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A Comparative Analysis of Image Retrieval Techniques for Web Based Images

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Abstract— An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images. Web Based Image Retrieval addresses the matching and retrieval of images which share similar visual content to search a concept from a large database of un-annotated images. Matching images based on visual content is a fundamental problem in computer vision systems from a variety of fields including image retrieval and robot localization. Image retrieval is based on different types of features such as Edge based, Template based, and Dense Scale Invariant Feature Transformation (DSIFT). In this approach a new web based image retrieval system using DSIFT with Bayesian approach based segmentation technique are implemented. It performs three main tasks: extracting image features, comparing with database images and retrieving similar images from database. The Bayesian probability is calculated for DSIFT features to retrieve the most similar images. The image retrieval based on quantization with Bayesian based DSIFT retrieving system gives better accuracy compare to edge and template based image retrieval techniques.

Keywords— content based image retrieval, edge based retrieval, Template based retrieval, Quantization with DSIFT, Bayesian classification with DSIFT.

I. INTRODUCTION

Image retrieval is the field of study concerned with searching and retrieving digital images from a collection of database. Image retrieval attracts interest among researchers in the fields of image processing, multimedia, digital libraries, remote sensing, astronomy, database applications and others related area. An effective image retrieval system is able to operate on the collection of images to retrieve the relevant images based on the query image which conforms as closely as possible to human perception. Two major research communities (database management and computer vision) study image retrieval from different perspectives, one being text-based and the other visual based [1]. Text-based image retrieval techniques employ text to describe the content of the image while visual based or content-based image retrieval (CBIR) used visual features to describe the content of images. Images have been used in human communications for a long time. Computers provide the facility of digital image capturing, processing and transmission, which makes the usage of digital images easily and widely. This helps to work better in some areas which are heavily dependent on images for communication, such as engineering, architecture, fashion, medicine etc. Since images are more expressive than words in some cases, most of web sites use images to express their contents.

II. LITERATURE SURVEY

Szummer and Picard [2] use a combination of color histograms, texture measures and discrete cosine transform (DCT) coefficients to train a nearest-neighbor classifier to distinguish between indoor and outdoor scenes. Empirical tests showed the method to have 90% accuracy in classifying a set of 1300 color photographs. Lipson et al. [3] propose a different approach, based on qualitative reasoning from templates specifying expected combinations of color layout for prototype scenes such as mountain or field. The experimental result shows 75% accuracy in classifying photographs of mountains, with 12% false positives. P.S. Suhasini et al. [4] the similarity measure used for texture features is Euclidean distance measure and for color features Quadratic distance approach. The experimental results demonstrate about 12% improvement in the Performance for color feature with segmentation. George R. Thomas et al. [5] Hierarchical classification showed slightly better performance than flat classification and using multi-modal features, achieved about 10–20 % higher accuracy than individual features.

N. Rao et al. [6] as there is a prominent increment in computing power, rapidly reducing storage cost and worldwide access to the Internet, digital acquisition of information has become increasingly popular in recent years. Digital information is preferable to analog formats because of convenient sharing and distribution properties. This trend has motivated research in image databases, which were nearly ignored by traditional computer systems due to the enormous amount of data necessary to represent images and the difficulty of automatically analyzing images. J.Z. Wang et al. [7] proposed a method for content based image indexing. For each image inserted into the database, a feature vector on the order of 500 elements is generated to accurately represent the content of the image. This vector is much smaller in size

than the original image. The difficult part of the problem is to construct a vector that both pre-serves the image content and yet is efficient for searching.

III. CONTENT BASED IMAGE RETRIEVAL

Content Based image retrieval (CBIR), also known as query by image content(QBIC) and content based visual information retrieval(CBVIR) is the application of computer vision techniques to the image retrieval problem, that is the problem of searching for digital images in large databases[8]. CBIR (Content Based Image Retrieval) is a term used to describe the process of retrieving images form a large collection on the basis of features(such as color, texture etc) that can be automatically extracted from the images themselves [9]. The retrieval thus depends on the contents of images. CBIR is relatively a new topic and has become a hot research topic in last few years. The features that are used in CBIR should correspond directly to general routine notions of the human vision. For example, color, texture and shape are general terms used by most of people. The most common representation of color information is in the form of color histogram, which statically is the probability of any given pixel having a specific intensity in each of the color channels. Color anglogram [10], Correlograms [11], color co-occurrence matrix (CCM) [12] are some of the other feature representations for color. "Content-based" means that the search will analyze the actual contents of the image rather than the metadata such as keywords, tags, and/or descriptions associated with the image. The term 'content' in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. Thus a system that can filter images based on their content would provide better indexing and return more accurate results.

IV. METHODOLOGY

Bayesian classification is used to find out the probability of the image features. Usually features are extracted from the images. The features are namely color, texture, shape etc based upon the similarity of features the images are retrieved from the large image database. The proposed work aims on the various types feature extractions such as edges, template, DSIFT, Bag of words. The features of DSIFT are compared with the Bayesian classification to find the probability of the extracted features. The retrieval rate is differed the various techniques. The aim of the work is to find the best retrieval technique among the four techniques. The proposed framework for image retrieval as shown in fig 1.

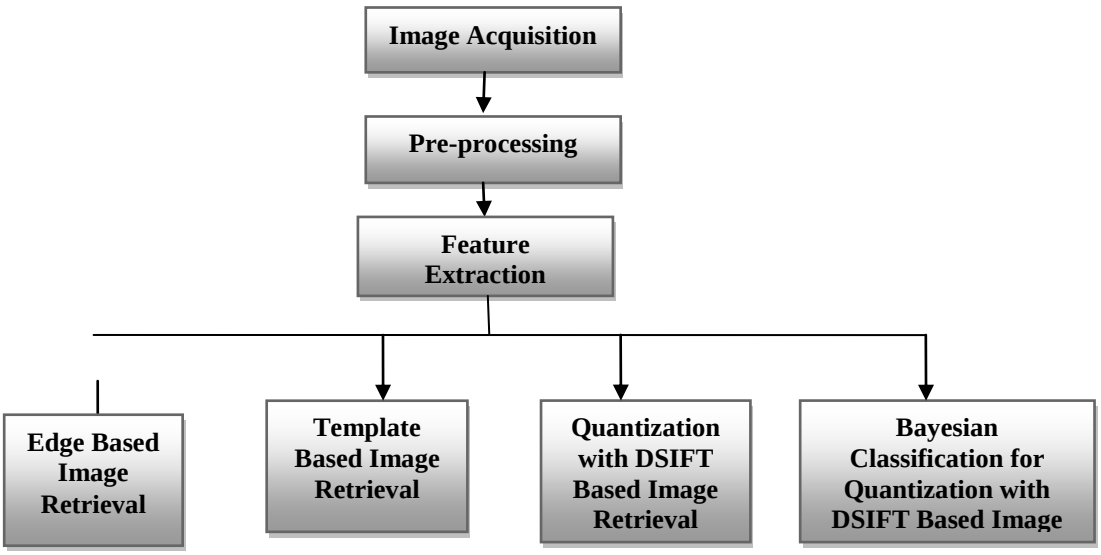

Fig. 1 Proposed Framework for Image Retrieval

A. *FEATURE EXTRACTION*

1) Edge Based Image Retrieval

Edges are pixels where image brightness changes abruptly. An edge is a property attached to an individual pixel and is calculated from the image function behavior in a neighborhood of the pixel. If a pixel's gray-level value is similar to those around it, there is probably not an edge at that point. If a pixel's has neighbors with widely varying gray levels, it may present an edge point. The Edge based image retrieval method will detects the edges of a query image. Image contains one or more objects and the edge detection is applied to those objects and it takes all the objects value as a single value in an image. Based upon the edge count the Matching process is done and it displayed the similar images.

2) Template Based Image Retrieval

Templates are similar to edge features. The individual object edges of same image is detected which is formed as template. In template based image retrieval the image is converted into grayscale image and it finding the edges of individual objects in the same image, so the retrieval results gives the similar matches.

3) Bag Of Words

In the Bag of visual model, each image is represented as a set of order less visual words. Recently few researchers have demonstrated its effectiveness in semantic based image retrieval. The local descriptors are much more precise and discriminating than global descriptors. When looking for a specific image in a image database or target object

within the image, this discrimination is very essential in retrieval system, but when looking for complex categories in a large image database, it becomes difficult. To minimize this problem, there is scope of improvement to propose a possible solution is the technique of visual dictionaries. It is made up of set of bag of visual words constructed using clustering approaches. In the visual dictionary label representation, each region of an image becomes a visual "word" of the dictionary.

4) Quantization And Dense Sift Features

In order to achieve efficient image retrieval using local features, to represent an image by a bag-of-words model in which every local feature is quantized into a visual word. Given the bag-of-words representation for images, a text search engine is then used to efficiently find the matched images for a given query. The Dense SIFT feature extraction algorithm is used to extract Web image features.

5) Bayesian And Quantization With Dense Sift Features

The Bayesian Classification represents a supervised learning method as well as a statistical method for classification. Assumes an underlying probabilistic model and it allows us to capture uncertainty about the model in a principled way by determining probabilities of the outcomes. Bayesian classifier is a statistical classifier that performs probabilistic prediction i.e. predicts class membership probabilities. The foundation is based on Bayes theorem. The Bayesian classification is used to find out the probability of the image features. In quantization with Dense SIFT feature, the retrieved features are displayed but in Bayesian classification with Dense SIFT feature the probability of the image features are displayed. So the unwanted retrieval results are eliminated in Bayesian classification and it produces higher accuracy. The performance measurement of image retrieval using Bayesian Classification as shown in fig. 2.

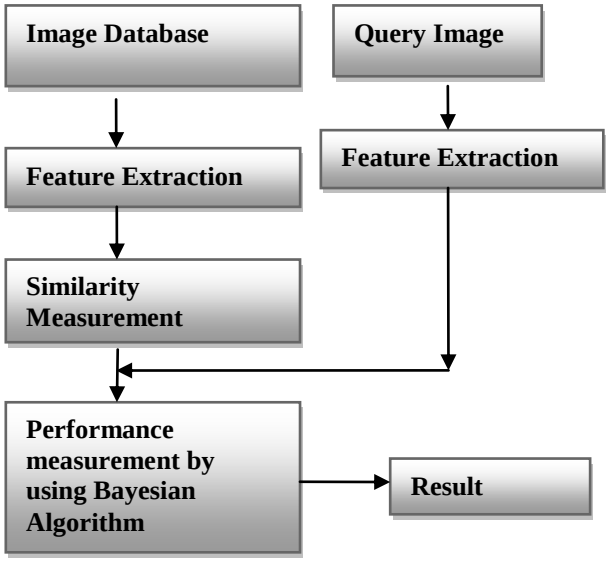

Fig. 2 Block diagram for Bayesian Classification

V. EXPERIMENTS AND RESULTS

This section concentrates on the implementation of proposed problem. The main aim of this work is to retrieve the more number of relevant images and comparing edge based image retrieval, template based image retrieval, quantization with Dense SIFT feature based image retrieval and Bayesian with Dense SIFT feature based image retrieval approach. In web based image retrieval system the query image is given as an input and it finds the relevant image as the output. The input image and destination images are compared by using Edge, Template, DSIFT features. These features are extracted from the images. The Edge based image retrieval method will detects the edges of a query image. Image contains one or more objects and the edge detection is applied to those objects and it takes all the objects value as a single value in an image. Based upon the edge count the Matching process is done and it displayed the similar images.

Template based image retrieval method detects edges of each objects in the image. For example (bat and cat) are 2objects in the same image. The edge based retrieval method takes the bat and cat as a whole object and it gives the 40% accuracy, In template based image retrieval the bat and cat are in the same image but the object bat and object cat are calculated their edges individually, so it produces better accuracy than edge based retrieval, that is the accuracy in template based image retrieval is 50%.

In order to achieve efficient image retrieval using local features, to represent an image by a bag-of-words model in which every local feature is quantized into a visual word. Given the bag-of-words representation for images, a text search engine is then used to efficiently find the matched images for a given query. The Dense SIFT feature extraction algorithm is used to extract Web image features. The accuracy level is higher in Quantization and Dense SIFT features, with the comparison of template based and edge based image retrieval.

In quantization with Dense SIFT feature, the retrieved features are displayed but in Bayesian classification with Dense SIFT feature the probability of the image features are displayed. So the unwanted retrieval results are eliminated in

Bayesian classification and it produces higher accuracy. The precision and recall values are calculated for each features and display the results it is used to compare the features accuracy.

A) PRECISION AND RECALL

The Performance of retrieval result is measured by Precision and Recall.

$$\text{Precision} = \frac{\text{No of Relevant Images Retrieved}}{\text{Total No of images Retrieved}} \quad (1)$$

$$\text{Recall} = \frac{\text{No of Relevant Images Retrieved}}{\text{Total No of Relevant images in database}} \quad (2)$$

The precision measures the hit-rate that the class of the retrieved images is the same as that of input reference image from the whole database. The recall measures the capability of finding the images with the same class from the whole class of images in the database. The effective retrieval system has the highest recall and precision rates.

Comparing with Edge, Template, Quantization and DSIFT, Bayesian quantization and DSIFT the precision value is more high in Bayesian quantization with DSIFT. The comparisons of precision values with different image retrieval features for different category of images as shown in TABLE I.

TABLE I
COMPARISONS OF PRECISION VALUES

Category	**Edge Based Retrieval**	**Template Based Retrieval**	**Quantization and Dense Sift Retrieval**	**Bayesian, Quantization and SIFT Based Image Retrieval**
Flowers	40	50	60	90
Food	42	45	59	85
Buildings	55	60	90	93
Beach	44	50	80	83
Elephants	39	50	52	71
Nature	47	49	50	77
Horses	52	55	68	79
Average	**45.57**	**51.28**	**64.85**	**83.29**

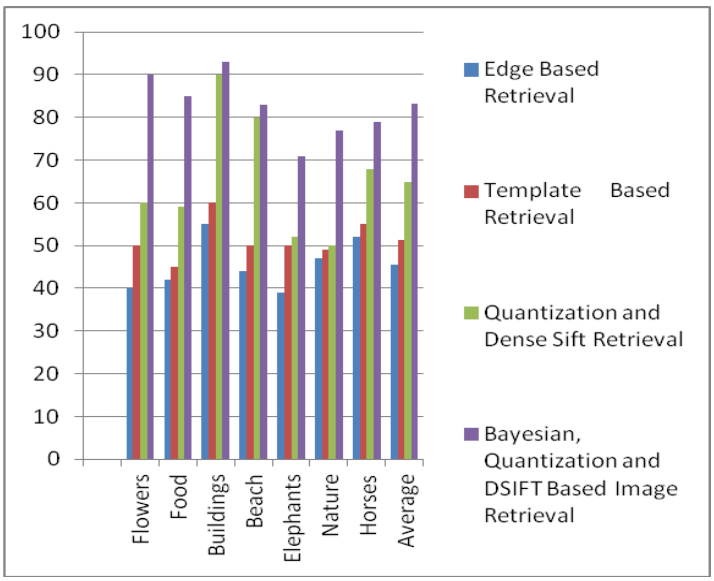

Fig. 3 Comparisons of Precision value

Comparing with Edge, Template, Quantization and DSIFT, Bayesian quantization and DSIFT the recall value is more high in Bayesian quantization with DSIFT. The comparisons of recall values with different image retrieval features for different category of images. The comparisons of recall values with different image retrieval features for different category of images as shown in TABLE II.

TABLE III
COMPARISONS OF RECALL VALUES

Category	Edge Based Retrieval	Template Based Retrieval	Quantization and Dense Sift Retrieval	Bayesian, Quantization and SIFT Based Image Retrieval
Flowers	12	16	19	25
Food	9	9	11	17
Buildings	10	12	18	18
Beach	13	15	16	16
Elephants	7	8	10	14
Nature	6	9	10	12
Horses	9	13	13	15
Average	**9.42**	**11.71**	**13.88**	**16.71**

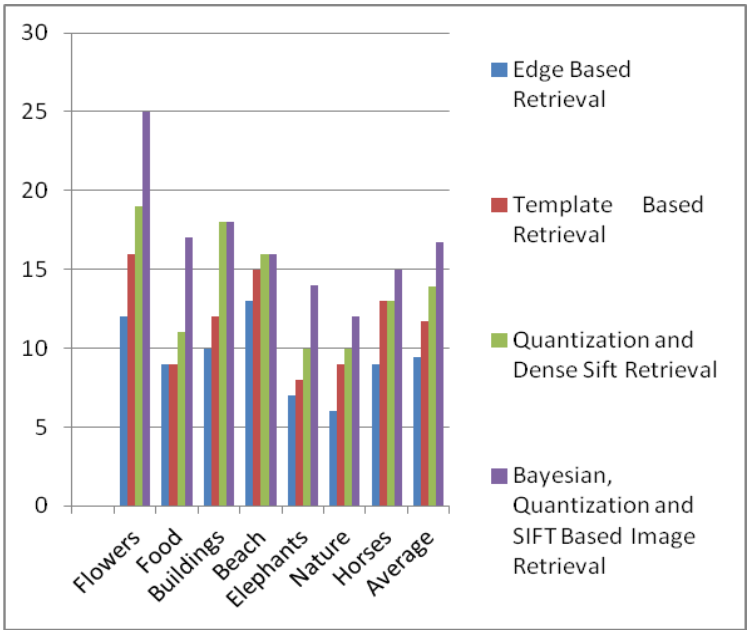

Fig. 4 Comparisons of Recall value

VI. CONCLUSION AND SCOPE FOR FUTURE WORK

A Comparative Analysis of Image Retrieval Techniques for Web Based Images describes an approach for analyzing image retrieval techniques. To show the performance of the retrieval techniques over a large image database. To obtain good results from using a Bayesian criterion based on marginal likelihoods, to find images most likely to a query image category. The experimental result shows that the performance of proposed system varies for edge, template based and DSIFT Feature. Comparing with the four phases of retrieval features the accuracy is higher in the fourth phase that is Bayesian Classification with DSIFT. In Future, new algorithm can be produce to reduce DSIFT feature. At further reducing the size of the image description by filtering key points with low matching likelihood algorithms can be used. Since the DSIFT feature extracting and the high-dimensional vector indexing are both costly computational procedures, parallel processing using multiprocessors can be used in some applications where the runtime is critical. Bayesian classification can also further be improved by various classification algorithms.

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