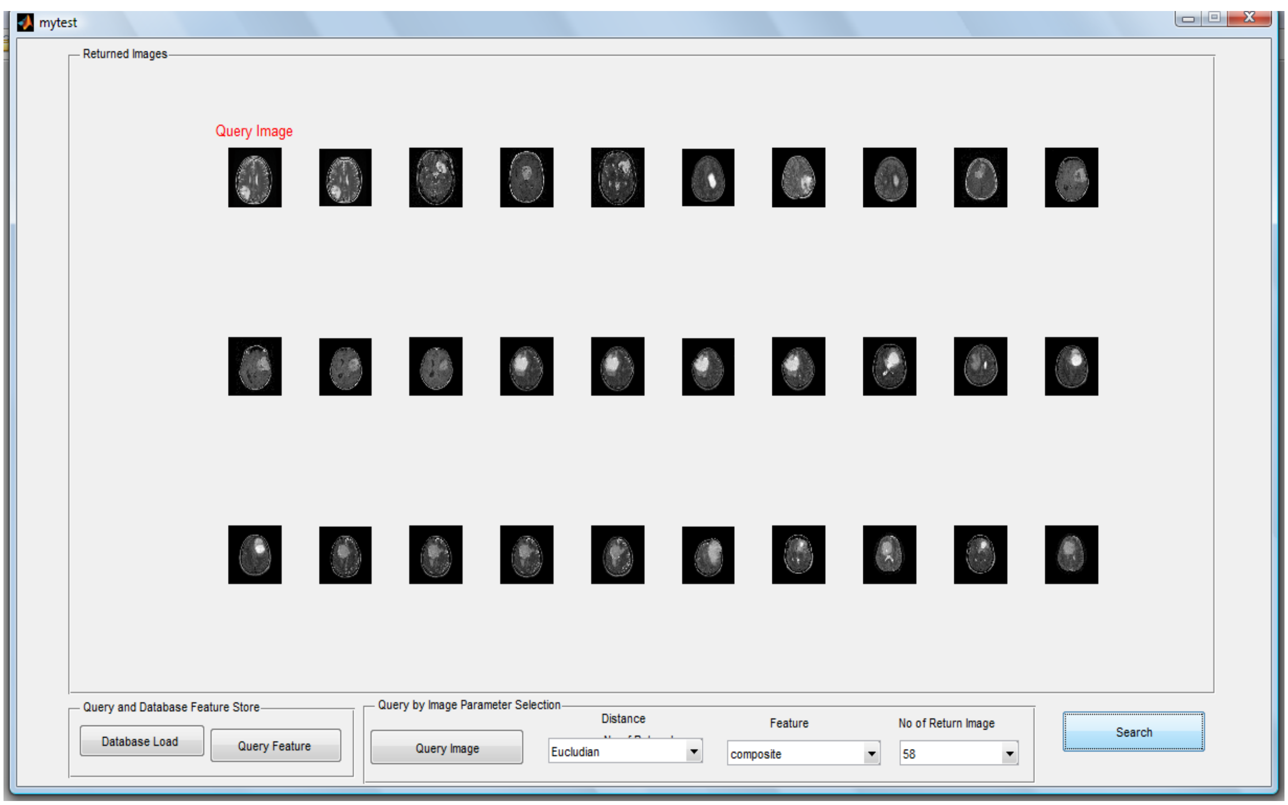
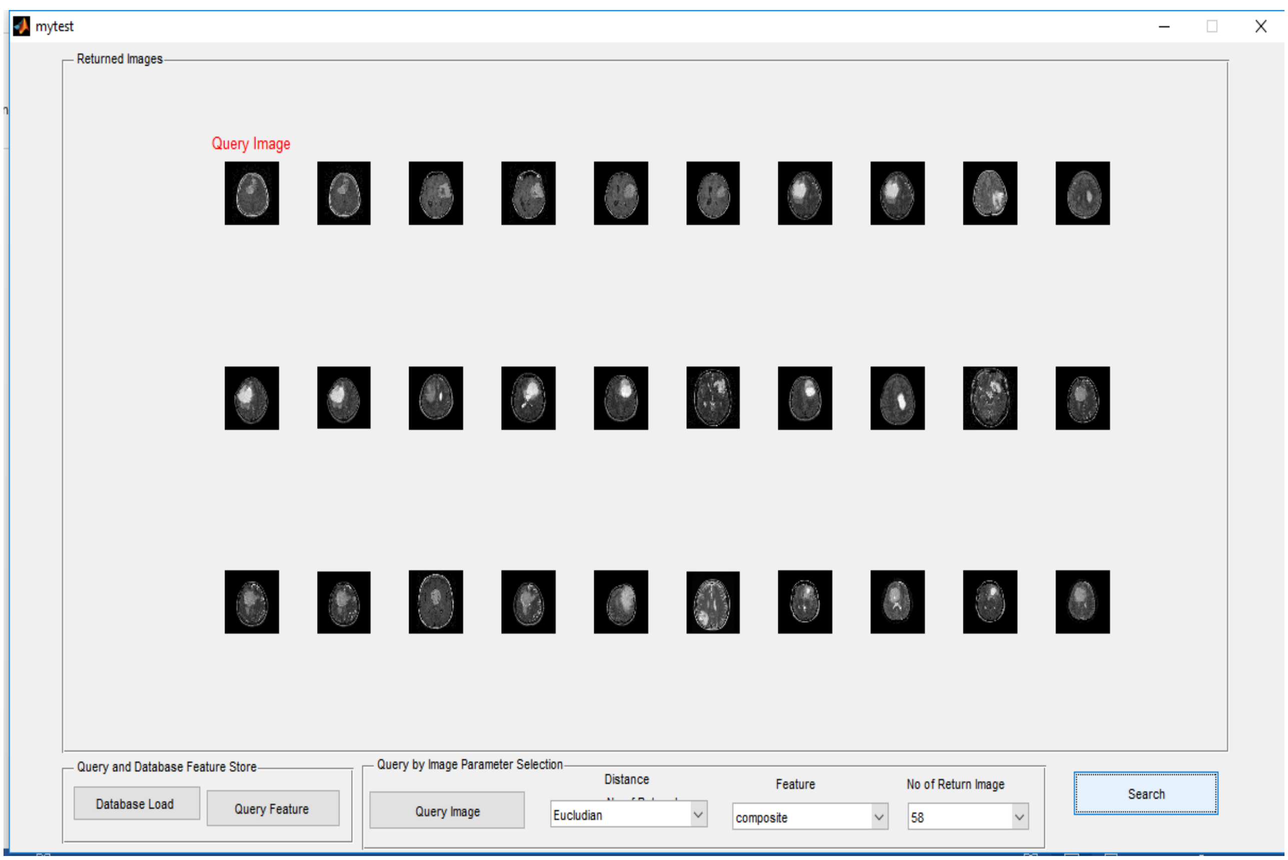


Fig. no. 5.19. Retrieval result (58) with composite features for first brain query image of MCBIR



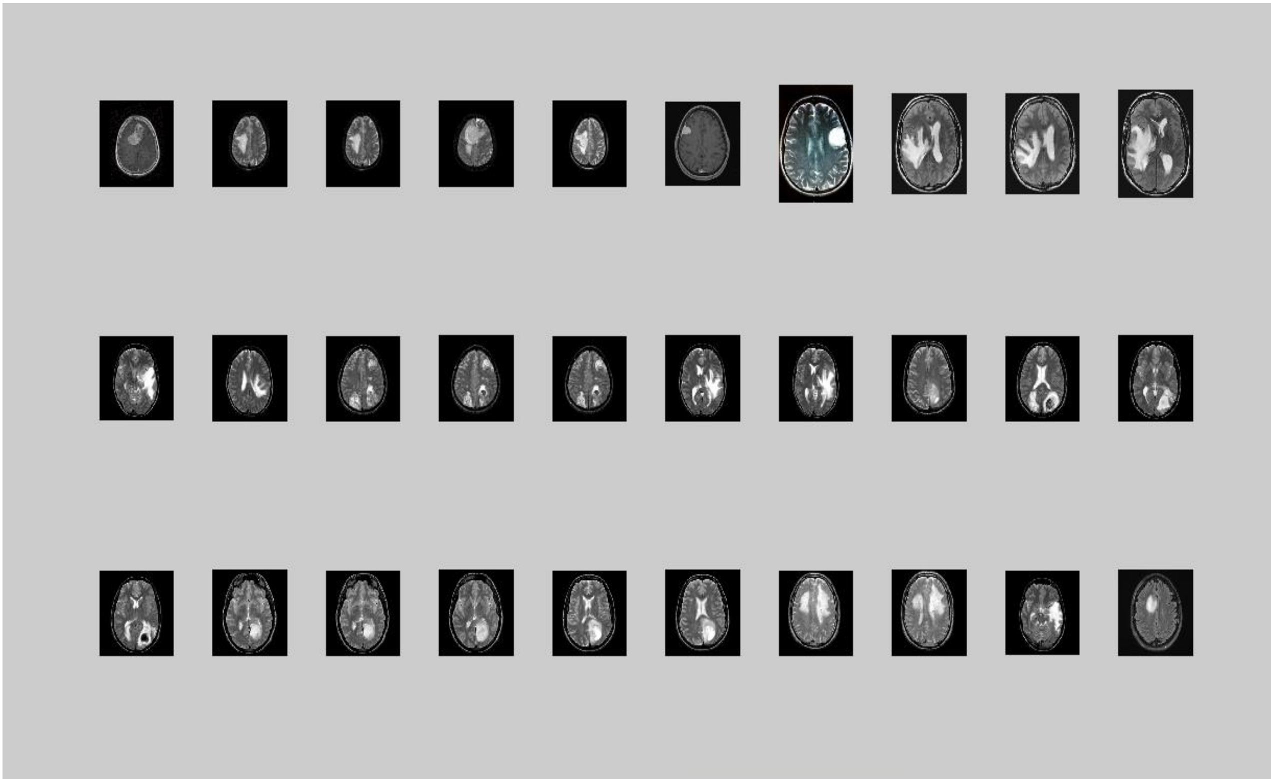


Fig. no. 5.20. Retrieval result (58) with composite features for second brain query image of MCBIR

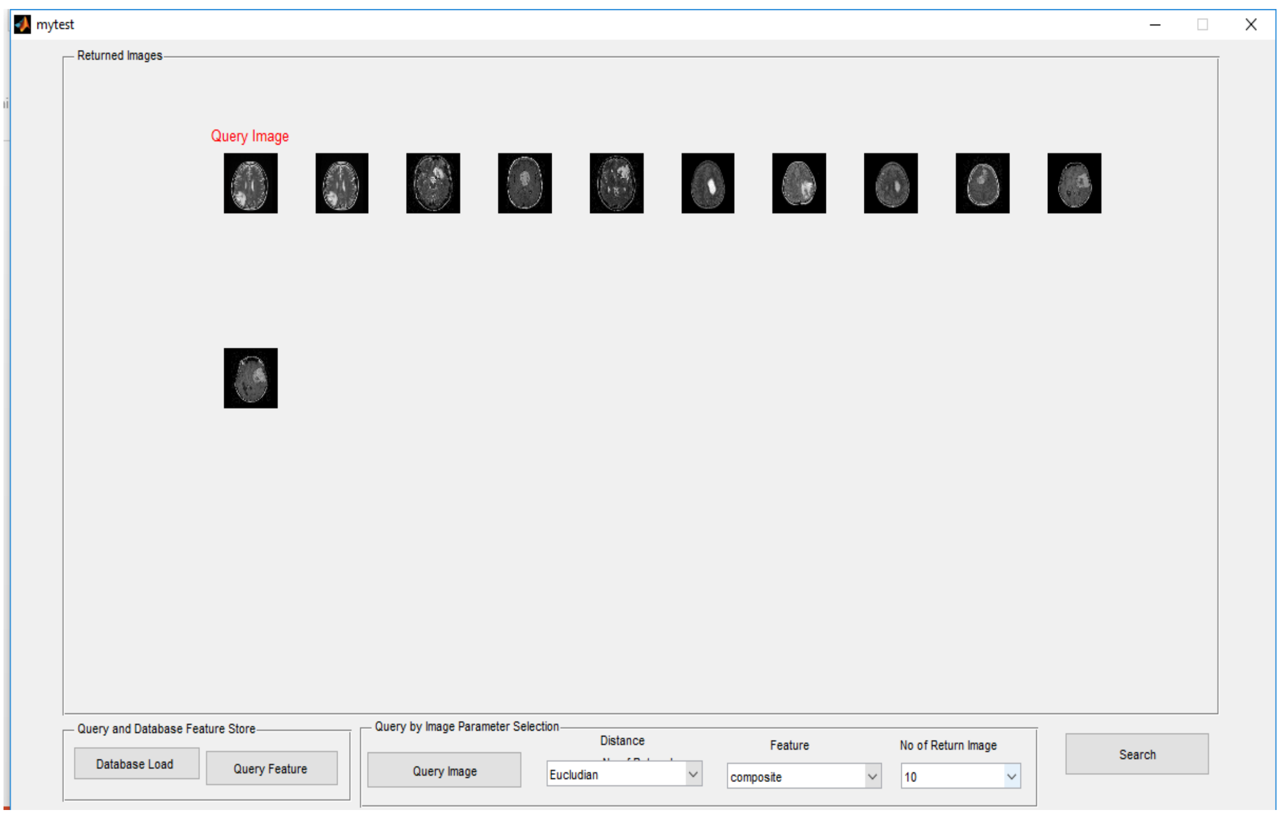


Fig. no. 5.21. Retrieval result (10) with composite features for brain query image of MCBIR

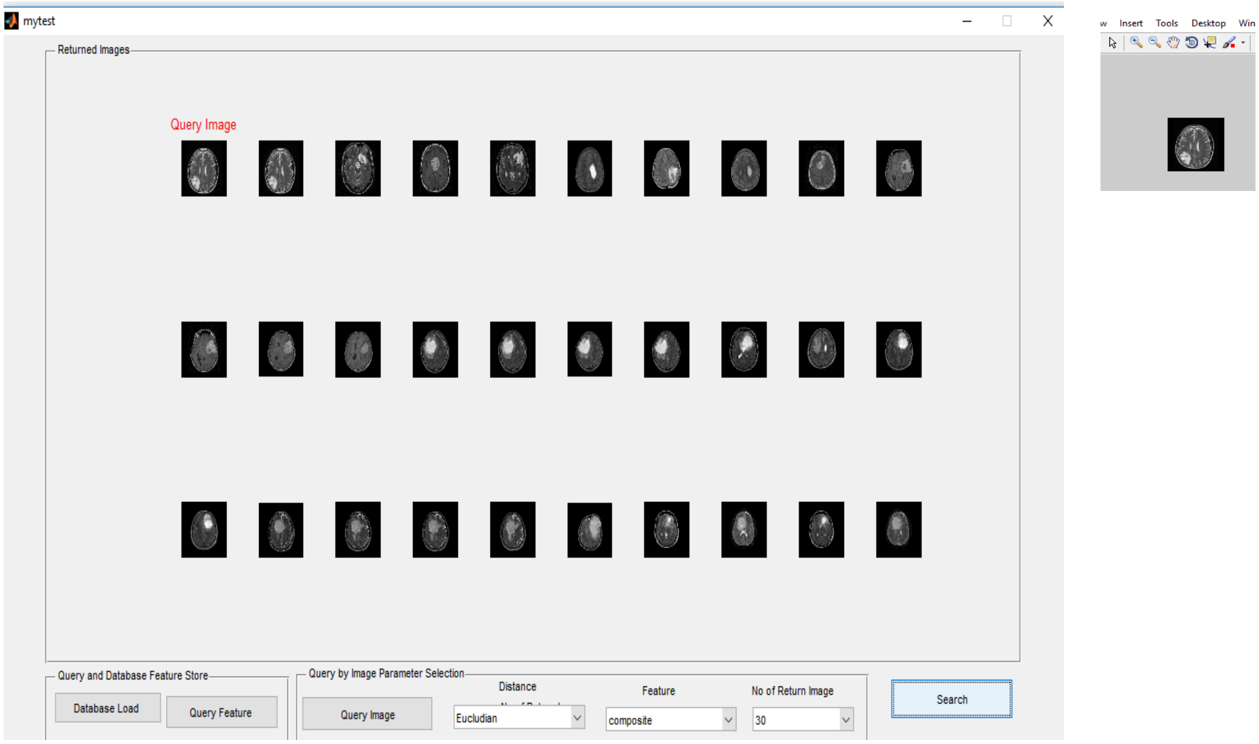


Fig. no. 5.22. Retrieval result (30) with composite features for brain query image of MCBIR

Composite=Texture+Shape Feature	Precision with Euclidian Distance	Recall with Euclidian Distance	Precision with Manhattan Distance	Recall with Manhattan Distance
Hand	100%	100%	100%	100%
Heart	100%	100%	100%	100%
Shoulder	100%	100%	100%	100%
Spine	100%	100%	100%	100%
BrainCT	100%	96%	100%	96%
Chest	97%	98%	97%	98%
BrainMri	97%	97%	97%	97%

Table no 5.5: Precision and Recall with composite Feature

No of Retrieval for heart and Brain	Precision	Recall per category image in database	Recall with full database image
Heart(5)	100%	25%	1.6%
Heart(10)	100%	50%	3.3%
Heart(15)	100%	75%	5%
Heart(20)	100%	100%	6.6%
Brain(20)	100%	33%	6.6%
Brain(30)	100%	50%	10%
Brain(40)	100%	66%	13.33%
Brain(58)	100%	96%	19.33%

Table no 5.6: Precision and Recall for heart and brain with Composite Feature

5.4 Classification Accuracy for Neural Network

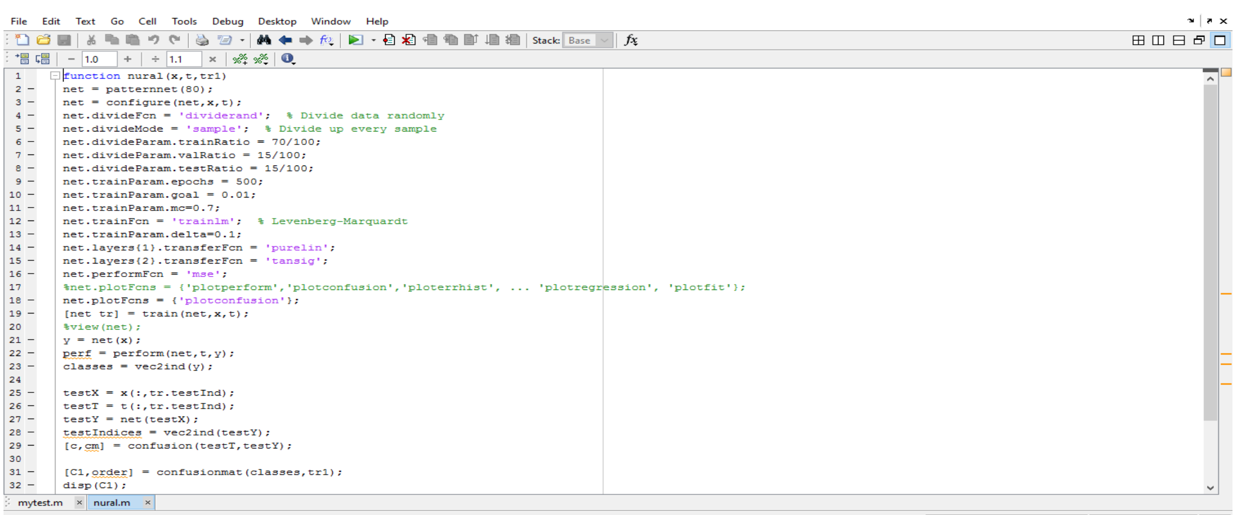
Based on the type of Neural networks can be classified as feed forward and feedback models. In this study we concentrate on feed forward networks with supervised learning. For the study Gaussian Fuzzy Feed Forward Neural Network architecture is given below that show in fig no. 5.34

Input Neuron	300
Output Neuron	2
Number of hidden layer	80
Number of processing elements	98
Transfer function of hidden layer	Fuzzy Gaussian
Step size	0.1
Momentum	0.7
Maximum Epoch	1000

In the neural network has input it is the feature vector of images. Based on feature the network is trained and tested with given number of samples and try to get the best output with classified the image into the no of classes. To the best output the transfer function is change in neural network with Gaussian fuzzy function in the layer. The first classification divide into 7 different classes. This classification can help easy to manage the image with database so searching can be done faster. Due to this classification database is arrange as per the category of image and retrieval can done faster. This 7 multi class classification done with texture, shape and composite features. That result shown in fig no 5.25, 5.28 and 5.33 respectively with texture, shape and composite feature.

In the neural network has input it is the feature vector of images. Based on feature the network is trained and tested with given number of samples and try to get the best output with classified the image into the two classes. To the best output the transfer function is change in neural network with Gaussian fuzzy function in the layer. The first classification divide into relevant and no relevant classes. Then again the neural network is train with relevant images feature vector and test again with number of samples and get the best output with classified image into the two classes like normal and abnormal images.

This neural network architecture is tested with texture, shape and composite features and generate the confusion matrix. That architecture with texture feature show in the figure no.5.23. That architecture with shape feature show in the figure no.5.26. The architecture with composite feature show in the fig no.5.29. The classification result we get from confusion matrix. Based on confusion matrix we can calculate the classification accuracy. For the heart query image based on texture feature classification given in fig no. 5.24. For the heart query image based on shape feature classification given in fig no. 5.27. For the first and second heart query image based on composite feature classification given in fig no. 5.30 and 5.31. For the first and second brain query image based on composite feature classification given in fig no. 5.32. In the table no 5.7 give classification accuracy with composite features.


```
function nural(x,t,tr1)
net = patternnet(80);
net = configure(net,x,t);
net.divideFcn = 'dividerand';  % Divide data randomly
net.divideMode = 'sample';  % Divide up every sample
net.divideParam.trainRatio = 70/100;
net.divideParam.valRatio = 15/100;
net.divideParam.testRatio = 15/100;
net.trainParam.epochs = 500;
net.trainParam.goal = 0.01;
net.trainParam.mc=0.7;
net.trainFcn = 'trainlm';  % Levenberg-Marquardt
net.trainParam.delta=0.1;
net.layers{1}.transferFcn = 'purelin';
net.layers{2}.transferFcn = 'tansig';
net.performFcn = 'mse';
%net.plotFcns = {'plotperform','plotconfusion','ploterrhist', ... 'plotregression', 'plotfit'};
net.plotFcns = {'plotconfusion'};
[net tr] = train(net,x,t);
%view(net);
y = net(x);
perf = perform(net,t,y);
classes = vec2ind(y);

testX = x(:,tr.testInd);
testT = t(:,tr.testInd);
testY = net(testX);
testIndices = vec2ind(testY);
[c,cm] = confusion(testT,testY);

[C1,order] = confusionmat(classes,tr1);
disp(C1);
```


Fig. no. 5.34. Architecture of neural network for MCBIR

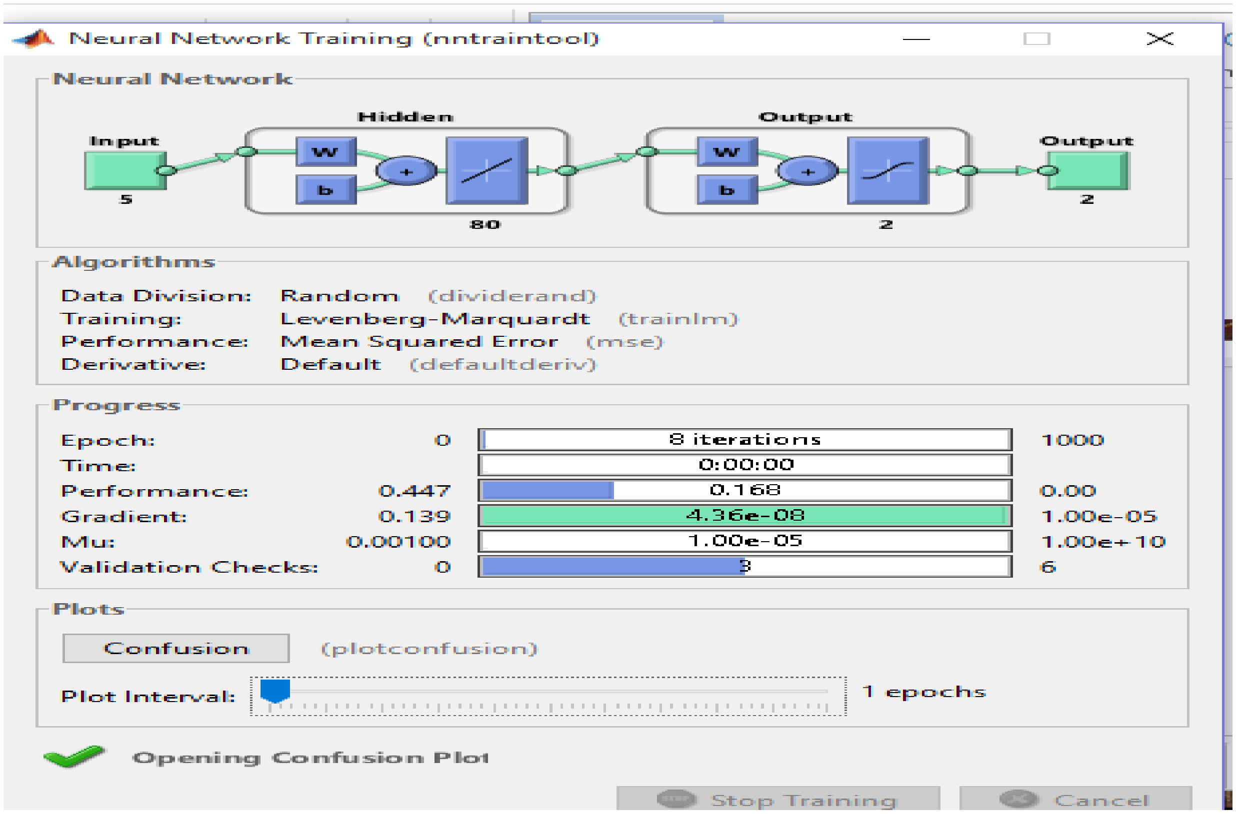


Fig. no. 5.23. Neural network with texture feature for MCBIR

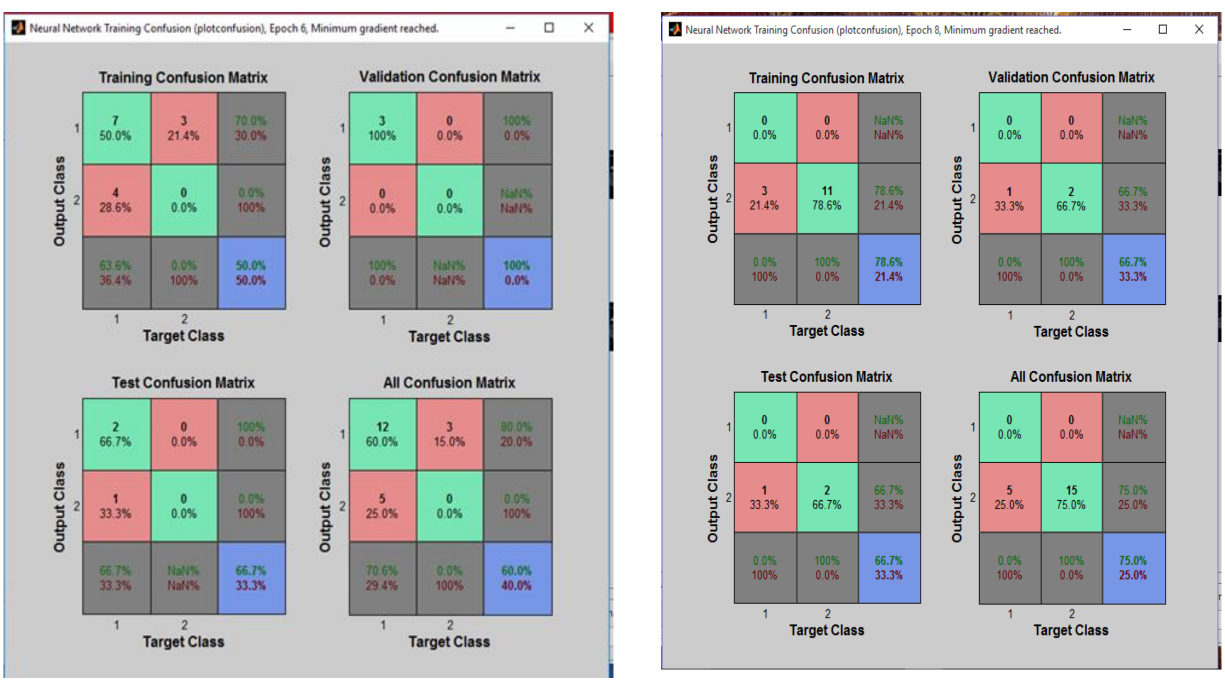


Fig. no. 5.24. Classification result with Texture and Shape features for heart query image of MCBIR

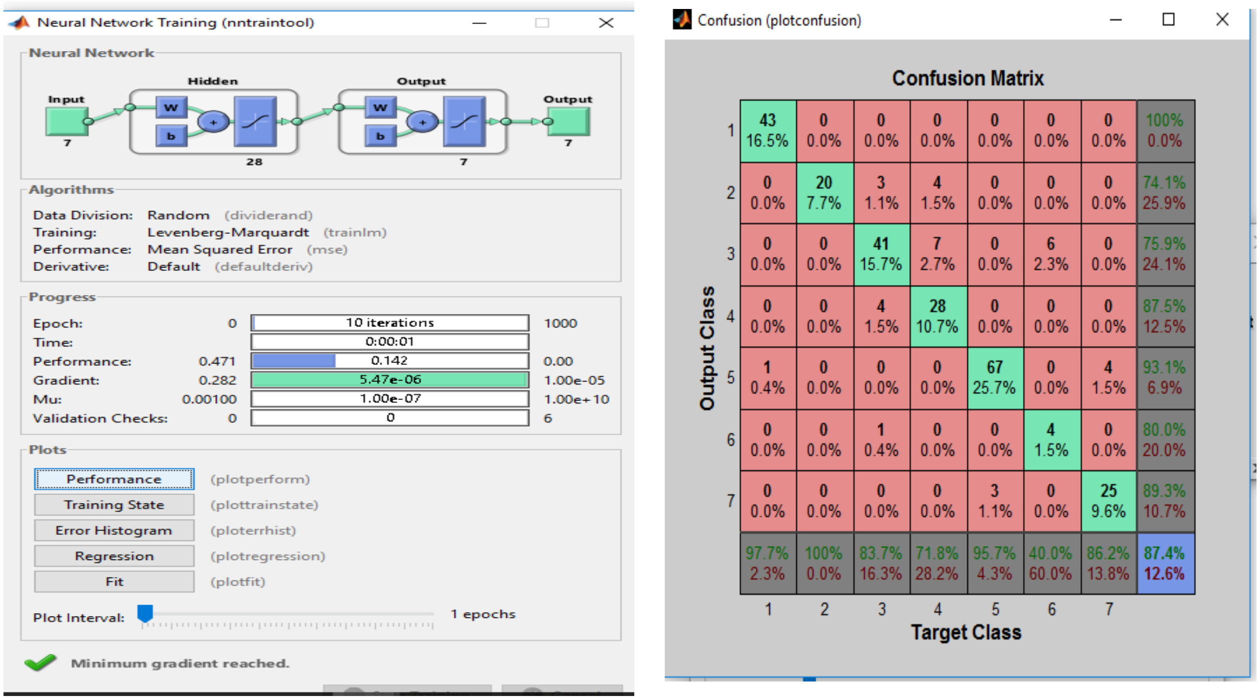


Fig. no. 5.25. Multi class classification result with Texture features for all types image of MCBIR

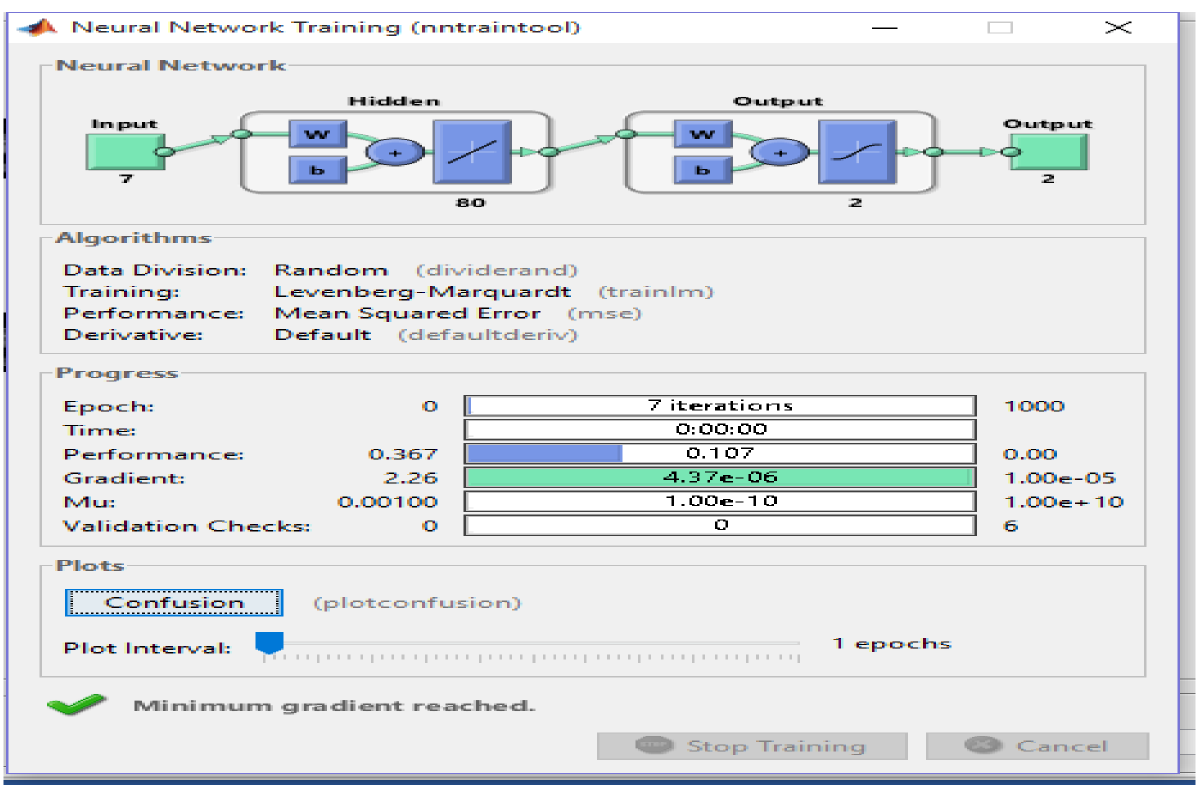


Fig. no. 5.26. Neural network architecture with Shape features for MCBIR

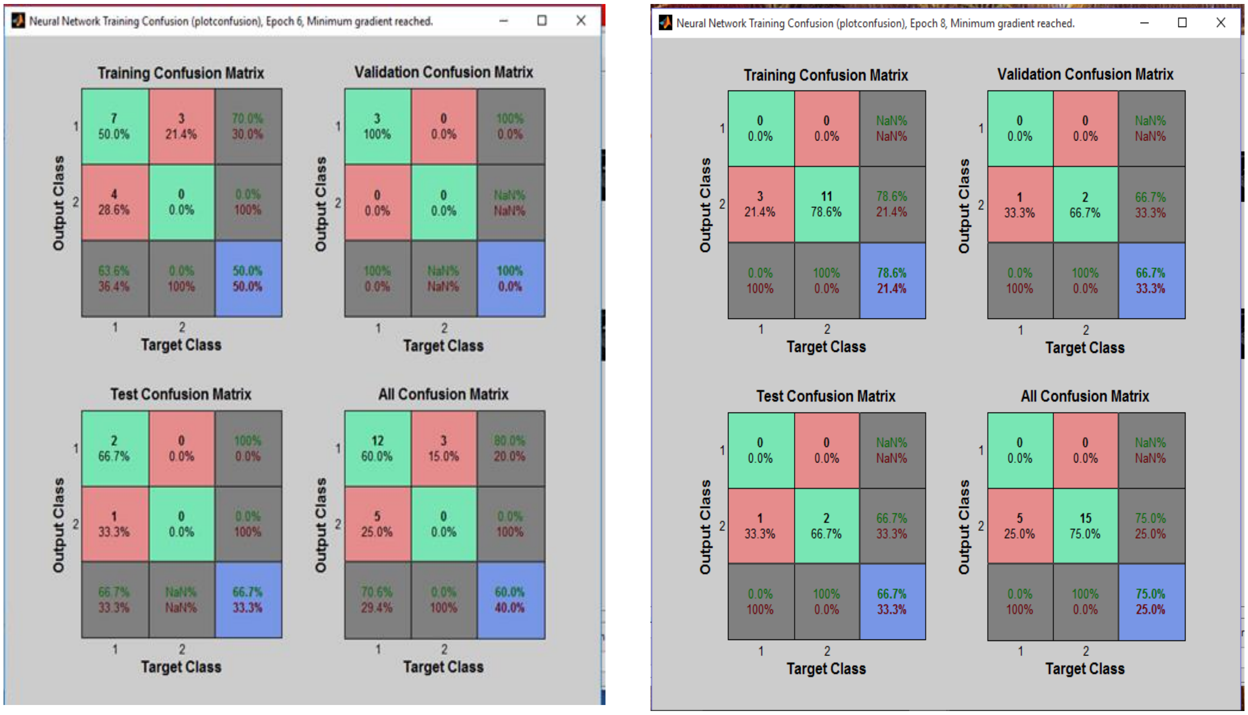


Fig. no. 5.27. Classification Accuracy result with Shape features for heart query image of MCBIR

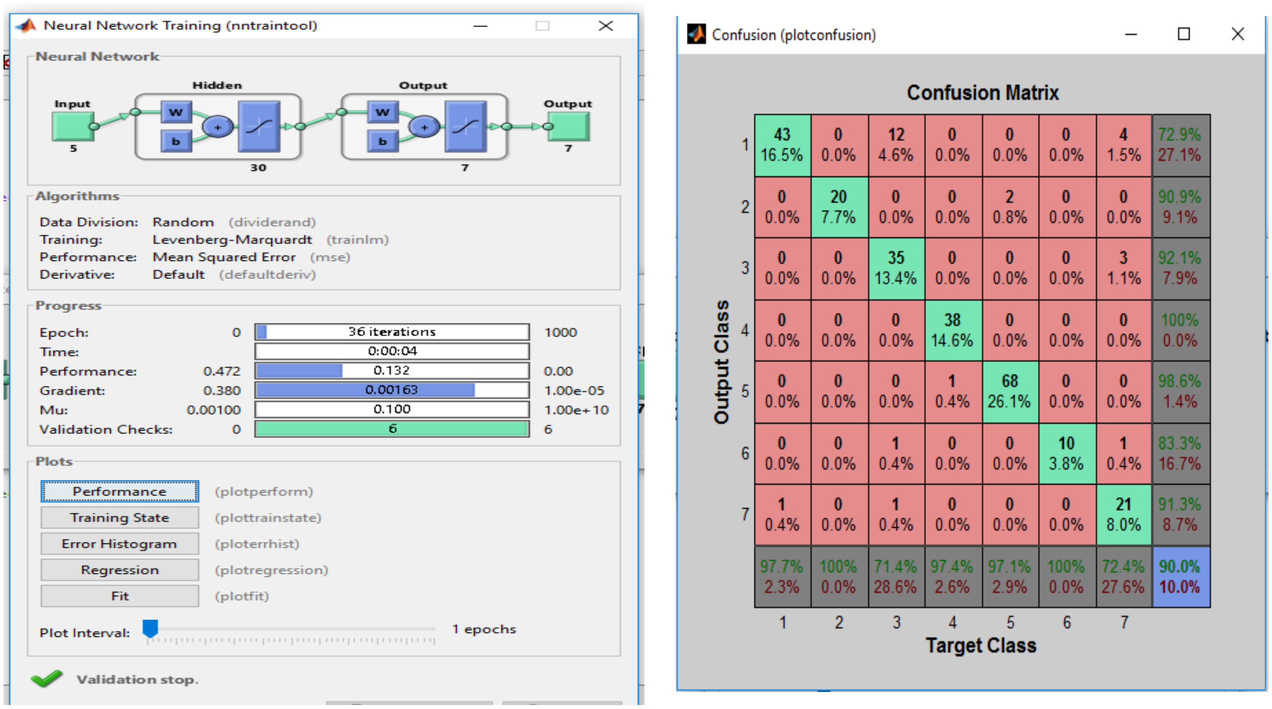


Fig. no. 5.28. Multi class classification result with Shape features for all types image of MCBIR

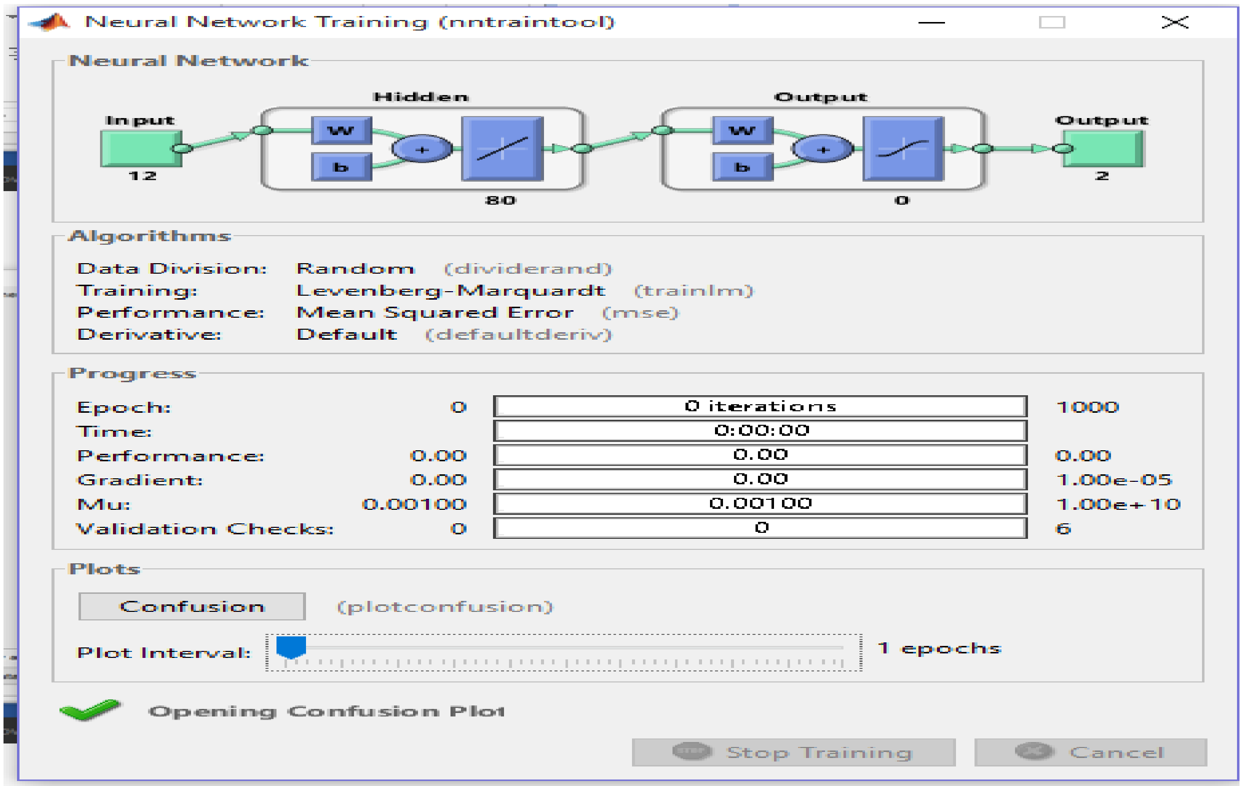


Fig. no. 5.29. Neural network architecture with composite features of MCBIR

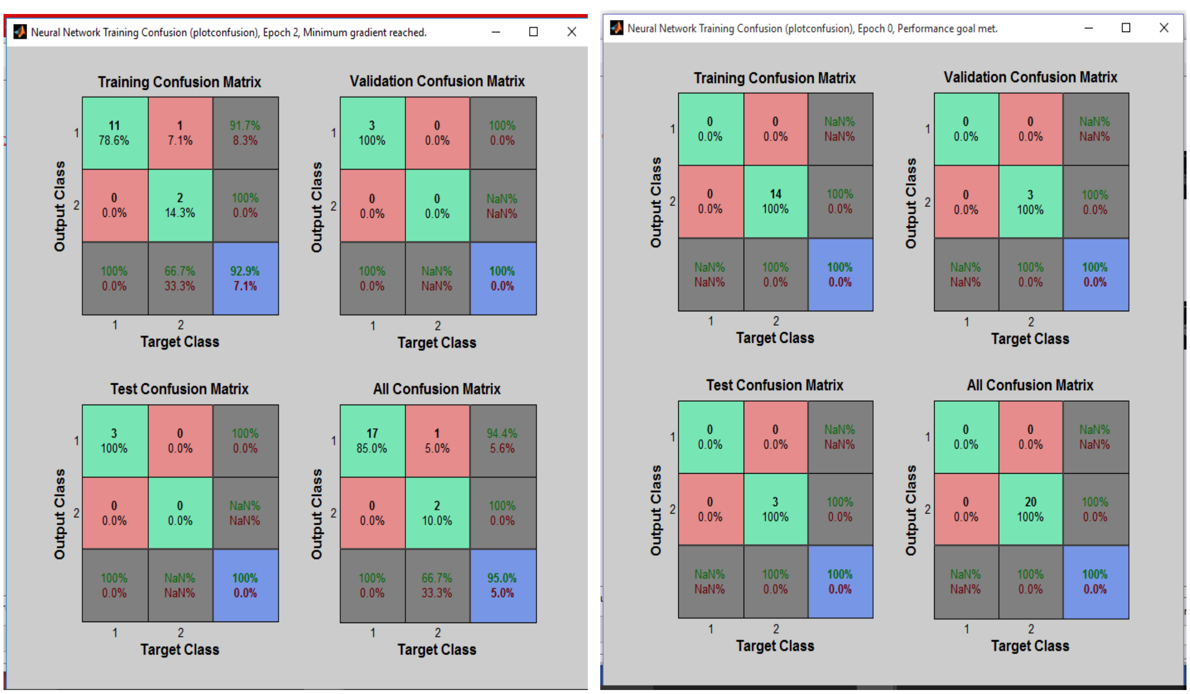


Fig. no. 5.30. Classification Accuracy result with composite features for first heart query image of MCBIR

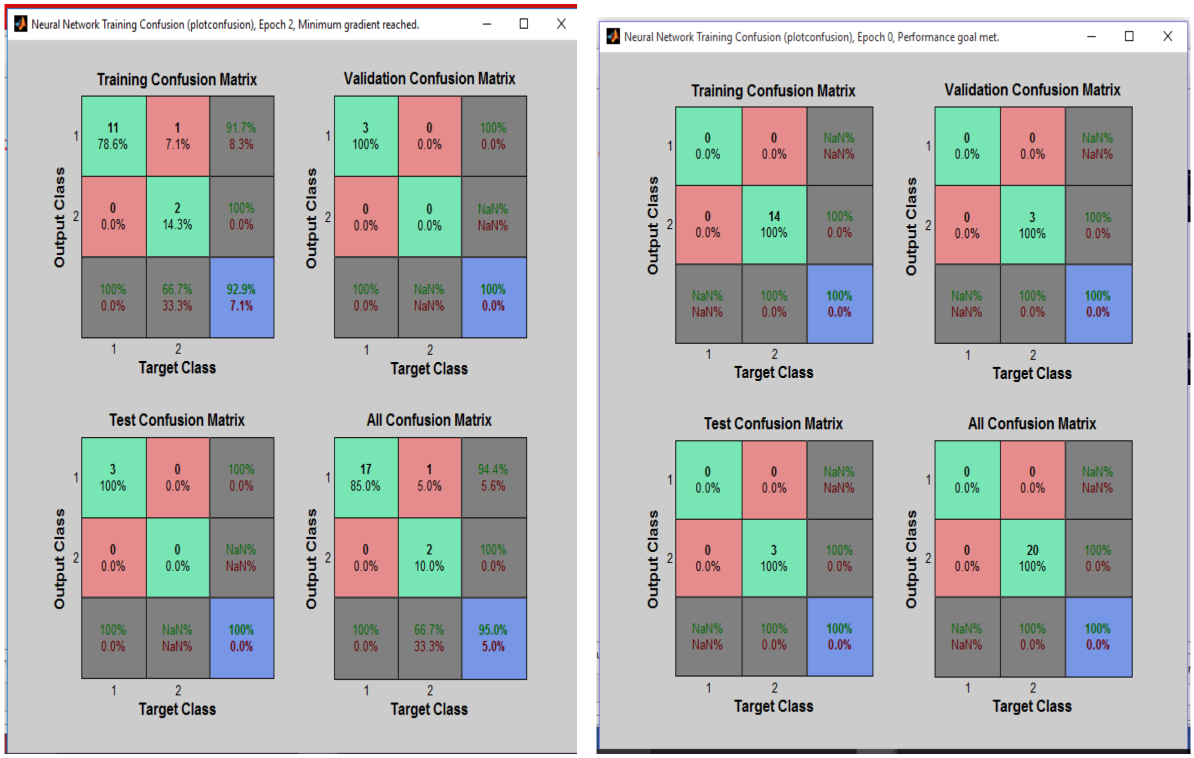


Fig. no. 5.31 Classification Accuracy result with composite features for second heart query image of MCBIR

Fig. no. 5.32. Classification Accuracy result with composite features for both brain query image of MCBIR

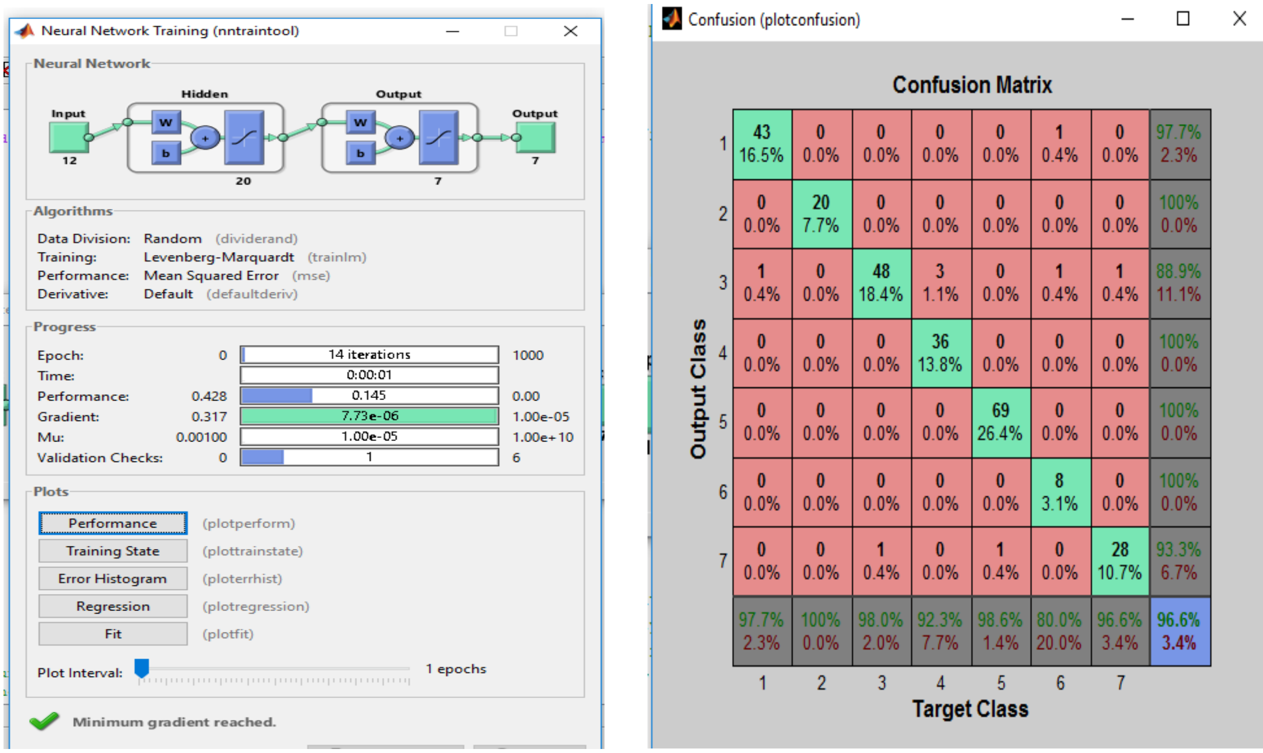


Fig. no. 5.33. Multi class classification result with composite features for all types image of MCBIR

Composite=Texture+Shape Feature	Accuracy with Euclidian Distance	Accuracy with Manhattan Distance
Hand	100%	100%
Heart	100%	100%
Shoulder	100%	100%
BrainMri	100%	100%
Spine	100%	100%
Chest	100%	100%
BrainCT	100%	100%

Table no 5.7: Classification Accuracy with composite Feature

5.5 Comparison with Relevance Feedback and Proposed System

In the general to get the maximum retrieval relevance feedback approach is used but it is nothing but iterative search. The main reason of CBIR created for relevance feedback is on retrieval process, permitting users to evaluate and mark the retrieval outcomes of CBIR, find out which are not relevant results and which are related to the query image, then feedback the related info that the users mark to the system as training samples for instruct next image retrieval and learning, So made the results more as per the requirements of users. A wider application of relevance feedback method changes the query vector on the one hand, using feedback information to change the weight of each feature vector in the formula, highlighting the more important vector of the query. The Relevance Feedback also implemented with heart and brain result with texture, shape feature. The heart query image tested with texture feature and relevance feedback, that is shown in fig no 5.34 and 5.35 respectively. The brain query image tested with shape feature and relevance feedback that is shown in fig no 5.37 and 5.38.

In the proposed system work with texture and shape composite feature with Euclidian and Manhattan distance for the retrieval accuracy it is nothing but more feature give nearer good result. So there is no human interaction in between the system. The heart and brain query image tested with composite feature, which is shown in fig no. 5.46, 5.37 and 5.39. The precision and recall is more in composite feature which is given in table no.5.8. As per the table you can see the proposed system precision and recall are more compare to relevance feedback.

To compare the existing system with proposed system, in the literature review already discussed the IRMA, MIRAGE, 3D PET, ASSERT and lot many system. This existing system IRMA, MIRAGE are compare with proposed system with precision and recall, which is given in table no.5.9. As per the table you can see the proposed system precision and recall are more than the existing system.

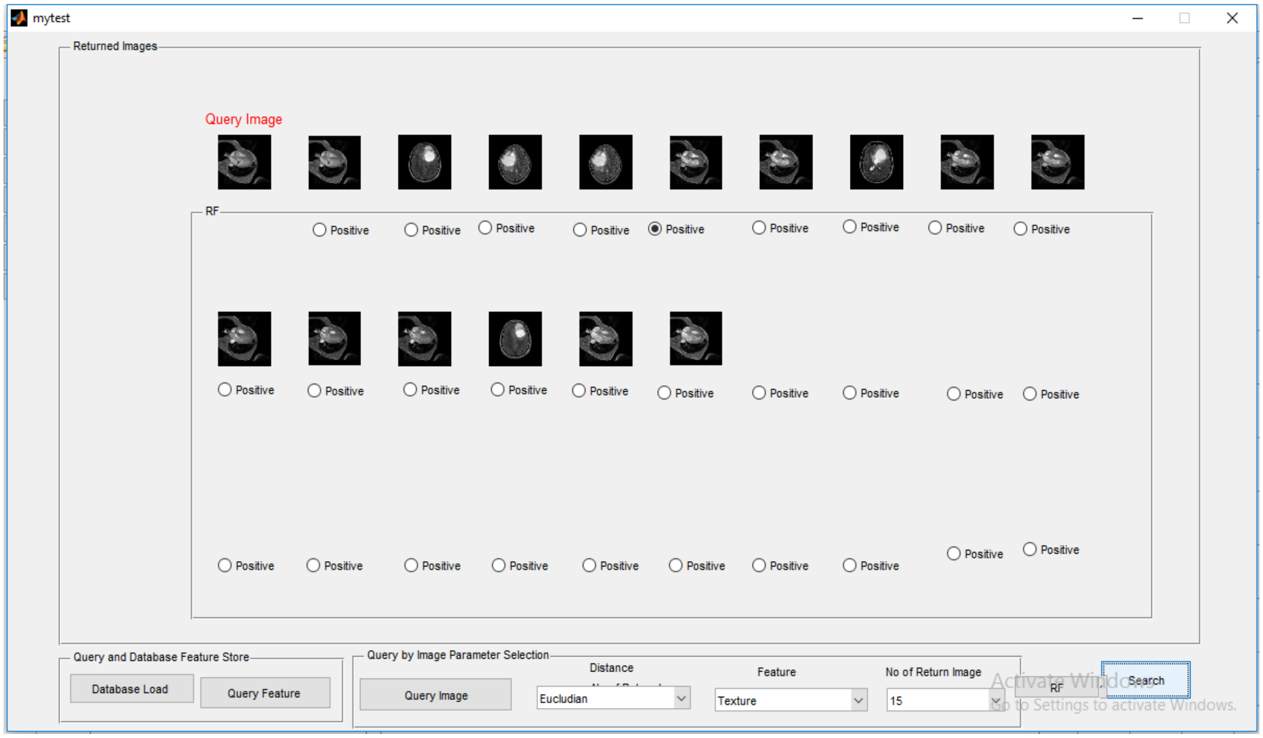


Fig. no. 5.46. Retrieval result(10) with Texture features for heart query image of MCBIR

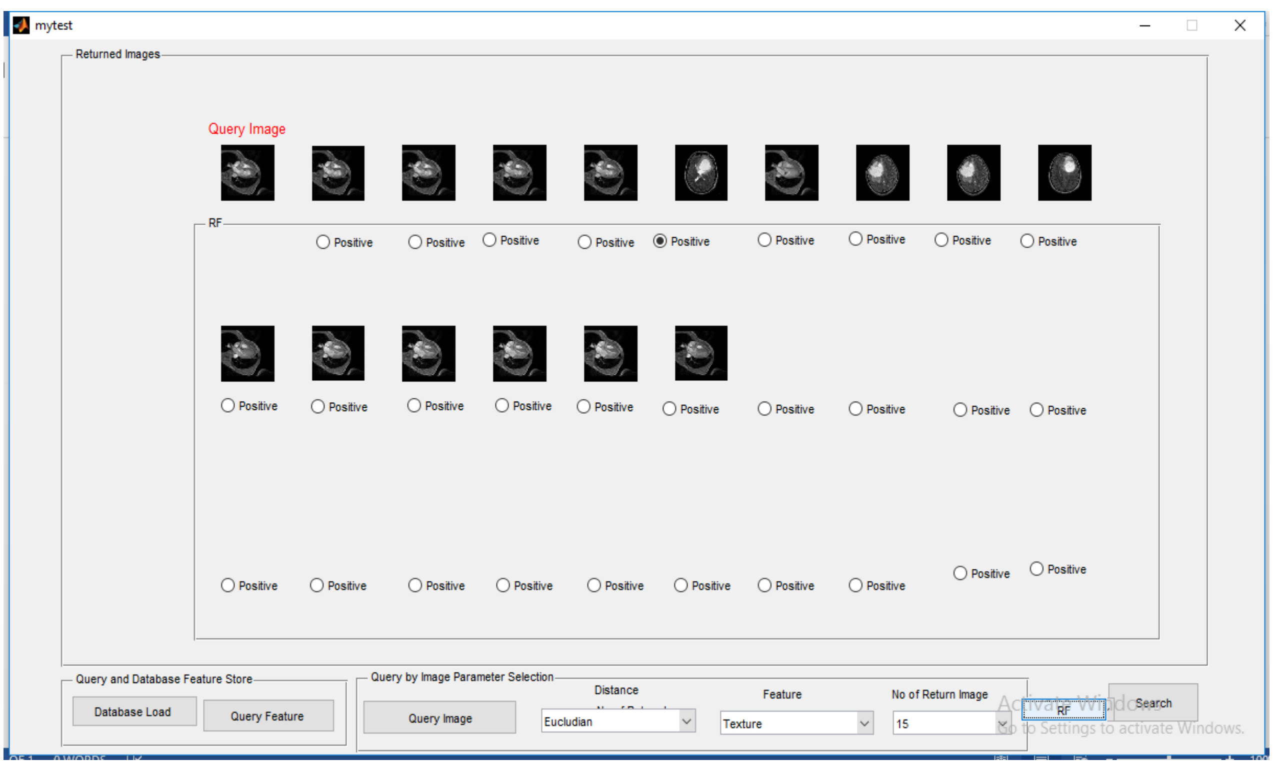


Fig. no.5.35. Retrieval result (11) with Texture features with RF for heart query image of MCBIR

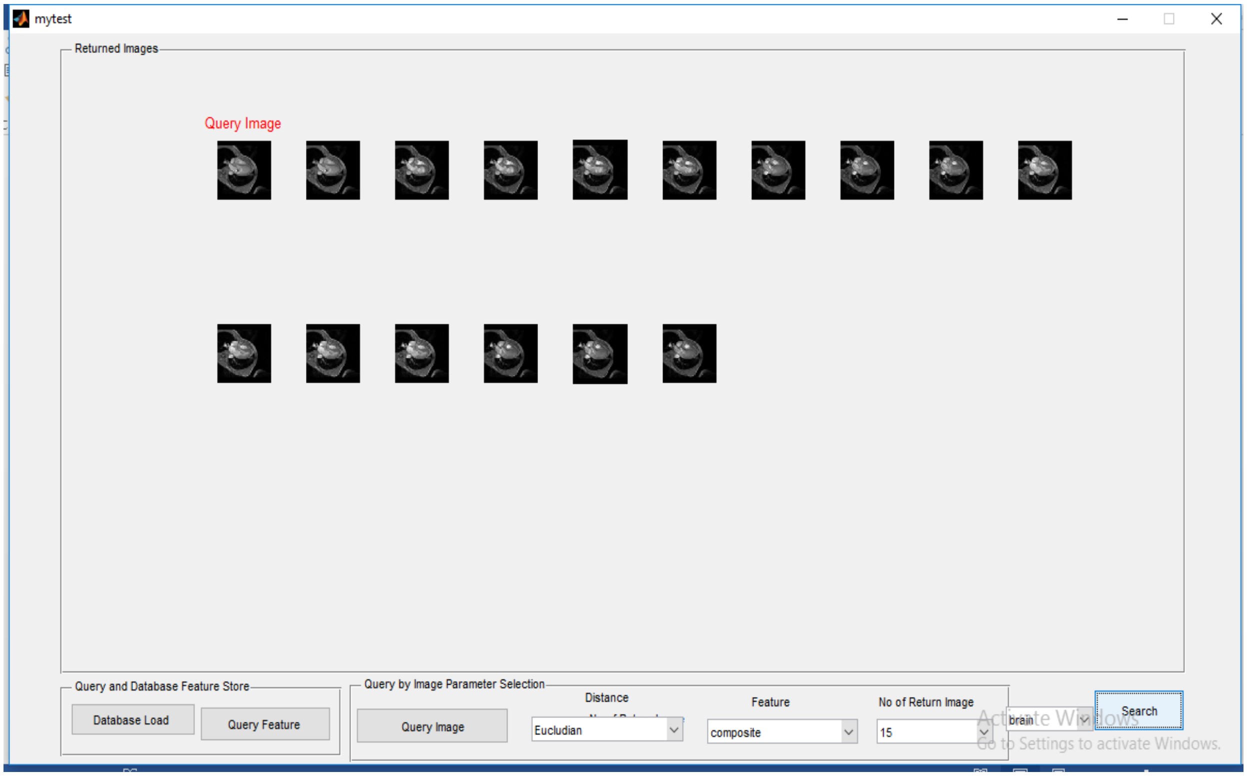


Fig. no.5.36. Retrieval result (15) with composite features for heart query image of MCBIR

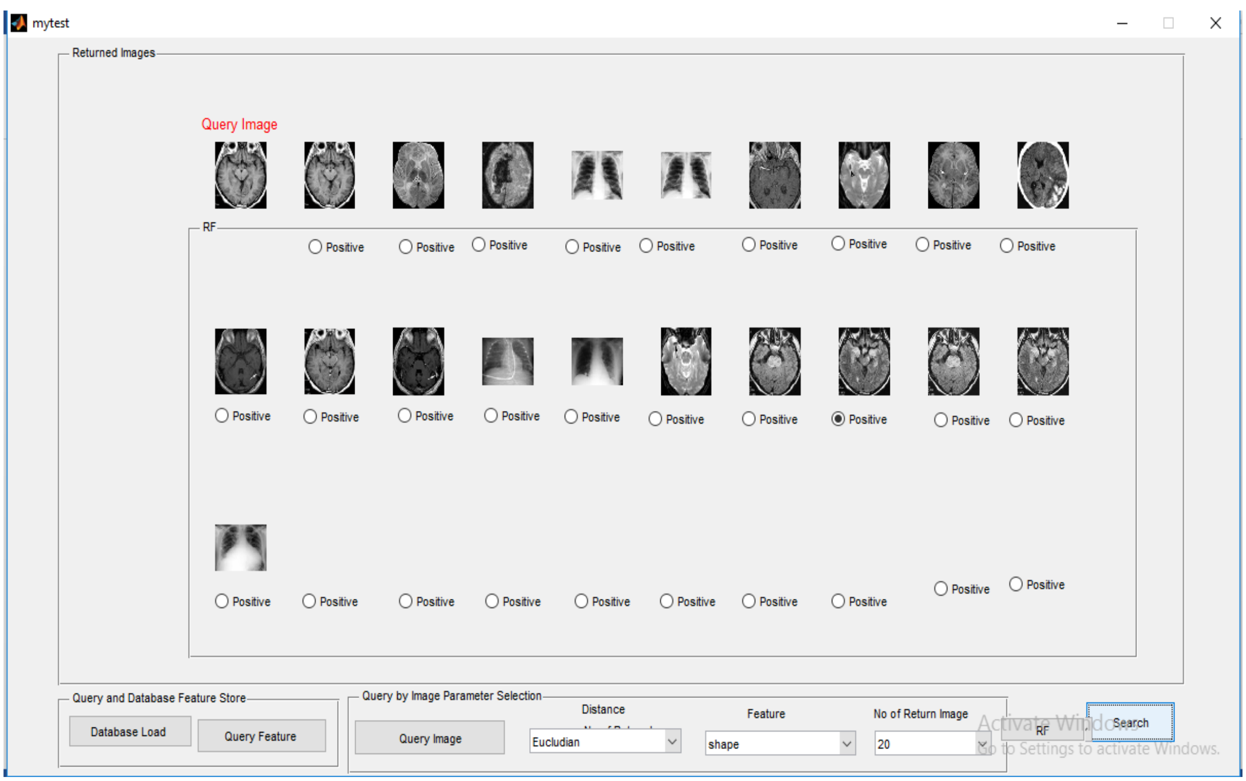


Fig. no.5.37. Retrieval result (15) with shape features for brain query image of MCBIR

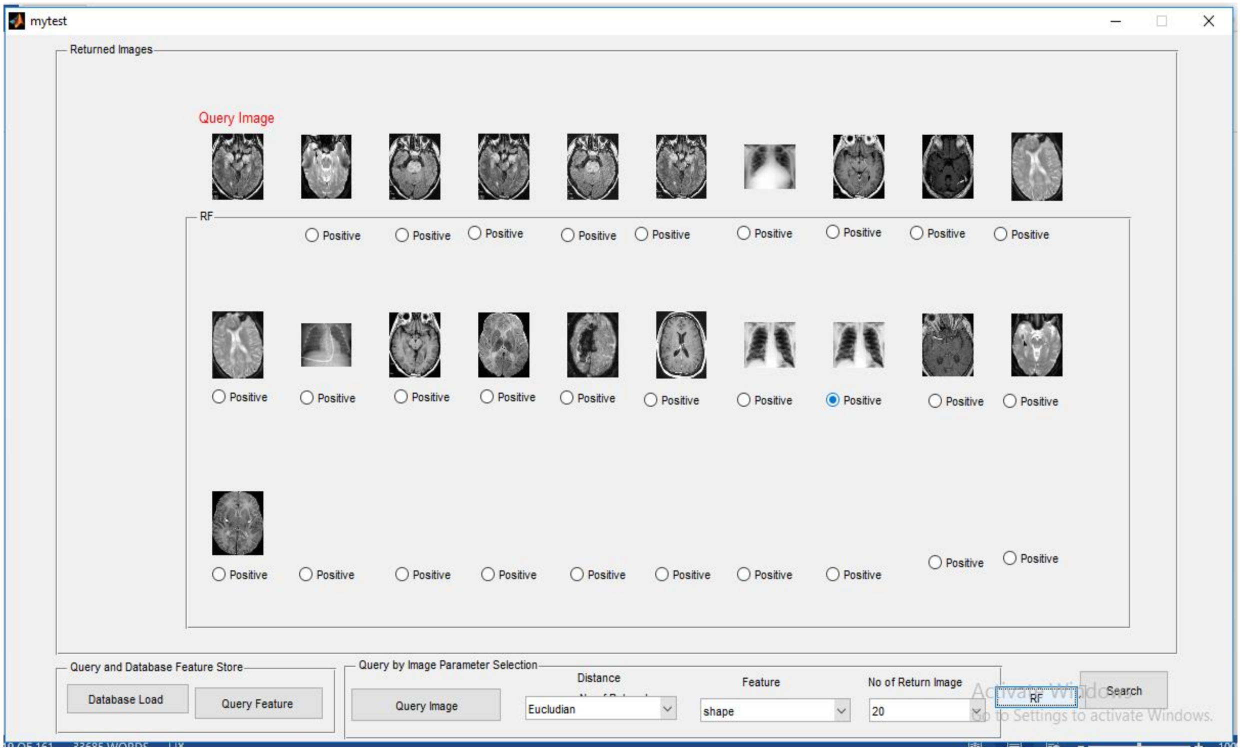


Fig. no.5.38. Retrieval result (16) with shape features with RF for brain query image of MCBIR

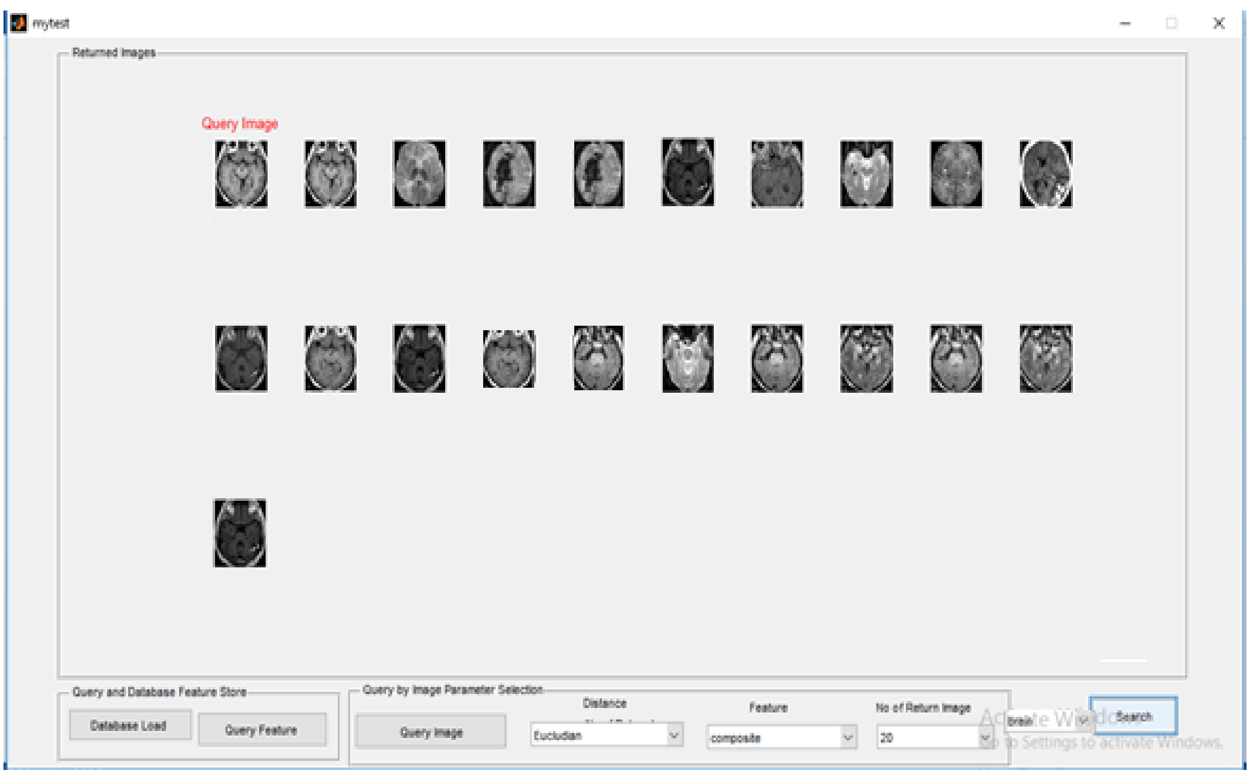


Fig. no.5.39. Retrieval result (20) with composite features for brain query image of MCBIR

Sr.No.	Algorithm	Image Type	True (Relevant) image	False(Non Relevant) image	Precision (%)
1	Texture	Heart(15)	10	5	66
2	Relevance Feedback Texture	Heart(15)	11	4	73
3	Shape	Brain(20)	15	5	75
4	Relevance Feedback Shape	Brain(20)	16	4	80
5	Proposed System(Composite)	Heart(15)	15	0	100
6	Proposed System(Composite)	Brain(20)	20	0	100

Table no 5.8: Comparison of relevance feedback and proposed system

SR.No	Existing System Online	No of Relevant Retrieved image(Heart)
1	TinEye	10
2	Bing	1
3	Google	4
4	Proposed System	20

Table no 5.9: Comparison of existing system and proposed system

5.6 Result

In this chapter, we have proposed a novel algorithm for the medical CBIR and classification. We have named our system with medical CBIR with neural network classification. We considered medical images with 6 category, more number of features and different distance formula in our work. Our algorithm used texture and shape features with combination for the retrieval result and classification accuracy.

In the general to get the maximum retrieval relevance feedback approach is used but it is nothing but iterative search. In the research work system work with texture and shape composite feature and Euclidian and Manhattan distance for the retrieval accuracy it is nothing but iterative search with both feature. So there is no human interaction in between the system. With the help of low level feature of texture and shape we get the semantic like relevant, not relevant, normal and abnormal image. With the help of Euclidian and Manhattan distance research get the nearer same result.

In the thesis research work result show with heart and brain query image with texture, shape and composite feature. That heart and brain retrieval result with composite feature give nearer 100% precision and recall in the result compare to texture and shape feature. That shown in fig no 5.44 to 5.45.

In the research work first CBIR tested with texture feature and get the precision and recall in between 50 % to 80%. In that case when the number of image are increased in database then precision and recall is decrease. That show in fig no 5.40.

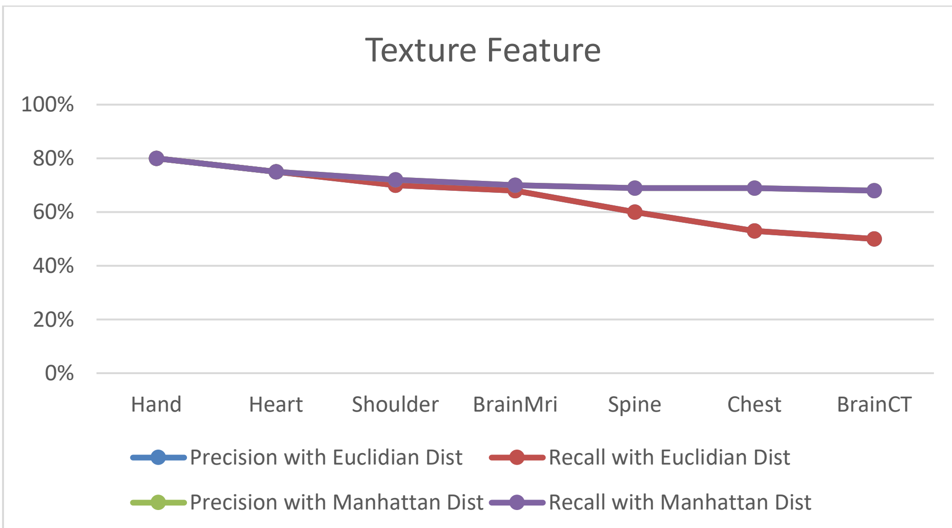


Fig. no. 5.40 Precision and Recall with Texture Feature

In the research work second CBIR tested with shape feature and get the precision and recall in between 55 % to 80%. In that case when the number of image are increased in database then precision and recall is decrease. That shown in given fig no 5.41.

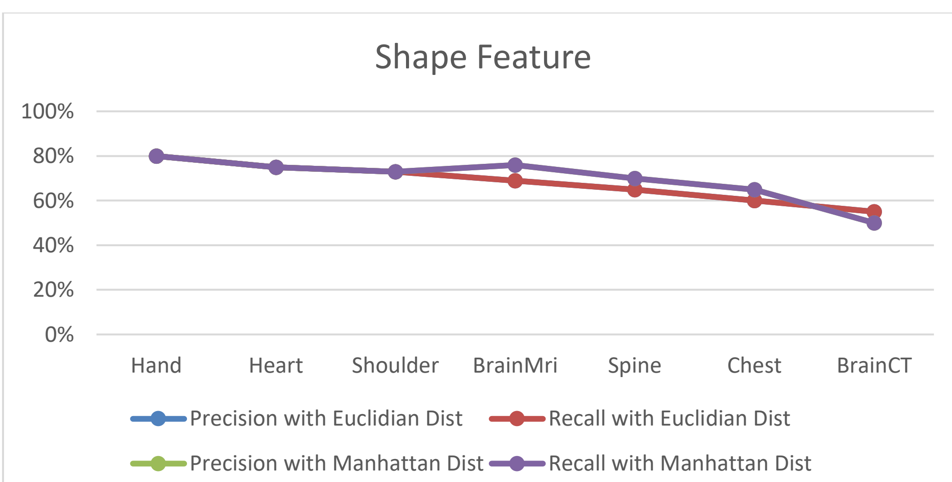


Fig. no. 5.41 Precision and Recall with Shape Feature

In the research work third CBIR tested with composite feature and get the precision and recall in between 97 % to 100% . In the research work the classification accuracy also we get more 100% for the composite feature. In that case when the no of image are increased in database then retrieval accuracy and classification accuracy is not decrease. That show in fig no 5.42 and 5.43.

The main advantage of our system that with the help of composite feature precision and recall we get nearer to 100% and classification with neural network with composite feature give 100% accuracy.

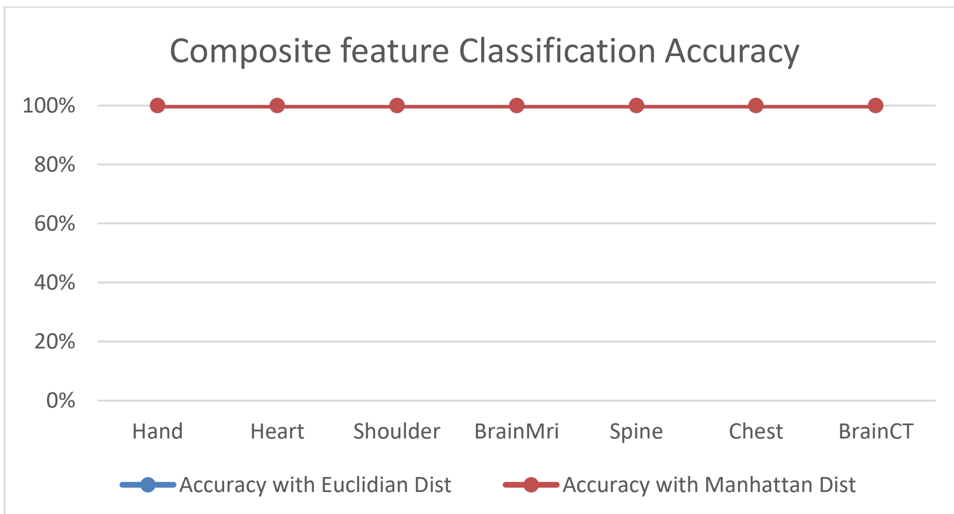


Fig. no. 5.42 Classification accuracy with Composite Feature

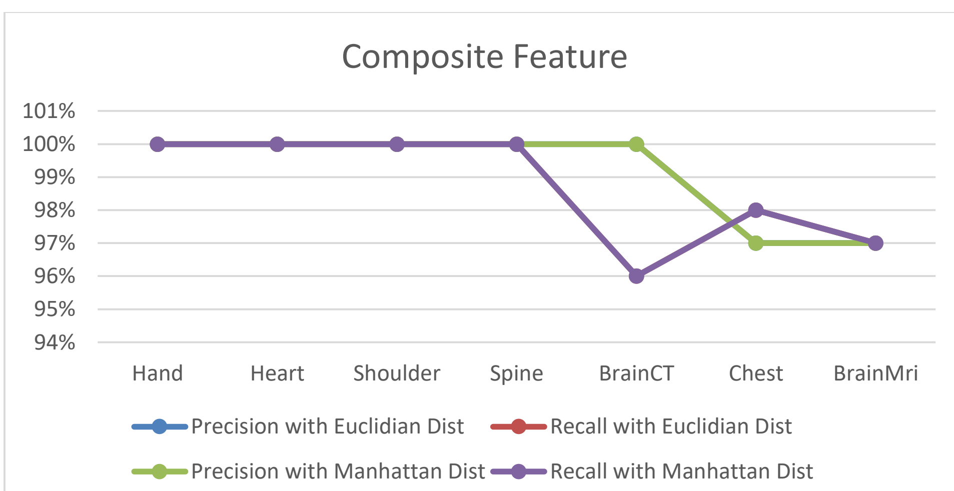


Fig. no. 5.43 Precision and Recall with Composite Feature

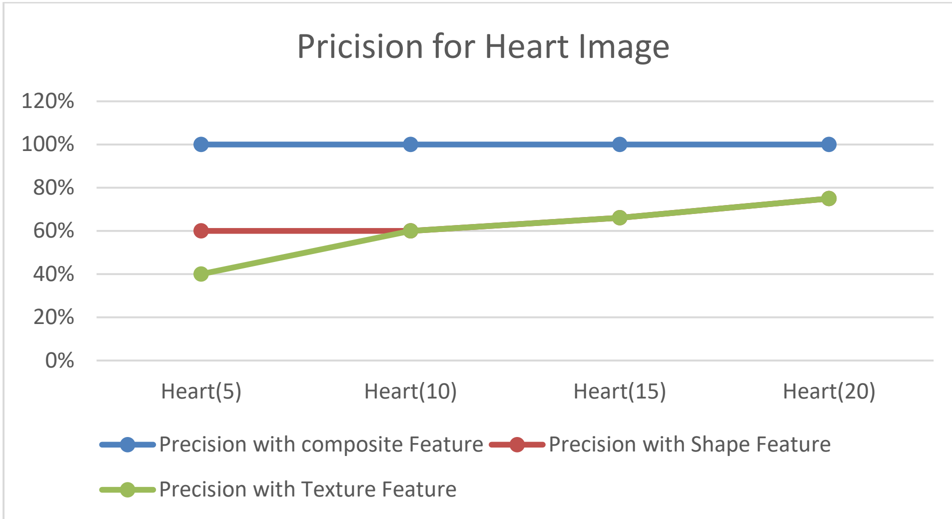


Fig. no. 5.44 Precision for heart image with all feature

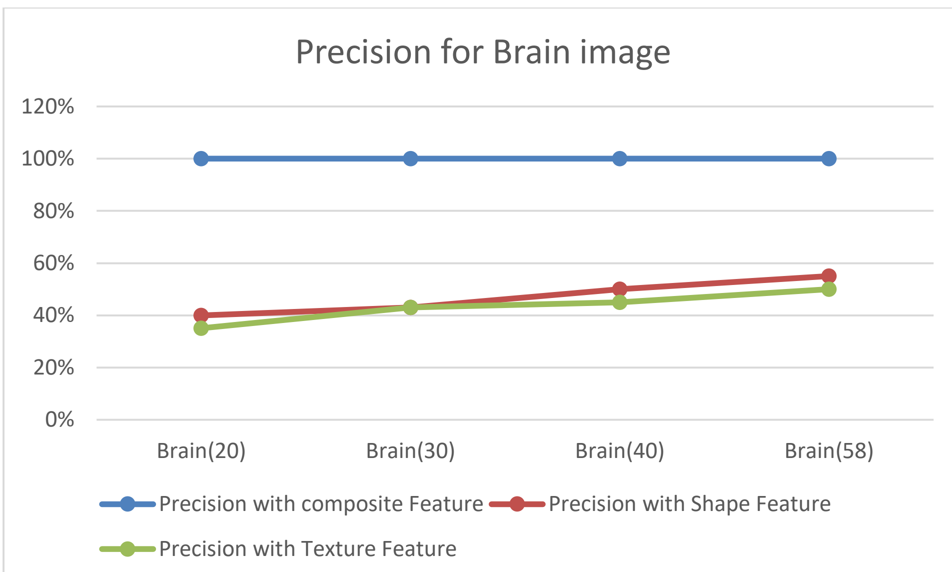


Fig. no. 5.45 Precision for Brain image with all feature

Chapter - 6
Conclusions & Future scope

CHAPTER - 6

Conclusions & Future Scope

6.1 Conclusions

This research work has cover information on the CBIR useful in medical area, the popular of the MCBIR systems have emerged as up gradation of the CBIR systems. The purpose of medical image databases is to give an effective resource for managing, penetrating, and indexing with higher collected of medical images. Medical content based retrieval is a talented method to get retrieval and has generated a various methods using texture and shape feature. CBIR approach provides semantic retrieval and effective feature extraction with precise techniques of shape and texture. The overall performance of neural network algorithms in this research work was analyzed based on the classification accuracy.

The primary aim of work is maximum retrieval with classification in MCBIR. The research work give the maximum retrieval if number of images are higher as per the category. So texture and shape both composite feature are helpful to retrieve the maximum for all the category of image. The neural network give the maximum classification accuracy for medical retrieval image.

6.2 Achievements

In this chapter, we have proposed a novel algorithm for the medical CBIR and classification. We have named our system with medical CBIR with neural network classification. We considered more number of features in our work. Our algorithm used texture and shape features with combination for the retrieval result and classification accuracy. In the research work tested with various feature and neural network algorithm.

In the research work first CBIR tested with texture feature and get the precision and recall in between 50 % to 80%. In that case when the no of image are increased in database then retrieval accuracy is decrease.

In the research work second CBIR tested with shape feature and get the precision and recall in between 55 % to 80%. In that case when the no of image are increased in database then precision and recall is decrease.

In the research work third CBIR tested with shape feature and get the precision and recall in between 97 % to 100%.

To compare the proposed system and Relevance Feedback system there is improvement in precision by 80% to 100% and recall by 55% to 100%.

In the research work the classification accuracy also we get more 100% for the composite feature and neural network.

In that case when the no of image are increased in database then retrieval accuracy and classification accuracy is not decrease.

6.3 Future Work

In this research the following things have been considered/included as the scope.

1. The research work can be extended with following two step
    a. If query image found in abnormal images so identified which part damage or crack
    b. If crack found so it is generally fractures on that part of human
2. The research work can included more category of human organ image
3. The research work can included different category of organ image with Position Emission Tomography (PET) scan image and electrocardiogram (ECG) image etc…
4. The research work can tested with higher database with more features
5. The research work if proper retrieval is not founded with composite then we can do the iterative search with more features
6. The research work can be included with color image of medical

Publication List

No.	Paper Title	Journal Name	Other data
1	Query by Image Content Using Color Histogram Techniques	International Journal of Engineering Research & Technology (IJERT)	Vol. 2 Issue 11, November – 2013
2	Medical Content Based Image Retrieval using Texture and Shape Feature	IEEE,WISPNET 2016 conferences	March-2016
3	Survey and Comparison of Classification Algorithm for Medical Image	International Journal Of Engineering And Computer Science ISSN:2319-7242	Volume 5 Issue 8 August 2016 Page No. 17679-17684
4	Classification of Content based Medical Image Retrieval using Texture and Shape feature with Neural Network	IJERT(SCOPUS Index Journal) WARSE Conferences	February-2017
5	Content Based Image Retrieval with Relevance Feedback and Composite Feature	JETIR(Journal of Emerging Technologies and Innovative Research) UGC approved Journal ISSN-2349-5162	Volume 6 Issue 1 January-2019 Page No. 379-382

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Appendices

Appendix-A

This appendix contains supplementary information of case studies that we have been considered for our work.

Sample code for Search by composite feature and GUI system

```
% clear all;
% close all;
function searchcomposite(i1,ni,metric,rei)

conn = database('mydsn','','');
curs=exec(conn,'select iname, mean, var, sd, cont, core, homo, ener, area,
peri, ed, ciru, ar from imvaule');
setdbprefs('DataReturnFormat','cellarray');
curs=fetch(curs,260);

aa=curs.Data;
%  disp(aa);
aa2=aa(:,2:13);

ir=ni;
curs=exec(conn,['select imrank from imra where imagename=' '''' i1 '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
rank=curs.Data;
disp(rank);
if size(ir,3) >1
 ir = rgb2gray(ir);
 end
arrayfun(@cla, findall(0, 'type', 'axes'));

subplot(3, 10, 1);
imshow(ir, []);
title('Query Image', 'color', [1 0 0]);

% qi=imhist(ir);
[r,c,j]=size(ir);
RM=sum(ir(:))/(r*c);
SM=sprintf('Mean=%f',RM);
% disp(SM);
diff=(ir-RM).^2;
ts=sum(diff(:));
ne=(r*c)-1;
tv=ts/ne;
SV=sprintf('Variance=%f',tv);
% disp(SV);
ts=sqrt(tv);
SS=sprintf('Standart Deviation=%f',ts);
% disp(SS);
GLCM2 = graycomatrix(uint8(ir),'Offset',[0 1]);

  stats = graycoprops(GLCM2,{'contrast'});
  stats1 = graycoprops(GLCM2,{'Correlation'});
   stats2 = graycoprops(GLCM2,{'homogeneity'});
  stats3 = graycoprops(GLCM2,{'Energy'});
  cont=struct2cell(stats);
  cont=cell2mat(cont);
```

```
  cor=struct2cell(stats1);
  cor=cell2mat(cor);
  homo=struct2cell(stats2);
  homo=cell2mat(homo);
  ener=struct2cell(stats3);
  ener=cell2mat(ener);

 a =r*c;

SA=sprintf('Area=%f',a);
% disp(SA);

 pe=2*(r+c);

SP=sprintf('Perimeter=%f',pe);
% disp(SP);

 equ=sqrt(4*a/3.14);

SED=sprintf('Equvilance Diameter =%f',equ);
% disp(SED);

 ci=(4*3.14)*(a/(pe*pe));

SC=sprintf('cirucularity=%f',ci);
% disp(SC);

as=r/c;
ASP=sprintf('Aspect ratio=%f',as);
% disp(ASP);
queryImageFeatureVector =[RM tv ts cont cor homo ener a pe equ ci as];
for w=1:260

  manhattan(w) = sum( abs(cell2mat(aa2(w, :)) - queryImageFeatureVector) ./
( 1 + cell2mat(aa2(w, :)) + queryImageFeatureVector ) );
  E_distance(w) = sqrt(sum((cell2mat(aa2(w,:))-
queryImageFeatureVector).^2));


end
[sortedDist indx] = sort(manhattan);
[sortedDist1 indx1] = sort(E_distance);

  if(rei>30)
      rei=rei+1;
  end

if metric==1
t=1;z=1;c=0;c1=0;
for q=1:rei
     if(q<30)
               iname(q)=aa(indx1(t),1);
        st=strcat('D:\Swity\phd all
data\dp7\finalcode\database\',char(iname(q)));
        di=imread(st);
            subplot(3, 10, q+1), imshow(di,[]);
              sn=char(iname(q));
    elseif (q==30)
                    figure
                    subplot(3, 10, 1); imshow(ir,[]);
```

```
                     sn=i1;
         else
            iname(q)=aa(indx1(t),1);
         st=strcat('D:\Swity\phd all
data\dp7\finalcode\database\',char(iname(q)));
         di=imread(st);
             subplot(3, 10, z+1), imshow(di,[]);
             z=z+1;
               sn=char(iname(q));
      end


              curs=exec(conn,['select imrank from imra where imagename=' ''''
sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
rank1=curs.Data;
%rank1=cell2mat(rank1);
if(rank==rank1)
    c=c+1;
    ta(q,1)=0;
    ta(q,2)=1;
    tr(q)=1;
    curs=exec(conn,['select imna from imra where imagename=' '''' sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
nor=curs.Data;
curs=exec(conn,['select mean, var, sd, cont, core, homo, ener, area, peri,
ed, ciru, ar from imvaule where iname=' '''' sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
in=curs.Data;
inp2(q,1)=in(1);
inp2(q,2)=in(2);
inp2(q,3)=in(3);
inp2(q,4)=in(4);
inp2(q,5)=in(5);
inp2(q,6)=in(6);
inp2(q,7)=in(7);
inp2(q,8)=in(8);
inp2(q,9)=in(9);
inp2(q,10)=in(10);
inp2(q,11)=in(11);
inp2(q,12)=in(12);

if(nor==0)
    disp(nor)


    c1=c1+1;
    disp(c1);
    ta1(q,1)=0;
    ta1(q,2)=1;
    tr1(q)=1;
else

    ta1(q,1)=1;
    ta1(q,2)=0;
    tr1(q)=2;
end
else
```

```
    ta(q,1)=1;
    ta(q,2)=0;
    tr(q)=2;
end
 curs=exec(conn,['select mean, var, sd, cont, core, homo, ener, area, peri,
ed, ciru, ar from imvaule where iname=' '''' sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
in=curs.Data;
inp(q,1)=in(1);
inp(q,2)=in(2);
inp(q,3)=in(3);
inp(q,4)=in(4);
inp(q,5)=in(5);
inp(q,6)=in(6);
inp(q,7)=in(7);
inp(q,8)=in(8);
inp(q,9)=in(9);
inp(q,10)=in(10);
inp(q,11)=in(11);
inp(q,12)=in(12);


           t=t+1;

end

str7= sprintf(' will be %f relevant.',c);
disp(str7);
acc=(c*100)/rei;
str8=sprintf('will be %f accuracy%.',acc);
disp(str8);
x=inp.';
x1=inp2.';
t=ta.';
t1=ta1.';
nural(x,t,tr);
nural(x1,t1,tr1);
end
  if metric==2


  t=1;z=1;c=0;c1=0;
for q=1:rei
    if(q<30)
        iname1(q)=aa(indx(t),1);
        st=strcat('D:\Swity\phd all
data\dp7\finalcode\database\',char(iname1(q)));
        di=imread(st);
            subplot(3, 10, q+1),  imshow(di,[]);
            sn=char(iname1(q));
             elseif (q==30)
                    figure
                    subplot(3, 10, 1); imshow(ir,[]);
                    sn=i1;
        else
           iname1(q)=aa(indx(t),1);
        st=strcat('D:\Swity\phd all
data\dp7\finalcode\database\',char(iname1(q)));
        di=imread(st);
            subplot(3, 10, z+1), imshow(di,[]);
```

```
            z=z+1;
            sn=char(iname1(q));
    end

             curs=exec(conn,['select imrank from imra where imagename=' ''''
sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
rank1=curs.Data;
%rank1=cell2mat(rank1);
if(rank==rank1)
    c=c+1;
    ta(q,1)=0;
    ta(q,2)=1;
    tr(q)=1;
    curs=exec(conn,['select imna from imra where imagename=' '''' sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
nor=curs.Data;
curs=exec(conn,['select mean, var, sd, cont, core, homo, ener, area, peri,
ed, ciru, ar from imvaule where iname=' '''' sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
in=curs.Data;
inp2(q,1)=in(1);
inp2(q,2)=in(2);
inp2(q,3)=in(3);
inp2(q,4)=in(4);
inp2(q,5)=in(5);
inp2(q,6)=in(6);
inp2(q,7)=in(7);
inp2(q,8)=in(8);
inp2(q,9)=in(9);
inp2(q,10)=in(10);
inp2(q,11)=in(11);
inp2(q,12)=in(12);

if(nor==0)
    disp(nor)


    c1=c1+1;
    disp(c1);
    ta1(q,1)=0;
    ta1(q,2)=1;
    tr1(q)=1;
else

    ta1(q,1)=1;
    ta1(q,2)=0;
    tr1(q)=2;
end
else
    ta(q,1)=1;
    ta(q,2)=0;
    tr(q)=2;
end
 curs=exec(conn,['select mean, var, sd, cont, core, homo, ener, area, peri,
ed, ciru, ar from imvaule where iname=' '''' sn '''']);
setdbprefs('DataReturnFormat','numeric');
curs=fetch(curs,1);
```

```
in=curs.Data;
inp(q,1)=in(1);
inp(q,2)=in(2);
inp(q,3)=in(3);
inp(q,4)=in(4);
inp(q,5)=in(5);
inp(q,6)=in(6);
inp(q,7)=in(7);
inp(q,8)=in(8);
inp(q,9)=in(9);
inp(q,10)=in(10);
inp(q,11)=in(11);
inp(q,12)=in(12);


           t=t+1;

end
%   disp(iname1);
str7= sprintf(' will be %d relevant.',c);
disp(str7);
acc=(c*100)/rei;
str8=sprintf('will be %f accuracy.',acc);
disp(str8);
x=inp.';
x1=inp2.';
t=ta.';
t1=ta1.';
nural(x,t,tr);
nural(x1,t1,tr1);

  end
end
```