

International Journal of Computer Science and Mobile Computing



A Monthly Journal of Computer Science and Information Technology

ISSN 2320-088X
IMPACT FACTOR: 7.056

IJCSMC, Vol. 10, Issue. 11, November 2021, pg.59 – 70

Use of Picture Information Measure using Color Features for Image Retrieval in CBIR

Roohi Ali¹; Manish Maheshwari²

^{1,2}Department of Computer Science and Application, Makhnallal Chaturvedi National University of Journalism and Communication, Bhopal (M.P.), INDIA

DOI: [10.47760/ijcsmc.2021.v10i11.008](https://doi.org/10.47760/ijcsmc.2021.v10i11.008)

ABSTRACT: *Content-Based Image Retrieval systems backups the image retrieval process using the primary characteristics of image like colour, shape, texture and spatial locations clubbed with the semantic approaches for better efficiency and performance. Various information measures have been proposed in order to increase the level of Retrieval. A method of picture information measures based upon the concept of the minimum number of gray level changes to convert a picture into one with a desired histogram is presented. In search of finding a new perspective an integrated approach of Picture Information Measure (PIM) employed with the primitive visual feature color. The retrieval results obtained by applying color histogram (CH) on PIM (PIM of Red Green and Blue and there integrated variation) + Color Moment to a 1000 image database demonstrated significant improvement in retrieval effectively.*

KEYWORDS: *PIM, Color Moment, Color Histogram.*

I. INTRODUCTION

The fundamental aim of computer vision technology and electronic multimedia digital image processing is to serve the mankind by automating different tasks to help the mankind by making them an easy application. Information and Image retrieval is an important step into it. Image Retrieval is a process of retrieving and searching of digital images from a giant multimedia database on the bases of some information related to that image.

The emergence of digital devices shows the prominence of multimedia technology as the dominance of rapidly expanding image collections on the internet expanding enormously in diverse areas such as entertainment, art galleries, education, fashion design, industry, medicine etc. Tempting the researchers to made significant efforts for effectual retrieval and analytics for the management of visual data. In the field of computer vision Images are mainly used.

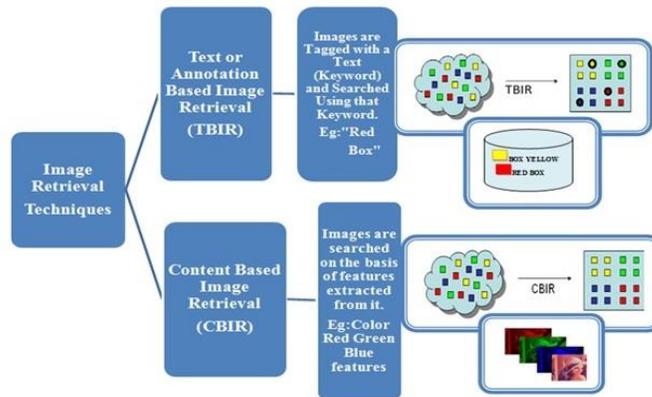


Figure 1. Image Retrieval Techniques: TBIR and CBIR

Evolution of Image Retrieval states that formerly the image was retrieved by text description scheme called as Text Based Image Retrieval [TBIR][8], where a text is tagged with every image used for indexing, matching and retrieval purpose. But the major limitation of this scheme is the need to have an additional database of text descriptors with images along with large scale multimedia databases increases the retrieval and storage requirements. Addition to this there are more chances of errors in labeling by different annotators according to their understandings about image contents as well as the process is subjective because too much time is consumed in annotating each image in large databases [15]. Therefore, due to these disadvantages TBIR cannot achieve high level of efficiency and effectiveness especially in task dependent queries [31].

In early 1990's the term CBIR was originated [15], Content based image retrieval is also called Query By Image Content (QBIC) [9]. CBIR is an automated technique, in which the input image is a query image while the output is a set of images similar to the input or query image. Content-based image indexing and retrieval (CBIR) systems often analyze image content via so-called low-level features, such as spatial location, color, texture, and shape [29] [1] [39] [22].

In this proposed work we used the technique of calculating Picture Information Measure (PIM) for representing features extracting from the images for retrieval, i.e. Histogram values are converted to a single value. In PIM, the bin values of the histograms are recorded through differentiation, and thus reduced to a single number. That will be in turn used to compare the relevant images using a similarity measure. The proposed model of the system is designed and implemented on MATLAB. The performance of the proposed system is tested and produces promising results.

II. LITERATURE REVIEW

CBIR owes its origins to the seminal work of David Marr who was first to note that primitive image features, such as lines, edges, angles, grayscale, RGB, spatial proximity, etc, were adequate for a machine to extrapolate meaning sufficient for limited image understanding, pattern matching, and retrieval. Although many such primitive measures are possible, there is no set of optimal ones that lead to perfect retrieval [28]. Content based image retrieval extracts the images depending upon the visual features like shape, color, texture. The initial phase of CBIR is to evaluate the features and producing it in the form of numeric values [40] [2], [37]. Earliest developed CBIR adopted various color descriptors. Color is very essential level of any image [19] proposed a signature-based color-spatial image retrieval

system. A CBIR scheme based on global and local color distributions in an image is presented in [38]. The main aim of region based methods is the ability to store and represent the image content [23]. Region based image retrieval works as follows: Images are divided into assorted regions, Features are drawn out from each region, and the combination of all the features represents the image content.

The PIM approach aims to illustrate the functioning and the meaning of one of the most popular tools for Information measure. They suggested a formula called a Picture Information Measure (PIM) generalized from the classical Lorenz Information Measure (PIM). [28].

A .Feature Extraction

In Image Retrieval, Feature Extraction is the process of interacting with images and performs extraction of meaningful information of images. The measurements or properties used to classify the objects are called Features, and the types or categories into which they are classified are called classes. Low-level visual features such as color, texture and shape often employed to search relevant images based on the query image. An n-dimensional feature vector represent an image where n is the selected number of extracted features [27].

Color Spaces. Color space consists of three dimensional spaces and color is used as a vector in it. Color Spaces are required for description of color based retrieval of image. Mostly RGB, CMYK, HSV (Hue, Saturation, and Value), HSL (Hue, Saturation and Luminance) etc are used. The selection of color space is done from uniformity characteristics and uniformity means to have colors points having similar distance in color space as perceived by human eye.

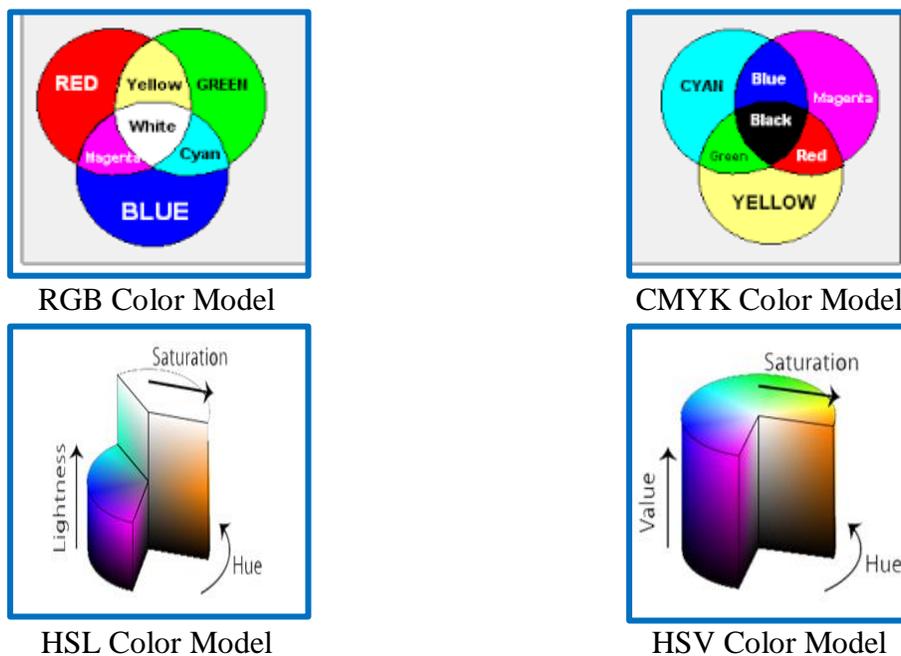


Figure 2 Different color Models

Color Feature Extraction. In content based Image retrieval, Color property is one of the most widely used visual features because of its strong correlation with the underlying image objects. It can be partially reliable for retrieval using an efficient variation and selection of color model, color spaces representation, features combination, even in presence of changes in lighting, view angle, and scale.

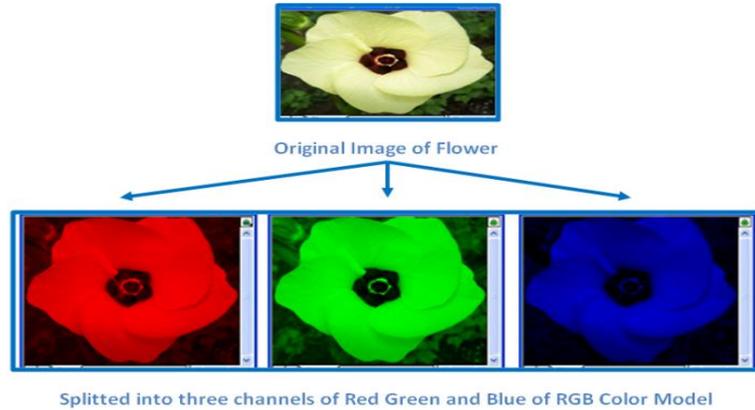


Figure 3. RGB Color Space depicting three dimensional components of an image

Color Histogram. It is the most used descriptor in image retrieval. The color histogram is easy to compute, simple and effective in characterizing the global and the local distribution of colors in an image. The color histogram extraction algorithm uses three steps: partition of the color space into cells, association of each cell to a histogram bin, and counting of the number of image pixels of each cell and storing this count in the corresponding histogram bin. This descriptor is invariant to rotation and translation [11].

A color histogram H for a given image is defined as a vector

$$H = \{H_0, H_1, H_2, H_i \dots H_n\} \text{ or}$$

$$H = \{H_{[0]}, H_{[1]}, H_{[2]} \dots H_{[i]} \dots H_{[n]}\}$$

Where, i represent the color in color histogram and $H_{[i]}$ represent the number of pixels of color i in the image, and N is the number of bins used in color histogram. For comparing the histogram of different sizes, color histogram should be normalized. The normalized color histogram is given as

$$H' = H / P$$

Where, P is the total number of pixels in the image. [27]

In this paper, RGB color space is used for calculating histogram for each color channel (Red Green Blue) as features for image database.

Color Moment. Color moments have been successfully used in several retrieval systems such as QBIC. This approach involves calculating the mean, the variance and the third moment for each color channel, for providing a unique number used to index. Color moments have been proved efficient in representing color distributions of images. They are defined as [21] use three central moments of an image's color distribution in which p_{ij}^k is the value of the k -th color component of the ij -image pixel and P is the

height of the image, and Q is the width of the image. They are Mean, Standard deviation and Skewness [28].

MOMENT 1: Mean:-

$$E_k = \frac{1}{PQ} \sum_{i=1}^P \sum_{j=1}^Q P_{ij}^k$$

Mean can be understood as the average color value in the image.

MOMENT 2: Standard Deviation:-

$$SD_k = \text{SQRT} \left(\frac{1}{PQ} \sum_{i=1}^P \sum_{j=1}^Q (P_{ij}^k - E_k)^2 \right)$$

The standard deviation is the square root of the variance of the distribution.

MOMENT 3: Skewness:-

$$S_k = \left(\frac{1}{PQ} \sum_{i=1}^P \sum_{j=1}^Q (P_{ij}^k - E_k)^3 \right)^{\frac{1}{3}}$$

Skewness can be understood as a measure of the degree of asymmetry in the distribution.

III. PROPOSED WORK

Picture Information Measure

The picture information measure is based upon the minimal number of gray level changes to convert a picture to one having a desirable histogram. In the case of PIM_1 , the desirable histogram consists of a peak at a single (arbitrary) gray level. For PIM_k , the desirable histogram consists of k peaks at k (arbitrary) gray levels [35].

Let $h: \{0, 1, \dots, L-1\} \rightarrow N$ represent the histogram of f , where $h(i)$ is the number of pixels with gray level i . We define the pictorial information measure $PIM(f)$ as follows:

$$PIM(f) = \left\{ \sum_{i=0}^{L-1} h(i) \right\} - \max h(i)$$

$NPIM_k$, denote the normalized picture information measure where PIM_k , is the minimum number of pixel gray level changes to convert a picture to k gray levels.

Suppose the P_i 's are ordered such that

$$P_0 < P_1 < \dots < P_{L-1}$$

It can be seen that $NPIM_k(f)$ is 1 minus the sum of the last k terms in the sequence $P_0, P_1 \dots P_{L-1}$, which is equal to the sum of the first $L - k$ terms in the sequence.

and $NPIM$, is accordingly defined as

$$NPIM(f) = 1 - \left\{ \sum_{i \text{ is one of the } k \text{ largest } p_i\text{'s}} P_i \right\}$$

In particular, $NPIM(f)$ or $NPIM_1(f)$ is the sum of the first $L - 1$ term in the sequence $P_0, P_1 \dots P_{L-1}$. The following equalities hold:

$$0 = NPIM_L(f) \leq NPIM_{L-1}(f) \leq \dots \leq NPIM_1(f) \leq NPIM_0(f) = 1$$

The reasons for using $NPIM$ or $NPIM_k$, as information measures, instead of using the usual entropy function, are (1) they have an intuitively meaningful interpretation with respect to pictures, (2) they are easy to compute, and (3) they represent a family of picture information measures, so that for a given application, a desirable one can be selected by adjusting the various thresholds and constraints.

To define similar pictures, we can use a combination of the following criteria: (1) their physical (and/or logical) histograms are similar, (2) their Lorenz information curves are similar, (3) their Lorenz information measures are similar, and (4) their structured information measures are similar.

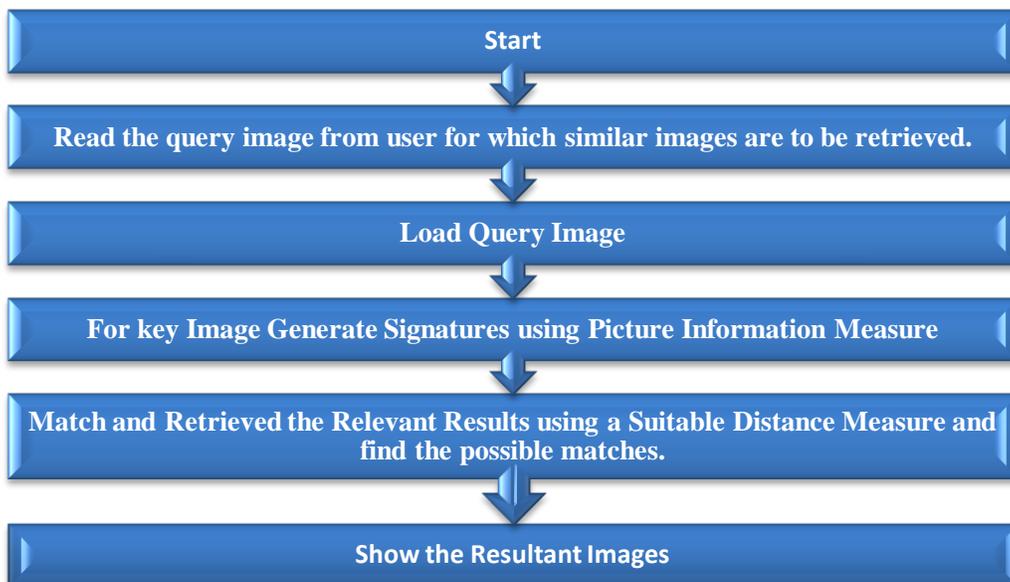


Figure 4 Stepwise algorithm of PIM on RGB color features

IV. Working of CBIR using PIM

The proposed CBIR workflow is illustrated stepwise in figure 5 below.

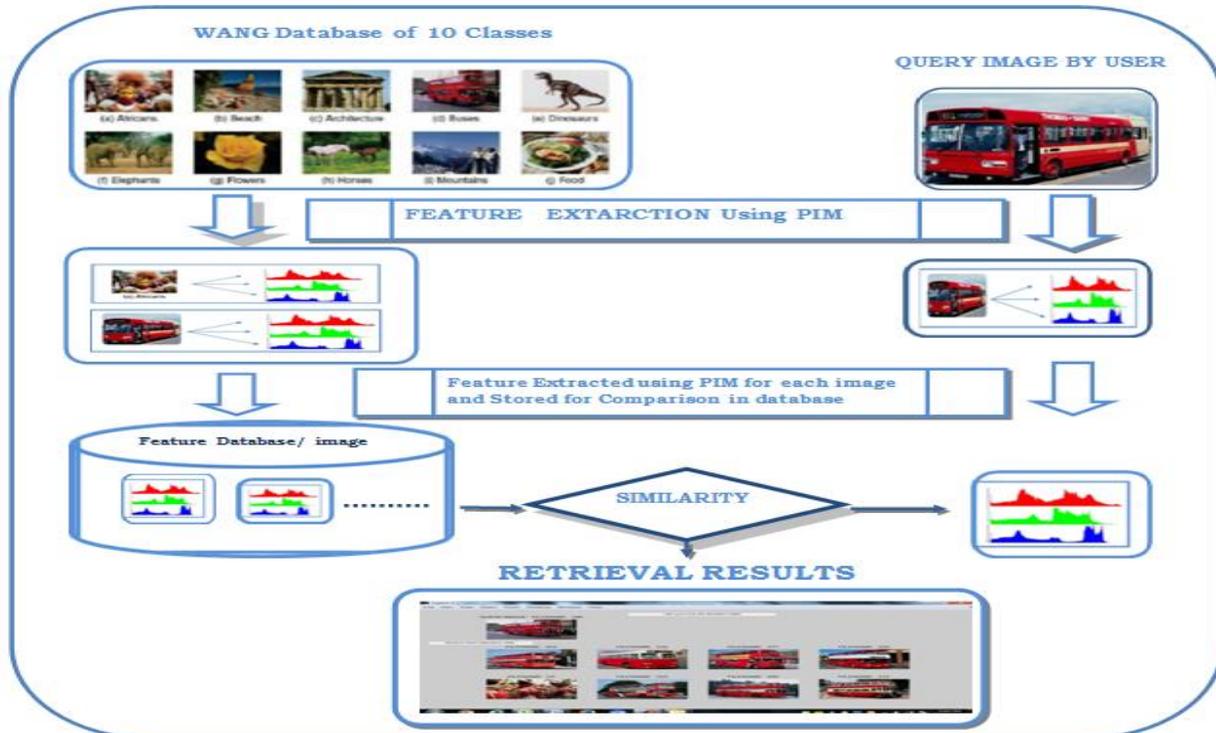


Figure 5. Diagram of Proposed CBIR showing the working how the query image of Bus is retrieval.

Figure 5. Illustrate complete process from how a query image is given, features are then extracted using Histogram of Red, Green and Blue applied to PIM resulting into the values of the RGB separately and stored in the database. Likewise the Histogram value of query image “Bus” is also calculated. Now using the Euclidean distance the similarity is computed. Resulting the relevant query images to be fetched. The Designed CBIR interface shows the results.

V. EXPERIMENTAL AND COMPUTATIONAL DETAILS

The results and discussion of the proposed content-based image retrieval system has been implemented using MATLAB (Mat lab 2014a). In the proposed method, twelve Content-based image features are derived using two techniques PIM and Color Moment shown in the Figure 6. below:

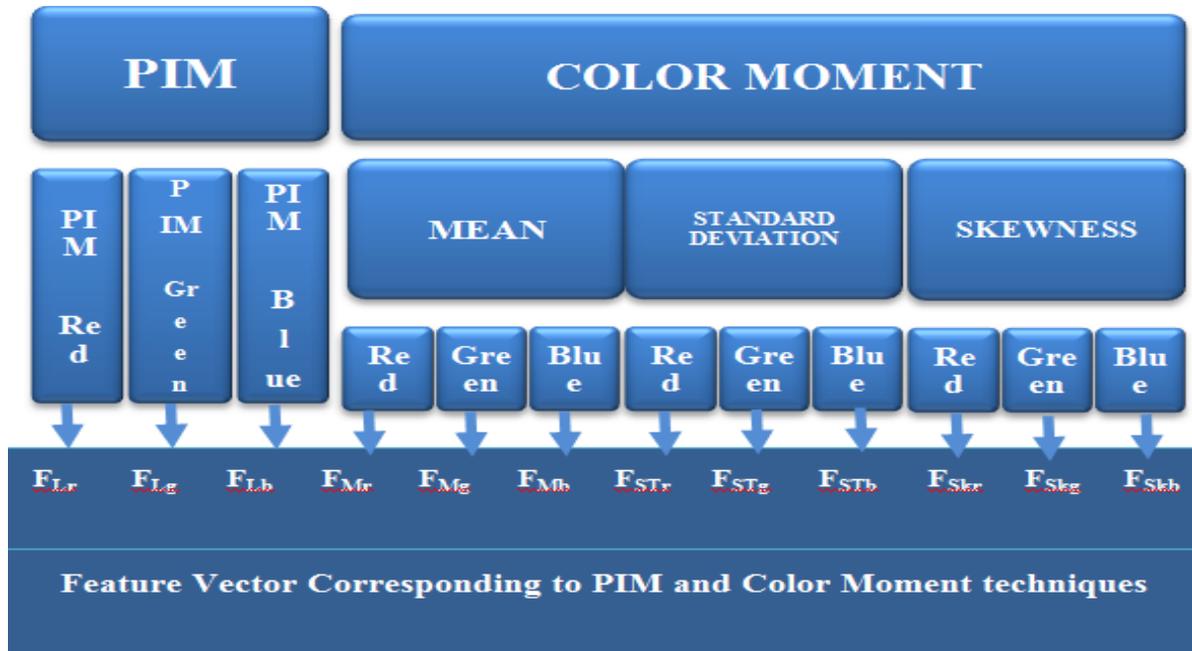


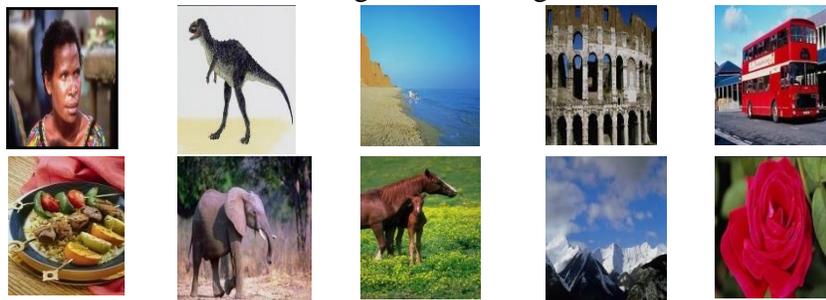
Figure 6. Features Extracted Using PIM and Color Moment

Total nine features are extracted using color moment i.e. Moment Mean for Red(FMr), Green(FMg), Blue(FMb), Moment Standard Deviation for Red(FSTr), Green(FSTg), Blue(FSTb) and Moment Skewness for Red(FSKr), Green(FSKg), Blue(FSKb). These 9 features are used for feature vector calculation.

The PIM approach aims to simplify image data derived largely as histograms in order to ease processing requirements. Three Features are extracted using the PIM technique i.e. PIMRed(FLr), PIMGreen(FLg), PIMBlue(FLb) of an image the values are then calculated and stored as feature vectors and then used for matching and Retrieval of relevant images.

The database used in the experimentation consists of 10 different groups as listed in Table.1.1. Each group consists of 100 images in JPEG format, from Wang database, downloaded from the website <http://wang.ist.psu.edu/iwang/test1.tar>. All these images in the database are natural images. Each image is of size 384*256 or 256*384 pixels. All the images are in the RGB color space [22].

Table 1: Categories of Wang Databases



Within this database, it is known whether any two images are of the same category. In particular, a retrieved image is considered a match if and only if it is in the same category as the query. It is considerable, to choose an image as a query from each of the category to show semantic distinctions. There are approximately 1000 images used whose RGB histogram is pre-calculated and stored in a .mat file, as it will reduces the time required for similarity function evaluation [19][20].

Table 2. Illustrates some of the query results of our retrieval interface based on indexing developed using the integrated approach of PIM. In each of the result interface showed in figure the Query is randomly selected from one of the 10 categories the result will be listed in order of relevancy low to high according to the Δd Euclidean distance calculated between indexing vectors of the query and retrieved images. It measures the distance between two vectors of images by calculating the square root of the sum of the squared absolute differences and it can be calculated [29] as:

$$\Delta d = \sqrt{\sum_{i=1}^n (|Q_i - D_i|)^2}$$

Where,

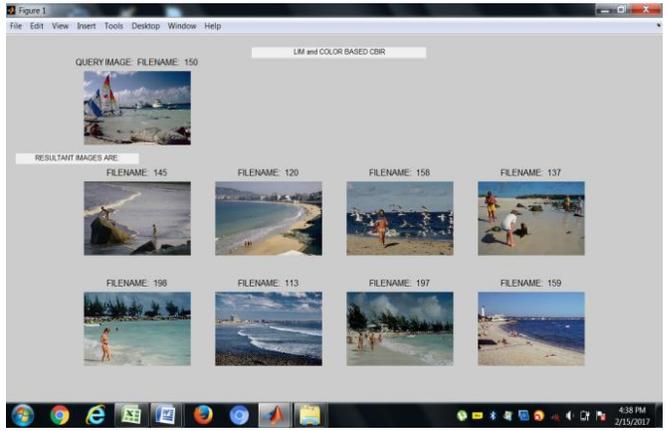
n = number of features,

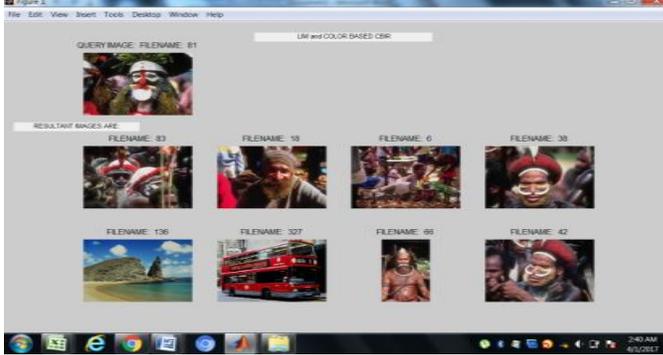
i= 1, 2...n.

Both images are the same for $\Delta d= 0$ and

Small value of Δd shows the relevant image to the query image [13].

Table 2: Description and Result of Different Sample Query Images Using Mat lab Interface

Category and Title of Sample Query Image	Total no. of Relevant Image Retrieved	User Interface showing the Retrieved Resultant Images
Beach 150.jpg	8	

<p>Horse 777.jpg</p>	<p>8</p>	 <p>Figure 1: A screenshot of a software application window titled 'LMI and COLOR BASED CBR'. It shows a 'QUERY IMAGE: FILENAME: 777' which is a horse. Below it, under 'RESULTANT IMAGES ARE:', there are eight smaller images of horses with filenames: FILENAME: 790, FILENAME: 795, FILENAME: 797, FILENAME: 792, FILENAME: 778, FILENAME: 792, FILENAME: 727, and FILENAME: 792. The interface includes a menu bar (File, Edit, View, Insert, Tools, Desktop, Window, Help) and a taskbar at the bottom.</p>
<p>Roses 666.jpg</p>	<p>8</p>	 <p>Figure 1: A screenshot of a software application window titled 'LMI and COLOR BASED CBR'. It shows a 'QUERY IMAGE: FILENAME: 666' which is a rose. Below it, under 'RESULTANT IMAGES ARE:', there are eight smaller images of roses with filenames: FILENAME: 614, FILENAME: 621, FILENAME: 625, FILENAME: 636, FILENAME: 615, FILENAME: 672, FILENAME: 621, and FILENAME: 663. The interface includes a menu bar and a taskbar at the bottom.</p>
<p>Dinosaurs 438.jpg</p>	<p>8</p>	 <p>Figure 2: A screenshot of a software application window titled 'LMI and COLOR BASED CBR'. It shows a 'QUERY IMAGE: FILENAME: 438' which is a dinosaur. Below it, under 'RESULTANT IMAGES ARE:', there are eight smaller images of dinosaurs with filenames: FILENAME: 491, FILENAME: 464, FILENAME: 401, FILENAME: 442, FILENAME: 419, FILENAME: 465, FILENAME: 469, and FILENAME: 432. The interface includes a menu bar and a taskbar at the bottom.</p>
<p>Buses 346.jpg</p>	<p>7</p>	 <p>Figure 1: A screenshot of a software application window titled 'LMI and COLOR BASED CBR'. It shows a 'QUERY IMAGE: FILENAME: 346' which is a red double-decker bus. Below it, under 'RESULTANT IMAGES ARE:', there are seven smaller images of buses with filenames: FILENAME: 354, FILENAME: 332, FILENAME: 377, FILENAME: 300, FILENAME: 34, FILENAME: 302, FILENAME: 398, and FILENAME: 322. The interface includes a menu bar and a taskbar at the bottom.</p>
<p>African 11.jpg</p>	<p>6</p>	 <p>Figure 1: A screenshot of a software application window titled 'LMI and COLOR BASED CBR'. It shows a 'QUERY IMAGE: FILENAME: 11' which is a person in traditional African attire. Below it, under 'RESULTANT IMAGES ARE:', there are six smaller images with filenames: FILENAME: 18, FILENAME: 6, FILENAME: 38, FILENAME: 136, FILENAME: 137, FILENAME: 95, and FILENAME: 42. The interface includes a menu bar and a taskbar at the bottom.</p>

VI. CONCLUSIONS

In summary, we have performed both an experimental and theoretical study of the Picture Information Measure for image retrieval with respect to the color feature in the Content based image retrieval environment. The experimental results have been successfully interpreted statistically in the Mat lab IDE using the Normalized PIM method which shows promising results in all the categories of the multimedia image database.

REFERENCES

1. A. Pentland, R. S. (1996). Photobook: content-based manipulation of image databases. *International Journal of Computer Vision* (18) , 233-254.
2. A. W. M. Smeulders, M. W. (1349–1380). Content-based image retrieval at the end of the early years. *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 22, no. 12, Dec. 2000.
3. S. Manjunath, W.-Y. M. (1999). NeTra: A toolbox for navigating large image databases. *Multimedia Systems* 7 (Springer-Verlag), 184-198.
4. B.G.Prasad, S. K. (2001). Color and Shape Index for Region-Based Image Retrieval. *IWVF4 LNCS* 2059, 716-725.
5. Bellù, L. G. (2005). *Charting Income Inequality: The Lorenz Curve*. Urbino, Italy: EASYPol.
6. Bellù, L. G. (2006, December). *Inequality Analysis: The Gini Index*. Online Resource Material for Policy Making, pp. 1-14.
7. Chang, S. (1992). Image Information system. *IEEE*, 431-442.
8. Chang, S. L. (1984). Picture Indexing and Abstraction Techniques for Pictorial Databases. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 6(4) ISSN: 0162-8828, 475-483.
9. Content Based Image Retrieval. (2014). Retrieved from Wikipedia.org: www.wikipedia.org
10. Deng, Y. K. (1999). Peer Group Filtering and Perceptual Color Image Quantization. *Proc. of IEEE Intl. Symposium on Circuits and Systems (ISCAS)*.
11. Deng, Y. M. (1997). Content-based Search of Video Using Color, Texture, and Motion. *Proc. of IEEE Intl. Conf. on Image Processing*, vol. 2 (pp. 534-537). Santa Barbara,CA: IEEE.
12. Eakins, J. G. (1999). Content-based Image Retrieval: A report to the JISC Technology Applications Programme.
13. EL ASNAOUI Khalid, C. Y. (2016). Efficient Use of Texture and Color features in Content Based Image Retrieval (CBIR). *International Journal of Applied Mathematics and Statistics*, Vol. 54; Issue No. 2 , 54-65.
14. Elasnoui, K. A. (2015). Color Image Retrieval Based on a two-Dimensional Histogram. *International Journal of Mathematics and Computation*, Vol. 26; Issue Num. 2 , pp 10-18.
15. F.Long, H. a. (2003). *Fundamentals of Content-Based Image Retrieval in Multimedia Information Retrieval and Management*. Springer.
16. Fazal Malik, B. B. ((2013) 25). Analysis of distance metrics in content-based image retrieval using statistical quantized histogram texture features in the DCT domain. *Journal of King Saud University – Computer and Information Sciences*, 207–218.
17. G. Castellano, A. F. (n.d.). *Fuzzy Shape Clustering for Image Retrieval*.
18. H K Lee, S. I. (December, 2001). Intelligent Image Retrieval using Neural Network. *IEICE Trans Inf & System*.
19. H.-W. Yoo, H.-S. P.-S. (347–357). Expert system for color image retrieval. *Expert Syst. Appl.*, vol. 28, no. 2 , Feb. 2005.
20. Han, K. M. (1996). Image Organization and Retrieval with Automatically Constructed Feature Vectors. 19th International ACM SIGIR Conference on Research and Development in Information Retrieval.

21. Hemlata, C. L. (July 2011). A Hybrid Image Mining Technique using PIM-based Data Mining Algorithm. *International Journal of Computer Applications* (0975 – 8887), 1-5.
22. J.R.Smith, S. C. (November, 1996). VisualSEEK: a fully automated contentbased image query system. *Proceedings of ACM Multimedia* (pp. 87–98). Boston: ACM Multimedia.
23. Ji Wan, D. W. (2014). *Deep Learning for Content-Based Image Retrieval: A Comprehensive Study*. ACM, November, 3–7.
24. M. H. Pi, C. S. (Oct. 2006). A fast and effective model for wavelet subband histograms and its application in texture image retrieval. *IEEE Trans. Image Process.* vol. 15, no. 10 .
25. M. Kokare, P. K. (Dec. 2005). Texture image retrieval using new rotated complex wavelet filters. *IEEE Trans. Syst., Man, Cybern. B, Cybern.*, vol. 35, no. 6.
26. M.Orengo, M. a. (1995). Similarity of color images. *Storage and Retrieval for Image and Video Databases III (SPIE)* , 381-392.
27. Manish Maheshwari, M. M. (Volume 57– No.15, November 2012). Content based Color Image Clustering. *International Journal of Computer Applications* , 38-43.
28. Mark Rorvig, K. T. (n.d.). *Image Retrieval by Content Measure Metadata Coding*. Intel Corporation.
29. MUVIS. (2010). A System for Content-Based multimedia indexing and retrieval in multimedia databases. Retrieved from muvis: <http://muvis.cs.tut.fi/>
30. Nancy Goyall, N. S. (July 2014). A Review on Different Content Based Image Retrieval Techniques Using High Level Semantic Features. *IJIRCCE*, Vol. 2, Issue 7 .
31. P.S. Hiremath, J. P. (2007). Content Based Image Retrieval using color, Texture and Shape features. *International Conference on Advanced Computing and Communications* , 780-784.
32. S. Antani, R. K. (945–965). A survey of the use of pattern recognition methods for abstraction, indexing and retrieval of images and video. *Pattern Recognit.*, vol. 35, no. 4 , Apr. 2002.
33. Santhana Krishnamachari, M. A. (n.d.). Hierarchical clustering algorithm for fast image retrieval. Mottaleb Philips Research .
34. Subrahmanyam Murala, A. B. (6-7 March 2009). Color and Texture Features for Image Indexing and Retrieval. *IEEE International Advance Computing Conference (IACC 2009)* (pp. 1411-1416). Patiala, India: IEEE.
35. Shi-kuo chang and chung-chun yang,(30 july 1982). Picture Information Measures for Similarity retrieval. *Computer vision, graphics, and image processing* , 366-315.
36. Syed Hamad Shirazi, N. u. (2016). Content-Based Image Retrieval Using Texture Color Shape and Region. (*IJACSA*) *International Journal of Advanced Computer Science and Applications* , 418-426.
37. Szabolcs, S. (2008). Color histogram features based image classification in content-based image retrieval systems. *International Symposium on Applied Machine Intelligence and Informatics* , (pp. 221–224).
38. T.C. Lu, C.-C. C. (Mar. 2007). Color image retrieval technique based on color features and image bitmap. *Information Processing Management*, vol. 43, no. 2 .
39. W. Niblack, R. B. (1996). The QBIC project: querying images by content using color, textures and shape. *Storage and Retrieval for Image and video Databases* (pp. 124-128). *Proceedings of SPIE*.
40. Y. Liu, D. Z. (Jan. 2007.). A survey of content-based image retrieval with high-level semantics. *Pattern Recognition* vol. 40, no. 1. , 262–282.