ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 2, Issue 10, October 2013

Quad tree Segmentation Based Bayesian Classifier for Content Based Image Retrieval

S.Subhakala[1], Ms.S.Bhuvana [2,]Prof. P.Tamije Selvy[3] and Dr. R.Radhakrishnan[4]

[1]PG Student, [2,3]Assistant Professor, [4]Principal.

[1,2,3]Department of Computer Science and Engineering, Sri Krishna College of Technology, Coimbatore, India.

[4]Principal , Sri Shakthi Institute of Engineering and Technology, Coimbatore, India.

***Abstract*— Retrieving similar images based on its visual content is an important yet difficult problem. Content Based Image Retrieval (CBIR) systems provide potential solution of retrieving similar images from large image repositories. Existing methods like vector quantization (VQ), color coherence vector (CCV) and chromaticity moments (CM) are used for image retrieval. The main problem in vector Quantization is retrieval efficiency depends on the codebook. Color histogram method is sensitive to noise. In color coherence vector, histogram refinement is not possible. To overcome such problems in existing methods the proposed system uses Quad tree Segmentation based Bayesian classifier for Image retrieval. It allows the image retrieval with high accuracy and better performance. It includes the following phases (i)Segmenting an image using Quad tree Segmentation technique (ii)Feature Extraction using Speeded Up Robust features(SURF) (iii)Image Classification using Bayesian Classifier (iv) Design of codebook using Lindae-Buzo-Gray(LBG)algorithm (v)Measurement of Similarity between Query image and the Database image.This method could achieve the high accuracy and better retrieval rate than existing method.**

***Index Terms*— Bayesian Classifier, Content Based Image Retrieval, Codebook, Histogram, Quad tree Segmentation, Speeded Up Robust Features (SURF).**

I. INTRODUCTION

Content Based Image Retrieval is the retrieval of images based on visual features such as colour, texture and shape. Content-based image retrieval (CBIR), also known as query by image content (QBIC). It is a technique which uses visual features of image such as color, shape, texture, moments and spatial relationship to search user required image from large image database according to user's requests in the form of a query image. Content-based image retrieval systems have become a reliable tool for many image database applications. There are many advantages of image retrieval techniques compared to other simple retrieval approaches such as text-based retrieval.

Content based image retrieval used in the field of Crime prevention by Automatic face recognition systems, used by police forces. Security Check by Finger print or retina scanning for access privileges and Medical Diagnosis Using CBIR in a medical database of medical images to aid diagnosis by identifying similar past cases.

Earlier the retrieval system uses a traditional approach such as image numbering and text description. In such systems text based query for image retrieval was fired. Such systems have a several limitations. Such as retrieval result may not contain the desired images, or result is altogether not valid in required context techniques. Accuracy of the Retrieval result may be in poor manner.

In recent years, many studies have been performed in Image retrieval, such as vector Quantization (VQ) [14], the Discrete Cosine Transform (DCT), the Discrete Wavelet Transform (DWT) and Local Adaptive thresholding methods.

Local adaptive thresholding [1 ,13] is a best method for mass detection than global thresholding .but local adaptive thresholding is a pixel-based operation and cannot accurately separate pixels into the suitable sets, and an adaptive clustering process is used to refine the result attained from the localized adaptive thresholding.

In this proposed system, we propose a method for image retrieval that uses Quad tree segmentation [1] for segment the images and then Speeded Up robust feature (SURF) extraction [8] for extracting the features and then Bayesian classifier[9] for classification of images. From the classification of images, codebook [1, 2, 15] is constructed and image indexing is performed for that classified images. Then Histogram [1, 6] for each image is constructed using the codebook. Histogram intersection [1] is calculated for similarity measure between the query image and the database image.

1.1 Segmentation

Image segmentation [3,7] is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).Fig1 (a) represents the normal grayscale image and Fig1 (b) represents the image after segmentation. Practical applications of image segmentation are,

a. Content based image retrieval

b. Machine Vision

c. Medical Imaging

d. Object Detection

e. Recognition Task

Fig 1(a) Grayscale image

Fig 1(b) Segmented image

1.2 Feature Extraction

Feature extraction [4,8] is a special form of reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant then the input data will be transformed into a reduced representation set of features which is also named as features vector. Transforming the input data into the set of features is called feature extraction. There may be a number of Features of an image including **point, edge, line region and corner point** . It can be used in the area of Image processing which involves using algorithms to detect and isolate various desired portions or shapes (features) of a digitized image

1.2.1 Classification of features

Features can be categorized in different ways. But the most acceptable categories are,

a. Low level Features

b. High level Features

1.2.2 Low Level Feature Extraction

Low level features are the basic features that are to be extracted automatically from an image without any shape information. Thresholding is a form of low-level feature extraction performed as a point operation.

1.2.3 High-Level Feature Extraction

High level features cannot be directly extracted from an image. It must be based on low level features. It concerns finding shapes and objects in computer images. This method involves finding objects, regardless of their positions, orientation or size. Ridge Density and Ridge direction are the high level Features.

1.3 Classification

Classification [1, 9, 13, 15] includes broad range of decision-theoretic approaches to the identification of data or images. Classification consists of assigning a class label to a set of unclassified cases. All Classification methods include two steps:

a. Training
b. Testing

a. *Training:*

In this step a Classifier is built describing a predetermined set of data classes or concepts. For images characteristic properties of typical image features are isolated and based on these, a unique description of each Classification category named training class is created.

b.*Testing*:

In this step a model is used to predict a class label for given data. In images feature-space partitions are used to classify image features. Classification methods:

a. Supervised
b. Unsupervised

a. *Supervised Classification:*

This method includes the input data, also called the training set and consists of multiple records each having multiple attributes or features. Each record is tagged with a class label. The objective of classification is to analyze the input data and to develop an accurate description or model for each class using the features present in the data. This model is used to classify test data for which the class descriptions are not known.

b.Unsupervised Classification:

In this method Set of possible classes is not known. After classification we can try to assign a name to that class. Unsupervised classification is also called clustering.

1.4 Histogram Construction

Histogram [5]is a graphical representation of distributed data and it also represents the tabulated frequencies. Fig 2 is a example for histogram An image histogram is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance. In the field of computer vision, image histograms can be useful tools for thresholding. Because the information contained in the graph is a representation of pixel distribution as a function of tonal variation, image histograms can be analyzed for peaks and/or valleys which can then be used to determine a threshold value. This threshold value can then be used for edge detection, image segmentation, and co-occurrence matrices.

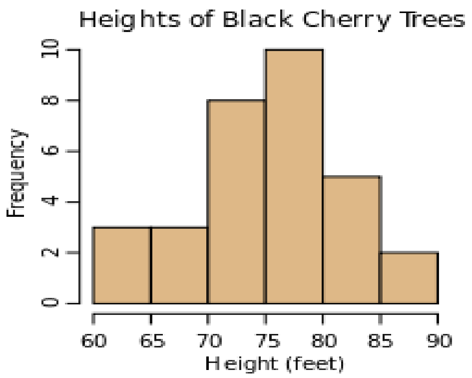


Fig 2 Histogram

A color histogram is a representation of the distribution of colors in an image. For digital images, a color histogram represents the number of pixels that have colors in each of a fixed list of color ranges that span the image's color space, the set of all possible colors.

II. RELATED WORKS

In this section, conventional image retrieval methods are discussed. The color histogram [5] is easy to implement for image indexing, but it includes only the global color distribution instead of considering the spatial relationship between pixels. To consider spatial correlation Properties based on the histogram approach, there are two methods to achieve high retrieval performance CCV [16] and CAC . Image Indexing is performed using Color correlogram [14]. In [16], Greg et.al. Proposed the CCV, a number of coherent and incoherent pixels for each color, which are classified based on the initial pixel cluster. However, histogram refinement is not possible in this method.

In recent years, many VQ-based retrieval methods [2, 10, 13] were proposed.Prerana karnik and nitin shahane describe VQ[2] in three steps includes generating codebook, encoding image and decoding image. But in this method retrieval efficiency depends on the accuracy of the codebook.

Hebert Bay et.al. Proposed [8] the Speeded-Up Robust Features (SURF) which describes the novel scale and rotation invariant detector and descriptor. This method uses Hessian matrix for interest point localization.Hsin-Hui et.al. Proposed Quad tree Classified vector Quantization[1] using Local Adaptive Threshold Classifier. But Local Adaptive Thresholding Classifier is a pixel based operation and cannot accurately separate pixels into the suitable sets.

The rest of the paper is organized as follows: The Proposed work is discussed in section III.The result of the proposed system are reported in section IV.Conclusion is discussed in section V..

III PROPOSED WORK

The goal of the proposed system is to provide the system with Fast retrieval and greater accuracy in image retrieval. The First step in proposed system is Segmentation of an images using Quad tree Segmentation[1]. The Second stage is the feature extraction from the Segmented images. The feature extraction is done using the SURF[8]. The goal of feature extraction is to detect the interest points using object descriptors. The third step is to apply Bayesian classification[9] on the extracted features of an image. Then Codebook [15]is designed from the classified image. From the codebook, histogram[1] is constructed for each image in the database as well as query image. From that histogram intersection is calculated for similarity measure between query image and the database image. Smaller value of histogram intersection indicates that query image and the database image are more similar. Figure 4 depicts the overall process of the proposed system .

3.1 Quad tree Segmentation

Quadtree segmentation [1, 7] is one of the segmentation techniques. A quadtree is a tree data structure in which each internal node has exactly four children. Quad trees are most often used to partition a two-dimensional space by recursively subdividing it into four quadrants or regions **.**Quad tree segmentation procedure is based on the variances of blocks in gray-level image information and it uses a hierarchical data structure to efficiently address variable block size regions. The whole segmentation technique is summarized into following steps.

a. A color image is first transformed into a gray level image.
b. Graylevel image is segmented uniformly into blocks of size 16×16.

c. The splitting process is continued until the smallest block of size 4×4 is acquired or the variance of the block is not greater than a predefined threshold.
d. The threshold value will be chosen between 0 and 1.

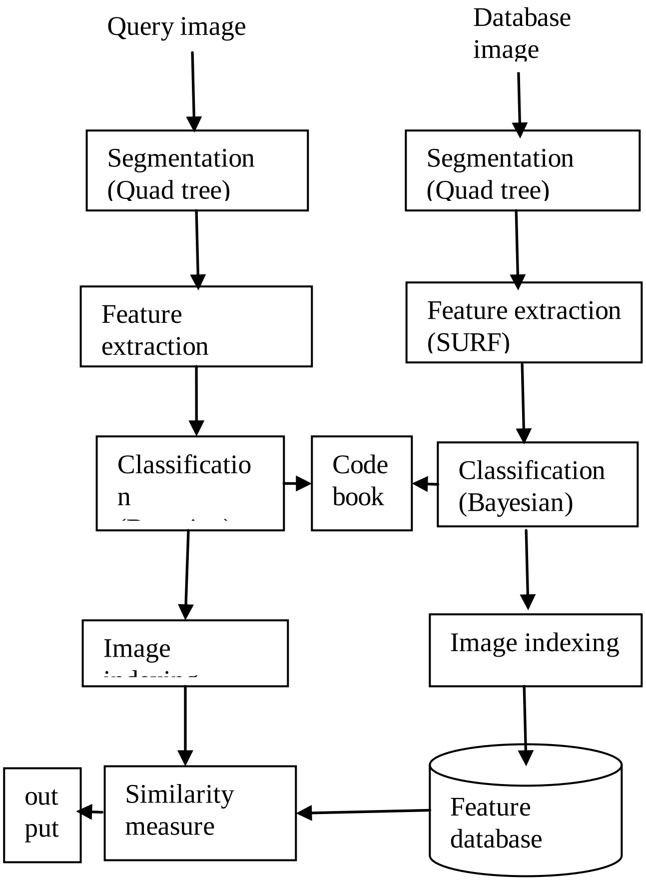


Figure 3 Overall Process of the Proposed System.

3.2 Feature Extraction (SURF)

The Speeded-up Robust Features (SURF) technique[4,8] has been developed for both the detection and description of local features. The main advantages are repeatability, distinctiveness, and robustness with less computation time and SURF is also referred as "Fast-Hessian" detector. The whole SURF technique is summarized into following steps.

a. Interest Points Localization (SURF Detector):

The interest points (their locations and sizes) are chosen automatically using a Fast- Hessian detector that is based on the determent of the Hessian matrix shown in Equation

$$H = \begin{bmatrix} L_{xx}(x,y,\sigma) & L_{xy}(x,y,\sigma) \\ L_{xy}(x,y,\sigma) & L_{yy}(x,y,\sigma) \end{bmatrix}$$

where L_{xx} is the convolution of the Gaussian second-order derivative with an image I at the point (x,y).

b. Interest Point Descriptors (SURF Descriptors):

SURF descriptors are calculated in the square regions centered on each interest point. The region is divided into 4×4 equal sub regions. In each sub region, the Harr wavelet responses in the horizontal (d_x) and vertical (d_y) directions are calculated. Therefore, the underlying descriptor of each square is described by the vector $\vec{v}$ as

$$\vec{v} = \left(\Sigma d_x, \Sigma d_y, \Sigma|d_x|, \Sigma|d_y|\right)$$

Due to the division into 4 × 4 sub regions, each feature point has 64 descriptors. Finally, the SURF descriptor is formed by normalizing the 64 descriptors to guarantee invariance to scale.

3.2.1 Feature Extraction Algorithm

Steps:

a. Segmented image is taken as Input
b. Apply SURF on the Segmented images using equation (1)
c. The robust matching point vectors ($\vec{v1}$ and $\vec{v2}$) along with position vectors (X1,Y1)and (X2,Y2) is obtain
d. The interest points are obtained.

3.3 Bayesian Classification

Bayesian Classifier[9] is a Statistical classifier. It performs Probabilistic prediction i.e. predicts class membership probabilities Based on Bayes' Theorem. A simple Bayesian classifier, naïve Bayesian classifier, has comparable performance with decision tree and selected neural network classifiers. Each training example can incrementally increase/decrease the probability that a hypothesis is correct — prior knowledge can be combined with observed data. Even when Bayesian methods are computationally intractable, they can provide a standard of optimal decision making against which other methods can be measured.

Bayes theorem:

$$P(C|X) = P(X|C)\cdot P(C) / P(X)$$

a. P(X) is constant for all classes
b. P(C) = relative freq of class C samples
c. C such that P(C|X) is maximum = C such that P(X|C)·P(C) is maximum

Advantages:

An advantage of the naive Bayes classifier is that it requires a small amount of training data to estimate the parameters (means and variances of the variables) necessary for classification

3.4 Image Indexing and Similarity measure

For the purpose of Image Indexing codebook is generated using Lindae-Buzo-Gray (LBG) algorithm[1,15]. Steps includes

a. some images from each class in the database training images are selected based on the classification method.
b. For each class of blocks, an initial vector is

calculated by averaging all of the training vectors in a class to form a code vector for a sub codebook of size 1

c. Splitting technique is used to produce two vectors from the initial code vector by adding and subtracting a predefined value δ.

d. These vectors are served as initial vectors to generate the codebook of the next level. Therefore, if the size of the current codebook is N, then, at the next level, the size of the codebook becomes 2N.

e. This process is continued until the desired codebook size is achieved .

Image Indexing is performed using the codebook. Each block in an image is encoded by the codebook to generate an index. Then frequencies of indices will be counted to build an index histogram as the feature for each image in the database.

To compare the similarity of two images, we will calculate the distance between their index histograms using histogram intersection (HI) in (1).

If the overlapping area of HQ(i) and HD(i) is large, the query image Q and the database image D are concluded to be similar. Retrieval efficiency would be calculated using Precision and Recall.

$$\text{Precision} = \frac{\text{Number of relevant images retrieved}}{\text{Number of images retrieved}}$$

$$\text{Recall} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of relevant images}}$$

IV EXPERIMENTAL RESULTS

The performance of the proposed Image retrieval framework is demonstrated using a MATLAB platform. The natural-scene image database used in this work is taken from COREL photographs, which were used by Wang et. al. [12]. The database consists of 1,000 color images stored in the JPEG format and can be divided into ten classes, each containing 100 images of size 384×256 or 256×384. The ten classes are Africans, Beach, Building, Bus, Dinosaur, Elephant, Flower, Horse, Mountain, and Food. In this experiment, the database images are rescaled to the size of 192×128 or 128×192 for computational convenience, and each of them is tested as a query in turn making a total of 1,000 queries. Fig. 5 depicts database images . The Segmented image is shown in Fig. 6

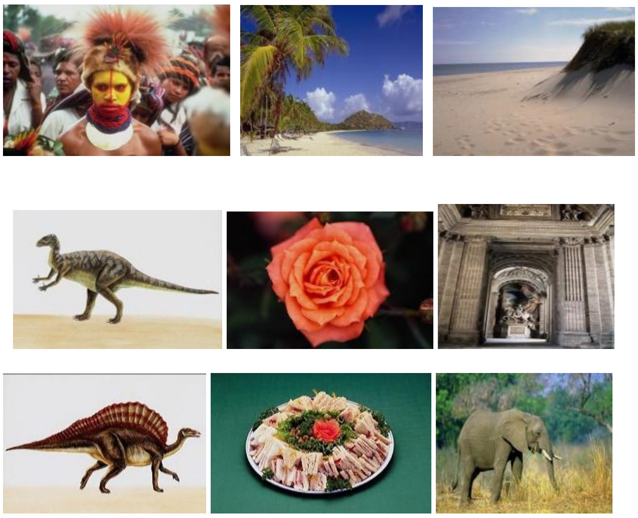
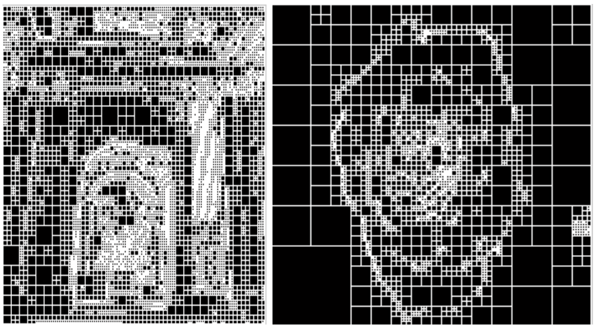


Fig 4 Database images

Fig 5 Input image for Quad tree segmentation



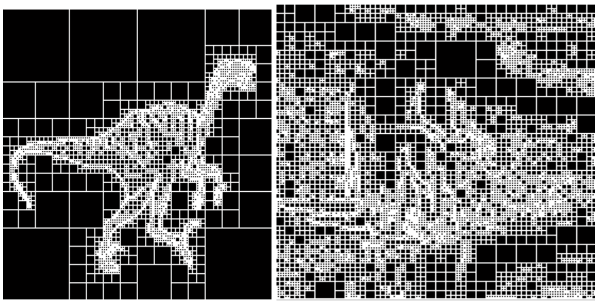
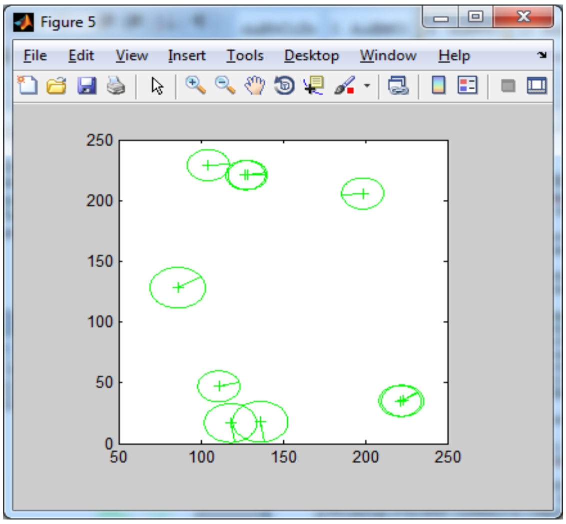
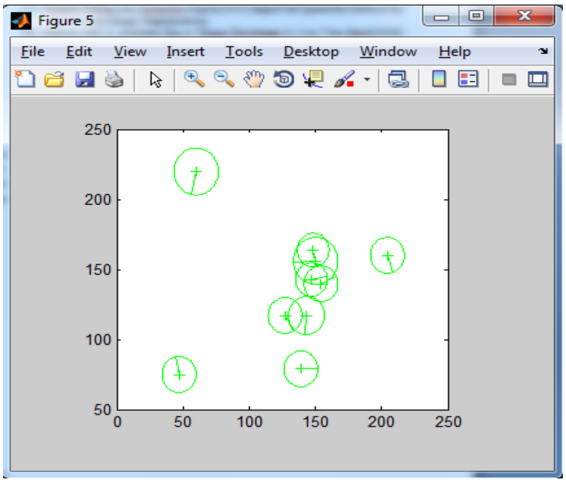
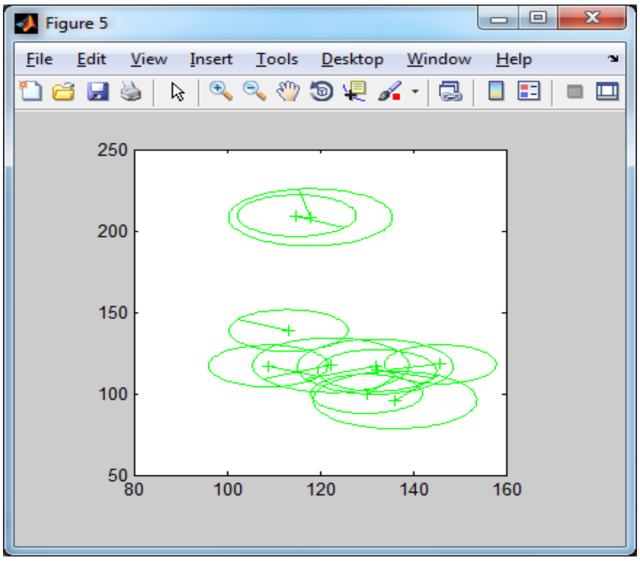


Fig 6.Output image after Quad tree segmentation

SURF Feature Extraction is used for extracting the Features and also it is Robust against scale and rotation of the image. Fig 7 and Shows the Interest points of the segmented images using SURF Feature extraction. This Feature Extraction reduces the input size of the Classification process.







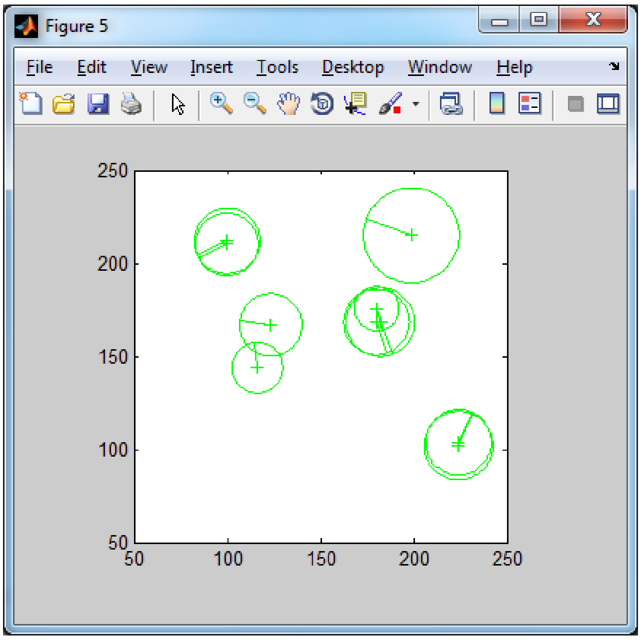


Fig 7 Interest points for segmented images using SURF feature extraction

V CONCLUSIONS

The Image Retrieval Based on Quad tree Bayesian Classifier method is Proposed to improve the retrieval efficiency and the Retrieval performance .Quad tree is the best method for Segmentation while comparing other methods of Segmentation. An Efficient method SURF is used for the feature extraction. SURF is Robust against rotation and scale. From the extracted Features Classification will be performed using Bayesian classifier and the codebook also generated using LBG algorithm. Finally histogram is constructed and the similarity is measured. This system will produce the image retrieval with better retrieval rate and high accuracy than existing methods.

VI REFERENCES

[1] Hsin-Hui Chen , Jian-Jiun Ding and Hsin-Teng Sheu(2013) Image retrieval based on quadtree classified vector quantization. Springer Science+Business Media New York
[2] Prerana Karnik and Nitin Shahane(2013) A survey on Content based Image Retrieval using Vector Quantization. International Journal of Computer Applications
[3] C.Sriramakrishnan, A.Shanmugam and C.S.Smruthy(2012) Performance Analysis of Advanced Image Segmentation Techniques. International Journal of Computer Applications
[4] Yamazaki T, Fujikawa T, Katto J (2012)Improving the performance of SIFT using bilateral filter and its application to generic object recognition. IEEE Int Conf Acoust Speech Signal Process
[5] Neetu SS, Paresh RS, Jaikaran SS (2011) Efficient CBIR using color histogram processing. Signal Image Process 2(1):94–112
[6] Van de Sande KEA, Gevers T, Snoek CGM(2010) Evaluating color descriptors for object and scene recognition. IEEE Trans Pattern Anal Mach Intell
[7] Deepali Kelkar and Surendra Gupta(2010) Improved Quadtree Method for Split Merge Image Segmentation
[8] Herbert Bay a, Andreas Ess a, Tinne Tuytelaars b, Luc Van Gool(2006) Speeded-Up Robust Features (SURF).Science Direct,Computer vision and image understanding
[9] Katherine A. Heller , Zoubin Ghahramani (2006)A Simple Bayesian Framework for Content-Based Image Retrieval. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition
[10] Ajay HD, James AS (2005) Content-based image retrieval via vector quantization. Lect Notes Comput Sci3804:502–509
[11] Paschos G, Radev I, Prabakar N (2003) Image content-based retrieval using chromaticity moments. IEEE Trans Knowl Data Eng 15(5):1069–1072
[12] James Z.Wang, Jia Li and Gio Widerhold(2001)SIMPLIcity:Semantic-Sensitive Integrated Matching for Picture Libraries
[13] Hrvoje Dujmic, Nikola Rozic, Dinko Begusic, Jurica Ursic(2000)Local thresholding classified vector quantization with memory reduction
[14] Jing H, Kumar SR, Mandar M, Wei-Jing Z, Ramin Z (1997) Image indexing using color correlogram.Proc Conf Comp Vision Pattern Recog 97:762–768
[15] M.K.Quweider and E.Salari(1996)Efficient classification and codebook design for CVQ
[16] Greg P, Ramin Z, Justin M (1996) Comparing images using color coherence vectors. Proc ACM Multimed 96:65–73

Authors

Subhakala S was born in Tamilnadu, India, in 1991. She received her Bachelor of Technology degree in Information Technology from Anna University, Chennai, India in 2012. She is currently pursuing M. E in Computer Science and Engineering under Anna University, Chennai, India.

Prof. S. Bhuvana received her Bachelor of Engineering degree in Computer Science and Engineering from Sri Ramakrishna Engineering College, India, in 1999 and her Master of Engineering degree in Computer Science and Engineering from Kumaraguru College of Technology, India in 2007. At Present, she is working as Assistant Professor in the department of Computer Science & Engg., Sri Krishna College of Technology, Coimbatore. Currently she is pursuing her research work in Image Retrieval. Her research interests include Image Processing and Machine Learning

Prof. P.Tamije Selvy received B.Tech (CSE), M.Tech (CSE) in 1996 and 1998 respectively from Pondicherry University. Since 1999, she has been working as faculty in reputed Engineering Colleges. At Present, she is working as Assistant Professor (SG) in the department of Computer Science & Engg, Sri Krishna College of Technology, Coimbatore. She is currently pursuing PhD under Anna University, Chennai. She has published more than 40 papers in reputed journals and conferences Her Research interests include Image Processing, Data Mining, Pattern Recognition and Artificial Intelligence.

Dr.R.Radhakrishnan is the principal of Sri Sakthi Institute of Engineering And Technology.He obtained his Bachelor's degree in Engineering in Electronics and Communication Engineering from Bharathidasan University, received his Masters Degree from P.S.G.College of Technology, Coimbatore, in the year 1997 and the Ph.D from Anna University Chennai in the year 2008. His research interest includes Wireless Communication, Signal Processing, Networking and Mobile Communication. He has published more than 20 Journal papers in the field of CDMA systems, Mobile communication, Wireless Networking and Signal Processing.