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# COMPARATIVE ANALYSIS OF CBIR SYSTEM USING ENTROPY

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## ABSTRACT

*Content-based image retrieval (CBIR) is known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of computer vision techniques to retrieve image from the large image database. CBIR or Content Based Image Retrieval is the retrieval of images based on visual information such as colour, texture and shape.*

*The existing systems have problem in retrieving relevant results according to the user query, which is that many large image databases, traditional methods of image indexing have proven to be insufficient, laborious, and extremely time consuming. These old methods of image indexing, ranging from storing an image in the database and associating it with a keyword or number, to associating it with a categorized description, have become obsolete.*

*The solution initially proposed was to extract the primitive features of a query image and compare them to those of database images. The image features under consideration were colour, texture and shape. Thus, using matching and comparison algorithms, the colour, texture and shape features of one image are compared and matched to the corresponding features of another image. This comparison is performed using colour, texture and shape distance metrics.In this paper comparison performance analysis of CTS (color texture shape) and CTSE (color texture shape and entropy) on CBIR system is given. Experimental results show that CBIR system with entropy feature gives 82% accuracy.*

***Keywords- Content based image retrieval (CBIR), Color space; Classification; Feature extraction, Similarity measure;***

## I. INTRODUCTION

The development in the advancement of computer processors, computing power, storage and information technology is rapidly increased with the time. There are many web sites which are related to digital information like images and video. Web Sites have different categories of images which are uploaded and downloaded by the users every moment. The digital information available to people in terms of images which are digital contents and it is very useful to many geography, medicine, architecture, publishing, advertising, design, fashion, and many more areas. Now a trivial task is that retrieval of images from the huge amount of storage of images.

Content Based Image Retrieval (CBIR) is a process that finds a particular image from the image database according to the content of the query image which explores the applications of content based image retrieval and some of the existing CBIR systems.CBIR is the retrieval of images based on visual features such as shape or color or texture or based on other properties of images. In CBIR, each image that is stored in the database has its features extracted and compared to the visual features of the query image. Because of that it is also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR).

When image's content analysis is used for searching images rather than the metadata such as keywords, tags, or descriptions associated with the image, this kind of searching is known as content based searching. The term "content" in this can be refer to visual features that is be derived from the image itself. Retrieval of images based on metadata is dependent on completeness and annotation quality, for this CBIR is desirable. Having humans manually provide metadata or keywords in a large image database for annotation of images. It is time consuming and does not capture the metadata desired to provide visual information of the image. The retrieval of images based on keyword has not been well-defined and efficient. In the same manner, CBIR system has some challenges in defining success in term of precision and recall. The problem with the existing system is that many large image databases, traditional methods of image indexing have proven to be insufficient, time consuming and extremely laborious. These old methods of image indexing, ranging from storing an image in the image database and providing it with a keyword or number, to associating it with description is categorized, have become obsolete.

Because of that, the interest in CBIR has grown in retrieval of images technology. CBIR provides efficient uses of large range of image retrieval. The existing image retrieval system uses textual information about the images, which can be easily searched. For textual information based searching requires manually provide a particular description for each image in database, but it can be impractical for images which are generated automatically or for huge databases which contains millions of images. There is also possibility to miss images which uses synonyms of the description of the image. There is also a problem with keyword based searching is that images are categorizing in semantic classes for example "elephant" as a subclass of "animal" can avoid the miscategorization problem, but it requires more efforts by the user for finding relevant images as results. Keyword based image retrieval system still faces miscategorization and scaling problems.

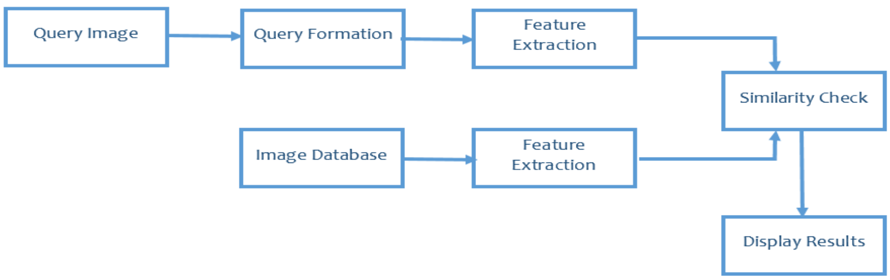


**Figure Content based image retrieval system**

CBIR system basically follows two steps which are as following:

1. **Feature Extraction:** In this, the process is extracting image features like color, texture and shape to a distinguishable extent.

2. **Matching:** In this, CBIR involves similarity metric matching using these features to provide results that are visually similar to query

## II. FEATURE EXTRACTION

Feature is the property of an object, which can discriminate an object from others. Usually humans use color, shape and texture to analyze and recollect the contents of an image [11].feature is defined as an interesting part of an image and features are used as a starting point for many computer vision algorithms. Since features are used as the starting point and main primitives for subsequent algorithms, the overall algorithm will often only be as good as its feature detector.Therefore, it is natural to use features based on these attributes for image retrieval. The details of used features are discussed in sections A-C, section D gives the detail of used classifier for the detection of query image.

***A. Colour Feature***

Colour has strong correlations with the underlying objects in

an image, soit has been successfully applied for the retrieval of images [10]. This paper uses HSV(Hue, Saturation, and Value)colour space for Histogram and RGB(Red, Green, and Blue) for Colour moments& Colour auto-correlogram.

*1) **Colour Histogram***

Colour histogram is one of the most important descriptor used in content-based image retrieval; which shows, how many pixels in an image are of a particular colour. Colour histogram is represented as bar chart, where each bar (bin) represents a particular colour of the colour space being used [5, 9, 19]. For the purpose of saving time, here we have reduced the number of bins through quantization, by taking colours that are very similar to each other and putting them in the same bin.

The color histogram also represents the possibility of any pixel, in image I, that in color Ci. The color histogram is implemented using a one-dimensional array. The index of the array represents the color frequency. An element of the array represents the number of pixels with the color frequency represented by the array index.

Formula for Histogram comparison

$$D = \sum_{i=1}^{256} \left( \left| count1[i] - count2[i] \right| \right)$$

Where, D= DISTANCE

count1 – histogram for the query image

count2 – histogram for the image in the database

The image in the database whose histogram when compared with the histogram of the query image gives minimum distance will be displayed at the output panel.

***2) Color Moments***

Color moment is a compact representation of color features to discriminate a color image. Color moments of an image's for color distribution are defined as [10].

***3) Color Auto-Correlogram***

The weak point of the histogram method is lack of space information in color. Color auto-correlogram is technique proposed to integrate spatial information with color histograms. For each pixel in the image, the auto-correlogram approach needs to go through all the neighbors of that pixel. So the color auto-correlogram shows how the spatial autocorrelation of color changes with distance.

**B.Texture**: Texture contains important information about the structural arrangement of surfaces and their relationship to the surrounding environment. It is an inherent property of virtually all surfaces including clouds, trees, bricks, hair, and fabric. Texture provides useful information of the surfaces about their structures and the relationship with the surrounding.

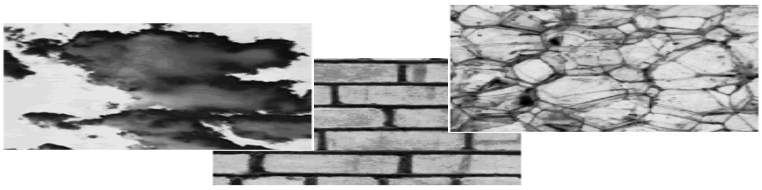

**Fig Examples of Textures**

Texture analysis can be studied at three levels i.e. as follows

i. Statistical level; a set of statistics extracted from the image is called texture.
ii. Structural level, the primitives of the image and their placement rules are known as its texture.
iii. Spectral level, the texture is defines as a set of coefficients in the transform domain.

**Wavelet Transform based Features** Wavelet transform is a signal processing technique extensively used in texture analysis & extraction of visual texture features based on multiresolution decomposition of the images, and representing textures in different scales [2]. Wavelet transform, transforms the images into a multi-scale representation with lower computational cost. When we apply Discrete Wavelet Transform (DWT) to the input images, it decomposes the images into four parts (LL, LH, HL and HH). Further, low-low sub bands are decomposed, and repeat for LL sub band as desired number of decomposition. Here in this work, we have taken 3- level of decomposition from Coiflet wavelet family with mean and standard deviation of the transform coefficients as a feature vector.

**Gabor Filter based features** Gabor filter is an example of linear wavelet filters, capturing energy at a specific frequency and a specific direction, and frequently used in many image processing applications such as; synthesis of images, segmentation, edge detection, pattern recognition etc. In all such applications, it is necessary to analyse the spatial frequency parts of an image in a localized manner using a Gaussian envelope [1, 23]. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have justified being appropriate for extracting useful texture features from an image.

. After applying Gabor filters on the images with different orientation at different scale, we obtain an array of transformed coefficients. Mean square energy, Mean amplitude of these Gabor coefficients are used to represent the homogenous texture feature of the region [18].

With the help of these levels the textures can be identified but the textures may not agree with human way of evaluating the textures. [3] These reasons are semantic gap and human perception subjectivity. Texture feature describes spectral features which are taken using wavelet transform, statistical features, tamura texture features etc. Tamura explored the texture representation from a different viewpoint. [4]Texture and color queries can be formulated in similar way, by selecting desired textures or by supplying a query image.

**C. Shape**: Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. In image retrieval, depending on the applications, some require the shape representation to be invariant to translation, rotation, and scaling, while others do not. Shape features of objects or regions have been used in many content-based image retrieval systems. Compared with color and texture features, shape features are usually described after images have been segmented into regions or objects. Shape may be defined as the characteristic surface configuration of an object; an outline or contour. It permits an object to be distinguished from its surroundings by its outline [15]. Shape representations can be generally divided into two categories [2]:

I. Boundary-based, and

II. Region-based.

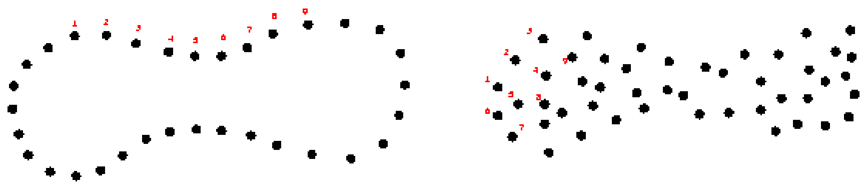

**Fig Boundary-based & Region-based**

Boundary-based shape representation only uses the outer boundary of the shape. This is done by describing the considered region using its external characteristics; i.e., the pixels along the object boundary. Region-based shape representation uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region [17].

The term shape refers to the information that can be deduced directly from the image. Shape is represented through perceptually grouped geometric cues such as edges, contours, joints, and polygonal regions extracted from an image. Such a grouping can serve as a spatial layout or as a rough sketch by additional post processing. Shape features are known as geometric features. Shape feature are commonly used – global features such as aspect ratio, circularity and moment invariants and local features such as sets of consecutive boundary. [6]

**D. Entropy:-**

This is the third and important criteria for performing Content Based Image Retrieval. There is a built-in method in MatLab to calculate the entropy values of any gray scale image, which helps us perform a deeper analysis on images to analyze the statistical measure of randomness in the images. This parameter is defined as follows,

$$-\text{sum}(p.log2\ (p))$$

Where, 'p' is the histogram count of the image under consideration. We first found the entropy value of the query image followed by all the images in the database. Then we subtracted the entropy values of every image from the entropy value of the query image. In order to filter the irrelevant images from the results, we had to choose a threshold for the difference value.

## III. IMPLEMENTATION

***Recall and Precision Evaluation***

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.

The first measure is called **Recall**. It is a measure of the ability of a system to present all relevant items. The equation for calculating recall is given below:

Recall= number of relevant items retrieved/number of relevant items in collection

The second measure is called **Precision**. It is a measure of the ability of a system to present only relevant items. The equation for calculating precision is given below.

Precision= number of relevant items retrieved/total number of items retrieved.

**Table Precision of CBIR using Color, Texture, Shape and Entropy**

| | N=5 | N=10 | N=20 |
|---|---|---|---|
| African | 0.17 | 0.18 | 0.18 |
| Beach | 0.2 | 0.18 | 0.3 |
| Building | 0.28 | 0.3 | 0.38 |
| Buses | 0.28 | 0.38 | 0.28 |
| Dinosaurs | 0.15 | 0.28 | 0.3 |
| Elephants | 0.28 | 0.3 | 0.28 |
| Flowers | 0.12 | 0.28 | 0.16 |
| Horses | 0.22 | 0.16 | 0.24 |
| Mountains | 0.26 | 0.24 | 0.24 |
| Foods | 0.14 | 0.26 | 0.26 |

The number of relevant items retrieved is the number of the returned images that are similar to the query image in this case. The number of relevant items in collection is the number of images that are in the same particular category with the query image. The total number of items retrieved is the number of images that are returned by the search engine.

Now the values of recall and precision can be calculated. The test should be repeated by selecting other query images from other categories in the database and this will provide the user with many values of recall and precision. These values are then plotted in the **Recall-Precision Graph**.

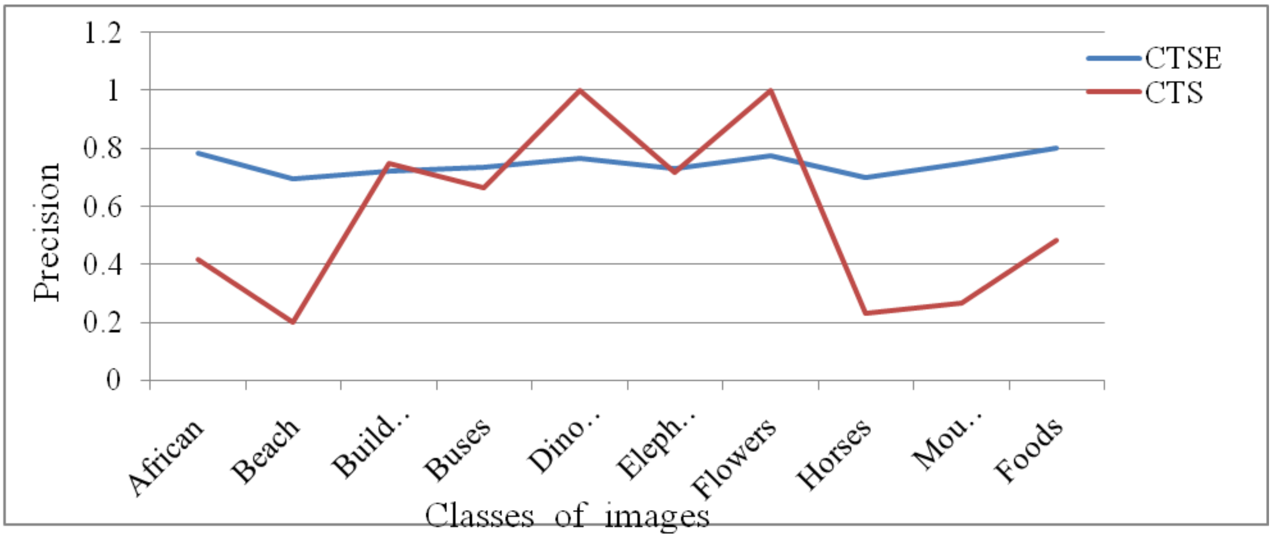


**Fig: Comparison of precision of CTSE and CTS**

Graph show the comparison of precision of CBIR system with color texture shape and entropy feature set with the color texture shape feature set.

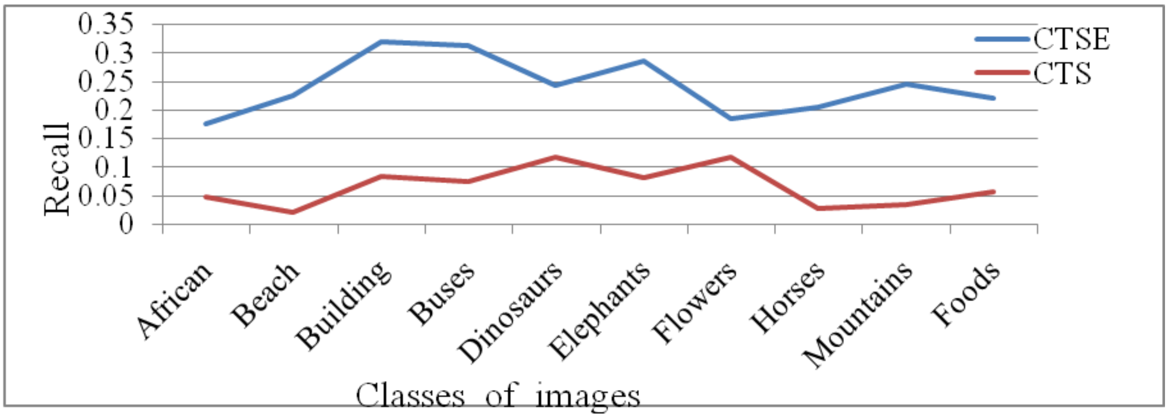


**Figure: Comparison of Recall of CTSE and CTS**

Graph show the comparison of recall of CBIR system with color texture shape and entropy feature set with the color texture shape feature set.

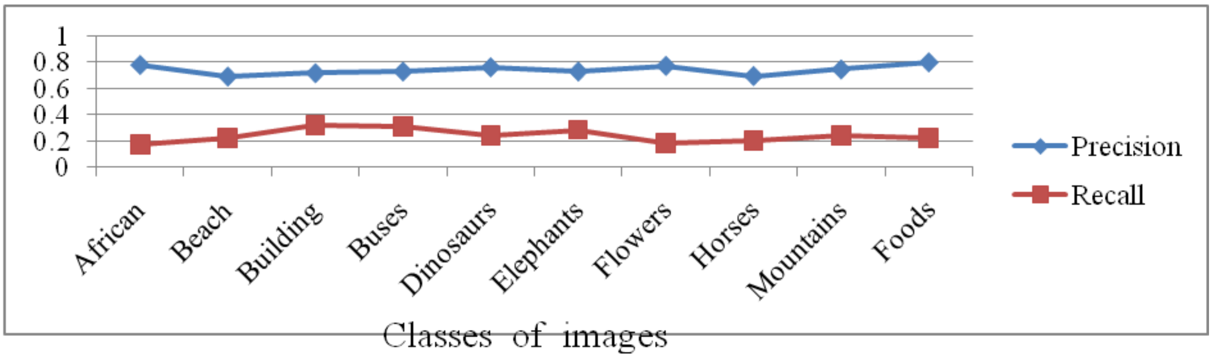


**Fig :Precision and recall of CTSE**

## IV. CONCLUSION

In CBIR, performance of system is increased using color texture shape with the combination of entropy .Using CTSE in CBIR it predicted class accurately and provide efficient and accurate results. Accuracy of the classification of images is done through SVM and generates a confusion matrix. So, overall accuracy of the CBIR is 82 %.

## V. FUTURE WORK

The system that we have developed shows a retrieval efficiency of nearly 82% at the end of entropy based retrieval. The CBIR system can be made to work on the Region of Interest in an image. We are planning to further improve the search based on some region of interest chosen by the user. The user will have to choose a region in the query image to insist upon the particular pattern as a symbol of training the system. The system will then have to work on that particular region. The region will be analysed based on the histogram properties and the entropy properties, to revise the query and retrieve the images with the even improved efficiency

## REFERENCES

[1]. Vibhav Prakash Singh , Rajeev Srivastava "Design & Performance Analysis of Content Based Image Retrieval System Based on Image Classification Using Various Feature Sets" 1st International conference on futuristic trend in computational analysis and knowledge management (ABLAZE 2015) 2015.

[2]. Deepika Shukla ,"Image Retrieval System Using Block-Based Statistical Features" 2st International conference on Image information processing (ICIIP-2013).

[3]. A.Srinagesh, K.Aravinda, G.P.Saradhi Varma, A.Govardhan, M. SreeLatha" A Modified Shape Feature Extraction Technique For Image Retrieval" International Journal of Emerging Science and Engineering (IJESE) ISSN: 2319–6378, Volume-1, Issue-8, June 2013.

[4]. Ahemd J Afifi and Wesam M. Content-Based Image Retrieval Using Invariant Color and Texture Features. IEEE Digital Image Computing Techniques and Applications (DICTA), 2012 International Conference on Date 3-5 Dec. 2012.

[5]. Jagadeesh pujari, S N pushpalatha, D padmashree"Content-Based Image Retrieval using color and shape descriptor", IEEE Signal and Image Processing (ICSIP), 2010 International Conference on Date 15-17 Dec. 2010

[6]. Ja-Hwung Su, Wei-Jyun Huang, Philip S. Yu and Vincent S. Tseng. "Efficient Relevance Feedback for Content Based Image Retrieval by Mining User Navigation Patterns", IEEE transactions on knowledge and data engineering, vol. 23, no. 3, march 2011.

[7]. K. Satya Sai Prakash, RMD. Sundaram. Combining Novel features for Content Based Image Retrieval. IEEE explores digital library pages: 373 – 376, 12 November 2007.

[8]. Arnold W.M. Smeulders, Marcel Worring, Simone Santini, Amarnath Gupta and Ramesh Jain. Content-Based Image Retrieval at the End of the Early Year. IEEE transactions on pattern analysis and machine intelligence, vol. 22, no. 12, December 2000.

[9]. Rahul Metha, Nishkhol Mishra, Sanjeev Sharm, "Color – Texture based image retrieval system", International Journal of Computer Applications (0975 – 8887), Volume 24 – No. 5 June 2011.

[10]. Kondekar V. H., Kolkure V. S., Kore S.N. "Image Retrieval Techniques based on Image Features: A State of Art approach for CBIR", Internation-al Journal of Computer Science and Information Security,Vol. 7, No. 1, 2010.

[11]. Arnold W.M. Smeulders, Marcel Worring, Simone Santini, Amarnath Gupta and Ramesh Jain. Content-Based Image Retrieval at the End of the Early Year. IEEE transactions on pattern analysis and machine intelligence, vol. 22, no. 12, December 2000.

[12]. Dumitru Dan Burdescu, Liana Stanescu. "Online software system for content based visual query of a colour medical imagery", IADIS, International Conference on Applied Computing 2005.

[13]. MatLab Manual.

[14]. A.M.W. Smeulders, M. Worring, S. Santini, A.Gupta, and R. Jain, "Con-tent-based image retrieval at the end of early years, "IEEE Trans. On Pat-tern Analysis and machine intelligence, vol. 22, no. 12, december 2000.

[15]. Liana Stanescu, "on-line software system for content-based visual query of a color medical imagery", IADIS International Conference on Applied Computing, 2005

[16]. Neetesh Gupta, R.K.Singh, "A New Approach for CBIR Feedback based Image Classifier", International Journal of Computer Applications (0975 – 8887) Volume 14– No.4, January 2011.

[17]. Wasim Khan, Shiv Kumar. Neetesh Gupta, Nilofar Khan, "A Proposed Method for Image Retrieval using Histogram values and Texture De-scriptor Analysis" , International Journal of Soft Computing and Engineer-ing (IJSCE) ISSN: 2231-2307, Volume-I Issue-II, May 2011.

[18]. Shengjiu Wang, "A Robust CBIR Approach Using Local Color Histograms," Department of Computer Science, University of Alberta, Edmon-ton, Alberta, Canada, Tech. Rep. TR 01-13,October2001,