Efficient CBIRS Using fused feature ELM

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ABSTRACT

Content based image retrieval, in the last few years has received a wide attention. Content Based Image Retrieval (CBIR) basically is a technique to perform retrieval of images from a large database which are similar to image given as query. CBIR is closer to human semantics, in the context of image retrieval process. In a typical CBIR system, image low level features like color, texture, shape and spatial locations are represented in the form of a multidimensional feature vector. The feature vectors of images in the database form a feature database. The retrieval process is initiated when a user query the system using an example image or sketch of the object. The query image is converted into the internal representation of feature vector using the same feature extraction routine that was used for building the feature database. The proposed framework initially selects pertinent images from a large databases using color moment information. Color information can be extracted from the image by both global and local techniques. consequently local binary pattern(LBP) and edges detection methods are used to extract the texture and edge features respectively from the query and resultant images of initial stage of this framework .The texture information is often estimated locally from the gray-level representation of an image and ELM for machine learning classifier is designed for unfussiness and speed.

Index Terms— *Image retrieval, machine learning, image extraction, Histogram intersection, CBIRS technique.*

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1. INTRODUCTION

With the advancement in internet and multimedia technologies, a huge amount of multimedia data in the form of audio, video and images has been used in many fields like medical treatment, satellite data, video and still images repositories, digital forensics and surveillance system. This has created an ongoing demand of systems that can store and retrieve multimedia data in an effective way. Many multimedia information storage and retrieval systems have been developed till now for catering these demands. Image retrieval is a method of browsing , searching and retrieving images from a large database of digital images . Image reclamation has been a very dynamic research area since 1970s. Image retrieval methods can be classified into two categories, Text- based image retrieval (TBIR) and Content-based image retrieval(CBIR). We can examine content with the help of images. CBIR maintains the extracted features for both the dataset images and query images[1]. Content – based image retrieval is a technique uses visual contents such as (color, texture and shape) to search images from large scale image databases according to users interest . In CBIR , every image in the dataset extracts its features and compares with the query image . In recent years, combined feature based image retrieval is an active research area in CBIR. Because of issues that exist in finding suitable feature extraction methods and their combinations, precision of the retrieval system is still scanty. The proposed framework mainly concentrates on improving the retrieval accuracy of the CBIR system by integrating the low- level features such as color, texture and edge of an image in a multilevel fashion [2].

1.1 Content Based Image Retrieval System

The most common retrieval systems are Text Based Image Retrieval (TBIR) systems, where the search is based on automatic or manual annotation of images. A conventional TBIR searches the database for the similar text surrounding the image as given in the query string [1]. The commonly used TBIR system is Google Images. The text-based systems are fast as the string matching is computationally less time-consuming process. However, it is sometimes difficult to express the whole visual content of images in words and TBIR may end up in producing irrelevant results. In addition, annotation of images is not always correct and consumes a lot of time. For finding the alternative way of searching and overcoming the limitations imposed by TBIR systems more intuitive and user-friendly content-based image retrieval systems (CBIR) were developed. A CBIR system uses visual contents of the images described in the form of low-level features like color, texture, shape and spatial locations to represent the images in the databases. The system retrieves similar images when an example image or sketch is presented as input to the system. Querying in this way eliminates the need of describing the visual content of images in words and is close to human perception of visual data.[3]

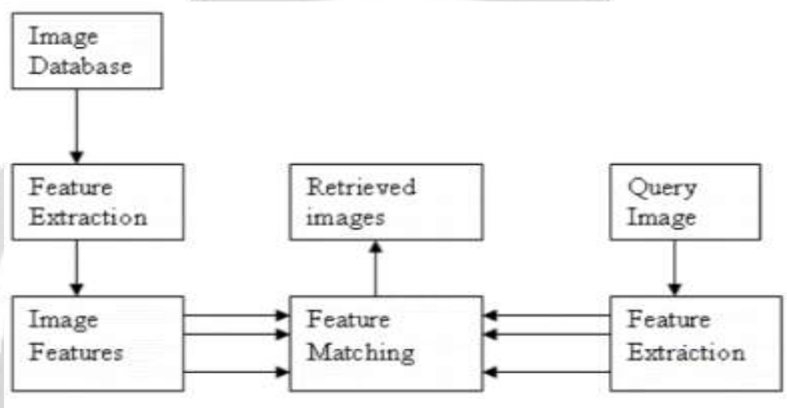

Figure 1: Architecture of a typical CBIR system

1.2 Need of CBIR

Since last few decades, systems working with retrieving large amount of multimedia data have been growing rapidly. Systems such as search engines, e-business systems, online tutoring system, GIS, and image archive are among few to them. These systems involve retrieving multimedia data based on pictorial content. In the image archive for example, a simple query such as searching for bird with yellow feathers requires the system to be able to find all images in the database which contains a bird with yellow feathers. This is a challenging task since it requires system to browse every single image in database and compare it to query image. Manual browsing the database to search for identical images would be impractical since it takes a lot of time and requires human efforts. A more practical way is to use Content based image retrieval (CBIR) technology. CBIR has provided an automated way to retrieve images based on the content or features of the images itself. The CBIR system simply extracts the content of the query image matches them to contents of the search image.[4]

II. RELATED WORK

Kommineni Jenni et al. [5] Proposed mechanism for CBIR systems is based on two works. The first work is based on filtering technology which includes anisotropic morphological filters, hierarchical Kaman filters and particle filters. The second work is based on the feature extraction which includes color and gray level features and after this the results were normalized. Finally, the experimental results show that this proposed technique of CBIR using advanced filter approaches is much better than the existing system GLCM and color feature extraction for CBIR process. **Krishnan Nallaperumal et al. [6]** was desired to improve the effectiveness of retrieving images on the basis of color content by Color Averaging technique. Firstly, an average mean-based technique with reduced feature size is proposed. Secondly, a feature extraction technique based on central tendency is proposed. The proposed CBIR techniques are tested on Wang image database and indexed image database. In the last, results that are obtained compared with the existing technique based on memory utilization and query execution time. The experimental results show that proposed technique gives the better performance in terms of higher precision and recall values with less computational complexity than the conventional techniques. **B.Jyothi et al. [7]** Presents a model for representation and indexing of flower images for purpose of retrieving flowers of interest based a query sketch. The scheme for flower retrieval system based on shape descriptors viz., Scale Invariant Feature Transform (SIFT), Histogram of Gradients (HOG) and Edge Orientation Histograms (EOH). To uphold the efficiency of proposed method, an experiment has been conducted on their own flower data set and from this it achieves a good accuracy with indexing approach. **H B Kekre et al. [8]** Provides a system for the large-scale database is designed and implemented. Million images on internet is a big challenge for accurate and efficient image retrieval. Here, the proposed system exploits semantic binary code generation techniques with semantic hashing function, fine and coarse similarity measure technique, automatic and manual relevance feedback technique which improve accuracy, speed of image retrieval. In this experimental result clearly shows that performance of image retrieval is improved in terms of accuracy, efficiency and retrieval time. **Sushant Shrikant Hiwale et al. [9]** here proposed an approach to perform content-based image retrieval. It is an integrated approach used to extract color and texture feature from images. By using single feature, correct results can never produce. So multi feature extraction is more beneficial to perform image retrieval. To extract the color feature, higher order of color moment is used which is the descriptor of color. To extract texture, LBP is used which is the descriptor of texture. Local binary pattern is mainly used to face recognition. In future, she will try to propose a new technique which will give more sufficient results. Clustering approach will be applied to reduce the searching time. Classification will perform to improve the system performance so that results can be much better. **Y. Mistry et al. [10]** introduced a new Hybrid scheme for efficient CBIR using spatial features such as color auto-Correlogram, moments, and HSV histogram features, Gabor wavelet transform features are used to increase precision of the presented approach. Finally in order to improve the precision we extracted CEDD and BSIF descriptors, which resulted in higher precision. Both global and local features are combined to obtained higher retrieval rate. Various distance metrics are used to obtain best retrieval time [5]. **A. Alfaki et al. [11]** introduced CBIR system that uses the combination of HSV color moment features and Gabor texture features. This method implemented on the WANG image database. Experimental results for ten class images showed the combination of color and texture features has higher retrieval accuracy than used only color or texture features. Also this method approved the presented images by its features need size of storage media less than use the images itself [6]. **Y. Zheng et al.[12]** introduced with the development of digital pathology, histological sections can be scanned by pathologists using micro-scanners during their rest time and stored as digital whole slide images (WSIs).The time between scanning and diagnosis is a valuable resource for computer-aided diagnosis (CAD). After or during35 the scanning period, the WSIs can be analyzed using a reliable artificial intelligent algorithm, which can promote the diagnostic accuracy and relieve the workload of the pathologists. pattern generate by the SCAN methodology. The SCAN is a recognized language-based 2D spatial-accessing methodology generated a wide range of scanning path or space substantial curves.

III PROPOSED WORK

The typical feature descriptors used in the proposed work to extract the local features like color, texture and edge are illustrated in this section. The generalized architecture of the proposed framework is shown in Fig. 1.3.

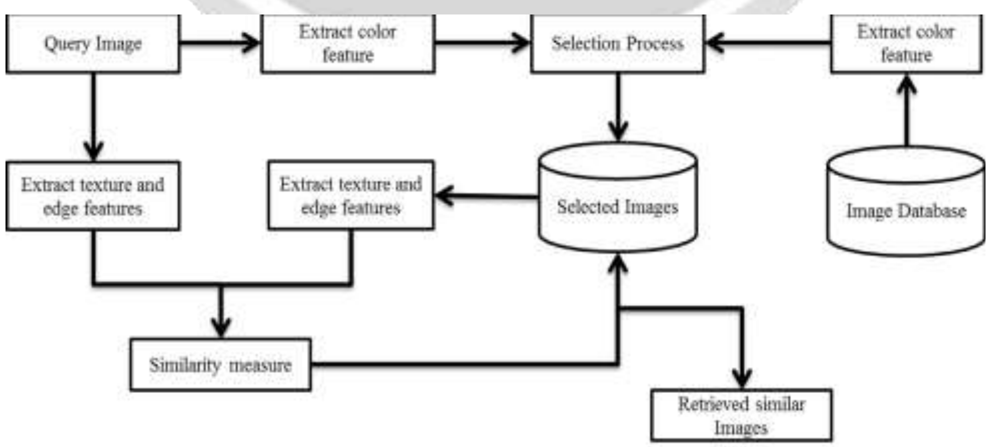

Figure.7 Block Diagram Of Colour, Texture and Edge Based CBIR

2.1 Color descriptor

In the proposed work, for minimizing the complexity and improving the effectiveness of the CBIR, the global color descriptor is used in the first level of retrieval. Hence, color moments (statistical measure) are chosen to represent the color details of the image. It gives the pixel distribution information of the image in two compact forms [14]. The first order moment gives average information about the pixel distribution of a given image and the closeness of the pixel distribution about mean color is estimated by second order moment. Moreover, the usage of color feature in the proposed work is different from the conventional CBIR system although both employ color moments. In the first stage of the retrieval process, average color information (mean) and the quantity of the amount of pixels that differs from the mean (standard deviation) of the query image are estimated globally from the three color channels (Red, Green, and Blue) of the RGB color space using Eq. (1) and (2). If the pixels present in the image are close to the average value, it decreases value of standard deviation. A high standard deviation indicates that the huge amount of color pixel is not close to mean value.

Mean (*Ic*) = 1 *M* ×*N M* _ *i* =1 *N* _ *j*=1 *P cij* , *c* = { *R*, *G*, *B* } Eq..(1)

Std(*Ic*) = _ 1 *M* ×*N M* _ *i* =1 *N* _ *j*=1 _*P cij* −*Mean* (*Ic*) _2 _ 1 2 , *c* = { *R*, *G*, *B* } Eq..(2)

Where *Ic* holds the color channel information of an image. *M* and *N* are the row and column size of an image. *P cij* indicates the value of image pixel in the *i*th row and *j*th column of the particular color channel. Only the mean value of R, G and B color channels is required for the database images to obtain the reduced search space. Meanwhile, standard deviation of the image is also important to give details about the distribution of image pixel around the average information. Hence, standard deviation details are added and subtracted with the mean. The results of these operations give two threshold values for each channel. They are represented as Low-Threshold (LT) and High-Threshold (HT) which is given as follows:

$$LT(Ic) = Mean(Ic) - Std(Ic),\ c = \{R, G, B\} \quad \text{Eq..(3)}$$

$$(HT(Ic) = Mean(Ic) + Std(Ic),\ c = \{R, G, B\} \quad \text{Eq..(4)}$$

If the first order color moment of each channel (R, G and B) of the database images lies in between the two thresholds (including two threshold values) then those images are selected for the next stage of feature extraction process. The threshold values of the R, G and B color channels are combined by the logical AND (&&) operator. Here, first stage of the proposed work behaves as a filter that takes all images from the database and passes the images which satisfy the well-defined rule in this level. At the end of this first stage, selected images collectively form a subset from the original database. Subsequent level of the retrieval system uses this subset of images instead of using the original database for image retrieval.

2.2 Texture descriptor

This extraction algorithm is performed over the subset of images selected from the first level of the retrieval process. Before exploring LBP on the selected images, RGB to gray scale transformation is carried out as a pre-processing step on these images. For iteration it takes 3 ×3 overlapping gray scale image as input [13]. The pixel value available in the Center Position (CP) of the 3 ×3 sub block acts as a threshold value for its neighboring pixels. Using this threshold value, binary representation of that sub block is created. Then, the LBP value of the 3 ×3 sub block is evaluated in the counter clockwise direction. Finally, the LBP value is updated in the center pixel position of that block in the image. First iteration of the LBP is illustrated in fig 3.2 and Eq. (5) shows the estimation of LBP for a 3 ×3 block representation:

LBP N = *N*−1 _ *i* =0 *f*(*P i* −*CP*) 2 *i* ;*f*(*p*) = _1 ;*P* ≥0 0 ;*P* < 0 Eq..(5)

where *N* denotes the total number of neighboring pixels for the center pixel in the 3 ×3 sub block, here *N* = 8. *P i* holds the value of neighboring pixels, *i* = {0, 1, 2,..., 7}. *CP* is the center pixel value of the sub block. In fig 3.2(a) the first 3 ×3 sub block is taken from the simple 5 ×5 size gray image. In this, the center pixel value 21 is the threshold value for its 8 neighbors. The difference between the value of every neighbor pixel and the center pixel value is calculated. If the difference value is greater than or equal to 0 then that particular pixel value is turned into 1, otherwise 0 is updated in its place. Subsequently, these 8 bit binary values are converted to decimal values and rehabilitated in the place of the center pixel.

2.3 Edge descriptor

Normally, edges are formed by the abrupt change in the intensity value of the image which is captured by the edge detection algorithms and it holds the boundary representation of the objects present in Fig. 1.4.

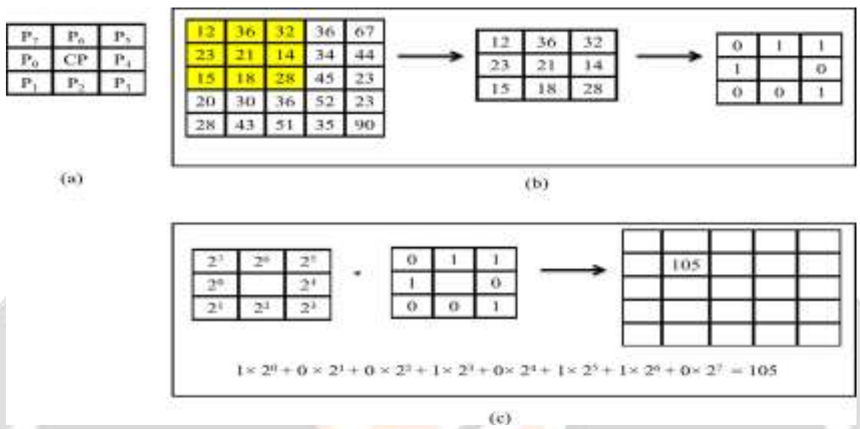

Fig 1.4 First iteration of LBP: (a) Pixel position of 3 ×3 block image (b) Binary value creation using threshold value (c) LBP value generation through the obtained binary values.

Low -level visual content of an image can also be expressed and preserved in the form of edges. Human perception is highly sensitive to edges [11]. In RGB color space, each color channel is highly correlated with other**.** Color channels such that the splitting of chrominance and luminance information is impossible and is perceptually non-uniform to human perception. Gray scale information is enough to mark edges in images but gray to RGB conversion is not possible to produce color image. Hence, color space transformation has to be performed to obtain the edge details from the intensity plane of an image. This is the first step in edge feature extraction process. RGB to HSV conversion [20] takes place as per Eq.(6)–(8).

$H = 60 \times\_(G - B)\ \delta,\ R = \max(R, G, B)\ 60 \times\_2 + \_B - R\ \delta,\ G = \max(R, G, B)\ 60 \times\_4 + \_R - G\ \delta,\ B = \max(R, G, B)$ Eq..(6)

Where $\delta = \max(R, G, B) - \min(R, G, B)$ Eq..(7)

$S = \delta \max(R, G, B)\ (7)\ V = \max(R, G, B)$ Eq..(8)

where H and S carry the chrominance details of the given image. V channel holds the intensity distribution of that image. Canny edge detection algorithm is run over the V channel. Then, the edge extracted V channel is combined with un-modified H and S channel and transformed back to RGB color space. After that, these color edge features are estimated through the histogram of R, G and B channels separately.

III. EXPERIMENTAL RESULTS

For the purpose of experimentation and verification, experiments are conducted over the Wang's [22], Corel-5K [23] and Corel-10K [23] databases. Each database contains 1000 images respectively of size 256 ×384 or 384 ×256(Wang's). In Wang's database, 1000 images are divided into 10 groups and a sample image from each class (African tribes, Food, Sea, Buildings, Bus, Dinosaurs, Elephants, Flowers, Horse and Mountains) is shown in Fig. 1.5. Wang's database images are also divided into 50 and 100 classes and each class has 100 images into it. Here, the experiments are executed in the MATLAB R2013a, an environment along with the dual core processor, 2 GB memory and 64 bit windows operating system and the experiment is performed over the three databases.

4.1. Stage 1: Image selection

Retrieval accuracy and similar image search space of this hybrid system is highly dependent on the result of global visual content descriptor. Color is the easily assessable, more powerful and widely used visual content in image and video based retrieval systems. Beyond that, here it plays an additional role as a filter to restrict the set of images which do not fall within the limits defined in Eq. (3) and (4).

4.2. Stage 2: Texture and edge feature extraction

The feature extraction process is carried out with images from the new database and query image. For texture feature extraction, each image in the subset is converted to it corresponding gray scale form and then LBP extraction is applied over those images which serve texture information in 256 values. LBP creation of an image is shown in Fig.1.5

Fig 1.5 LBP texture and edge feature extraction

Efficiency of the proposed system's image selection process is tabulated in Table 1 which is evaluated by measuring the average number of images involved in second level feature extraction process and their retrieval time. The experimental results of this work show that it approximately takes 490, 1850 and 3500 number of images from the Wang's, Corel-5K and Corel-10K database for the subsequent process. Size of the image is also responsible for the feature extraction time and retrieval efficiency. Here, feature calculation time of the Corel-5K and Corel-10K database image is less than the Wang's database image since image size of the Corel database is less. Moreover, Corel-5K is a subset of the Corel-10K database so that the average time taken for feature extraction is same in both databases but the retrieval time of these databases is different as it depends on the size of the database.

catname	Category	Base-Precision	Proposed-Precision
African Tribes	1	90	95
Sea	2	85	100
Building	3	65	90
Bus	4	100	100
Dinosaurs	5	100	100
Elephants	6	80	95
Flowers	7	100	100
Horse	8	97.5	97.5
Mountain	9	55	100
Food	10	82.5	95
	Avg. Precision	**85.5**	**97.25**
	Avg. ExeTime.	0.246156	0.182674

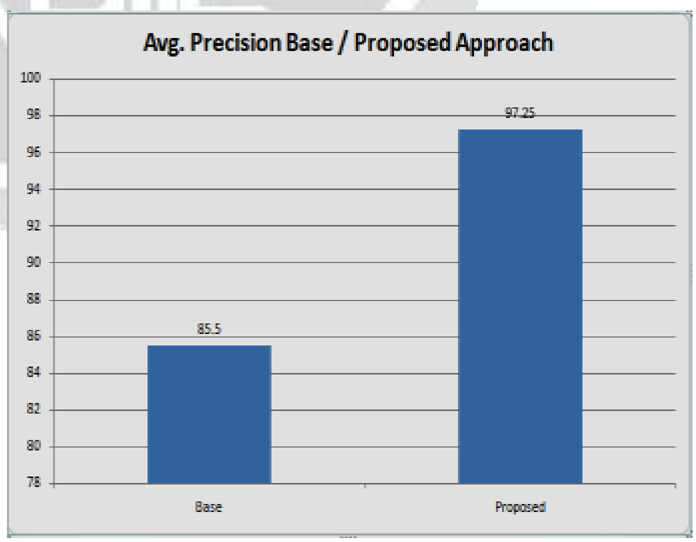

Fig.1.6 feature extraction process and their retrieval time

Fig.1.7 comparison between base LBP precision and proposed ELM precision

The average precision has been calculated for all matrices and categories this and precision is averaged after getting average outcomes from all categories shown in fig. 1.6 and Fig.1.7. Here the comparison between LBP precision and ELM precision technique clearly shown that there is an improvement in performance of CBIR.

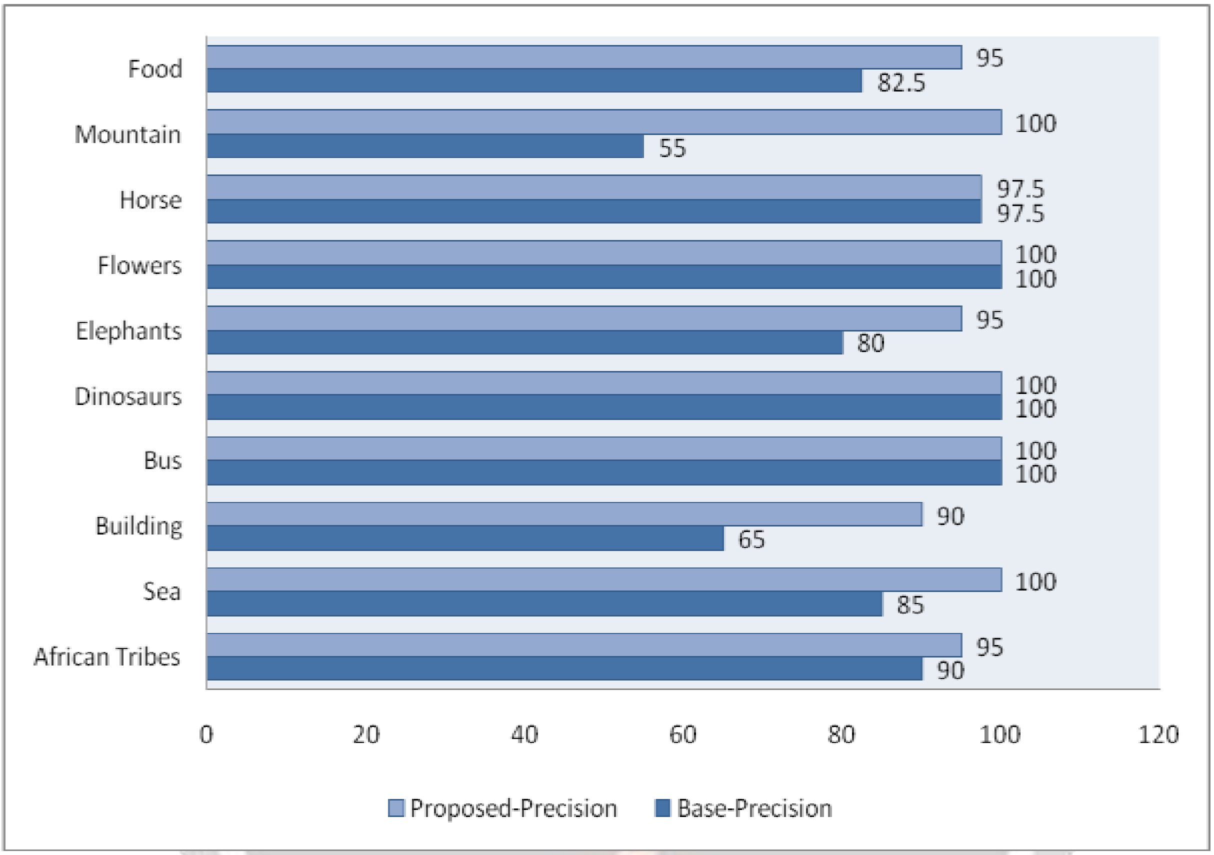

Fig.1.7 category-wise precision comparison

IV.CONCLUSION

A new hybrid feature scheme is proposed for efficient CBIR in this thesis based on color and texture with various distance metrics. The main benefaction of this work is to construct an efficient (well organized) and effective (productive) CBIR system using fusion and machine learning that tends to be workable for massive datasets. Therefore, this proposed work has presented an efficient image indexing and search system based on color and texture features. The color features are described by the edge extracted V channel is combined with un-modified H and S channel and transformed back to RGB color space. A group of experiments was executed to select the optimum vocabulary size that obtains the best retrieval performance. All considered retrieval procedures are analyzed on Wang datasets in RGB color spaces. The proposed approach is effective in image retrieval. LBP technique gives texture features extraction obtained 85.5% average precision, where proposed ELM which is used to extract color features obtained 97.25% average precision.

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