RELEVANCE FEEDBACK USING MAXIMUM MARGINAL ANALYSIS FOR INTERACTIVE CBIR

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Introduction

Content-based image retrieval (CBIR) is one of the application of computer visualization techniques to the image retrieval problem, that is, the problem of searching for digital images in huge databases. CBIR is also well-known as query by image content (QBIC) and content-based visual information retrieval (CBVIR)

In "Content-based image retrieval" the search analyzes the contents of the image rather than the metadata such as keywords, tags associated with the image. The word "content" refer to colors [12], shapes [14], textures [13], or any other information that can be resulting from the image itself.
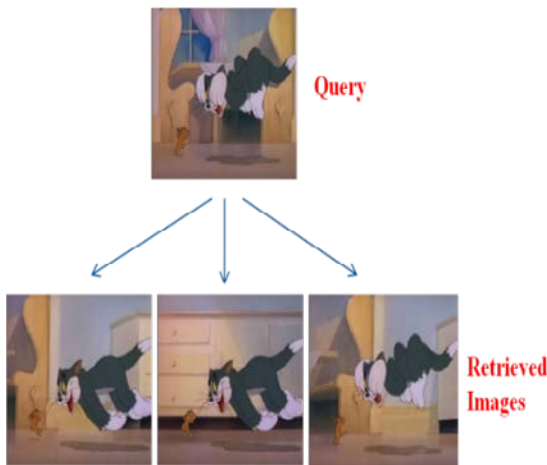

Fig 1.1 Content based image retrieval.

With lots of possible realistic applications, Content-Based Image Retrieval (CBIR) has attracted great attention in the past few years. But the performance is not acceptable, because in this method user perception subjectivity and high level concept is not well modeled. Different persons, or the same person under different circumstances, may perceive the same visual content differently. This is called human perception subjectivity. The subjectivity exists at various levels. For example, one person may be more interested in an image's color feature while another may be more interested in the texture feature.

To overcome this drawback many Relevance feedback method is developed. It takes the advantage of human computer interaction. In this method user selects the relevant images from previous retrieved result and also can label a few more images as new example for the retrieval engine. Drawback of this technique is it treats positive sample (relevant image) and negative sample (irrelevant images).To improve, support vector machine based RF is used to classify positive and negative samples. But it still ignores the information contained in negative sample and also doesn't take unlabeled sample into account. To explore solution to this problem in this project we are making use of semi supervised biased maximum margin analysis [1].

1.1. Application of CBIR

The CBIR technology has been used in some applications such as

- **Crime prevention:** To find out Criminals Automatic face recognition systems used by police forces.
- **Security Check:** In many organisation Finger print or retina scanning used for access privileges.
- **Medical Diagnosis:** CBIR used in a medical database of medical images to assist diagnosis by identifying related old cases.
- **Intellectual Property: CBIR technology is used in** Trademark image registration, So that a new candidate mark is compared with existing marks.

1.2 Problem statement

Content based image retrieval (CBIR) is the application used to search for digital image in large databases. In this method high level concept and user perception subjectivity cannot be well modeled, so many irrelevant images will be displayed in retrieved result .A variety of relevance feedback (RF) schemes have been developed to overcome this problem. Among them Support vector machine RF (SVM RF) is the most popular technique. Drawback of this technique is, it treats positive samples (relevant images) and negative samples (irrelevant images) equally. To explore solution to this problem, in this project we propose semi supervised biased maximum margin analysis to the traditional SVM RF scheme.

1.3 Motivation

Content-based image retrieval has been extensively used nowadays. It has many applications such as Web searching, Crime prevention, Biomedical etc.

In CBIR method high level concept of image and user perception subjectivity cannot be well modeled .A variety of relevance feedback (RF) schemes have been developed to overcome this problem. Among them Support vector machine RF (SVM RF) is the most popular technique. Drawback of this technique is, it treats positive samples (relevant images) and negative samples (irrelevant images) equally. To explore solution to this problem, in this project we propose and semi supervised biased maximum margin analysis to the traditional SVM RF Scheme.

The main aim of this system is to improve the existing content based image retrieval (CBIR) system, in such a way is to personalize the CBIR system based on user behaviors which in turn benefits the user very much.

1.4 Existing system

CBIR has attracted great attention in multimedia management from past few years. In this an image query is described using one or more example images and low level features (Color, Texture, and Shape). In this method high level concept and user perception subjectivity cannot be well modeled. A variety of relevance feedback (RF) schemes have been developed to overcome this problem. Among them Support vector machine RF (SVM RF) is

the most popular technique. In this user will label relevant images (Positive feedback) and irrelevant images (negative feedback).Images which have not labeled by the user, system will select them as unlabeled samples. Drawback of this technique is, it treats positive feedback and negative feedback equally and also does not consider unlabeled samples.

Support vector machine is used to constructs a hyperplane or set of hyperplane in a high or infinite dimensional space, which can be worn for classification, regression. A good separation is achieved by the hyperplane that has the largest distance to the nearest training data point of any class (functional margin), given that in general the larger the margin the lower the generalization error of the classifier. There are many hyperplane that might classify the data. The best hyperplane is the one that represents the largest separation or margin between the two classes. In hyperplane, the distance from it to the nearest data point on each side is maximized. If such a hyperplane exists, it is known as a maximum margin hyperplane and the vectors closest to the hyperplane are called support vectors.
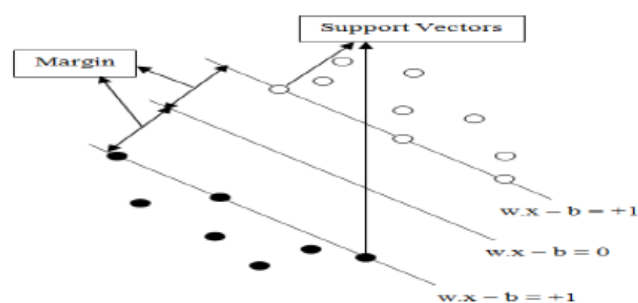

Fig 1.2 SVM Model

Fig 1.2 shows, the line w. X –b =0 is known as the margin of separation or marginal line. The circle and the shaded circle represent the positive and negative instances. One-class SVM is used to estimated the density of positive feedback samples. The density estimation method ignores any information contained in the negative feedback samples. Plagiaristic from one-class SVM, a biased SVM innate the qualities of one-class SVM but incorporated the negative feedback samples

Disadvantages of Existing System:

1. It treats the positive and negative feedbacks equally, which is not appropriate since the two groups of training feedbacks have distinct properties.

2. Most of the SVM-based RF techniques do not take into account the unlabeled samples, although they are very helpful in constructing a good classifier.

1.5 Proposed System

To explore solutions to these two problems in the current technology, we apply a semisupervised BMMA (SemiBMMA) for the traditional SVM RF schemes. It differentiates positive feedbacks from negative ones based on maximum margin analysis which develops maximum margin between positive and negative samples .And also can effectively integrate information of unlabeled samples.

Advantages of Proposed System:

1. The SemiBMMA differentiates positive feedbacks from negative ones.
2. SemiBMMA can effectively integrate information of unlabeled samples.

1.6 Organization of the Report
Chapter 1: Introduction

This Chapter gives brief introduction of Content based image retrieval, problem statement of the project, Existing system and the proposed system.

Chapter 2: Literature Survey

This chapter gives the information regarding Image processing,Image retrieval and also growth of traditional CBIR technology .

Chapter 3: Requirement Specification

This chapter gives the functional and nonfunctional requirements ,Hardware requirements and software requirements of the project .

Chapter 4: Design

This chapter gives detail of high level and low level design of the project with Data flow diagram

Chapter 5: Implementation

This chapter gives information of technology used and coding part.

Chapter 6: Testing

This chapter gives the details of test cases and scenario.

Chapter 7: Results and Performance Analysis

This Chapter gives detail of results and the performance of the proposed scheme.

Chapter 8: Conclusion and future work

This chapter gives the details of conclusion and future enhancement of the project.

Summary

This chapter gives the brief introduction to CBIR and problem statement, Existing System, motivation, proposed system of the project.

Literature survey
2.1 Image Processing

An image can be defined as an array, or a matrix, of square pixels (picture elements) which are arranged in columns and rows. Pictures are the most common way of conveying or transmitting information. A picture is equal to thousand words. Pictures give the information about emotions, positions, sizes and objects inter relationships. Human beings are good at gathering information from images, because of our inborn visual and mental abilities. Human receives about 75% information in the form of pictures.

Images are have to be digitized to place in a computer's memory or on some type of storage media such as a hard disk or CD-ROM. This digitization mechanism can be done via a scanner, or by a video camera linked to a frame grabber board in a computer. Once the image has been digitized, it can be operated by different image processing operations.

Image processing operations can be generally divided into three major categories, Image Compression, Image Enhancement and Restoration, and Measurement Extraction.

Image compression is well-known to most people. It involves reducing the quantity of memory needed to store a digital image.

Using Image Enhancement techniques can recover image defects, which could be caused by the digitization process or by faults in the imaging set-up (for example, bad lighting). Once the image is in good condition, the Measurement Extraction operations can be used to obtain useful information from the image.

Image restoration may be considered as reversing the harm done to an image by a known cause, for example taking out of blur caused by linear motion, removal of optical distortions and also removing periodic interference.

2.2 Image Retrieval

An **image retrieval** method is a computer system used for browsing, searching and retrieving images from a huge database of digital images. Most traditional and common methods of image retrieval make use some method of adding metadata such as captioning, keywords, or descriptions to the images so that retrieval can be done over the annotation words.

Discovery of the digital camera has given the common man the freedom to capture his world in pictures, and easily share them with others. One can today generate large numbers of images with content as diverse as family get-togethers and national park visits. Low-priced storage and easy Web hosting has fueled the metamorphosis of common man from a passive consumer of photography in the past to a current-day active producer.

Today, searchable image data exists with extremely different visual and semantic content, spanning geographically different locations, and is fast growing in size. All these factors have created innumerable possibilities and hence considerations for real-world image search system designers. As far as technological advances or research are concerned, growth in content-based image retrieval has been indubitably rapid. In recent years, there has been significant effort put into understanding the real world implications, applications, and constraints of the technology. In real-world application of the technology is presently limited. We devote this section to understanding to learn image retrieval in the real world and discuss user expectations, system constraints and requirements, and the research effort to make image retrieval a reality in the not-too-distant future. Designing an omnipotent real-world image search engine capable of serving all categories of users requires understanding and characterizing user-system interaction and image search, from both user and system points-of-view.
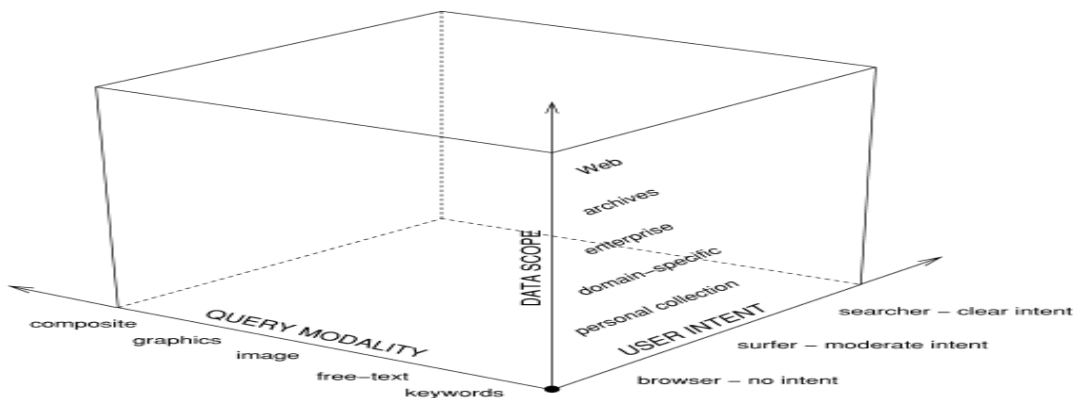

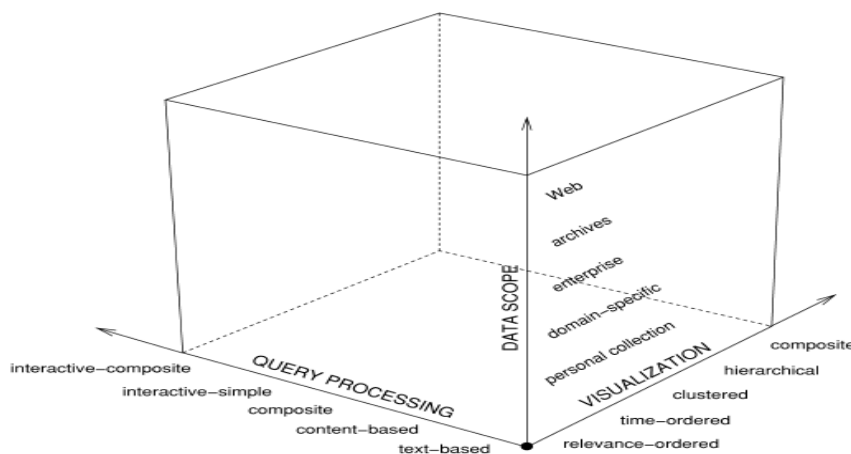Fig 2.1 Visualizing image from user perspective

Fig 2.2 Visualizing image from user perspective

In Figure 2.1 and Figure 2.2, we propose one such dual characterization, and attempt to represent all known possibilities of interaction and search. From a *user perspective*, embarking on an image search, journey involves

considering and making decisions on the following fronts: (1) clarity of the user about what she wants, (2) where she wants to search, and (3) the form in which the user has her query. In an alternative view from an image retrieval *system perspective*, a search translates to making arrangements as per the following factors: (1) how does the user wish the results to be presented, (2) where does the user desire to search, and (3) what is the nature of user input/interaction. These factors, with their respective possibilities, form our axes for Figure 3. In the proposed user and system spaces, real world image search instances can be considered as isolated points or point clouds, and search sessions can consist of trajectories while search engines can be thought of as surfaces. The intention of drawing cubes versus free 3D Cartesian spaces is to emphasize that the possibilities are indeed bounded by the size of the Web, the nature of user, and ways of user-system interaction. We believe that the proposed characterization will be useful for designing context-dependent search environments for real-world image retrieval systems.

2.2.1 Search Methods

Image search is a specialized data search used to find images. To search for images, a user may provide query terms such as keyword, image file/link, or click on some image, and the system will return images "similar" to the query. The similarity used for search criteria could be meta tags, color distribution in images, region/shape attributes, etc.

Image Meta search - search of images based on associated metadata such as keywords, text, etc.

Content-based image retrieval (CBIR) – It is the application of computer vision to the image retrieval. CBIR aims at avoiding the use of textual descriptions and instead retrieves images based on their visual similarity to a user-supplied query image or user-specified image features.

2.3 CBIR

The term CBIR seems to have originated in 1992, when it was used by T. Kato to describe experiments into automatic retrieval of images from a database, based on the colors and shapes present.

During past few years, people have been substantially attracted towards Content-Based Image Retrieval (CBIR) because of its varied multimedia applications. CBIR is one of the most popular research areas of digital image processing. An image retrieval system designed to serve a personal collection should focus on features such as personalization, flexibility of browsing, and display methodology [2,3]. It is motivated by the explosive growth of image records and online accessibility of remotely stored images.

In CBIR, an image query is described using one or more example images and low-level visual feature (eg color[8], texture[8],shape],etc)are automatically extracted to represent the images in the database. In similarity measure, the query image feature vector and database image feature vector are compared using the distance metric. The images are ranked based on the distance value. The feature is defined as a function of one or more measurements, each of which specifies some quantifiable property of an object, and is computed such that it quantifies some significant characteristics of the object. We classify the various features currently employed as follows.

General features: Application independent features such as color, texture, and shape.

Global features: Features calculated over the entire image or just regular sub-area of an image.

Domain-specific features: Application dependent features such as human faces, fingerprints, and conceptual features. These features are often a synthesis of low-level features for a specific domain [9]

Most systems perform feature extraction as a preprocessing step, obtaining global image features like color, shape and texture. Typically, the color of an image is represented through some color model. There exist various color models to describe color information. A color model is specified in terms of 3-D coordinate system and a subspace within that system where each color is represented by a single point. The more commonly used color models are *RGB* (red, green, blue), *HSV* (hue, saturation, value).

Texture is not as well-defined as color features, some systems do not use texture features. However, texture provides important information in image classification as it describes the content of many real-world images such as fruit skin, clouds, trees, bricks,

and fabric. Hence, texture is an important feature in defining high-level semantics for image retrieval purpose. Texture representation methods can be classified into two categories: structural; and statistical [9].However, the low-level features captured from the image may not accurately characterize the high-level concept.

Shape is a fairly well-defined concept. Shape features of general applicability include aspect ratio, circularity, Fourier descriptors, moment invariants, consecutive boundary segments, etc. Shape features are important image features though they have not been widely used as color and texture features. Shape features have shown to be useful in many domain specific images such as man-made objects. For color images used in most papers, however, it is difficult to apply shape features compared to color and texture due to the inaccuracy of segmentation. Despite the difficulty, shape features are used in some systems and has shown potential benefit for RBIR

The concept of relevance feedback was initially developed to improve document retrieval [Rocchio1966]. In general, a document retrieval system presents a ranked set of documents relevant to the user's initial query and from there on iteratively solicits the user for feedback on the quality of the documents and uses the feedback to compose an improved set of documents. Since keywords in a query can be matched one-on-one with text in a document, it is relatively easy for the retrieval system to determine which documents are relevant and which not. This same technique can be applied to image retrieval – or multimedia retrieval in general – and hence it was also introduced into these fields Relevance Feedback (RF) was introduced as a powerful tool to enhance the performance of CBIR [4].

2.3.1 Relevance Feedback Technique in CBIR

Relevance Feedback (RF) techniques are used to adjust the query by user''s feedback. RF is a powerful technique used in traditional CBIR system. It is a process of automatically adjusting an existing query using information fed back by the user about the relevance of previously retrieved objects such that the adjusted query. The issue in relevance feedback

is how to utilize the feedback information for improving the retrieval performance. After obtaining retrieval results, user provides the feedbacks for checking results are relevant or not relevant. If the results are not relevant, the feedback loop is repeated many times until the user is satisfied. The basic idea behind the RF scheme is to shift the burden of finding the right query formulation from the user to the system. In order to make this true, the user has to provide the system with some information, so that system can perform well in answering the original query. The concept of RF was introduced into CBIR from the concept of text based information retrieval in the 1998''s and then has become a popular technique in CBIR.

In this RF method Support Vector RF is the most popular technique. The Support Vector Machines (SVM) [5, 6, 7] based relevance feedback (SVM RF) has shown promising results owing to its good generalization ability. Drawback of relevance feedback technique is, it treats positive and negative sample equally and SVMRF based technique do not take into unlabeled sample.

To explore solution to this problem, we propose a semi-Supervised Biased Maximum Margin analysis [1] for the traditional SVMRF scheme. These schemes are mainly based on the concept that it treats the positive and negative feedback unequally. Also, labeled positive feedbacks are mapped as close as possible and negative feedbacks are separated from positive feedbacks by a maximum margin in reduced subspace.

The traditional SVM combined with SemiBMMA can better model the relevance feedback process and reduce the performance degradation caused by distinct properties of the two groups of feedbacks.

The SemiBMMA can incorporate the information of unlabelled samples into the relevance feedback and effectively alleviate the over fitting problem caused by the small size of labeled training samples. This method is used to deal with the unlabeled samples to assist with the supervised classification method. By this method we will be able to deal with unsupervised classification. This shows that this method is able to deal with the situation where labeled data points are abundance.

Sometimes both supervised and unsupervised methods do not able to obtain

efficient result, but semi-supervised approach gives the accurate result and focuses completely on efficiency which is the principle of semi-supervised classification. Semi-supervised method does their classification in three steps. Firstly it selects the labeled or un-labeled data points, i.e. data point selection. After selecting the data point it creates the initial classifier, which is useful in third step. And the last step is to clustering the data points to find classifier. Semi- supervised technique is best suited in much application and will give the accurate results[11].

Several CBIR systems currently exist, and are being constantly developed. Examples are

- *QBIC* or *Query By Image Content* was developed by IBM, Almaden Research Centre, to allow users to graphically pose and refine queries based on multiple visual properties such as colour, texture and shape. It supports queries based on input images, user-constructed sketches, and selected colour and texture patterns [2].
- *VIR Image Engine* by Virage Inc., like QBIC, enables image retrieval based on primitive attributes such as colour, texture and structure. It examines the pixels in the image and performs an analysis process, deriving image characterization features .
- *VisualSEEK* and *WebSEEK* were developed by the Department of Electrical Engineering, Columbia University. Both these systems support colour and spatial location matching as well as texture matching.
- *NeTra* was developed by the Department of Electrical and Computer Engineering, University of California. It supports colour, shape, spatial layout and texture matching, as well as image segmentation.
- *MARS* or *Multimedia Analysis and Retrieval System* was developed by the Beckman Institute for Advanced Science and Technology, University of Illinois. It supports colour, spatial layout, texture and shape matching.
- *Viper* or *Visual Information Processing for Enhanced Retrieval* was developed at the Computer Vision Group,

University of Geneva. It supports colour and texture matching.

Summary

This chapter gives the information regarding Image processing, Image retrieval and also growth of traditional CBIR technology.

System Requirement Specification

The System Requirement Specification (SRS) phase is an important steps comes in software development life cycle and it is a complete description of the behavior of the system to be developed. The purpose of this system requirement specification is to specify the user goal and task that need to be achieved.

A system requirements specification describes software system need to be developed. It provides a necessary requirement that helps in project development. It in includes Hardware requirement, software requirement, functional requirement, on functional requirement.

3.1 Purpose of the Project:

Human interactive systems have attracted a lot of research interest in recent years, especially for content-based image retrieval systems. The purpose of this system is to improve the existing content based image retrieval (CBIR) system, in such a way is to personalize the CBIR system based on user behaviors which in turn benefits the user very much.

3.2 Scope of the Project:

This project is mainly developed to retrieve the images based on user query. RF methods are used to interact with the system.

3.3 Hardware Requirement:

The hardware requirement specification gives the complete hardware requirement for the system, this section contains all hardware requirement detail sufficient to design a system to satisfy those requirement and tester to test that the system satisfies those requirements

The hardware requirements for the project are as follows:

Processor	:	Pentium IV
Hard Disk	:	160 GB
Ram	:	1 GB

3.4 Software Requirement:

Software requirements deal with defining software resource requirements and prerequisites that need to be installed on a computer to provide optimal functioning of an application. These requirements or prerequisites are generally not included in the software installation package and need to be installed separately before the software installed.

Operating system : Windows XP Professional.

Coding Language : MAT Lab

Database : Microsoft Office Access

3.5 Functional requirements

Functional requirement defines a function of a system and its component. A function is described as a set of inputs, the behavior, and outputs. Functional requirements may be calculations, technical details, data manipulation and processing and other specific functionality that define what system is supposed to accomplish. The functional requirements of the project are:

- **Database Collection:** To implement this project we need Collection of images. Here we collected 335 images of jpg format

- **User interface:** User to interact with the system user interface is required, so that he can enter the image and also can enter the feedback. We have developed using GUI in mat lab.

- **Feature extraction:** It is method to extract the feature of images. This is required to retrieve the images from the database. It takes the input as an image and generates feature.

3.6 Non functional requirements

The Non Functional requirements specify the criteria that can be used to evaluate the operation of the system rather than the system behavior.

3.4.1 Performance requirement

- **Usability**

A very interactive GUI is provided which helps the user to easily interact with the system. This application allows users to operate with little or no learning.

- **Response Time**

It is the time a generic system or functional unit takes to react to a given input.

Responsiveness, how quickly an interactive system responds to user input.

- **Safety Requirements**

No harm is expected from the use of the product either to the OS or any data that resides on the system.

Summary

This chapter gives purpose and scope of the project and minimum hardware and software requirement needed for the project. It also specifies functional and non functional requirement of the project.

System Design

Systems design is the process of defining the components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. The purpose of this phase is to get solution for the given problem by applying suitable plan.

The software Design Document provides us the detail of the project developed. System design identifies the modules that should present in the system. In our project there are three modules, which are given below.

4.1 Modules

They are three modules in our project which are given

- Feature Extraction
  - Color Features
  - Texture Features
  - Edge histogram Features
- Categorize and retrieving
- Feedback model

4. 2Module Description

4.2.1Feature Extraction:

Features are considered as the identity of the image. We concentrate on color features, Texture features, and Shape features.

➢ **Color Features:**

It is captured by averaging the intensities of pixels in a block, referred to as mean feature. Pixel Color Information is nothing but R, G, and B value. Mean component is calculated by following formula.

Mean component (R, G or B) = Sum of that component for all pixels /Number of pixels.

➢ **Texture feature**
• Gabor features

It captures a number of salient visual properties, including spatial localization, orientation selectivity, and spatial frequency selectivity, they are robust to illumination Eq.1=>

$$\mathcal{J}_{\mathbf{k}}(\mathbf{z}) = \int\int \mathcal{I}(\mathbf{z}')\psi_{\mathbf{k}}(\mathbf{z} - \mathbf{z}')d\mathbf{z}'$$

with a family of Gabor filters

$$\psi_{\mathbf{k}}(\mathbf{z}) = \frac{\mathbf{k}^T\mathbf{k}}{\sigma^2}\exp(-\frac{\mathbf{k}^T\mathbf{k}}{2\sigma^2}\mathbf{z}^T\mathbf{z})\left(\exp(i\mathbf{k}^T\mathbf{z}) - \exp(-\frac{\sigma^2}{2})\right),$$
(2)

where $\mathbf{z} = (x, y)$ and $\mathbf{k}$ is the characteristic wave vector:

$$\mathbf{k} = (k_\nu\cos\varphi_\mu \quad k_\nu\sin\varphi_\mu)^T \quad (3)$$

with

$$k_\nu = 2^{-\frac{\nu+2}{2}}\pi, \quad \varphi_\mu = \mu\frac{\pi}{8}, \quad (4)$$

$$\nu = 0, 1, 2, 3, 4, \quad \mu = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}.$$

• To get texture feature apply a set of Gabor filters with specific parameters such as frequency, sharpness of Gaussian envelope and different rotation angles. The object image undergoes convolution with these Gabor filters to produce Gabor jets. These Gabor jets are processed in various ways to form the feature vectors.

➢ **Shape feature**

To calculate the shape feature Edge Histogram method is used. It Captures edge or gradient structures that are characteristic

variations since they detect amplitude-invariant spatial frequencies of pixel gray values.

• Gabor wavelets (filters or functions):

Gabor wavelets are based on physiological studies of simple cells in the human visual cortex. The cells are selectively tuned to orientation as well as spatial frequency, and their response can be accurately enough approximated by 2D Gabor filters. Thus, the increased popularity of this approach is biologically well justified. A 2D Gabor wavelet transform is defined as the convolution of the image I(z):

of local shape. An image descriptor based on the image's gradient orientations. This descriptor is based on dominant edge orientations. Image will be divided into cells.

4.2.2 Categorize and retrieving

The test image features are fed to Multi-class SVM classifier to predict its category. Here, the test features are projected in the trained matrix feature space to predict its category.

I. Multiclass SVMs

SVMs are inherently two-class classifiers. In particular, the most common technique in practice has been to build $|C|$ one-versus-rest classifiers (commonly referred to as ``one-versus-all" or OVA classification), and to choose the class which classifies the test datum with greatest margin. Another strategy is to build a set of one-versus-one classifiers, and to choose the class that is selected by the most classifiers. While this involves building $|C|(|C|-1)/2$ classifiers, the time for training classifiers may actually decrease, since the training data set for each classifier is much smaller.

However, these are not very elegant approaches to solving multiclass problems. A better alternative is provided by the construction of multiclass SVMs, where we build a two-class classifier over a feature vector $\Phi(\vec{x}, y)$ derived from the pair consisting of the input features and the class of the datum. At test time, the classifier chooses the class $y = \arg\max_{y'} \vec{w}^T \Phi(\vec{x}, y')$. The margin during training is the gap between this value for the correct class and for the nearest other class, and so the quadratic program formulation will require that

$$\forall i \; \forall y \neq y_i \; \vec{w}^T \Phi(\vec{x}_i, y_i) - \vec{w}^T \Phi(\vec{x}_i, y) \geq 1 - \xi_i$$

. This general method can be extended to give a multiclass formulation of various kinds of linear classifiers. It is also a simple instance of a generalization of classification where the classes are not just a set of independent, categorical labels, but may be arbitrary structured objects with relationships defined between them.

4.2.3 Feedback model:

In feedback model we proposed Semi BMMA classifier is trained using the extracted features. It takes the feature of images, which is given by user as relevant images.

I. Mathematical Concept SemiBMMA

- In each round of feedback iteration, there are n samples $P = \{p1, p2 \ldots\ldots\ldots\ldots pn\} \epsilon \; Rh$. For simplicity, we assume that the first $n+$ samples are positive feedbacks, $pi(1 \leq i \leq n+)$, the next $n-$ samples are negative feedbacks $pi(n+ +1 \leq i \leq n+ + n-)$, and all others are unlabelled samples $pi(n+ +n- +1 \leq i \leq n)$. Let $l(pi)$ be the class label of sample Pi. We denote $l(pi)=1$ for positive feedbacks, $l(pi)= -1$ for negative feedbacks and $l(pi)=0$ for unlabelled samples.

- To better show the relationship between the proposed approaches, we use the similar notations and equations in graph embedding frame work. Firstly, two different graphs are formed: 1) the intrinsic graph G, which characterizes the local similarity of feedback samples, 2) the penalty graph Gp, which characterizes the local discriminate structure of the feedback samples. For all positive feedbacks, we first compute the pair wise distance between each pair of positive feedbacks. Then for each positive feedback Pi, we find its ki nearest neighborhood positive feedbacks, which can be represented as a sample set Nis, and put an edge between $x1$ and its neighborhood positive feedbacks.

- The intrinsic graph measures the total average distance of the $|Nis|$ nearest neighborhood sample pairs, and is used to characterize the local within-class compactness for all the positive feedbacks. For the penalty graph Gp, its similarity matrix represents geometric or statistical properties to be avoided and is used as a constraint matrix in the graph embedding framework. In the BMMA, the penalty graph is constructed to represent the local separability between the positive class and the negative class. More strictly speaking, we expect that the total average margin between the sample pairs with different labels should be as large as possible. For each feedback sample, we find its $k2$ neighbor feedbacks with different labels and put edges between corresponding pairs of feedback samples For each unlabelled samples $pi(n+ + n- +1 \leq i \leq n)$, for each unlabelled samples we find its $k1$ nearest unlabelled samples which can be represented as a sample set $Niii$, and put an edge between the unlabelled pi and its neighborhood unlabelled

samples. This matrix term is known as Laplacian matrix.

II. SemiBMMA algorithm

Input: P = *{p1,p2................. pn}ε Rh*, stand for all feedback samples and unlabelled samples which include the positive set P+ , the negative sample set P- , and unlabelled samples .

Step 1: Construct the supervised intrinsic graph G and calculate the matrix value of positive feedbacks

Step 2: Construct the supervised penalty graph Gp and calculate the matrix value of negative feed backs.

Step 3: Construct the Laplacian regularizer and calculate the matrix value of unlabelled samples
Step 4: Calculate the projection matrix α: project all positive, negative and remaining

samples in the database on to the reduced subspace respectively.

Output: Positive and Negative samples Y+ and Y- , in this reduced subspace.

4.2 High level Design

High level design gives overview of the project. Here we have used use case diagram and dataflow diagram to provide overview of the project

4.2.1 Use case diagram:

The use case diagram is used to identify the primary elements and processes that form the system. The primary elements are termed as "actors" and the processes are called "use cases." The use case diagram shows which actors interact with each use case.
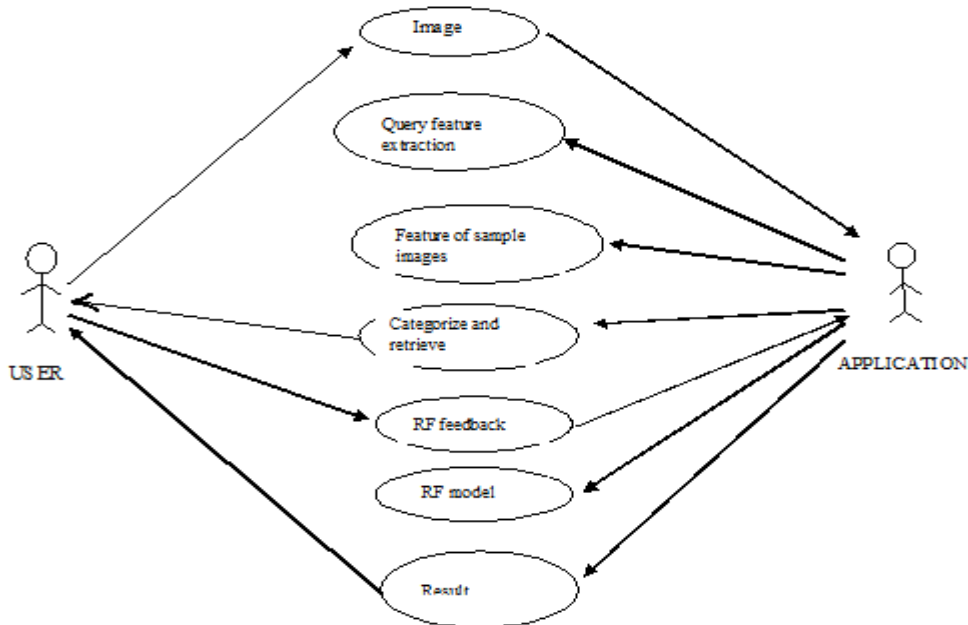

Fig 4.1 Use case diagram

The above diagram describes the user interaction with the processes, user enters the image to system .System retrieve the images and display. User observes the images and gives the feedback. System take this feedback gives the result once again

4.2.2 Data Flow Diagram

A Data Flow Diagram (DFD) is a graphical representation of the "flow" of data through an information system, modeling its *process* aspects. A DFD is often used as a preliminary step to create an overview of the system, which can later be elaborated. DFDs can also be used for the visualization of data processing..
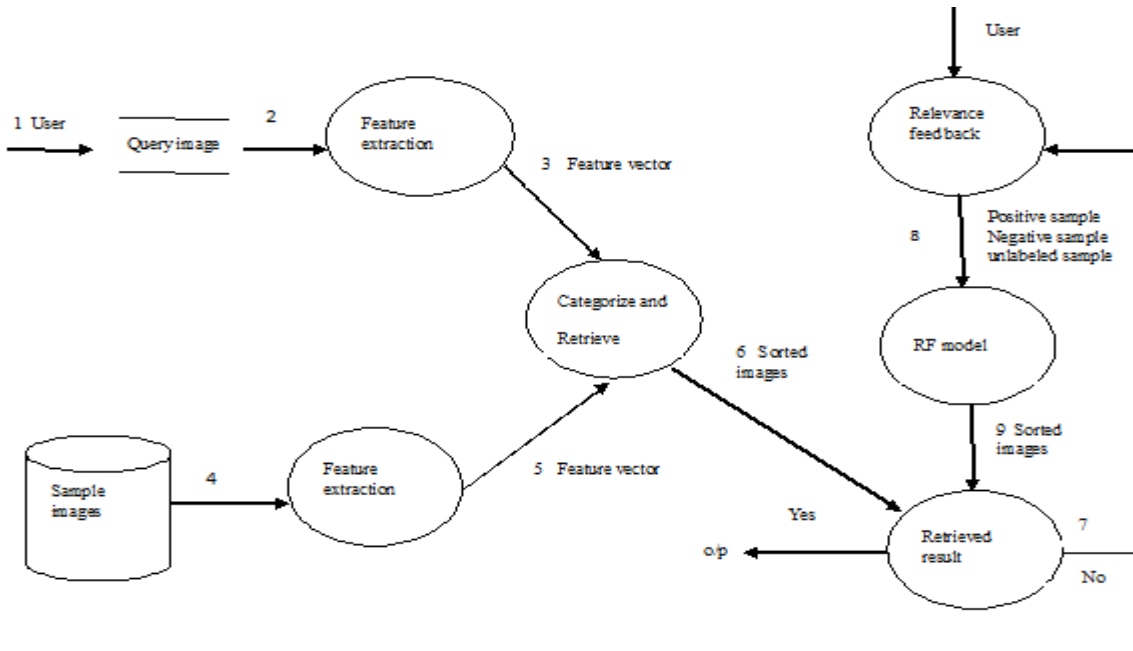
Fig4.2 Level1 Dataflow diagram

User enters query image, its features are extracted by feature module and this feature will be compared with the features in the database. Categorize and retrieve model extract the images which having similar feature of that query image. If user is not satisfied with the result he/she enters feedback. Feedback model consider this feedback information using SemiBMMA approach it will retrieve the images.

4.3 Low level design diagram

Large systems are decomposed into sub-system called as module. Low level design gives the internal logic of the system.

4.3.1 Sequence diagram

A sequence diagram represents the interaction between different objects in the system. The important aspect of a sequence diagram is that it is time-ordered. This means that the exact sequence of the interactions between the objects is represented step by step. Different objects in the sequence diagram interact with each other by passing "messages". The Sequence diagram of proposed system is given below.
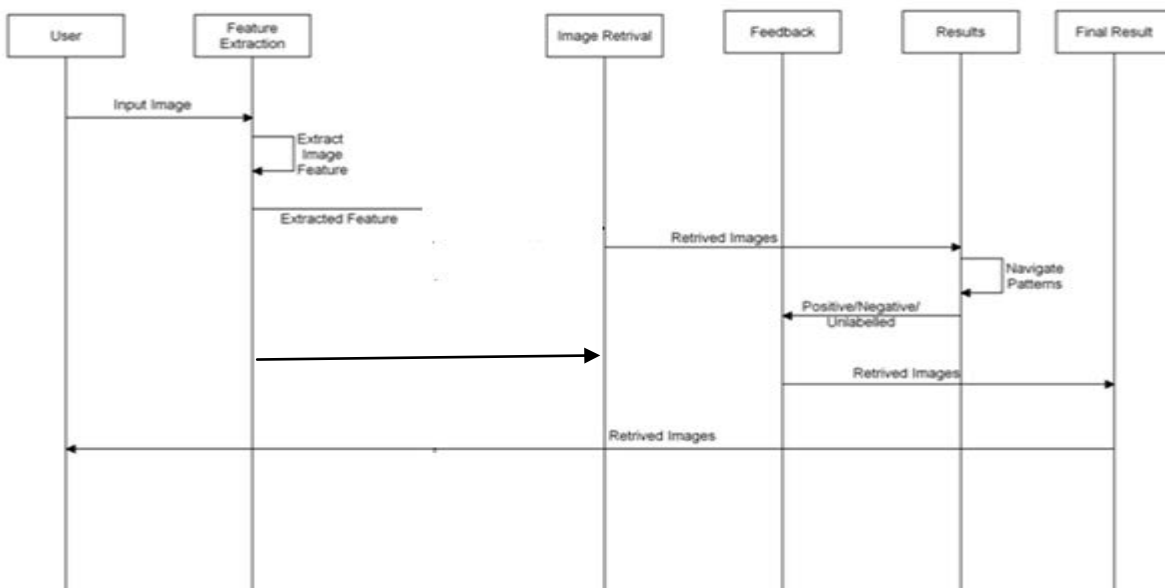
Fig4.3 Sequence diagram

4.3.2 Module design
Module1: Feature extraction module
In this Feature of images are retrieved. Here we are retrieving Color, Texture, Shape feature of the image using Color mean method, Gabor wavelets and Edge histogram respectively. Below fig4.4 Shows the level0 DFD for feature Extraction module.
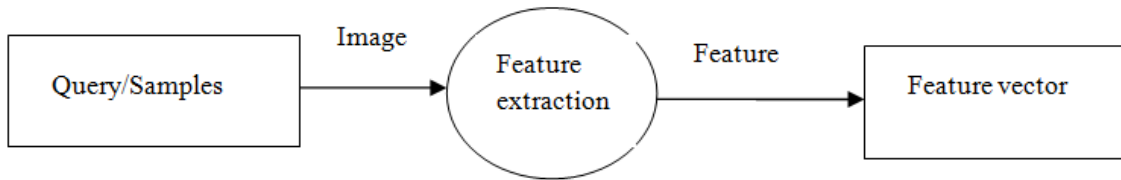
Fig4.4.Level 0 DFD for Feature extraction method

Module2:Categorize and retrieve
    Categorize and retrieve function takes Feature of query image and feature of sample images as input. Here we are using multiclassSVM to match the similar images .This function Retrieve the images whose feature is matching with query image.
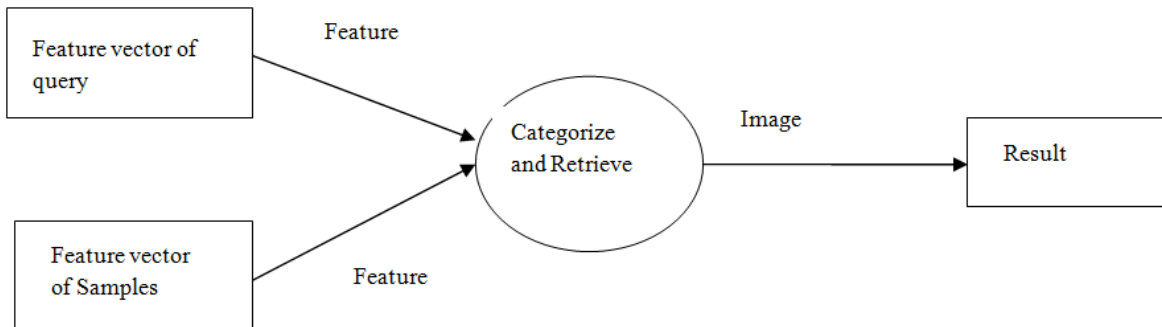
Fig4.5.Level 0 DFD for Categorize and Retrieve module

Module3: RF model

    This RF model takes the Feature of feedback query and feature of database images as a input. Here RF model make use SemiBMMA approach and retrieve the images.

Fig4.6.Level 0 DFD for RF module

Summary

This chapter describe design phase. It includes High level design and low level design description with dataflow diagram

Implementation

5.1 Technology Used

The proposed work has been implemented in MATLAB. MATLAB (matrix laboratory) is a numerical computing environment. MATLAB (matrix laboratory) is a numerical computing environment and fourth generation programming language.

5.1.1 Mat Lab Key Features

- MATLAB provides a language and environment for numerical computation, data analysis, visualisation and algorithm development
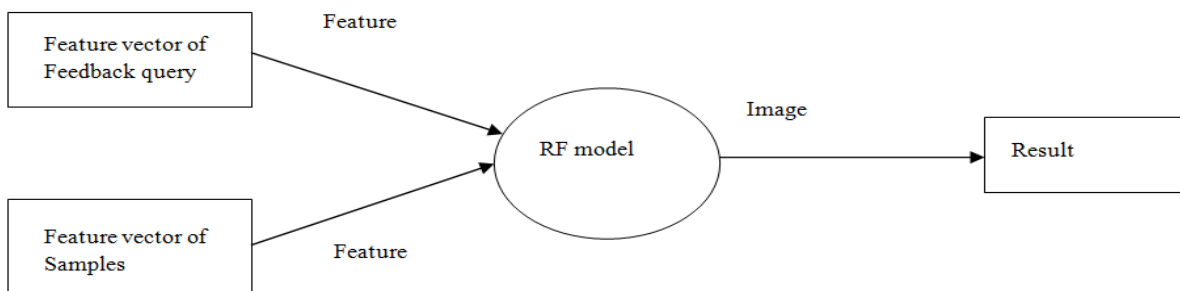
- MATLAB provides functions that operate on
  Integer, real and Vectors and matrices

- Mathematical functions for linear algebra, statistics, numerical integration, and solving ordinary differential equations

- Built-in graphics for visualizing data and tools for creating custom plots

5.1.2 Working on MATLAB

When MATLAB opens, the screen should look something like what is pictured in figure below.
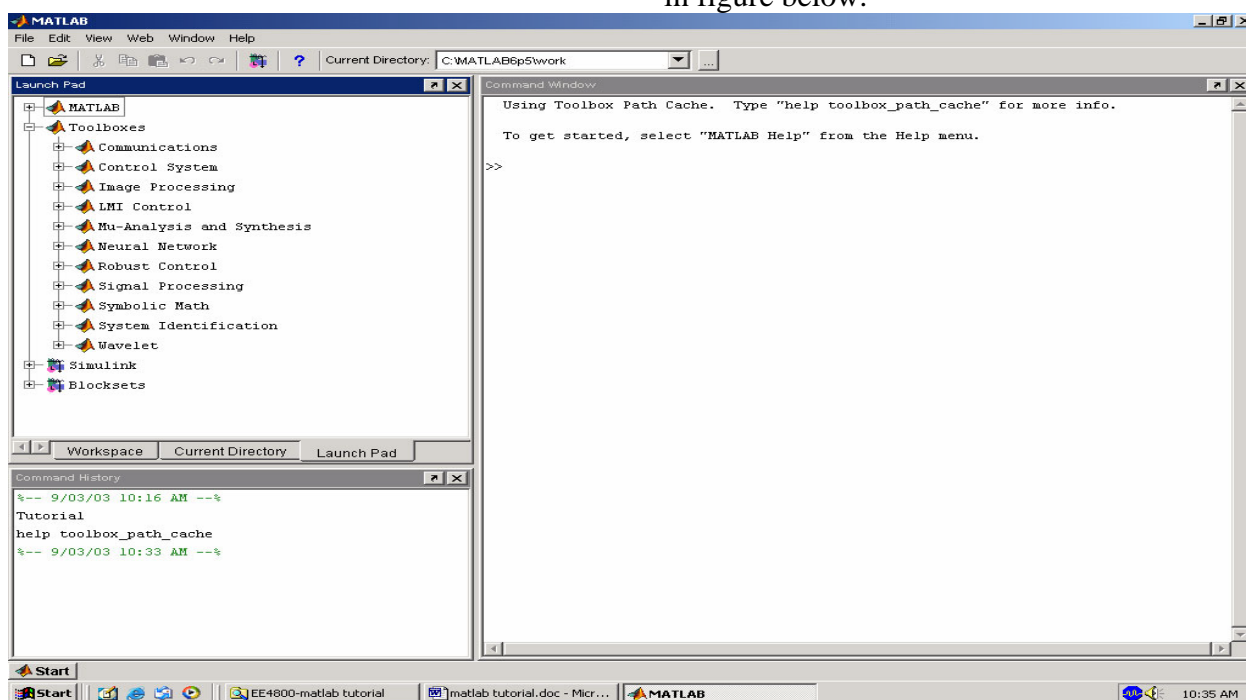
Fig 5.1 Command window

The **Command Window** is the window on the right hand side of the screen. This window is used to both enter commands for MATLAB to execute, and to view the results of these commands.

The **Command History** window, in the lower left side of the screen, displays the commands that have been recently entered into the Command Window. In the upper left hand side of the screen there is a window that can contain three different windows with tabs to select between them. The first window is the **Current Directory**, which tells the user which M-files are currently in use. The second window is the **Workspace** window, which displays which variables are currently being used and how big they are. The third window is the **Launch Pad** window, which is especially important since it contains easy access to the available toolboxes, of which, Image Processing is one. If these three windows do not all appear as tabs below the window space, simply go to **View** and select the ones you want to appear.

5.1.3 M-file

An M-file is a MATLAB document the user creates to store the code they write for their specific application. **Creating an M-file is highly recommended**, although not entirely necessary. An M-file is useful because it saves the code the user has written for their

application. It can be manipulated and tested until it meets the user's specifications. The advantage of using an M file is that the user, after modifying their code, must only tell MATLAB to run the M-file, rather than reenter each line of code individually.

5.1.4. Images

The first step in MATLAB image processing is to understand that a digital image is composed of a two or three dimensional matrix of pixels. Individual pixels contain a number or numbers representing what grayscale or color value is assigned to it. Color pictures generally contain three times as much data as grayscale pictures, depending on what color representation scheme is used. Therefore, color pictures take three times as much computational power to process. In this tutorial the method for conversion from color to grayscale will be demonstrated and all processing will be done on grayscale images. However, in order to understand how image processing works, we will begin by analyzing simple two dimensional 8-bit matrices.

5.2 Image Toolbox

The Image Processing Toolbox is a collection of functions that extend the capability of the MATLAB ® numeric computing environment. The toolbox supports a wide range of image processing operations.

5.2.1 Reading images

IPT accepts images of type TIFF, JPEG, GIF, BMP, PNG and XWD. It reads file using imread function. Filename is string of complete filename (i.e.path (if not in pwd) and extension).use quotes for strings!!
f=imread('picture.jpg');
f=imread('D:\images\picture2.jpg');
f=imread('.\images\picture3.jpg');

5.2.2 Conversion

It also provide function which convert image from one format to another,someof them are listed below
- gray2ind - intensity image to index image
- im2bw- image to binary
- im2double - image to double precision
- im2uint8 - image to 8-bit unsigned integers

- im2uint16 - image to 16-bit unsigned integers
- ind2gray - indexed image to intensity image
- mat2gray - matrix to intensity image
- rgb2gray - RGB image to grayscale
- rgb2ind - RGB image to indexed image

5.2.3 MATLAB and images

- The help in MATLAB is very good, use it!
- An image in MATLAB is treated as a matrix
- Every pixel is a matrix element
- All the operators in MATLAB defined on Matrices can be used on images: +, -, *, /, ^, sqrt, sin, cos etc.

- **MATLAB can import/export several image formats**
    - BMP (Microsoft Windows Bitmap)
    - GIF (Graphics Interchange Files)
    - HDF (Hierarchical Data Format)
    - JPEG (Joint Photographic Experts Group)
    - PCX (Paintbrush)
    - PNG (Portable Network Graphics)
    - TIFF (Tagged Image File Format)
    - XWD (X Window Dump)
    - MATLAB can also load raw-data or other types of image data
- **Data types in MATLAB**
    - Double (64-bit double-precision floating point)
    - Single (32-bit single-precision floating point)
    - Int32 (32-bit signed integer)
    - Int16 (16-bit signed integer)
    - Int8 (8-bit signed integer)
    - Uint32 (32-bit unsigned integer)
    - Uint16 (16-bit unsigned integer)
    - Uint8 (8-bit unsigned integer)

    - **Images in MATLAB**
        - Binary images : {0,1}
        - Intensity images : [0,1] or uint8, double etc.
        - RGB images : m-by-n-by-3
        - Indexed images : m-by-3 color map

- ▪ Multidimensional images m-by-n-by-p (p is the number of layers)

5.3 Source code
5.3.1 Source code for module Feature extraction
This code Extract the color feature of training images

```
train_colorfea=zeros(335,256);
for i=1:335

fimage=imread(['database\',num2str(i),'.jpg']);
  fnimage=imresize(fimage,[256 256]);
  cimage=rgb2gray(fnimage);
  colorfea=mean(cimage);
  train_colorfea(i,:)=colorfea;
end
save train_colorfea train_colorfea
f7 =    figure('NumberTitle','off','Name','Train
Image Colour Feature','Position',[100 100 300
150]);
t7=
uitable('Data',train_colorfea,'Parent',f7,'Position'
,[20 20 250 100]);
```

This code extract the shape feature of training images

```
train_Hogfea=zeros(335,81);
for i=1:335

fimage=imread(['database\',num2str(i),'.jpg']);
   fnimage=imresize(fimage,[256 256]);
 hoimage=rgb2gray(fnimage);
Hogfea=HOG(hoimage);
train_Hogfea(i,:)=Hogfea';
end
save train_Hogfea train_Hogfea
f6 =    figure('NumberTitle','off','Name','Train
Image Edge Histogram Feature','Position',[100
100 300 150]);
t6=
uitable('Data',train_Hogfea,'Parent',f6,'Position',
[20 20 250 100]);
```

5.3.2 Code for categorize and Retrieve
This code retrieve images which matches features of query image given by the user

```
function
Categorizeandretrieve_Callback(hObject,
eventdata, handles)
% hObject    handle to Categorizeandretrieve
(see GCBO)
% eventdata  reserved - to be defined in a future
version of MATLAB
% handles    structure with handles and user
data (see GUIDATA)
%**************************************
******************
%%%%%%%%%%              Retrieval
%%%%%%%%%%%%%%%%
%**************************************
*****************

global slino querycate neighcategory fqefea
RIC
load testimfea
prompt = {'Enter No.of images(10,15):'};
dlg_title = 'Select A Number';
num_lines = 1;
def = {'10'};
slino                            =
inputdlg(prompt,dlg_title,num_lines,def);
slino = str2num(slino{1,1});
load trainimfea
load Imgcate

  queryfea=testimfea;
  tic
  [querycate]          =          multisvm(
trainimfea,Imgcate,queryfea);
   %--------------------------------------------------

subplot(4,4,h),imshow(retim);xlabel(num2str(n
eighborIds(h)));
%
   end
   retrieval_endtime = toc
   pause(0.2)
   figure(9)
   bar3(neighborDistances,0.25,'detached');
   xlabel('NeighborIndex');
   zlabel('NeighborDistances');
```

Summary
        This chapter describe technology which is used for the project and also source code for the function feature extraction andcategorize retrieve

Testing
        Testing is a development procedure where programmers create tests as they develop software. The tests are simple short tests that test funtionally of a particular unit or module of their code, such as a class or function.

6.1 Types of Testing

I. System Testing:

The application is tested with respect to its typical working environment. Consequently for many processes no clear division between validation and system testing can be made. Specific tests which can be performed in either or both stages include the following.

II. Integration Testing:

Integration Testing can proceed in a number of different ways, which can be broadly characterized as top down or bottom up. In top down integration testing the high level control routines are tested first, possibly with the middle level control structures present only as stubs. Subprogram stubs were presented in section2 as incomplete subprograms which are only present to allow the higher. Level control routines to be tested.

III. Unit Testing:

Unit testing deals with testing a unit as a whole. This would test the interaction of many functions but confine the test within one unit. The exact scope of a unit is left to interpretation. Supporting test code, sometimes called *Scaffolding*, may be necessary to support an individual test. This type of testing is driven by the architecture and implementation teams. This focus is also called black-box testing because only the details of the interface are visible to the test. Limits that are global to a unit are tested here.

6.2 Test Cases

Module1: Feature Extraction

Sl # Test Case : -	UTC-1
Name of Test: -	Features Extraction of Training Images
Items being tested: -	"Features" button in GUI
Sample Input: -	Click on the Features button
Expected output: -	It should show all images in the training folder and features should be extracted using appropriate method
Actual output: -	Working as it is fine.
Remarks: -	Pass.

Sl # Test Case : -	UTC-2
Name of Test: -	Database Classification
Items being tested: -	"Database classification " button in GUI
Sample Input: -	Click on the Database classification button
Expected output: -	All training features should be classified as different types of classes.

Actual output: -	Working as it is fine.
Remarks: -	Pass.

Sl # Test Case : -	UTC-3
Name of Test: -	Query Image and Feature Extraction
Items being tested: -	"Select image and Feature Extraction button"
Sample Input: -	Click on Select image button
Expected output: -	One browse window should come and user should select the query image, then features of those images should be extracted using appropriate method.
Actual output: -	Working as it is.
Remarks: -	Pass.

Modul2:Categorize and retrieve

Sl # Test Case : -	UTC-1
Name of Test: -	Categorize and Retrieve
Items being tested: -	Categorize and Retrieve button
Sample Input: -	Click on Categorize and Retrieve button
Expected output: -	It should query to user"Enter number of images display (10-15)". Then user should enter the number of images. Click on button. It will retrieve those numbers of similar images of training dataset.
Actual output: -	Working fine
Remarks: -	Pass.

Module3:RF module

Sl # Test Case : -	UTC-1
Name of Test: -	Enter feedback

Items being tested: -	Enter feedback button
Sample Input: -	Click on Enter feedback button
Expected output: -	It should ask the feedback of retrieved images. User can enter the feedback of retrieved image numbers.
Actual output: -	Working fine
Remarks: -	Pass.

Sl # Test Case : -	UTC-2
Name of Test: -	Result
Items being tested: -	Result button
Sample Input: -	Result button
Expected output: -	Display images. It will come as user input of feedback.
Actual output: -	Working fine
Remarks: -	Pass.

Summary

This Chapter describe various types of testing procedure and test cases.

Chapter 7

Results and Performance Analysis

7.1 Performance Analysis:

The retrieved images are subjected to precision and recall analysis.

7.1.1Precision & Recall Analysis:

CBIR performance is analyzed by computing the values of precision and recall. Precision and Recall value calculated by following formula

Precision = Number of relevant images retrieved / Total number of images retrieved

Recall = Number of relevant images retrieved / Total number of relevant images in the database

To Compare SVM with our Proposed system we have taken SVM precesion value from the paper."Asymmetric Bagging and Random Subspace for Support Vector Machines-Based Relevance Feedback in Image Retrieval Dacheng Tao, Student Member, IEEE, Xiaoou Tang, Senior Member, IEEE, Xuelong Li, Member, IEEE, and Xindong Wu, Senior Member, IEEE". The fig shows precision curve with the Existing system SVM and Proposed System SemiBMMA.This shows SemiBMMA Works better than SVM.
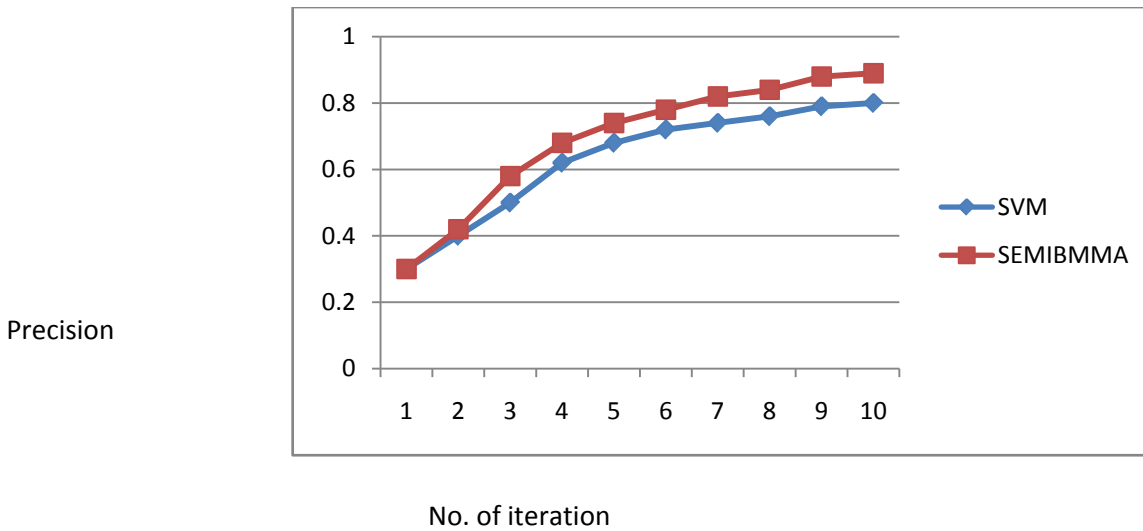
No. of iteration

Fig 7.1 precision graph for SVM and SemiBMMA

7.2 Snapshots

Fig7.2, this is the Snapshot of main GUI. This GUI helps user to interact with the system very easily.
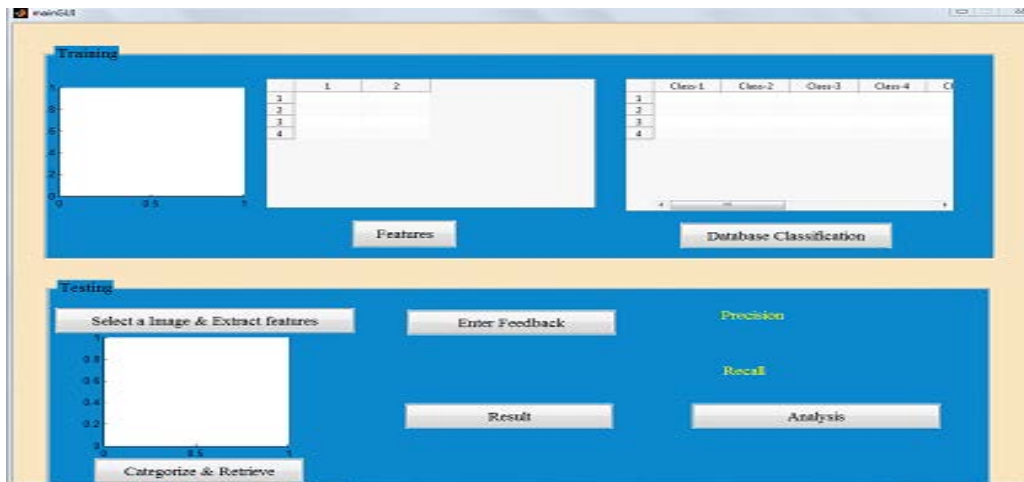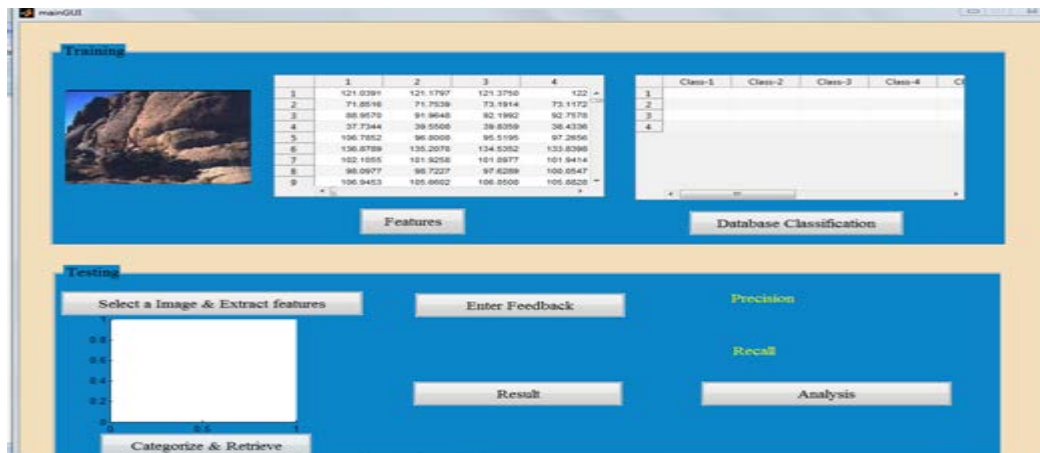

Fig7.2 Snapshots of main GUI

Fig7.3 snapshots for feature extraction

Fig7.3 shows feature of Database image. This will be generated after clicking the feature button feature of the database images are extracted.
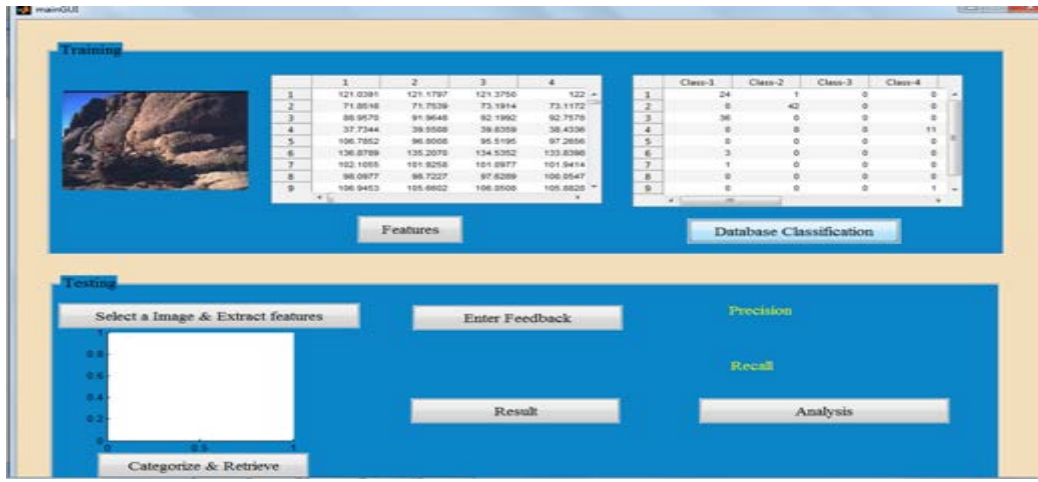
Fig 7.4 Classes of images

This shows the classification of images,here we have Ten Classes of images.Each classes having different number of images
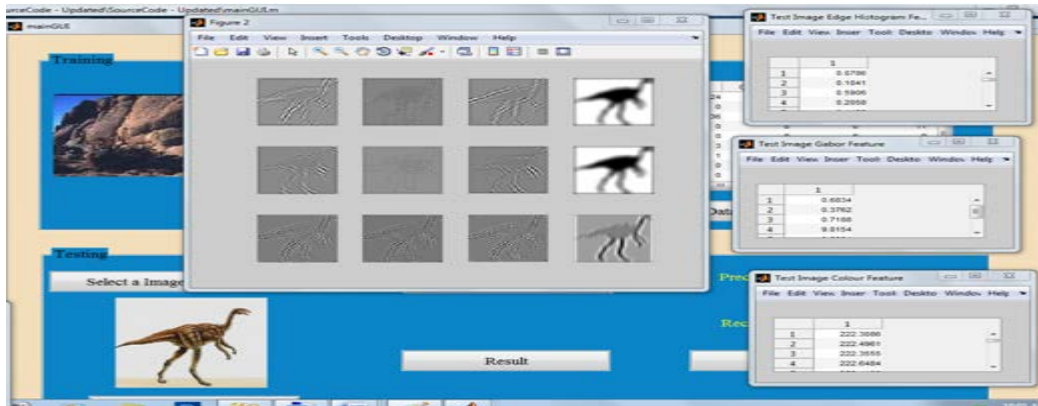
Fig 7.5 Query feature extraction

User can enter query image using select and Extract feature button. Here user has entered query image. The fig shows Color, Texture, Shape feature of query image.
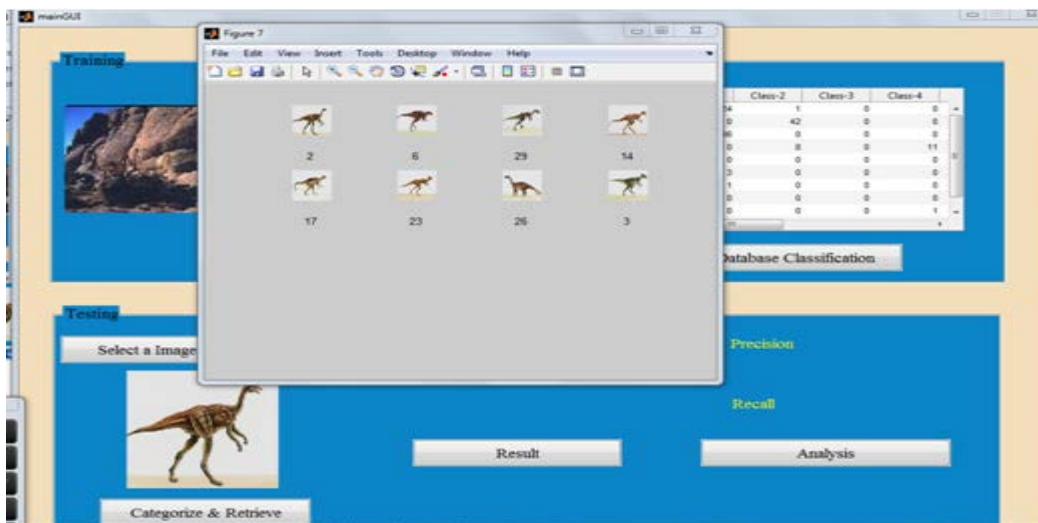

Fig7.6 Categorize retrieve

These are the images retrieved after clicking the Categorize and retrieve button .In this we can notice that we have entered dinosaur which having legs up .In retrieved images image no. 26 is not matching. So we go for RF model
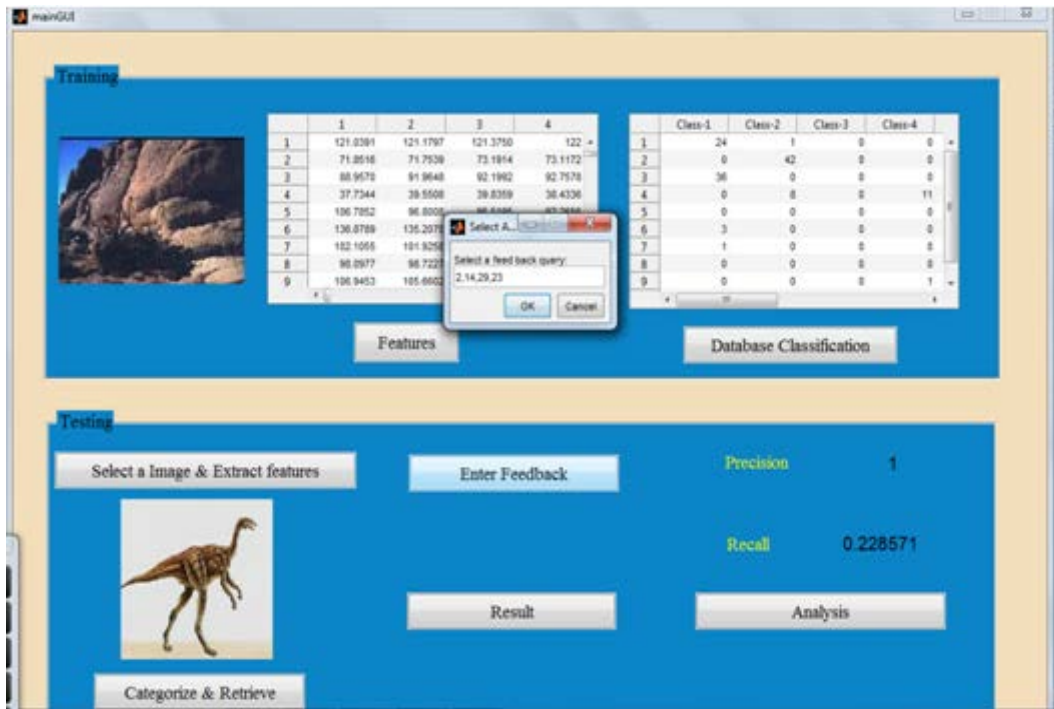

Fig 7.7 user feedback

The fig7.7 shows method of entering the feedback. Here we have entered images2, 14, 29, and 23 as relevant images. To enter this we need to click Enter feedback button
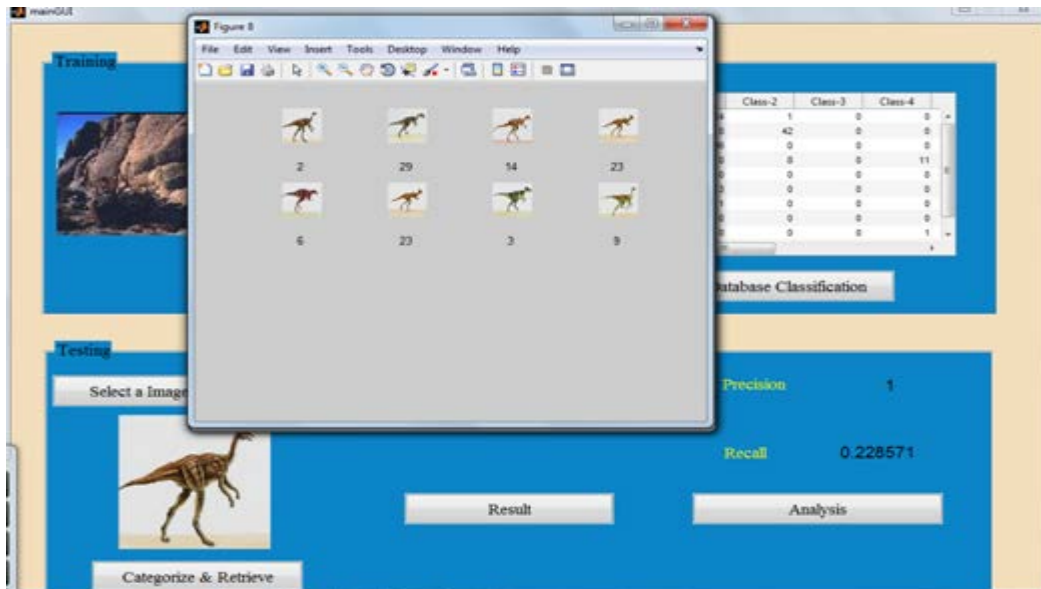

Fig 7.8 RF model

This fig7.8 shows images those are retrieved after giving feedback. In this all are relevant images.

Conclusion and Future Enhancement

Content based image retrieval (CBIR) is the application used to search for digital image in large databases. In this method high level concept and user perception subjectivity cannot be well modeled, so many irrelevant images will be displayed in retrieved result, To overcome this problem, we propose semisupervised biased maximum margin analysis.

We presented CBIR which uses SemiBMMA approach to relevance feedback module. It classify positive and negative sample and also it consider the information of unlabelled sample.

Future Enhancement

CBIR is still a developing science. To this project can use other feature extraction technique to improve the result. High quality of test database can be used for the better performance.

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