International Journal of Computer Applications (0975 – 8887)
Volume 24– No.8, June 2011

Image Retrieval using Entropy

NST Sai
Tech Mahindra Limited,
Mumbai, India.

R. C. Patil
Mukesh Patel School of Tech.Mgmt. and Engineering,
SVKM'S,NMIMS University,
Mumbai, INDIA.

ABSTRACT
Content based image retrieval address the problem of retrieving images relevant to the user needs from image databases on the basis of low-level visual features that can be derived from the images. Grouping images into meaningful categories to reveal useful information is a challenging and important problem. This paper represent effective approaches for Content Based Image Retrieval (CBIR) that represent each image in the database by feature vector computed by using entropy of sub block of bit plane image. This paper present four method for calculating the feature vector of image .All the proposed methods tested on image database which include 800 images with 8 classes. Euclidean distance is used for similarity measure. Performance of each method calculated by using overall average precision and overall average recall for comparison of proposed method. Overall precision and overall recall computed using 40 queries on the image database. It is found that as the image divide into more sub block the performance goes on increasing.

General Terms
Image identification,Pattern Recognition.

Keywords
CBIR; Entropy; Bit Plane; Image Sub block; Precision; Recall; Euclidean Distance.

1. INTRODUCTION
People from various fields use image-related information. For instance, doctors use X-ray image information, cartographers and geographers use aerial image information, and meteorologists use satellite image information. These images are almost always converted to digital form and stored in image databases for later use.

With the advancement in image capturing device, the image data been generated at high volume. If images are analyzed properly, they can reveal useful information to the human users**.** Most of the image retrieval systems associate keyword or text with each image & required to enter the keyword or text descriptor of desired image. Through text description, images can be organized by topical or semantic hierarchies to facilitate easy navigation & browsing based on standard Boolean queries. However since automatically generating descriptive text for a wide spectrum of images is not feasible, most text based image retrieval systems require manual annotation of images. Obviously, annotating images is a cumbersome & expensive task for large image database & is often subjective [10, 11].Because of all these problem in recent year ,there has been interest in developing effective method for searching large image database on image content by ranking relevance between query image feature vector & database image feature vector .The goal of content based image retrieval is to operate on collection on the images & response to visual queries. CBIR describe the process of retrieving desired image from large collection on the basis of feature that can be automatically extracted from image themselves.

This leads to issues such as reducing storage space and querying the database; that is, getting the information you need from the database as accurately and quickly as possible. As a consequence of the size of image databases, research on content-based retrieval of images has received much attention recently. According to the scope of representation these features are of two types global feature & local feature .The first category include texture histogram, color histogram, color layout & feature selected by multidimensional discriminates analysis of a collection of images [1][2][4],while color, texture & shape in other category. Content-based retrieval implies the use of low-level visual features such as shape [6,7], color[2,3], and texture[8,9] for search and retrieval of images from image databases. Texture, shape and color are the most commonly used low-level features in content-based image retrieval. In typical content based image retrieval system(Fig.1),the visual content of the image in data base form a feature database .To retrieve the image user s provide the retrieval system with query image. Then system then changes this query image in internal representation of feature vector. The similarities /distance between the feature vector of query image & those of the images in the database are then calculated & retrieval is performed with the aids of an indexing.

Feature that can be extracted from an image are color, shape & texture.

1.1 Color
Color is a very important feature in aerial RS image and other single band image. Histogram is the major tool to express color feature .RGB (Red, Green and Blue) color system is usually used to express colorful image.

1.2 Shape
Shape is also important image content used to retrieval. The primary mechanisms used for shape retrieval include identification of features such as lines, boundaries, aspect

ratio, and circularity, and by identifying areas of change or stability via region growing and edge detection.

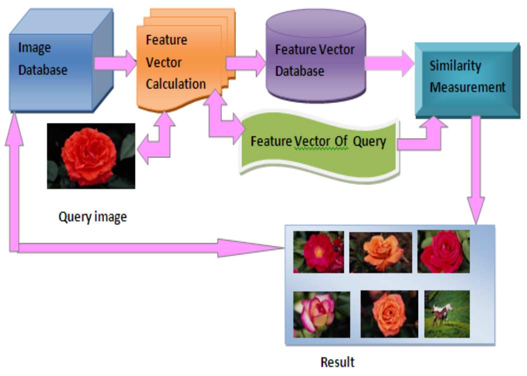

Fig 1.Content Based Image Retrieval (CBIR) System.

1.3 Texture

Texture is a difficult concept to represent. The identification of specific textures in an image is achieved primarily by modeling texture as two-dimensional grey level 4 variations. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality may be estimated.

2. THEROTICAL CONSIDERATION

Color image or gray scale image $I(i, j)$ is represented as a M X N intensity matrix, where each $I(i, j)$ element have different intensity value which is lying [0-255] for gray scale image and[26] it varies for the color image. Each intensity value of each pixel in the image can be represented by "1" or "0" single bit which is also known as binary image or an 8-bit. Given image is converted into the bit plane image (binary image) using different techniques [1,2,3].

2.1 Single Bit Plane Formation using Interband Average Image

Single bit plane image is formed by using threshold .This threshold is mean of the image intensity value. First we consider the interband average image [9],[3],[4]. This inter band average image is formed by taking average of red, green and blue color planes. Let color image $I(i, j)$ having size $256X256$. Then $r(i, j)$, $g(i, j)$ and $b(i, j)$ are the three red, green and blue color plane for the given image respectively. $IBAI(i, j)$ is the interband average image having size $256X256$ and which is calculated as

$$IBAI(i, j) = \frac{1}{3}\sum_{i=1}^{256}\sum_{j=1}^{256} r(i, j) + g(i, j) + b(i, j) \qquad (1)$$

Then mean M value of this interband average image is calculated as

$$M = \frac{1}{(256X256)}\sum_{i=1}^{256}\sum_{j=1}^{256} IBAI(i, j) \qquad (2)$$

This mean value is considered as a threshold. Then single bit plane is created by comparing the mean value which is given above equation 2 with the each pixel value in the interband average image is greater than equal to the threshold then the corresponding pixel position of single bit plane will have a value of 1 otherwise it will have value of 0.Created $SBP(i, j)$ image is single bit plane image having the same size that of the original image.

$$SBP(i, j) = \begin{cases} 1 & if \quad IBAI(i, j) \geq M \\ 0 & if \quad IBAI(i, j) \langle M \end{cases} \qquad (3)$$

2.2 Three Bit Plane Formation using Three Color Plane

Most color images are recorded in RGB space, which is perhaps the most well-known color space. In this method the color image is dividing into R, G, and B components. Then compute three thresholds which is the mean of each color components MR , MG , MB for red, green and blue color component respectively given as

$$MR = \frac{1}{256X256}\sum_{i=1}^{256}\sum_{j=1}^{256} r(i, j) \qquad (4)$$

$$MG = \frac{1}{256X256}\sum_{i=1}^{256}\sum_{j=1}^{256} g(i, j) \qquad (5)$$

$$MB = \frac{1}{256X256}\sum_{i=1}^{256}\sum_{j=1}^{256} b(i, j) \qquad (6)$$

Here three bit planes will be computed as BMR, BMG and BMB. If a pixel in each component (R,G and B) is greater than or equal to the respective threshold, the corresponding pixel position of the bit plane will have a value of 1 otherwise it will have a value of 0.

$$BMR(i, j) = \begin{cases} 1 & If \quad r(i, j) >= MR \\ 0 & If \quad r(i, j) < MR \end{cases} \qquad (7)$$

$$BMG(i, j) = \begin{cases} 1 & If \quad g(i, j) >= MG \\ 0 & If \quad g(i, j) < MG \end{cases} \qquad (8)$$

$$BMB(i, j) = \begin{cases} 1 & If \quad b(i, j) >= MB \\ 0 & If \quad b(i, j) < MB \end{cases} \qquad (9)$$

R, G and B components for color image and bit plane $BMR(i,j)$ for red component, bit plane $BMG(i,j)$ for green component and bit plane $BMB(i,j)$ for blue component for given color image.

2.3 Bit-Plane Slicing

Image enhancement is the method to enhance the image which is of low contrast. But the drawback in this method is that all the pixels in the image are brightened totally and this may not be suitable for some applications [7][26]. So to overcome this, Bit-Plane Slicing method is used. Bit-Plane Slicing is a technique in which the image is sliced at different planes. It ranges from Bit level 0 which is the least significant bit (LSB) to Bit level 7 which is the most significant bit (MSB) as shown in Fig.2.

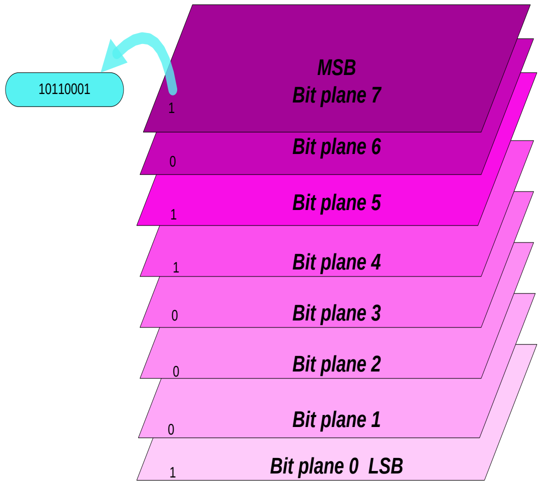

Fig.2. Bit plane Slicing.

It is clear that the intensity value of each pixel can be represented by an 8-bit binary vector $(b7,b6,b5,b4,b3,b2,b1,b0)$, where i is from 0 to 7 and each bi is either "0" or"1". In this case, an image may be considered as an overlay of eight bit-planes. Each bit-plane can be thought of as a two tone image and can be represented by a binary matrix[7] [8].

The formation of bit plane is given

$$\mathrm{I}bp(i,j) = R\{\frac{1}{2}\ floor[\frac{1}{2^i} I(i,j)]\}$$

(10)

where $I(i,j)$ = original image, $\mathrm{I}bp(i,j)$ = bit-plane information, R = remainder and $floor(i)$ = round the elements to i nearest integers less than or equal to i.

For each gray scale image we are getting 8 bit planes. Thus if we separate out R, G and B color components and create 8 bit planes for each color component then we can create total twenty four bit planes for the color image.

3. FEATURE VECTOR EXTRACTION

Color image is represented by entropy which is developed by Shannon [9] prospered by John[8].The generation of information can be modeled as a probabilistic process that can be measured in a manner that agree with intuition. With this supposition, a random event E with probability P(E) said to be contain

$$I(E) = \log\frac{1}{P(E)} = -\log P(E) \qquad (10)$$

unit of information. If P(E)=1 ,I(E) = 0 and no information is attributed to it. Because no uncertainty is associated with the event, no information would be transferred by communicating that the event has occurred. Given a source of statically independent random event from a discrete set of possible events $\{a_1, a_2 ....a_J\}$ with associated probabilities $p(a_1), p(a_2),........p(a_J)\}$, the average information per source output, called the information of the source, is

$$H = -\sum_{j=1}^{J} p(a_j)\log p(a_j) \qquad (11)$$

The a_j in this equation s a source symbols. Because they are statically independent, the source itself is call as zero-memory source. If the image is considered to be the output of an imaginary zero-memory intensity source, the intensity source's entropy becomes

$$H = -\sum_{k=1}^{L-1} p_r(r_k)\log_2 p_r(r_k) \qquad (12)$$

Discrete random variable r_k in the interval [0,L-1] is to be used to represent intensities of an M X N image and each r_k occurs with the probability $p_r(r_k)$ .For the image entropy is given by

$$E = \sum_{m=0}^{k} H(P_m) = -\sum_{m=0}^{k} P_m \log(P_m) \qquad (13)$$

where m is the intensity value of image. P_m is the probability of those pixels whose gray values is m in the whole image. This entropy is the global feature of the image.

3.1 Feature Vector from Full Bit Plane

In this paper we use entropy as a feature vector of each bit plane. As explained in the section 2 (2.1)(2.2) Bit planes are formed using threshold of interband average image and color image. By using bit plane slicing as in section 2.3 8 bit planes are obtained from gray scale image out of which higher four bit planes contains most of the visual information than the lower 4 bit planes[8]. So feature vector is extracted from the higher four bit planes. By using same bit plane slicing twelve bit planes (four out of eight for each color plane) are obtained. Calculate the feature vector for each bit plane from one bit plane to twelve bit plane increases feature vector size as shown in table I.

Table 1. Feature vector size for each full bit plane

Bit plane	Interband Average Image Single Bit Plane	Color Image Three Bit Plane	Gray Scale Image Four Bit Plane	Color Image Twelve Bit Plane
Feature Vector Size	1	3	4	12

3.2 Feature Vector form Sub-block of Each Bit Plane

Bit planes are divided into non-overlapping sub blocks .Then entropy based feature vector is to be extracted from each sub block. So that the feature vector size is variable. It goes on increasing as sub block goes on increasing. This paper consider N/2 X N/2,N/4 X N/4,N/8 X N/8, N/16 X N/16 non overlapping sub block. Table II shows the feature vector size each type of bit planes.

Table 2. Feature vector size and sub block method of bit plane images (bit plane size is 256 x 256)

Bit plane and Sub Block Method	Interband Average Image Single Bit Plane	Color Image Three Bit Plane	Gray Scale Image Four Bit Plane	Color Image Twelve Bit Plane
	Feature Vector Size			
N/2 X N/2	4	12	16	48
N/4 X N/4	16	48	64	192
N/8 X N/8	64	192	256	768
N/16 X N/16	256	768	1024	3072

4. EXPERIMENTAL RESULT

4.1 Similarity Measure

The different types of distances which are used by many typical CBIR systems are city block distance, chess board distance, intersection distance, the Earth mover's distance (EMD) and Euclidian distance. Minkowski (Euclidean distance when r=2) distance is computed between each database image & query image on feature vector to find set of images falling in the class of query image.

$$Ed(Q,I) = \left(\sum_{M=0}^{M-1} \left| H_Q - H_I \right|^r \right)^{1/r} \qquad (14)$$

Where Q-Query image

I- Database image.

H_Q-Feature vector query image.

H_I-Feature vector for database image.

M-Total no of component in feature vector.

4.2 Performance of CBIR

When a query image is submitted by a user, we need to compute the feature vector as before and match it to the precomputed feature vector in the database. This is shown in Fig. 3. The simulation engine consists of feature extraction process, batch. The feature extraction process is based upon the following .Which the batch feature extraction and storage process as described in the following steps.

a. Images are acquired from a collection one after another.
b. Feature extraction process is applied to them.
c. The resultant vector is saved in a database against the image name under consideration.

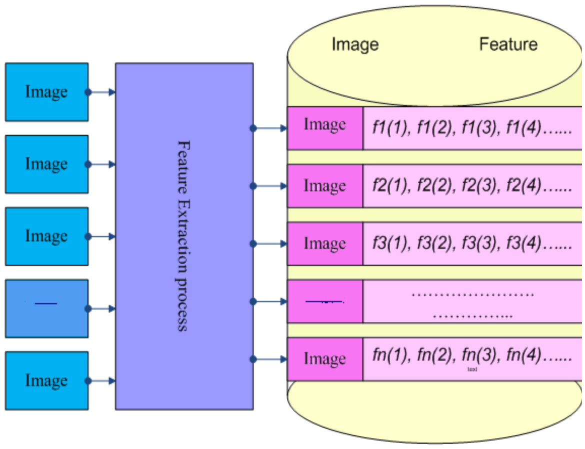

Fig. 3. Feature extraction and storage process for an image collection

After that query image and database image matching is done using Euclidean distance. Performance of image retrieval system can be analyzed by using two parameters precision and recall. As shown in Fig.4. Testing the effectiveness of the image search engine is about testing how well can the search engine retrieve similar images to the query image and how well the system prevents the return results that are not relevant to the source at all in the user point of view.

A sample query image must be selected from one of the image category in the database. When the search engine is run and the result images are returned, the user needs to count how many images are returned and how many of the returned images are similar to the query image. The first measure is called Recall. It is a measure of the ability of a system to present all only relevant images. The equation for calculating recall is given below.

$$\text{Recall} = \frac{\text{Number\_of\_relevant\_images\_retrieved(A)}}{\text{Total\_number\_of\_relevant\_images\_in\_database(A+D)}} \qquad (15)$$

The second measure is called Precision. It is a measure of the ability of a system to present relevant not relevant images. The equation for calculating precision is given below.

$$\text{Precision}=\frac{\text{Number\_of\_relevant\_images\_retrieved(A)}}{\text{Total\_number\_of\_images\_retrived(A+B)}} \quad (16)$$

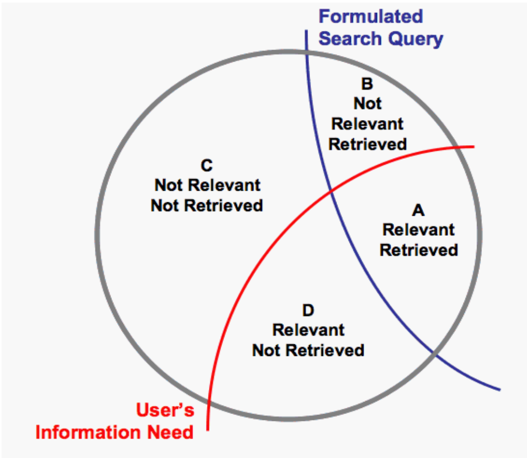

Fig. 4. Evaluation of CBIR

4.3 Implementation

The implementation of CBIR technique is done in MATLAB 7.0 using a computer with Intel Core 2 Duo Processor T8100 (2.1GHz) and 2 GB RAM. The CBIR technique are tested on the image database of 800 variable size images includes 8 categories of animals, buses, flowers ,bikes, beaches, Historical, Mountains etc.

Sample images from each category shown in Fig.5 for 40 query images (five from each category from database) the precision and recall is calculated for proposed methods and average recall precision is plotted against category.

The average precision is calculating by using following equation 17,18. The average precision for images belonging to the qth category has been computed by:

$$\bar{P}_q = \sum_{k \in Aq} P(I_K)/|(A_q)|, q=1,2,....5 \quad (17)$$

Finally, the average precision is given by:

$$\bar{P} = \sum_{q=1}^{5} \bar{P}_q / 5 \quad (18)$$

The average recall is also calculated in the same manner.

4.4 Result and Discussion

The overall average precision and overall average recall of this CBIR techniques act as a important parameter to find out their performance. The overall average precision and overall average recall plot of entropy of single bit plane (as per the section III A) interband average image is shown in Fig.6. as number of retrieved images are goes on increasing overall precision goes on decreasing. The crossover point[11,12] at which precision and recall value is same is 0.22325.As we take entropy of sub block of interband average image bit plane then cross over point goes on decreasing. As shown in Fig.7.Performance of entropy of 64 x 64 sub block is lower (0.1625 cross over point) and performance (0.22325 cross over point) of full bit plane of interband average image is greater.

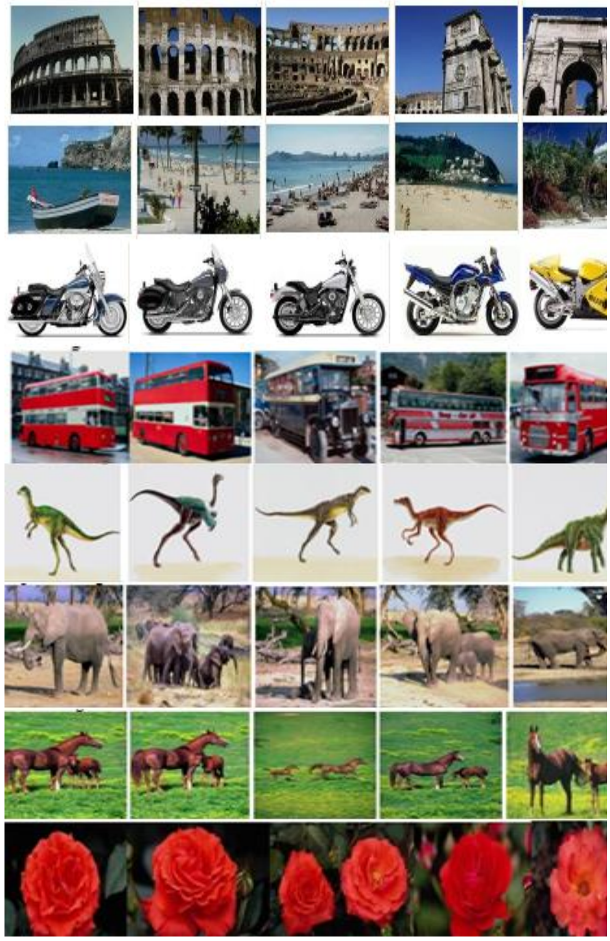

Fig. 5.Sample images from database.

Fig.8 shows overall average precision and overall average recall plot of all proposed methods of one bit plane (as per section 2.1) of inter band average image.

Fig.9 shows the overall average precision and overall average recall plot of three bit planes (as per the section 2.2) of color image, sub block of three bit planes. In this cross over point goes on increasing with sub block of three bit planes. Here entropy of 16 X 16 sub block of three bit planes cross over point s 0.4395.

Fig.10 shows overall average precision and overall average recall plot of all proposed methods of three bit planes (as per section 2.2) of color image. In which cross over point is 0,3631.

Fig.11 shows overall average precision and overall average recall plot of four bit planes (as per section 2.3) of grayscale image. As we consider sub blocks of four bit planes then it improves overall precision and overall recall values as shown in Fig.12.Fig.13 and Fig.14 show the overall precision and overall recall plot of twelve bit planes(as per section 2.3 color image).

Fig.15. shows comparison in the performance plot of one bit plane of interband average image, three bit plane of color image, higher four bit plane of grayscale image ,higher four bit plane of each color plane of color image so total twelve bit plane entropy feature vector .

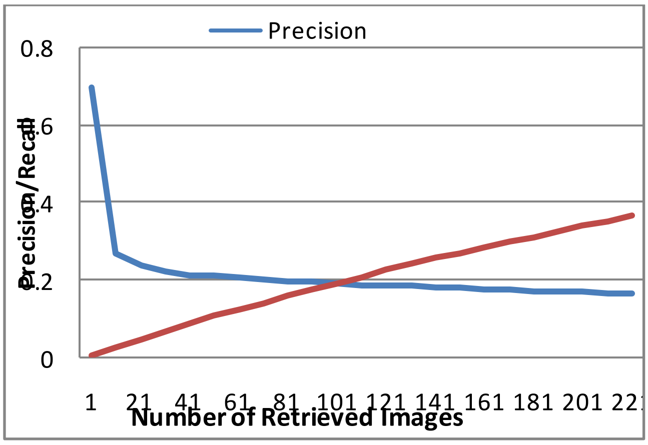

Fig. 6.Overall Average Precision and Overall Average Recall of Entropy of one bit planes of interband average image.

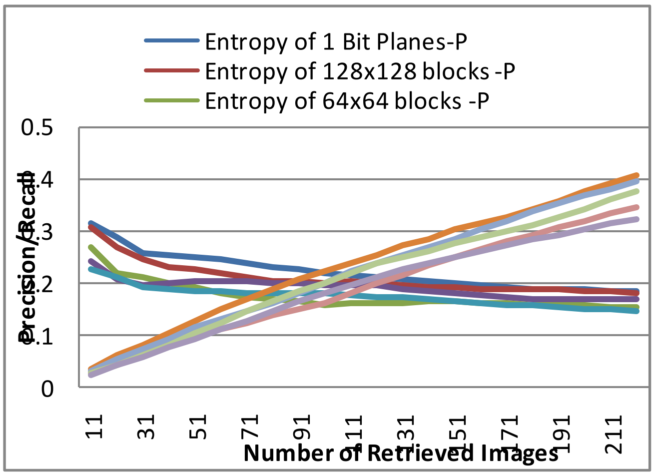

Fig. 7.Overall Average Precision and Overall Average Recall of Entropy of one bit planes,128x128 blocks of bit plane, 64x64 block of bit plane,32x32 block of bit plane and 16 x16 block of bit plane of interband average image.

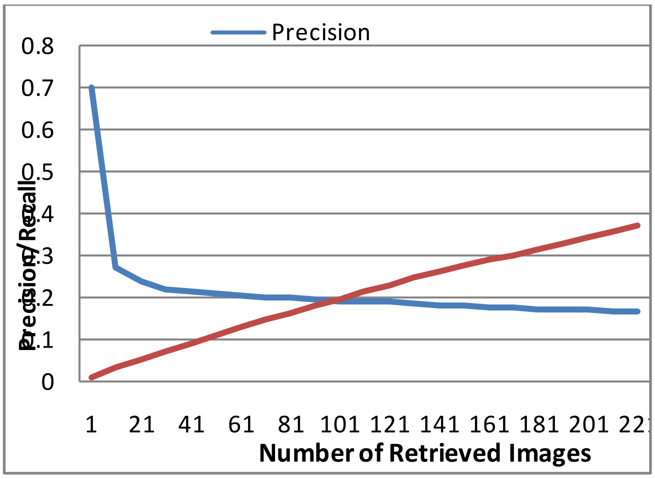

Fig. 8.Overall Average Precision and Overall Average Recall performance for Overall Average Precision and Average Recall of all methods of Entropy of one bit plane of interband average image.

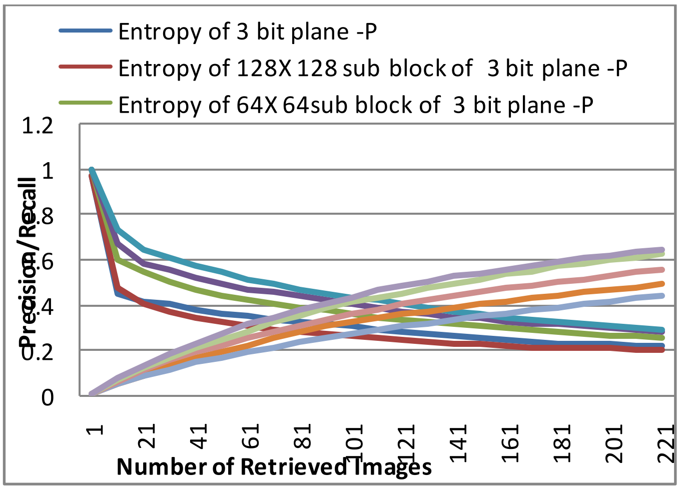

Fig. 9.Overall Average Precision and Overall Average Recall of Entropy of three bit planes,128x128 blocks of bit planes,64x64 blocks of bit plane,32x32 blocks of bit planes and 16 x16 block s of bit planes of color image .

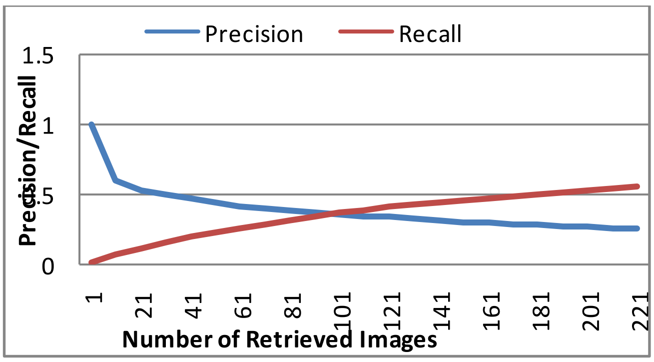

Fig. 10.Overall Average Precision and Overall Average Recall performance for Overall Average Precision and Overall Average Recall of all methods of Entropy of three bit plane of color image.

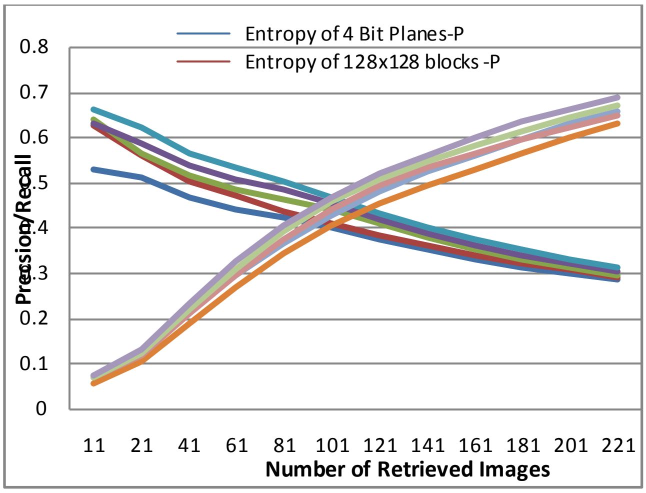

Fig. 11. Overall Average Precision and Overall Average Recall of Entropy of four bit planes,128x128 blocks of bit planes,64x64 blocks of bit plane,32x32 blocks of bit planes and 16 x16 blocks of bit planes of grayscale image .

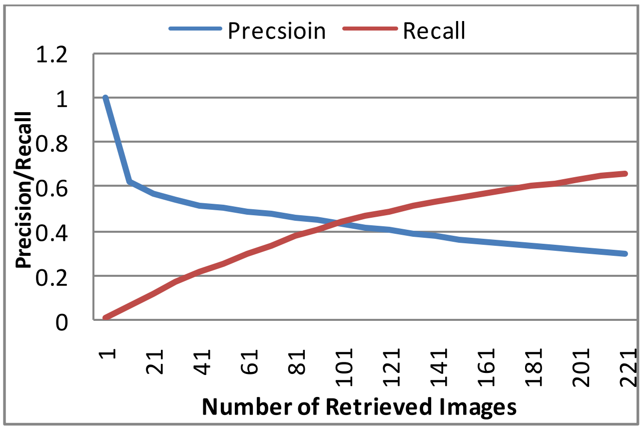

Fig. 12.Overall Average Precision and Overall Average Recall performance for Overall Average Precision and Overall Average Recall of all methods of Entropy of four bit plane of grayscale image.

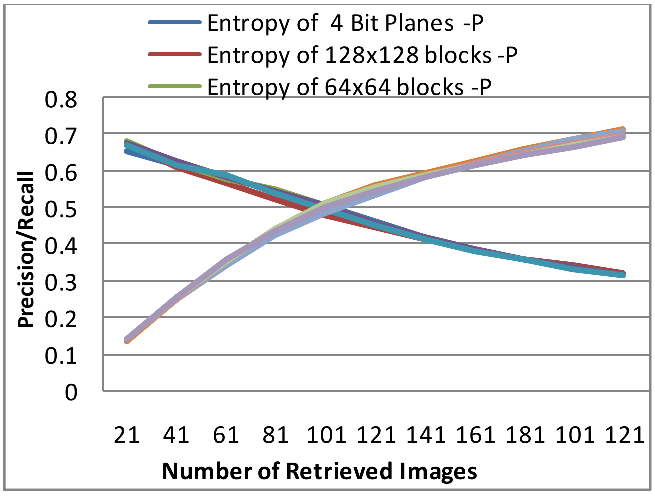

Fig. 13. Overall Average Precision and Overall Average Recall of Entropy of twelve bit planes,128x128 blocks of bit planes,64x64 blocks of bit plane,32x32 blocks of bit planes and 16 x16 blocks of bit planes of color image .

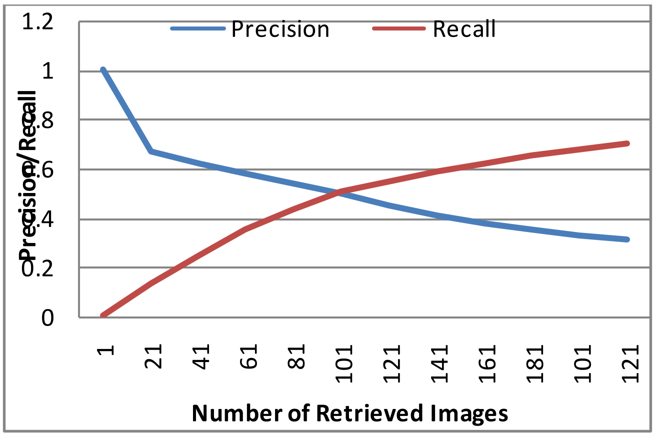

Fig. 14. Overall Average Precision and Overall Average Recall performance for Overall Average Precision and Overall Average Recall of all methods of Entropy of twelve bit plane of color image.

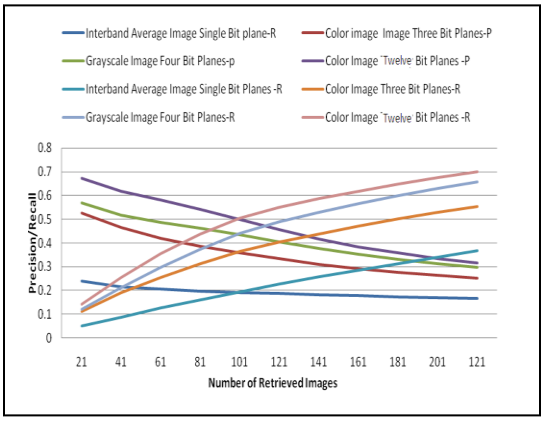

Fig. 15. Overall Average Precision and Overall Average Recall performance for Overall Average Precision and Overall Average Recall of all methods.

5. CONCLUSION

The new methods for retrieving the images from the database using the entropy of sub blocks of one, three, four and twelve bit plane as a feature vector. Using threshold bit plane one for interband average image and three for color image on other side using bit plane slicing upper four bit plane for gray scale image and twelve bit plane (upper four for each color plane) for color image entropy feature vector is calculated and compared with each other. To improve the precision and recall performance of each method entropy sub block of each type of bit plane calculate which performance is better than full bit plane .In this proposed techniques performance of twelve bit plane entropy feature vector of color image is better than other method. Because cross over points are 0.1979,0.3872,0.4611 and 0.54172 for one bit plane of interband average image, three bit plane for color image , upper four bit planes of bit plane slicing for gray scale image and twelve bit planes of bit plane slicing of color image respectively.

6. REFERENCES

[1] NST Sai, R.C. Patil ,"Average Row and Column Vector Wavelet Transform for CBIR", Second international conference on Advance in Computer Vision and Information Technology (ACVIT2009),Aurangabad, India.

[2] NST Sai, , R.C. Patil,"New Feature Vector for Image Retrieval Walsh Coefficients", Second international conference on Advance in Computer Vision and Information Technology (ACVIT2009),Aurangabad, India.

[3] NST Sai, , R.C. Patil,"Image Retrieval using DCT Coefficients of Pixel Distribution and Average Value of row and Column Vector "IEEE International Conference on Recent Trends in Information ,Telecommunication and Computing(ITC2009),Kochi, Kerala, India.

[4] NST Sai, , R.C. Patil," Moments of Pixel Distribution of CBIR" International Conference and Workshops on Emerging Trends in Technology (ICWET2010),Mumbai, India.

[5] NST Sai, Ravindra patil ,"New Feature Vector for Image Retrieval: Sum of the Value of Histogram Bins "IEEE Conference on Advance in Computing, Control & Telecommunication Technologies (ACT2009),Trivandrum, India.

[6] NST Sai, , R.C. Patil,"Image Retrival usng Equalized Histogram Image Bins Moment" Inter national Joint Journal Conference in Engneering ,IJJCE,2010,Trivandrum,India.

[7] R.C. Gonzalez, and R.E. Woods, Digital Image Processing 2nd ed.,Prentice Hall, Inc., New Jersey, 2002.

[8] K.C. Ting,D.B.L.Bong,Y.C.Wang,"Performance Analysis of Single and Combined Bit-Planes Feature Extraction for Recognition in Face Expression Database ", Proceedings of the International Conference on Computer and Communication Engineering 2008,May 13-15, 2008 Kuala Lumpur, Malaysia .

[9] Guoping Qiu, "Colour Image Indexing Using BTC", IEEE Transition on Image Processing, vol. No 12,.Janauary 2003.

[10] Pdamshree Suresh,RMD Sundaram,Aravindhan Arumugam," Feature Extraction in Compressed Domain for Content Based Image Retrieval ",International Conference on Advanced Computer Theory and Engineering.2008.

[11] H.B.Kekre, Sudeep D. Thepade, Archana Athawale, Anant Shah, Prathamesh Verlekar, Suraj Shirke, "Walsh Transform over Row Mean and Column Mean using Image Fragmentation and Energy Compaction for Image Retrieval", International Journal on Computer Science and Engg.(IJCSE),Volume 2S, Issue1, January 2010.

[12] H.B.Kekre, Sudeep D. Thepade, Archana Athawale, Anant Shah, Prathmesh Verlekar, Suraj Shirke, "Image Retrieval using DCT on Row Mean, Column Mean and Both with Image Fragmentation", (Selected), ACM-International Conference and Workshop on Emerging Trends in Technology (ICWET 2010), TCET, Mumbai, 26-27 Feb 2010, The paper will be uploaded on online ACM Portal.

[13] M. Flickner, H. Sawhney, W. Niblack, J. Ashley, Q. Huang, B. Dom, M. Gorkani, J. Hafner, D. Lee, D. Petkovic, D. Steele, and P. Yanker, "Query by Image and Video Content: The QBIC System", IEEE Computer, 28(9):23–32, Sept. 1995.

[14] A. W. M. Smeulders, M. Worring, S. Santini, A. Gupta, and R. Jain, "Content-based image retrieval at the end of the early years," IEEE Transaction on Pattern Analysis and Machine Intelligence (PAMI), 22(12):1349–1380, Dec. 2000.

[15] K. Hirata and T. Kato, ªQuery by Visual Example," Advances in Database Technology EDBT '92, Third Int'l Conf. Extending Database Technology, 1992.

[16] W.Y. Ma and B.S. Manjunath, "Pictorial Queries: Combining Feature Extraction with Database Search," Technical Report 18, Dept. of Electrical Eng., Univ. of California at Santa Barbara, 1994.

[17] W.Y. Ma and B.S. Manjunath, "Pictorial Queries: Combining Feature Extraction with Database Search," Technical Report 18, Dept. of Electrical Eng., Univ. of California at Santa Barbara, 1994.

[18] A. Gupta and R. Jain, ªVisual Information Retrieval," Comm. ACM, vol. 40, no. 5, 1997.

[19] C.E. Jacobs, A. Finkelstein, and D.H. Salesin, "Fast Multiresolution Image Querying," Proc. SIGGRAPH 95, 1995.

[20] W.J.Z. Wang, G. Wiederhold, O. Firschein, and S.X. Wei, "Wavelet Based Image Indexing Techniques with Partial Sketch Retrieval Capability," J. Digital Libraries, 1997.

[21] Seung Jun-Lee, Yong-Hwan Lee, Hyochang Ahn, Sang Burm Rhee, "Color image descriptor using wavelet correlogram," The 23rd international conference on Circuits/systems, computers and communication, 2008.

[22] A Gupata and R. Jain, "Visual Information Retrieval," Comman. ACM, vol.40, no.5, 70- 79, 1997.

[23] M.Mohammed Sathik,"Feature Extracton on ColorED x-Ray Images by Bit-plane Slicing Technique",International Journal of Engineering Science and Technology Vol. 2(7), 2010, 2820-2824.

[24] Govind Haldankar, Atul Tikare and Jayprabha Patil, "Converting Gray Scale Image to Color Image" in Proceedings of SPIT-IEEE Colloquium and International Conference, Mumbai, India, Vol. 1, 189.

[25] Pratt W.K., Digital image processing, A Wiley Interscience Publication, 1991.

[26] N.Ravia Shabnam Parveen, Dr. M.Mohamed Sathik, "Feature Extraction by Bit Plane Slicing Technique", in International Journal of Computing, Communication and Information System, Volume 1.

[27] M. K. Mandal, T. Aboulnasr, and S. Panchanathan,, "Image Indexing Using Moments and Wavelets", IEEE Transactions on Consumer Electronics, Vol. 42, No. 3, August 1996.