# CONTENT BASED IMAGE RETRIEVAL

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION, JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY-WAKNAGHAT.**



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**Submitted in partial fulfillment of the Degree of Bachelor of Technology.**

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# CERTIFICATE

This is to certify that the work entitled, "**Content Based Image Retrieval**" submitted by I.Aakash (031009) and T.Sravan Kumar (031062) in partial fulfillment for the award of degree of Bachelor of Technology in Electronics And Communications of Jaypee University of Information Technology has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Date: 23-05-07

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# Acknowledgment

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We are indebted to all those who provided reviews and suggestions for improving the results and the topics covered in this project, and extend our apologies to anyone whom we may have failed to mention.

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# Table of Contents:

# List Of Figures

# ABSTRACT

Retrieval efficiency and accuracy are two important issues in designing a content-based database retrieval system. Developing an automatic retrieval algorithm, which matches human performance, is an extremely difficult and challenging task. However, considering the substantial amount of time and effort needed for a manual retrieval from a large image database, an automatic shape-based retrieval technique can significantly simplify the retrieval task.

Our project proposes a method for image retrieval based on object information that would supplement traditional text-based retrieval systems. This system achieves both the desired efficiency and accuracy using a two-stage hierarchy. In the first stage, simple and easily computable global features are used to quickly browse through the database to generate a moderate number of retrievals when a query is presented; in the second stage, the extracted images from the first stage are screened using a local feature to discard spurious matches.

The algorithm using various query images has been tested. This is implemented on Matlab tool with a support of Image processing toolbox.

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION TO IMAGE PROCESSING :

Digital Image Processing generally refers to processing of a two dimensional images by a digital computer. A digital image is an array of real or complex numbers represented by a finite number of bits. Interest in DIP methods stems from two principal application areas: Improvement of practical information for human interpretation and Processing of scene data for autonomous machine perception. The Digital Image Processing is a highly studied research area within signal processing and computer graphics. It is a technique of image manipulation using appropriate algorithms and mathematical tools.

Technology in the form of inventions such as photography and television has played a major role in facilitating the capture and communication of image data. But the real engine of the imaging revolution has been the computer, bringing with it a range of techniques for digital image capture, processing, storage and transmission. The involvement of computers in imaging can be dated back to 1965, with Ivan Sutherlands Sketchpad project, which demonstrated the feasibility of computerized creation, manipulation and storage of images.

Various developments were made under image processing and are classified into different areas of application such as; Image segmentation, Image Enhancement, Image compression, Image recognition etc. The area of Image recognition is one such area, which can be explored to various applications for faster and efficient machine interpretation of foreign object.

## 1.2 DIGITAL IMAGE PROCESSING :

The fundamental steps involved in an image recognition system are as shown in Figure 1.1. Image acquisition is the first process could be as simple as being given an image that is already in digital form.

Image enhancement is among the simplest and most appealing areas of Digital image processing. Basically, the idea behind the enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image because" it looks better."

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on human subjective preferences regarding what constitutes a "good" enhancement result.

Morphological processing deals with tools for extracting image components that are useful in the representation and description of shape.

Segmentation procedures partition an image into its constituent parts or objects. In general, autonomous segmentation is one of the most difficult tasks in digital image processing. The more accurate the segmentation the more likely recognition is to succeed.

Representation and description almost always follow the output of segmentation stage, which usually us raw pixel data, constituting either the boundary of a region or all the points in the region itself. In either case, converting data to a form suitable for computer processing. The decision that must be made is whether the data should be represented as a boundary or as a complete region.

Choosing a representation is only part of the solution for transforming raw data in to a form suitable for subsequent computer processing. Description, also called feature selection, deals with extracting attributes that result in some quantitative information of interest or are basic for differentiating one class of objects from one another.

Recognition is the process that assigns a label to an object based on its descriptors. We conclude our coverage of digital image processing with the development methods for recognition of individual objects. The recognition process can be carried out in various approaches, in which CBIR, content based image retrieval, is an efficient approach.

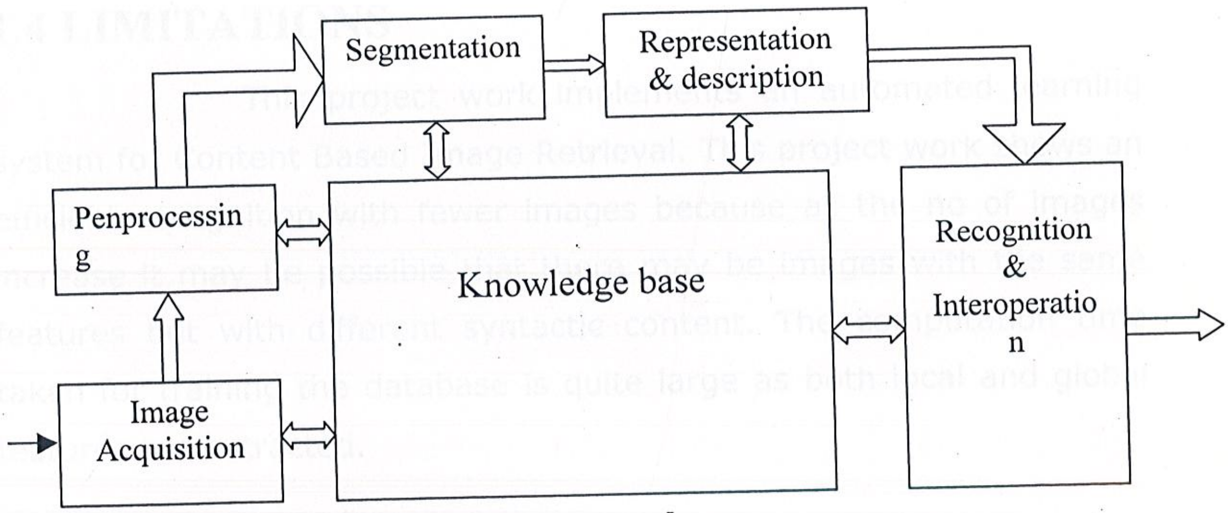


**Figure 1.1: Block Diagram representing steps involved in Image Processing**

## 1.3 OBJECTIVES OF STUDY:

The objective of this project work is to develop an automated Image Retrieval system. This work processes various images, extracting the features of the samples and developing a suitable Knowledge based Classifier model to classify and recognize the different types of images using three different types of feature sets, viz., color, texture and shape.

The Content Based Image Retrieval system development uses visual content to search images from large-scale image database according to user's interest, retrieving similar images from the database when an image is given as a query.

## 1.4 LIMITATIONS

This project work implements an automated learning system for Content Based Image Retrieval. This project work shows an efficient recognition with fewer images because as the no of images increase it may be possible that there may be images with the same features but with different syntactic content. The computation time taken for training the database is quite large as both local and global features are extracted.

## 1.5 METHODOLOGY

The work involves processing of different images, extracting the features of the sample and finally developing a suitable Knowledge based Classifier model to recognize the different types of images. Various kinds of images are obtained, and the color and textural features are extracted using image-processing techniques. These features are used to train the Knowledge-based classifier. The developed Knowledge-based classifier tested for classification of different images. The work carried out involves application of image processing, pattern recognition.

The recognition implements a CBIR system for the recognition of given query image. The problem of image retrieval is becoming widely recognized and the search for solutions is an increasingly active area for research and development. As more digitized images are collected, the number of multimedia computers increases, and networks became more predominant, large on-line databases (collections) of images and video become more popular.

Existing technologies are still primitive. So this requires for developing a user-friendly image retrieval. Querying by image content is a way to retrieve images based on their content. This method is called QBIC, and a system using QBIC is called a content-based image retrieval system.

The image queries can be characterized into three levels of abstraction: primitive features such as color or shape, logical features such as the identity of objects shown and abstract attributes such as the significance of the scenes depicted. CBIR operates on Primitive features characterizing image content, such as color, texture, and shape. These features are computed for both stored and query images, and used to identify the stored images most closely matching to the query.

# CHAPTER 2

# AUTOMATED IMAGE RETRIVAL SYSTEM

## 2.1 IMAGE RETRIEVATION :

Interest in the potential of digital images has increased enormously over the fast few years, fuelled at least in part by the rapid growth of imaging on the World Wide Web. Users in many professional fields are exploiting the opportunities offered by the ability to access and manipulate remotely stored images in all kinds of new and exciting ways. However, they are also discovering that the process of locating a desired image in a large and varied collection can be a source of considerable frustration. The problems of image retrieval are becoming widely recognized and the search for solution is an increasingly active area for research and development.

Significant improvement in processing technology in recent year coupled with the decrease in the cost of memory and storage has played a major role in the development of large multimedia data base systems. This explosion of multimedia data has rapidly created the need of new suitable tool to enable the user to manage and retrieve efficiently specific type of the information. A research objective in management of multimedia is to develop new retrieval tools that permit the users to manipulate multimedia information.

## 2.2 AN OVERVIEW:

Problems with traditional methods of image indexing have led to the rise of interest in techniques for retrieving images on the basis of automatically-derived features such as color, texture and shape – a technology now generally referred to as *Content-Based Image Retrieval* (CBIR). After a decade of intensive research, CBIR technology is now beginning to move out of the laboratory and into the marketplace, in the form of commercial products like QBIC. *Querying by image content* is a way to retrieve images based on their content. This method is called *QBIC*, and a system using QBIC is called a *content-based image retrieval* system. Problems with traditional methods of image retrieval have led to the rise of interest in techniques for retrieving images on the basis of automatically derived features such as color, texture and shape -a technology now generally referred to as **Content-Based Image Retrieval (CBIR).**

Content-based image retrieval and searching is one of the most burning issues in the fields of multimedia computing. Human perception is not understood well enough to automate the retrieval process. In this work we have designed a system for content-based image searching. Multimedia database are very big in size, so we cannot go for the exhaustive searching of images from these data base and it reduce the searching time of the images from the data base.

The goal of CBIR systems is to return images that are similar to a query image. Such system characterizes images using low-level perceptual features like color, shape and texture. The over all similarity of a query image with data base images. Due to rapid increase in tremendous amount of digital image collections, various techniques for storing, browsing, retrieving images have been investigated in recent years.

The traditional approach to image retrieval is to annotate image by text and then use text based data base management system to perform image retrieval. There are several drawback of using key words to achieve visual information. The keywords become inadequate for large database and it is difficult to phrase each of the images.

## 2.3 CONTENT BASED IMAGE RETREIVAL (CBIR) FUNDAMENTALS:

Digital images databases open the way to content based searching and thus the development of content-based image retrieval system. Content based image retrieval is characterized by the ability of the system to retrieve relevant images based on the visual and semantic content of the images. Accuracy and efficiency are the two important issues in designing CBIR Systems.

Text-based image retrieval uses traditional database techniques to manage images. Through text descriptions, images can be organized by topical or semantic hierarchies to facilitate easy navigation and browsing based on standard Boolean queries. However, since automatically generating descriptive texts for a wide spectrum of images is not feasible, most text-based image retrieval systems require manual annotation of images. Obviously, annotating images manually is a cumbersome and expensive task for large image databases, and is often subjective, context-sensitive and incomplete. As a result, it is difficult for the traditional text-based methods to support a variety of task-dependent queries.

Content-based image retrieval uses the visual contents of an image such as *color*, *shape*, *texture*, and *spatial layout* to represent and index the image. In typical content-based image retrieval systems (Figure 2-1), the visual contents of the images in the database are extracted and described by multi-dimensional feature vectors. The feature vectors of the images in the database form a feature database. To retrieve images, users provide the retrieval system with example images or sketched figures. The system then changes these examples into its internal representation of feature vectors. The similarities /distances between the feature vectors of the query example or sketch and those of the images in the database are then calculated and retrieval is performed with the aid of an indexing scheme.

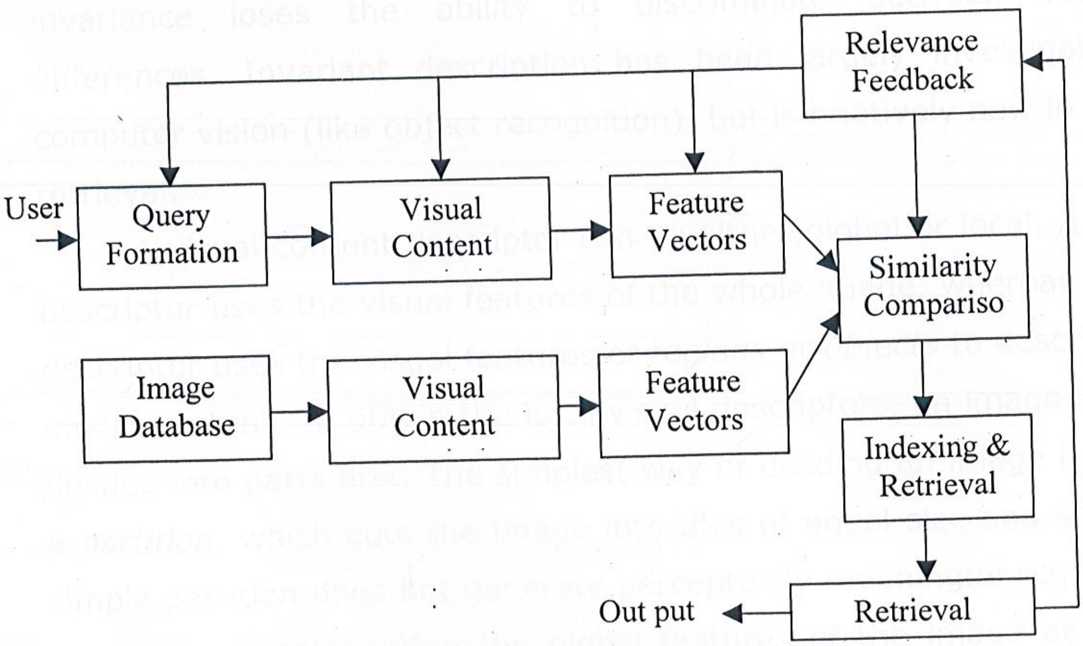


Figure 2-1. Diagram for content – based image retrieval system

## Image Content Descriptors:

Generally speaking, image content may include both visual and semantic content. Visual content can be very general or domain specific. *General visual content* include color, texture, shape, spatial relationship, etc. *Domain specific visual content*, like human faces, is application dependent and may involve domain knowledge. *Semantic content* is obtained either by textual annotation or by complex inference procedures based on visual content. A good visual content descriptor should be invariant to the accidental variance introduced by the imaging process (e.g., the variation of the illuminant of the scene).However, there is a tradeoff between the invariance and the discriminative power of visual features, since a very wide class of invariance loses the ability to discriminate between essential differences. Invariant description has been largely investigated in computer vision (like object recognition), but is relatively new in image retrieval.

A visual content descriptor can be either global or local. A global descriptor uses the visual features of the whole image, whereas a local descriptor uses the visual features of *regions* or *objects* to describe the image content. To obtain the local visual descriptors, an image is often divided into parts first. The simplest way of dividing an image is to use a *partition*, which cuts the image into tiles of equal size and shape. A simple partition does not generate perceptually meaningful regions but is a way of representing the global features of the image at a finer resolution. A better method is to divide the image into homogenous regions according to some criterion using *region segmentation* algorithms that have been extensively investigated in computer vision. A more complex way of dividing an image, is to undertake a complete *object segmentation* to obtain semantically meaningful objects (like ball, car, horse).

Here are some widely used techniques for extracting color, texture, shape and spatial relationship from images.

## Color

Color is the most extensively used visual content for image retrieval. Its three-dimensional values make its discrimination potentiality superior to the single dimensional gray values of images. Before selecting an appropriate color description, color space must be determined first.

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 the data set. The color histogram is easy to compute and effective in characterizing both the global and local distribution of colors in an image. In addition, it is robust to translation and rotation about the view axis and changes only slowly with the scale, occlusion and viewing angle. Since any pixel in the image can be described by three components in a certain color space (for instance, red, green, and blue components in RGB space, or hue, saturation, and value in HSV space), a *histogram*, i.e., the distribution of the number of pixels for each quantized bin, can be defined for each component. Clearly, the more bins a color histogram contains, the more discrimination power it has. However, a histogram with a large number of bins will not only increase the computational cost, but will also be inappropriate for building efficient indexes for image databases.

### Texture

Texture is another important property of images. Various texture representations have been investigated in pattern recognition and computer vision. Basically, texture representation methods can be classified into two categories: *structural* and *statistical*. Structural methods, describe texture by identifying structural primitives and their placement rules. They tend to be most effective when applied to textures that are very regular. Statistical methods, characterize texture by the statistical distribution of the image intensity.

### Shape

Shape features of objects or regions have been used in many content-based image retrieval systems. Compared with color and texture features, shape features are usually described after images have been segmented into regions or objects. Since robust and accurate image segmentation is difficult to achieve, the use of shape features for image retrieval has been limited to special applications where objects or regions are readily available. The state-of-art methods for shape description can be categorized into either *boundary-based or region-based methods*.

## 2.4 IMAGE PROCESSING TOOLBOX IN MATLAB:

This is an introduction on how to handle images in Matlab. When working with images in Matlab, there are many things to keep in mind such as loading an image, using the right format, saving the data as different data types, how to display an image, conversion between different image formats, etc. This worksheet presents some of the commands designed for these operations. Most of these commands require you to have the Image processing tool box installed with

Matlab. To find out if it is installed, type ver at the Matlab Prompt. This gives out list of what tool boxes that are installed on your system. For further reference on image handling in Matlab use Matlab's help browser. There is an extensive (and quite good) on-line manual for the Image processing tool box that can be accessed via Matlab's help browser.

A digital image is composed of pixels which can be thought of as small dots on the screen. A digital image is an instruction of how to color each pixel. A typical size of an image is 512 – by – 512 pixels. It is convenient to let the dimensions of the image to be a power of 2. For example, 2^9=512. In the general case we say that an image is of size m-by-n if it is composed of m pixels in the vertical direction and n pixels in the horizontal direction.

Let us say that we have and image on the format 512-by-1024 pixels. This means that the data for the image must contain information abut 524288 pixels, which require a lot of memory! Hence, compressing images is essential for efficient image processing. When you store and image, you should store it as a unit8 image since this requires far less memory than double. When you are processing an image (that is performing mathematical operations on an image) you should convert it into a double. Converting back and forth between these classes is easy.

### 2.4.1 Image formats supported by Matlab

The following images are supported by Matlab:

BMP, HDP, JPEG, PCX, TIFF, XWB

Most images you find on the internet are JPEG-images which is one of the most widely used compression standards for images. If you have stored an image you can usually see from the suffix what format it is stored in. For example, an image named my image. jpg is stored in the JPEG format and we will see later on that we can load an image of this format into Matlab.

If and image is stored as a JPEG- image on your disc we first read it into Matlab. However, in order to start working with an image, for example perform a wavelet transform on the image, we must convert it into a different format.

## Intensity image (gray scale image)

This is the equivalent to a "gray scale image" and this is the image we will mostly work with in this project. It represents an image as a matrix where every element has a value corresponding to how bright/dark the pixel at the corresponding position should be colored. There are two ways to represent the number that represents the brightness of the pixel: The double class (or data type). This assigns a floating number ("a number with decimals") between 0 and 1 to each pixel. The value 0 corresponds to black and the value 1 corresponds to white. The other class is called uint8 which assigns an integer between 0 and 255 to represent the brightness of a pixel. The value 0 corresponds to black and 255 to white. The class uint8 only require roughly 1/8 of the storage compared to the class double. On the other hand, many mathematical functions can only be applied to the double class.

## Binary image

This image format also stores an image as a matrix but can only color a pixel black or white (and nothing in between). It assigns a 0 for black and a 1 for white.

## Indexed image

This is a practical way of representing color images. An indexed image stores an image as two matrices. The first matrix has the same size ad the image and one number for each pixel. The second matrix is called the color map and its size may be different from the image. The numbers in the first matrix is an instruction of what number to use in the color map matrix.

## RGB image

This is another format for color images. It represents an image with three matrices of sizes matching the image format. Each matrix corresponds to one of the colors red, green or blue and gives an instruction of how much of each of these colors a certain pixel should use.

The following table shows how to convert between the different formats:

| **Image format conversion** (within the parenthesis you type the name of the image you wish to convert) | |
|---|---|
| Operation: | Matlab command |
| Convert between intensity / indexed/RGB format to binary format | dither() |
| Convert between intensity format to indexed format | gray2ind() |
| Convert between indexed format to intensity format | ind2gray() |

| | |
|---|---|
| Convert between indexed format to RGB format | ind2rgb() |
| Convert a regular matrix to intensity format by scaling | mat2gray() |
| Convert between RGB format to intensity format | rgb2gray() |
| Convert RGB format to indexed format | rgb2ind() |

The command mat2gray is useful if you have a matrix representing an image by the values representing the gray scale between, let's say, 0 and 1000. The command mat2gray automatically re scales all entries so that they fall within 0 and 255 (if you use the uint8 class) or 0 and 1 (if you use the double class).

## Reading and writing image files

| Operation: | Matlab command: |
|---|---|
| Read an image (Within the parenthesis you type the name of the image file you wish to read. Put the file name within single quotes ' ' . ) | imread() |
| Write an image to a file. (first argument you type the name of the image you have worked with. Second argument you type the name of the file and format that you want to write the image to. Put the file name within single quotes ' '.) | imwrite() |

Make sure to use semi-colon; after these commands, otherwise you will get LOTS OF number scrolling on your screen. You can then use the command colormap (gray) to "force" Matlab to use a gray scale when displaying an image. If you are using Matlab with an Image processing tool box installed, we mostly use the command imshow to display an image.

| **Displaying an image given on matrix form (with image processing tool box)** | |
|---|---|
| Operation: | Matlab command: |
| Display an image represented as the matrix X. | imshow(x) |

# CHAPTER 3

# IMAGE FEATURE EXTRACTION

## 3.1 FEATURE COMPUTATION

In order to recognize image, the image has to be segmented and the Shape of the image has to be extracted. On to the extracted shape, feature is computed. The steps for feature computation are as given below:

### Segmentation:

Segmentation is the process of separating objects from the image back ground and it subdivides an image into it's constitute parts or objects. The level to which this sub division is carried depends on the problem being solved and segmentation should stop when the edge of the image is detected i.e. the main interest is to isolate the image from its background.

## 3.2 FEATURE EXTRACTION:

In order to understand the image we have to extract the features from image and they can be broadly classified into;

1. Global feature
2. Local feature

### 3.2.1 Global Feature

This method finds Feature based on the external shape of image. The most important problem is to extract the meaningful features like Shape, color and Texture. The global method uses Shape based feature extraction and Color based feature extraction. Local Method uses Texture based feature extraction.

## Shape based feature extraction

The image shape is to be extracted to recognize the given image. The extracted shape using the process as explained above gives the outer boundary (edges) of the image, which is used as one detail feature in recognition.

## Color based feature extraction

The important color models used in color image processing are RGB (Red, Green, and Blue) The Motivation for Color Image Processing and different color models are explained below.

## Color Image Processing

In automated image analysis, color is a powerful descriptor that often simplifies Object identification and extraction from a scene.

## RGB Color Model

Color images are generally quantified by Red, Green, and Blue (RGB) values representing integrated responses over RGB spectral bands measured through color filters. The RGB response is affected by the specific configuration of a color vision system, including factors related to the intensity and the spectral distributions of illumination

## Color Feature Extraction from RGB Model

One of the most important features that makes possible the recognition of images by humans is color is a property that depends on the reflection of light to the eye and the processing of that information in the brain. We use color ever day to tell the difference between objects, place and the time of the day, usually colors are defined in 3 dimensional color Space these could either RGB. Most image format such as JPEG, BMP, GIF use the RGB color space to store information .The RGB color space is defined as a unit cube with Red, Green, & Blue thus a vector with 3-coordinates represent the color in this space. When all these co-ordinates are set to zero the color perceived is black. When all 3-coordinates are set to one, the color perceived is white, the other color space operate in the similar fashion but with a different perception. The color feature is probability the most feasible visual feature for Humans, by color representation we mean the method of representing overall image contents by "global" color Features, .Some method representing possible objects in images by "local" color features may be used in combination with other features such as shape Feature. Here we have used average RGB to calculate color similarities. Average RGB is to compute the average value in RGB channel of each pixel in an image so in the proposed system an attempt has been made to find a set of effective color features by systematic Experiments in region segmentation.

The 3 color features

(I1, I2 & I3) are as given below in 1,2 & 3

I1=(R+G+B)/3 ---------------------------------- ----(1)

I2=(R-B)/2 ---------------------------------- ----(2)

I3=(2G-R-B)/4 ----------------------------------------

### 3.2.2 Local Feature

### Texture Based Feature Extraction

Texture is a connected set of pixels that occur repeatedly in an image. Texture is one of the important characteristics used in identifying objects or regions of interest in an image. It provides the information about the variation in the intensity of a surface by quantifying properties such as smoothness, coarseness, and regularity. To describe texture features, the most widely accepted models are those that use the co-occurrence and run-length matrices. In this project, some easily computable textural features based on Gray Level Co-occurrence Matrices (GLCM) are extracted.

## Texture Fundamentals

Once these features are defined, image blocks can be categorized using any one of a multitude of pattern-recognition techniques. In search for meaningful features for describing pictorial information, it is only natural to look toward the types of features, which human beings use in interpreting pictorial information. Spectral, textural, and contextual features are three fundamental pattern elements used in human interpretation of color photographs. Spectral features describe the average total variations in various bands of the visible and or infrared portion of an electromagnetic spectrum, whereas textural features contain information about the spatial distribution of tonal variations within a band. Contextual features contain information derived from blocks of pictorial data surrounding the area being analyzed. When a machine independently processes small image areas from black and white photographs, and then texture is most important.

## Texture Features Extraction Using Co-occurrence Matrix

Texture is a characteristic of every image object and it deposits the structure of the object's surface, and different states from its surrounding in a picture; Textures allow humans to interpret picture information relatively easy .On the other Hand the lack of precision definition for the concept of texture makes it difficult to be recognized by computers. In order to implement an automatic mechanism that is capable of recognizing textures it is needed to find some measurable parameters that describe texture in fair manner in the literature. Different kinds of texture features have been purposed such as a multi channel features, fractal based features as co-occurrence features.

The procedure used for obtaining these features is be on the assumption that the texture Information on an image (I) is contained in the "average" spatial Relationship which the gray tones in the image (I) has to one another. The co-occurrence matrix is thought of as the joint probability density functions (PDF) of gray level parts in image. We have computed a set of such matrices for various angular relationships as distances below neighboring pixels on the image the matrices that we have obtained are generally symmetric and once Normalized are bounded by [0,1] the textural feature are derived from these matrices.

We can form the N*N gray level co-occurrence matrix M (d, θ) where d is Distance between neighboring pixel and θ is angle between pixel Point p1 and p2 we have assumed distance d=1 and $\theta=0^0,45^0,90^0$, &$135^0$ in the matrix the elements Represent probability of the co-occurrence of image values (i, j) at points P1, p2 separated by distance d at an angle θ.

The elements Xi, Yi represent the co-ordinates of pixel in a image and therefore represents only integer values, it is noted that as a result of the angle θ only 4 different values $0^0$, $45^0$,$90^0$, &$135^0$ are available which are shown below in figure 2. Eight different angles are not required because of the symmetric Property of the co-pixel Pi. For example, in direction $45^0$ relatively to pixel $P_j$ then it means that pixel Pj is positioned in direction $225^0$ relatively to pixel Pj to spare this redundant computation. The static's for one of angle and creates a new matrix from the matrix M.

The recognizer extracts the texture features to distinguish between normal and abnormal characters. Four co-occurrence matrices are constructed in four different spatial orientations horizontal, right diagonal, vertical and left diagonal ($0^0,45^0,90^0,135^0$) as shown in Figure 2.3 the features are used for prediction of suitable image from the data base depending on the minimum distance criterion. A set of eleven features is extracted in different orientations for training of samples. The GLCM method of texture description is based on the repeated occurrence of some gray-level configuration in the texture. This configuration varies rapidly with distance in fine textures and slowly in coarse textures. It is assumed that the texture-context information in an image, $f(x, y)$ is contained in the overall or "average" spatial relationships which the gray levels in image f (x, y) have to one another. Suppose the part of a textured image to be analyzed is an $M * N$ rectangular window. A GLCM is described by a matrix of relative frequencies $P_{\varphi,d}(x, y)$ , describing how frequently two pixels with gray-levels $(x, y)$ appear in the window separated by a distance $d$ in direction $\varphi$. Such matrices are a function of the angular relationship between the neighboring gray levels as well as a function of the distance between them.

## 3.3 ALGORITHMS:

### Calculation of co-occurrence matrix $P_{\varphi,d}(x,y)$ from the image $f(x, y)$.

**Input**: Input gray level image $f(x, y)$ (matrix of size $M*N$)

**Output**: Co-occurrence matrix $P_{\varphi,d}(x,y)$ for $d=1$ in the direction $\varphi$.

***Start***

**Step 1**: Assign $P_{\varphi,d}(x,y)=0$ for all $x,y \in [0,L]$, where $L$ is the maximum gray level.

**Step 2**: For all pixels $(x_1, y_1)$ in the image, determine $(x_2,y_2)$ which is at distance $d$ in

Direction $\varphi$ and perform

$$P_{\varphi,d}[f(x_1,y_1),f(x_2,y_2)] = P_{\varphi,d}[f(x_1,y_1),f(x_2,y_2)]+1$$

**Stop.**

From the co-occurrence matrix the following features are extracted

**1. Contrast (C):** this feature determines the illumination level of an image. The brightness of the image calculated at position P at the coordinates (i, j) is given by,

$$C = \sum_{i,j=0}^{n-1} Pij(i-j)^2$$

**2. Energy (E): the second feature extracted form the segmented fish image is the energy content of the image. This feature describes overall** pixel strength in the given image. The Energy for a given image is calculated as,

$$E = \sum_{i,j=0}^{n-1} P^2(i,j)$$

**3. Local Homogeneity (LM):** The local Homogeneity is one of the common features used for image recognition. This feature provides the information for same types of pixel values in a given image. The Local Homogeneity of the image is calculated as,

$$\mathrm{LH} = \sum_{i,j=0}^{n-1} \frac{Pi,j}{1-(i-j)^2}$$

**4. Custer Shade (CS): Cluster shade provides the information regards to the** Smoothness of image. The Cluster Shade of the image is calculated for the image P at the coordinates (i,j) as,

$$\mathrm{CS} = \sum_{i,j=0}^{n-1} (i-\mu i)+(j-\mu j)^3 P(i,j)$$

**5. Cluster Prominence (CP):** this feature finds group of pixel that appears repetitively in given image. The Cluster Prominence of a given image is calculated as,

$$\mathrm{CP} = \sum_{i,j=0}^{n-1} (i-\mu i)+(j-\mu j)^4 P(i,j)$$

**6. Entropy (EN): Randomness is one of the major factors of image. The** randomness of pixel values in a given image is considered to be a important feature of any image. The randomness nature of an image is called as Entropy. Entropy of image is calculated as,

$$\mathrm{EN} = -\sum_{i,j=0}^{n-1} P(i,j)\log P(i,j)$$

7. **Maximum Probability (MP):** it is a probability finding height occurring pixels. The Maximum Probability of the image is calculated for the image P at the coordinates (i, j).

$$EN = -\sum_{i,j=0}^{n-1} P(i,j)\log P(i,j)$$

## Training the system

**Input**: image of fish samples

**Output**: feature vector are

Begin:

Step1: training set image is taken.

Step2: construct co-occurrence matrix with angle of rotation

Degree $0^0$, $45^0$,$90^0$& $135^0$

Step3: compute feature vectors (Contrast, energy, local, homogeneity, Maximum,

Probability, entropy, cluster shade, and cluster prominence)

Step4: compute the average of each of the features along with the rules are stored in knowledge base

End

## Testing the system

**Input**: test sample of image + knowledge base

**Output**: classified fish image, the recognized fish image with percentage of accuracy.

Begin:

Step1: input test sample image of fish

Step2: construct co-occurrence matrix

Step3: compute feature Vectors (Contrast, energy, local homogeneity, Maximum probability, entropy, cluster shade, cluster prominence)

Step4: compute the average feature values of testing sample

Step5: compare the average range feature values of test sample With the values stored in the knowledge base.

Step6: if the values are matched approximately then the test sample is classified as one of the trained sample

Step7: comparing classified images to its query image we get recognize image with percentage of matching

# CHAPTER 4

# SYSTEM ANALYSIS

## 4.1SYSTEM DESIGN:

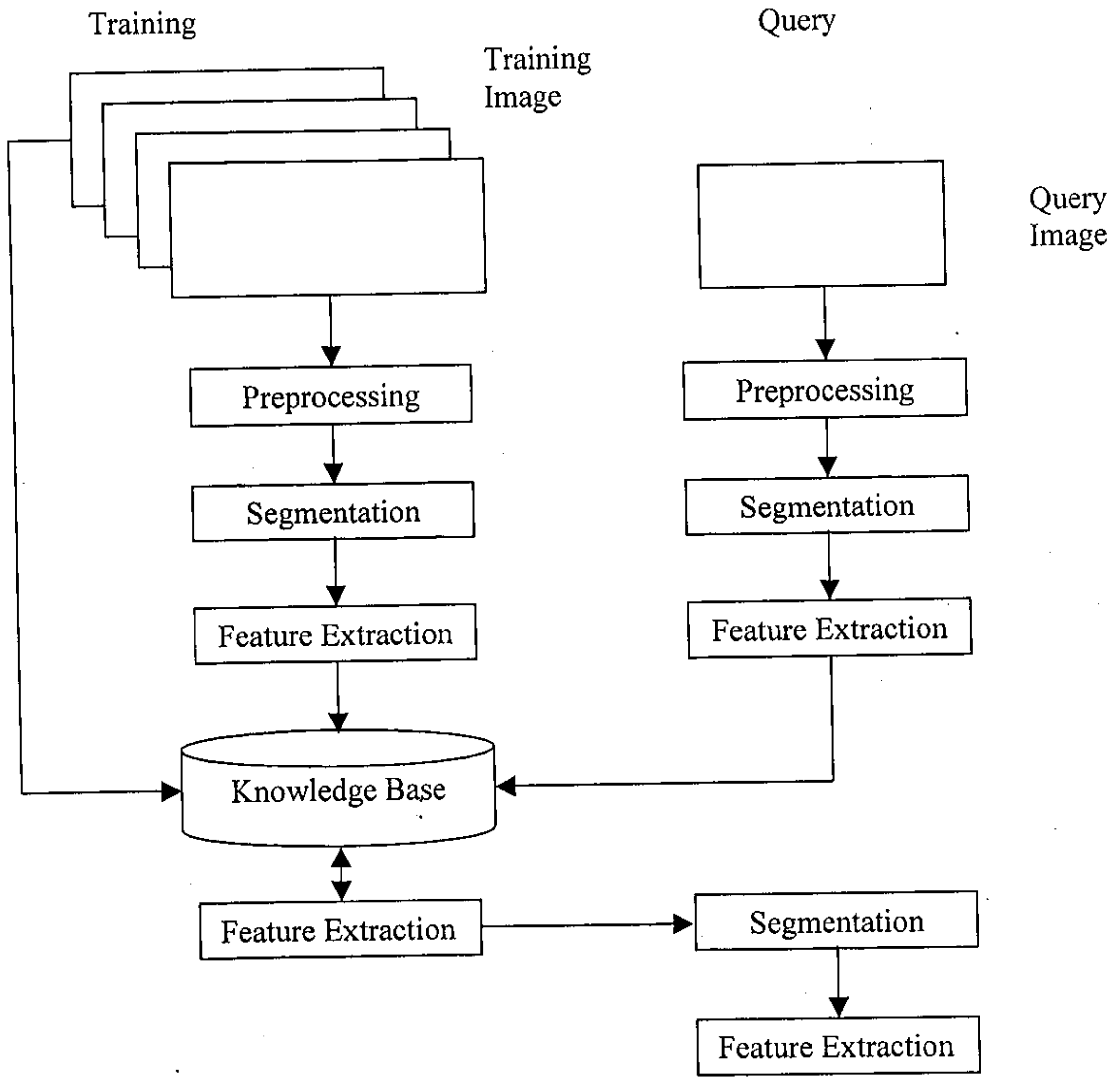


**Figure 4.1: Block Diagram of the implemented design.**

## 4.2OPERATIONAL FLOW CHART

Flow Chart for CBIR Systems

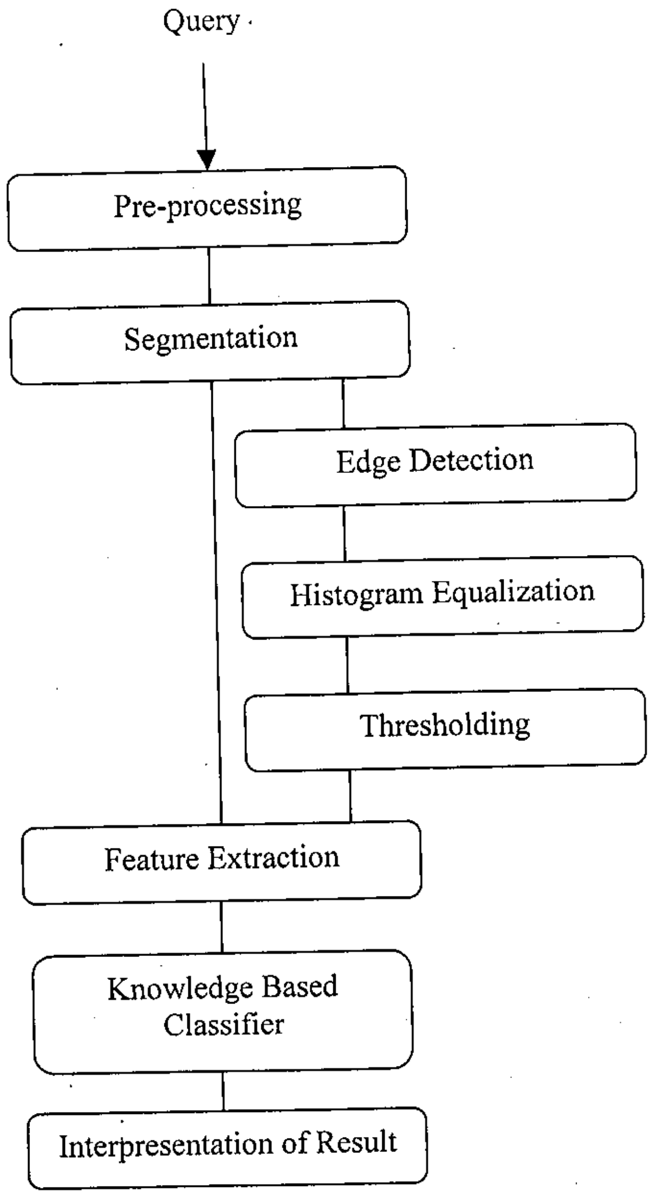


**Figure 4.2: Flow chart for Content based image retrieval system.**

## 4.3DATA FLOW DIAGRAM

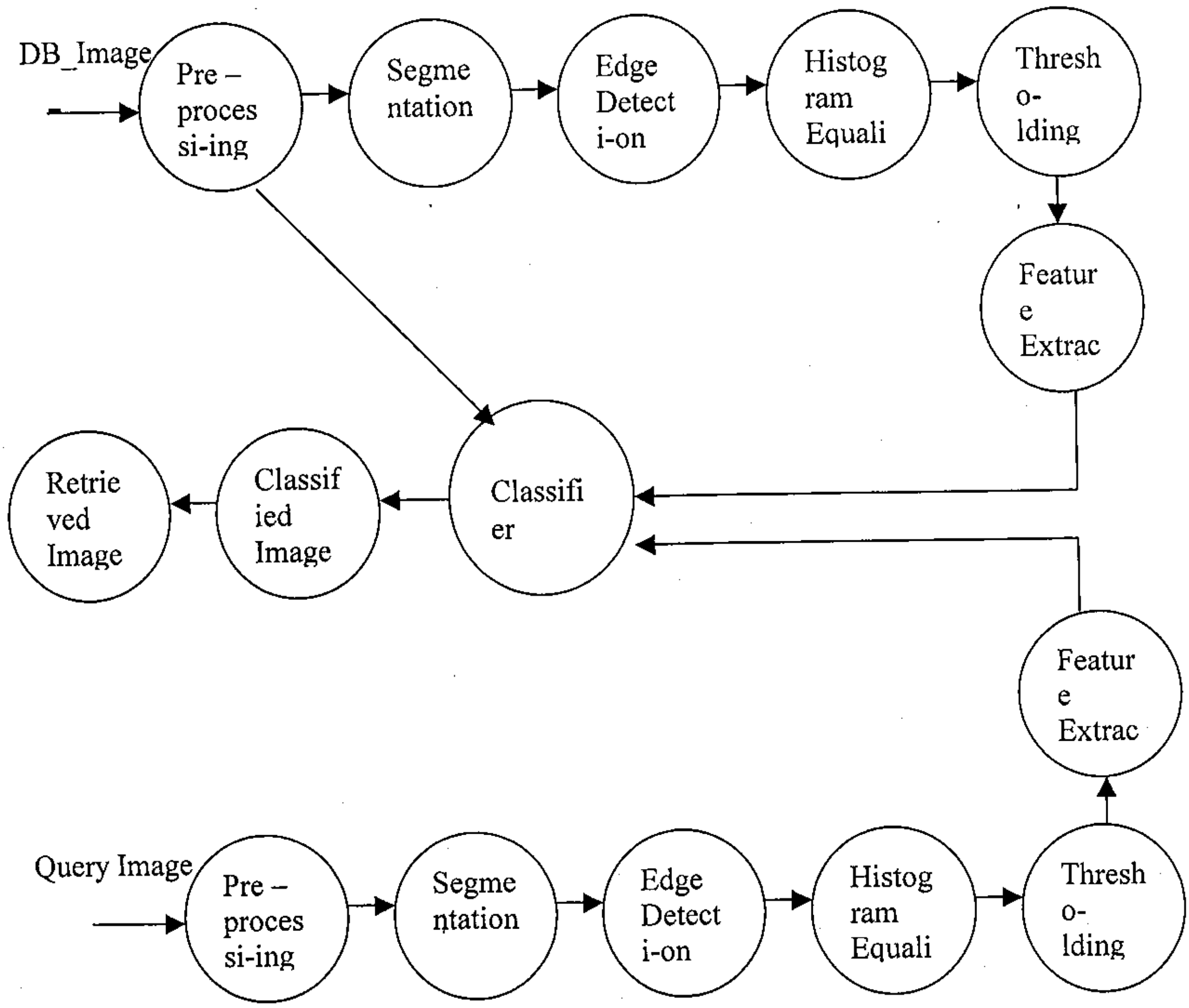


**Figure 4.3: Data Flow Diagram**

## 4.4 IMPLEMENTATION

### 4.4.1 Function description

For the implementation of the proposed design following functions are realized:

**TOP:** This function gives the top-level user interface to the implemented modules

**TD:** This function used to Train database.

**Tr:** This function compares the two trained data one of the test sample and the other pre-

Defined data and returns the status of reorganization.

**GUI:** The second level graphical user interface created for user interaction.

**EXIT:** This function responds to the exit button of user interface and closes all the Active figure windows.

**TRAINF00:** This function reads the co-occurrence value and calculates the 7 features namely contrast energy, entropy, local homogeneity, cluster shade and minimum possibility cluster prominent and train for zero order scanning.

**TRAINF45:** This function reads the co-occurrence value and calculates the 7 features namely contrast energy, entropy, local homogeneity, cluster shade and minimum possibility cluster prominent and train for zero order scanning.

**TRAINF90:** This function reads the co-occurrence value and calculates the 7 features namely contrast energy, entropy, local homogeneity, cluster shade and minimum possibility cluster prominent and train for zero order scanning.

**TRAINF135:** This function reads the co-occurrence value and calculates the 7 features namely contrast energy, entropy, local homogeneity, cluster shade and minimum possibility cluster prominent and train for zero order scanning.

**Z_Deg:** This function determines the co-occurrence vector for this image passed using 0 degrees scanning.

**Fty:** This function determines the co-occurrence vector for this image passed using 45 degrees scanning.

**Nty:** This function determines the co-occurrence vector for this image passed using 90 degrees scanning.

**Oth:** This function determines the co-occurrence vector for this image passed using 135 degrees scanning.

**In1:** This function gives the query images from query selection windows.

**Fextr:** This function is used for integrating the training in all four quadrants for the test

Sample as well as the optimized sample and find features.

**Classify:** This function classify the images based on its similarities existing in database.

These values used as knowledge for isolating the images

**Rec:** this function recognize exact image from among the classified image.

**Grp:** this function plots a corresponding recognition graph.

# CHAPTER 5

# INTERPRETATION OF RESULTS

## 5.1FIRST GRAPHICAL USER INTERFACE

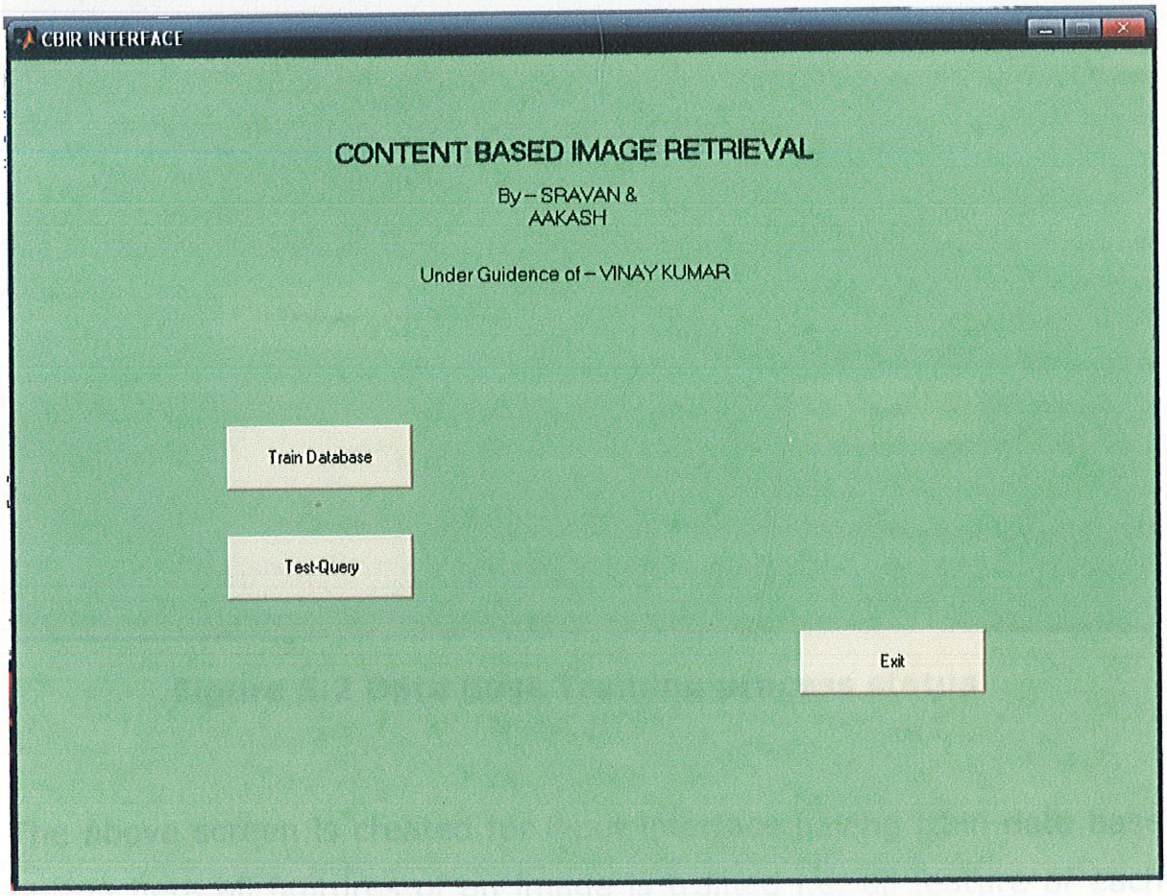


**Figure 5.1 Initial graphical user interfaces**

The Initial GUI created which shows the project title, and other details regarding the project work. In this window a train database button is used to train database for further processing, test query used to test a given query and a exit button to terminate application.

# 5.2TRANING DATA BASE

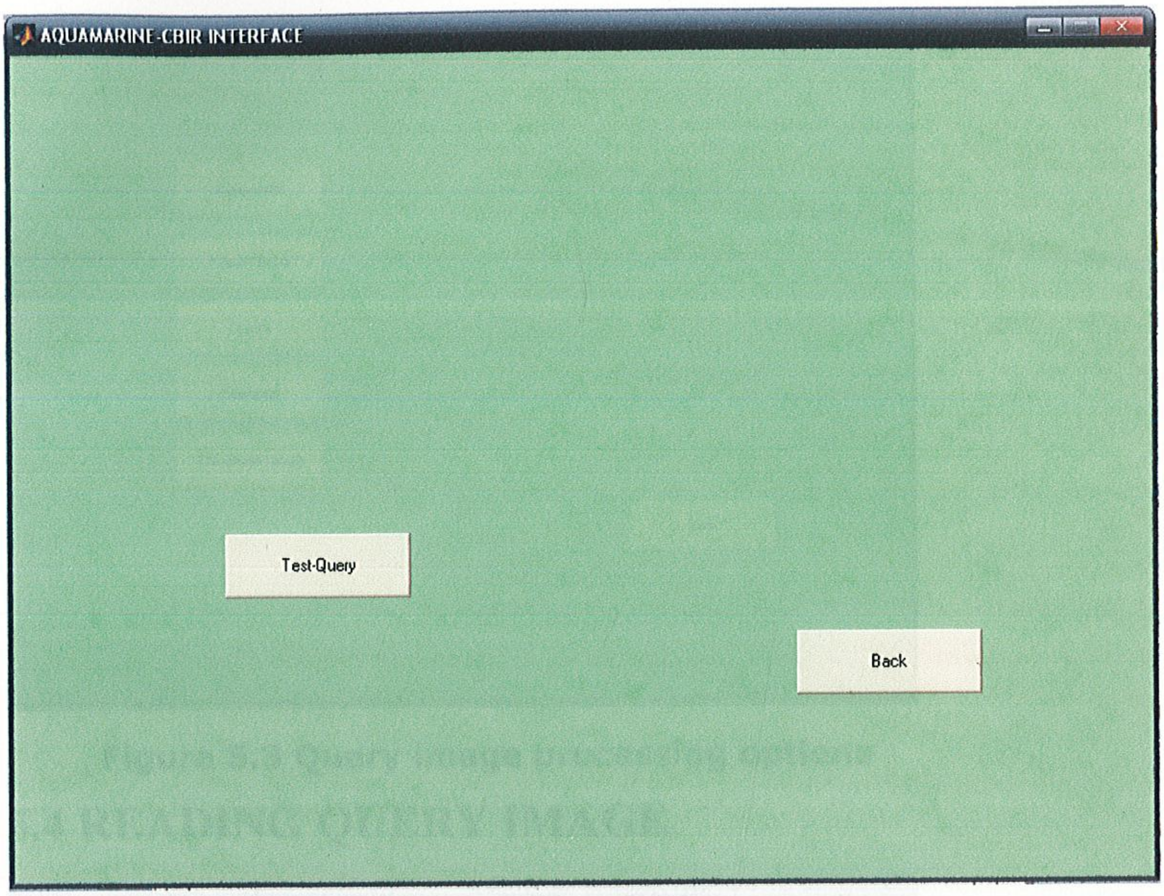


**Figure 5.2 Data Base Training process status**

The above screen is created for input interface having train data base button here all features of an image is trained i.e. all feature of each image in data base is pre computed. The test query helps to move in a test query window and back button move to first Graphical interface.

## 5.3QUERY IMAGE PROCESSING OPTIONS

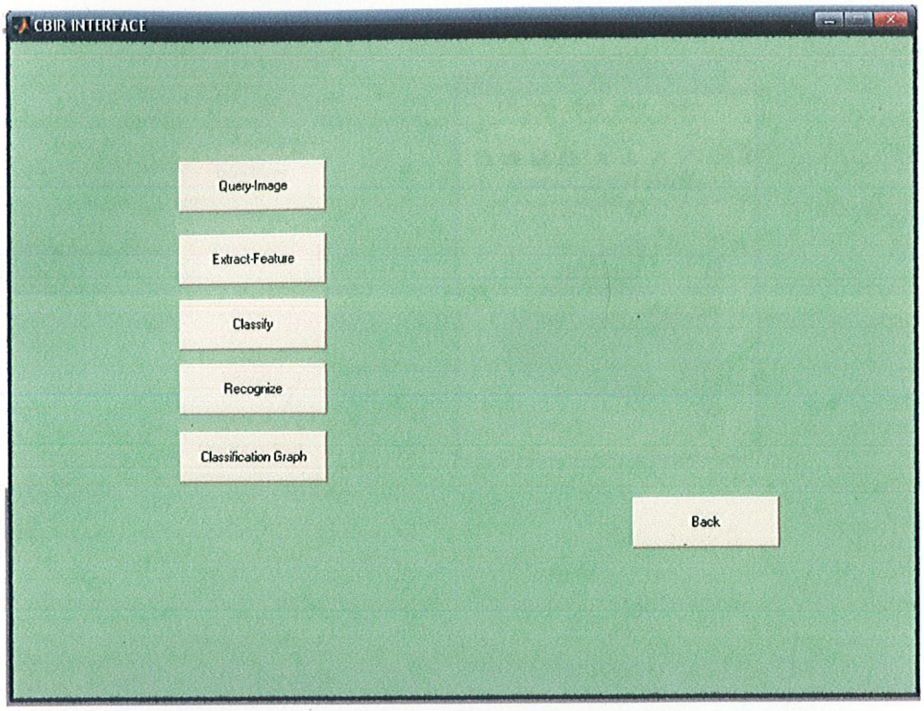


**Figure 5.3 Query image processing options**

## 5.4 READING QUERY IMAGE

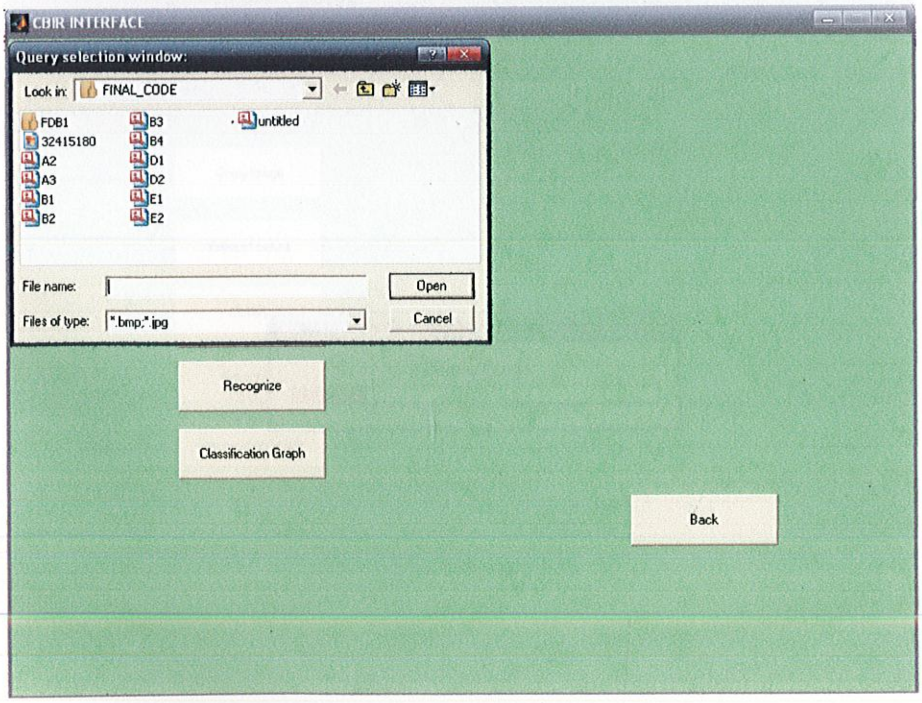


**Figure 5.4: Reading Query image**

## 5.5 SELECTED QUERY IMAGE

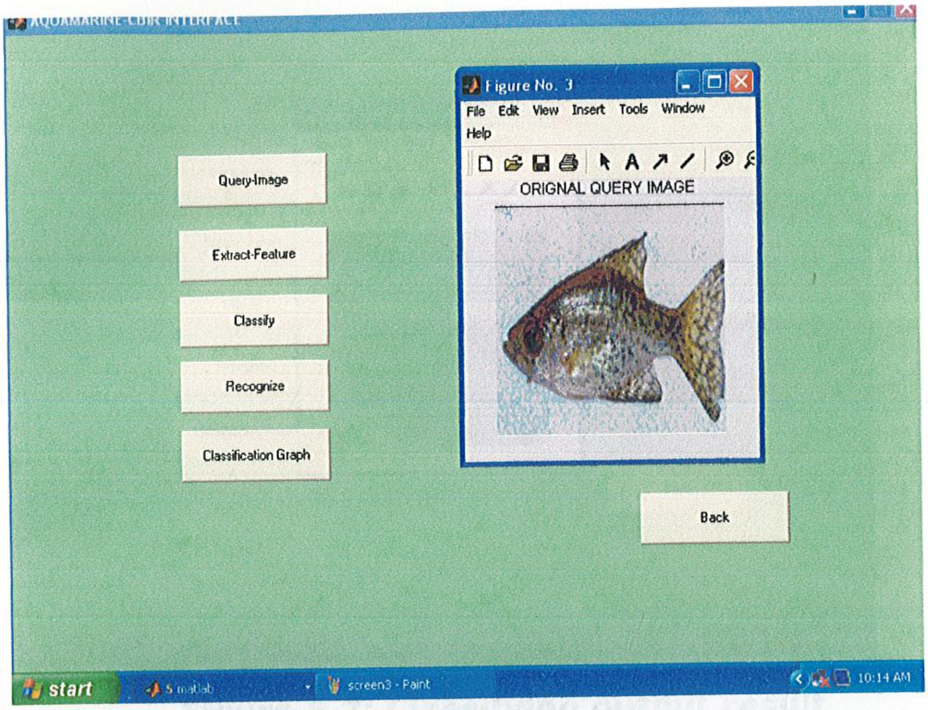


**Figure 5.5: Selected Query image**

## 5.6 FEATURE EXTRACTION

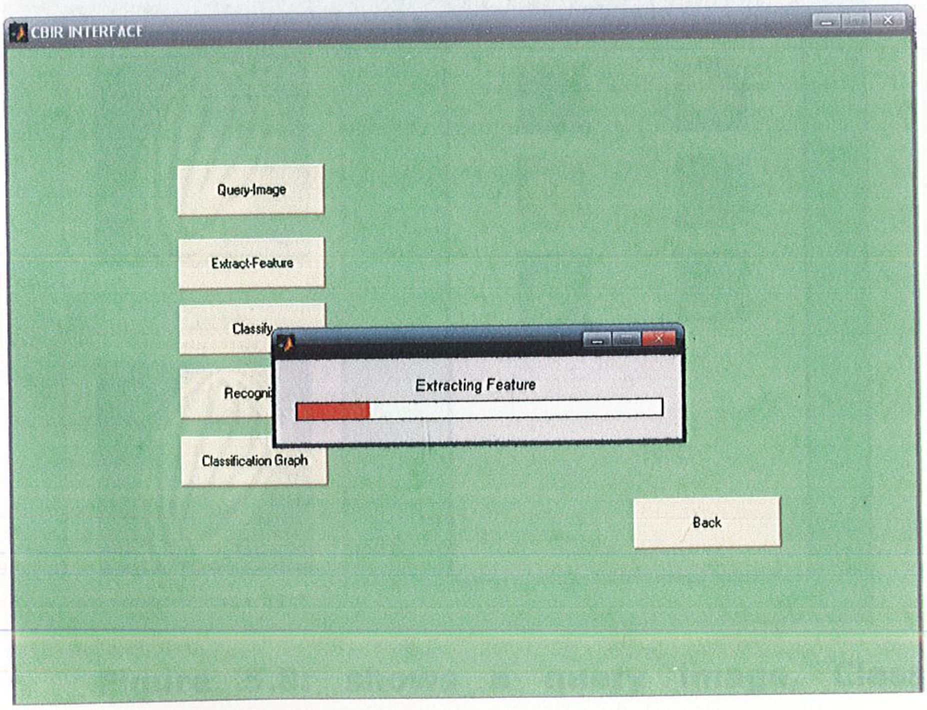


**Figure 5.6: Feature Extraction**

## 5.7 CLASSIFIED IMAGE

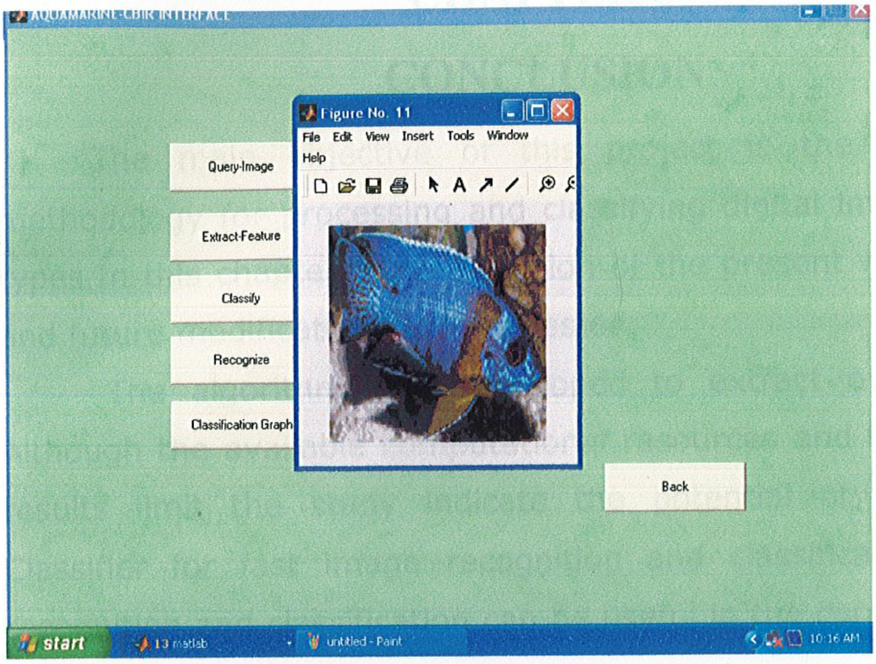


**Figure 5.7: Classifying output result**

## 5.8 RECOGNIZED IMAGE

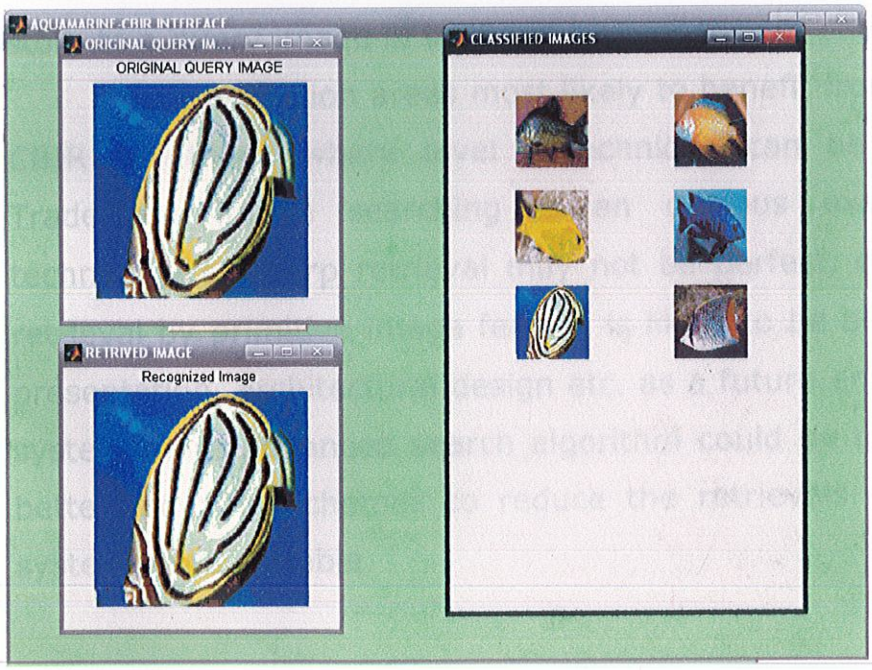


**Figure 5.8: shows a query image, Classified Image, recognized image**

# CHAPTER 6

# CONCLUSION

The main objective of this project is the development of methodology for processing and classifying digital images of different types.In this chapter, the conclusion of the present work is presented and future modifications are suggested.

The algorithms are developed to extract over 11 features. Although the available computational resources and training data, the results limit the study indicate the potential of Knowledge Base Classifier for fast image recognition and classification. Fast image recognition and classification can be useful in the control of real-world, application challenges.

We have designed and implemented a content based image retrieval system that evaluate the similarity of each image in its data store to a query image in terms of texture & color characteristics.

The application areas most likely to benefit from the adoption of CBIR are those where level 1 technique can be directly applied. Trademark image searching is an obvious example while the technology of sharp retrieval may not be perfect, other areas where retrieval by primitive image feature is likely to be beneficial are crime presentation, architectural design etc. as a future enhancement to this system more advanced search algorithm could be used together with better indexing schemes to reduce the retrievals time & make the system more scalable.

# FUTURE SCOPE

There are a lot of issues to be addressed in the future. There are no performance evaluation standards for content-based image retrieval system. Lot of work is left in the region based query and retrieval of the images. There are no standard feature sets that can be used directly in content-based image retrieval. In broad sense, it is a problem of handling multidimensional database. So solution of content-based image retrieval system can be used in other multidimensional databases.

To further improve Knowledge Base Classifier performance in image recognition and classification, other methods may be investigated in the future.

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