CBIR of Trademark Images in different color spaces using XYZ and HSI

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Abstract –"CBIR", Content Based Image Retrieval also known as query by image content and content based visual information retrieval is the system in which retrieval is based on the content and associated information of the image. The basis of presenting this paper is the retrieval of images based on the color and text components present in the query image. The proposed work presents matching assessment of trademark or logo images using color features based over the index of Hue, Saturation and intensity. Overall, the work experimentally compared the XYZ and HSV algorithm on the measurement of Euclidean distance for Content Based Image retrieval. The results evaluate that the proposed algorithm is quiet better as compare to XYZ for set of dataset of trademark images on the basis of color, text and logo

Index Terms –CBIR, HSV, Euclidean Distance, Similarity measure, Extraction, Indexing.

1. INTRODUCTION

Image retrieval in general and content based image retrieval in particular are well-known research fields in information management.[1] Content based image retrieval is one of the popular image processing field having huge scope forresearchers to work out the novel ideas that will produce the promising results. Core phases of CBIR where the research contribution is desired, are feature extraction based on image contents, Similarity measures used for comparison and the performance evaluation using various parameters. [2]

The main consideration of image retrieval is the structure of images in image database, Here, the database images are stored in structured manner. The scenario of CBIR is mainly indexing images in image database and retrieval. Firstly, using multiple features generates the feature vectors and those are accordingly stored in an index correlated to the database images. And then, based on the similarity measure between database images and query image the relevant images will be retrieved. [3]

Initially, Content-Based Image Retrieval (CBIR) systems were introduced to address the problems associated with text-based image retrieval. CBIR is a set of techniques for retrieving semantically-relevant images from an image database based on automatically-derived image features. The main goal of CBIR is efficiency during image indexing and retrieval, thereby reducing the need for human intervention in the indexing process. CBIR systems mainly involve research on databases and image processing handling problems which varies from storage issues to user friendly interfaces. CBIR systems are mostly developed in Database Management Systems (DBMS).

In other words, Content-based image retrieval technique uses visual contents to search images from large scale image databases based on users' interests. It becomes an active and fast advancing research area. Image content may include both visual and semantic content. Content-Based Image Retrieval (CBIR) is a technique for retrieving images on the basis of automatically-derived features such as color, texture and shape. These techniques includes several areas such as image segmentation, image feature extraction, representation, mapping of features to semantics, storage and indexing, image similarity-distance measurement and retrieval which makes CBIR system development as a challenging task.

1.1 CBIR Ranking Methods

There are various components we use to classify CBIR systems are how they construct the ranking function. These include into global and local methods.

Global Ranking Methods use all "meaningful" portions of the image in the ranking function. Observe that while salient point based methods only use the portions of the image around the salient points, if the ranking method is based upon the number of salient points that match those of the query image, then it is a global method since all portions of the image around the salient points are used in ranking the images. These methods can further be divided into two sub-categories.

Fixed Similarity Measure: A non-adaptive similarity measure is defined over the feature vector(s) which is then use to rank the images from the most to least similar with respect to the query image. Such a method is typically used when there is just a single query image (and no relevance feedback is used). For example, a cosine similarity measure can be used between the vectors defined by a colour histogram. Some very sophisticated similarity measures have been defined. For example, the integrated region matching (IRM) algorithm used within simplicity computes a global similarity measure based on a weighted sum of region-to-region distances with the weights selected to minimize the distance while ensuring that all regions are matched.

Trained Similarity Measure: A machine learning algorithm uses labelled images (generally obtained via relevance feedback) to improve the performance of the ranking algorithm by optimizing parameter value(s) of a parameterized similarity measure. For example traditional relevance feedback often re-weights the features when the image is represented using a single feature vector such as a colour histogram. More recently such approaches have been extended to representations using multiple feature vectors. ROI and Spatial Layout both partition the image into pre-defined blocks and employ standard relevance feedback at the block level using the spatially corresponding blocks of the feedback images. In ROI, the user is asked to draw a bounding box around the region of interest in the query image which is used to weight each block relative to how much of its area is in the bounding box.

Local Ranking Methods: Apply MIL algorithms to labelled images that are represented by a set of feature vectors. By using such an approach the ranking functions can focus on the feature vectors that are relevant to the user's query. For example, a salient point based method that learns which subset *S* of the salient points are contained in desirable images and ranks images based on how many of the salient point.

1.2 Main Fundamentals of CBIR TECHNIQUES

There are three fundamental bases for content-based image retrieval, i.e. visual feature extraction, multidimensional indexing, and retrieval system design. CBIR operates on a different principle, retrieving stored images from a collection by comparing features automatically extracted from the images themselves. The other approaches suggested here to make the content-based image retrieval truly scalable to large size image collections, efficient multidimensional indexing techniques need to be explored. These approaches for the content based image retrieval are described below.

A. Feature Extraction

In simple words, Feature means countenance, remote sensing scene objects with similar characteristics, associated to interesting scene elements in the image formation process. They are classified into three types in image processing, that is low, middle and high. Low level features are color, texture and middle level feature is shape and high level feature is semantic gap of objects. An image retrieval system is a computer system for browsing, searching and retrieving images from a large image database. Content Based Image Retrieval (CBIR) is a technique which uses visual features of image such as color, shape, texture, etc…to search user required image from large image database according to user's requests in the form of a query [11].

CBIR operates on a collection by comparing features automatically extracted from the images themselves. The features may include Text based features like keywords and annotations and visual features like color, shape, texture, shapes. Several methods for retrieving images on the basis of color similarity is that each image added to the collection is analyzed to compute a color histogram which shows the proportion of pixels of each color within the image. Second perspective is texture retrieval; texture refers to the visual patterns that have properties of homogeneity that do not result from the presence of only a single color or intensity. To extend the global color feature to a local one, a natural approach is to divide the whole image into sub blocks and extract color features from each of the sub blocks called segmentation based retrieval.

B. High Dimensional Indexing

To make the content-based image retrieval truly scalable to large size image collections, efficient multidimensional indexing techniques need to be explored. There are two main challenges in such an exploration for image retrieval: High dimensionality, Non-Euclidean similarity measure. For solving these problems, the approach of dimension reduction likes PCA and then to use appropriate multidimensional indexing techniques, which are capable of supporting non-Euclidean similarity measures. We have identified the embedded dimension of the feature vectors, as there was the need to select appropriate multidimensional indexing algorithms to index the reduced but still high dimensional feature vectors.

C. Image Retrieval System

Many image retrieval systems support one or more of the following options: random browsing search by example, search by sketch, and search by text (including key word or speech) navigation with customized image categories. QBIC is standing for query by image content, is the first commercial content-based image retrieval system. QBIC supports queries based on example images, user-constructed sketches and drawings, and selected color and texture patterns other system is Virago is a content-based image search engine similar to QBIC, supports visual queries based on color, composition, texture, and structure. The Novel approach to evaluate the possibilities of narrowing the Semantic Gap, is it possible to create a framework which can be used by an image retrieval system to assist in retrieving images with similar semantic content but differing structural content [12].

Therefore, there is an urgent need to remove the barriers to have a streamlined retrieval system which works for humans and with humans. There is a growing interest in CBIR because of the limitations inherent in metadata-based systems, as well as the large range of possible uses for efficient image retrieval. Commercially, CBIR widely used into the filtering and law enforcement markets for the purpose of identifying and censoring images with skin-tones and shapes that could indicate the presence of nudity, with controversial results [13].

The evaluation of CBIR retrieval is typically subjective, in recent years methods incorporating user relevance feedbacks start to show promise in resolving this issue. Two directions of research are observed in incorporating user relevance feedback in CBIR: (1) developing a weighting scheme to explicitly “guide” the retrieval. (2) Applying machine learning techniques such as Bayesian net and Support Vector Machine to reduce the problem to a standard reasoning and classification problem.

2. LITERATURE REVIEW

Lining Zhang et al. (2012) proposed a methodology on Biased Discriminate Analysis (BDA) which was one of the most promising Relevance Feedback (RF) approaches to deal with the feedback samples for Content-Based Image Retrieval (CBIR). However, the singular problem of the positive within-class scatter and the Gaussian distribution assumption for positive samples were two main obstacles impeding the performance of the BDA RF for CBIR

Daniel Manger (2012) presented biometric-based identification systems, tattoos and other body modifications have shown to provide a useful source of information. Besides manual category label assignment, approaches utilizing state-of-the-art content-based image retrieval (CBIR) techniques have become increasingly popular. While local feature-based similarities of tattoo images achieve excellent retrieval accuracy, scalability to large image databases can be addressed with the popular bag-of-word model[10].

Swati Aggarwal (2013) worked over Content Based Image retrieval using discrete wavelet transform and Edge Histogram Descriptor. The proposed work for image retrieval mainly based over shape and texture features only not on the basis of color information. In this paper a database of feature vectors was proposed from images using wavelet wavelet and edge histogram descriptor techniques and the search was usually based on similarity rather than on exact match and then retrieved results ranked according to similarity index for which they used Manhattan Distance[7].

T. Dharani et al. (2013) classified into three types in image processing that was low, middle and high. Low level features are color, texture and middle level feature is shape and high level feature is semantic gap of objects. An image retrieval system is a computer system for browsing, searching and retrieving images from a large image database.

Lining Zhang et al. (2013) proposed a Conventional content-based image retrieval (CBIR) systems with the Euclidean distance metric in a high-dimensional visual feature space usually cannot achieve satisfactory performance due to the semantic gap. Relevance feedback (RF) had been introduced as a powerful tool to involve the user in the system to improve the performance of CBIR. Despite the success, an on-line learning task can be tedious and boring for the user. Various schemes have been proposed to exploit the RF log data to further enhance the performance of CBIR[8].

R. Kingsy Grace (2014) mentioned a methodology of Medical Image Retrieval system in Grid using Hadoop framework. In this paper, texture based Content Based Image Retrieval algorithm was used for efficient image retrieval using Hadoop which was tested with three current operative nodes. The implementation was carried out in three different stages namely grid setup, storing data into HDFS and image retrieval. Finally, they concluded that the proposed work was used to store and retrieve medical images which facilities accurate retrieval of images matching the queried image. The result was quiet reliable and optimist for medical image retrieval system which was further very easy to adopt in cloud environment with minimal overhead and higher accuracy [4].

B. L. Deekshatulu (2014) presented a review paper in which not just the introduction to content based image retrieval system is discussed but a comprehensible definition of semantic gap is also discussed by giving reference to low level feature extraction methods which includes labeling of objects, segmentation, salient region annotation and low level numeric values. After discussing these, the author has also described three levels of queries which are possible in content based image retrieval which includes retrieval by abstraction, retrieval by low level features and retrieval by logical inference. The relevance of high level concepts (ontology) as well as using the concept of semantic templates to support high level image retrieval has also been discussed [5].

3.PORPOSED MODELLING

Nowadays, Trademark Images plays an important role for research in the field of CBIR. Due to enormous growth of logo and brand there is an urgent need to upload their database to secure the immunity of any community and organization. Logo gives a mark of the brand which has value in its own. This research mainly deals with the trademark images. In this thesis, an image retrieval system will be developed which helps to search the images as well as content inside them with high level of accuracy and see how experimental results value can be increased by reducing the semantic gap of Content Based Image Retrieval System for highly textured images or trademark images. In this work mainly dealing is done with different trademark images on the basis of color and context (texture) feature dependent. As there is digitalization happening across the world which is leading to creation of huge amount of documents created using various kinds of applications like Photoshop and Auto Desk etc., there is an urgent need to organize, classify and categorize the images using the content of the images. Then, secondly, information system(IR) suffer from sensory and semantic gaps due to difference in machine algorithms or how machine understand as compare to how humans need information. For e.g. if user is looking for rough image, the IR system cannot understand what the user is really looking for and specially when information is asked in linguistic terms and due course of time sometime the user himself is not able to explain what he is looking from the IR system. For e.g. he cannot describe the texture he is looking for, in simple words he is unable to explain in linguistic terms also. Thus sensory gap is also there. This research work will try to reduce both these gaps by using algorithms and linguistic descriptors. For, this GUI simulation approach is used and on the basis of color and context features we may retrieve data similar to the query images. Finally, the simulation is performed to find the goal of the objective.

4. METHODOLOGY

There are various steps and requirements to define the proposed work flow of the system with image processing. At initial stage, we start the processing and refining the set of data of dataset of trademark or logo images that we are using in our research and after doing one by one various associated steps finally result is evaluated. There are various tools and frameworks have been used for the implementation of the proposed work. One is Image Processing Toolbox which provides set of reference-standard algorithms and graphical tools for image processing, analysis, to examine a region of pixels, to detect and measure features, and analyze shapes and textures, visualization, and algorithm development. Another one is Image Acquisition Toolbox which mainly deals to acquire images and videos from cameras and frame grabbers directly into MATLAB. It has features to detect hardware automatically, configure hardware properties, preview an acquisition, and acquire images and video. And again another one is Statistics Toolbox which provides algorithms and tools for organizing, analyzing, and modeling data. It mainly includes specialized data types for organizing and accessing heterogeneous data. This tool has been used to analyze computations and to make result graphs.

The research started with the objective of processing and refining image dataset that we are using a in the proposed framework and algorithm and in this process, following steps and processes evolved which lead to development of the research work.

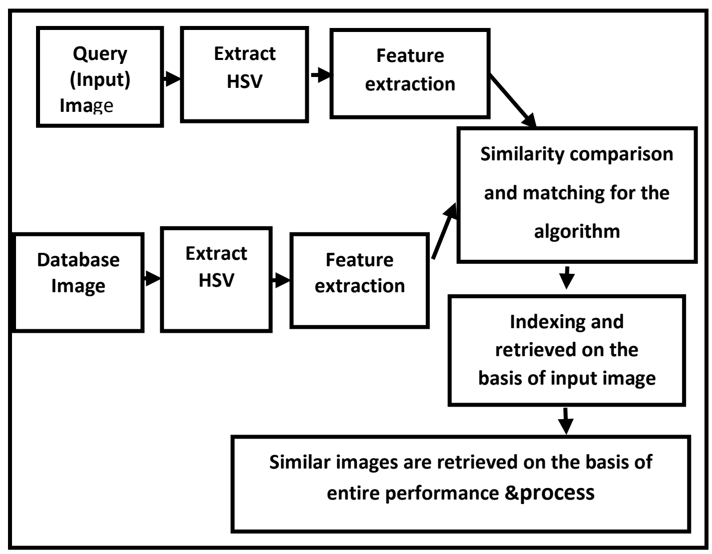

Figure 1. Steps of methodology

4.1Trademark Image Preprocessing

In order to conveniently compare with various different size images and consider the computer's speed, the size of all these images should be limited within 256*256 pixels.

First, it's necessary to choose a proper color space to express a color trademark image RGB color space, if needed converted to HSV color space which consisted of Hue, Saturation and Value, is much closer to human visual feelings. Hue and saturation together refers to as chroma. HSV space is more easily acceptable. Therefore, RGB space is frequently transformed.

4.2 Color and Context feature extraction

The theory of color feature extraction from digital images mainly depends upon the color representation, its space selection and quantization.

The most common color space is the RGB color space in which color are represented as combination of three colors namely Red (0-255), Green (0-255) and Blue (0-255) which is the primary colors of this model. In this model desired colors can be produced by adding them together.

4.3 XYZ Color Space

It is defined such that all visible colors can be defined using only positive values, and, the Y value is luminance. Values of red, green, and blue to be undesirable for creating a standardized color model which is suitable for all devices. Because of this reason CIE used a mathematical formula to convert the RGB data to a system that uses only positive integers

A.Quantization of Color Space

Quantization is the process of reducing the numbers of colors by putting similar color in the same. For this we are using histogram to find out this. Normally, quantization reduces computational and comparison time of color feature.

Since, in the proposed work first of all we are using HSV color space we are considering quantization on the basis of number of bins. Here we are using totally 256 bins for very large color components and to give better results."

In general, color descriptor can be determined by color histograms, color coherent vector etc. and used for CBIR according to performance of color histograms which represent the number of pixels that have colors in each range and the superior one is compared.

B.Euclidean OR Distance Measurements

It measures the similarity between the two different feature vectors [4]. Similarity comparison and matching procedure should be done using Euclidean or any other distance formula.

$$Euclidean\ Distance = \sqrt{\sum_{i=1}^{n}[Q_i - D_i]^2}$$

For 0 finding color co-occurrence matrix, here discrete wavelet transform method is being used for matching the retrieved input/query image matrix to the store database by dividing and segmenting into four segmented top left, top right bottom left and bottom right.

Work Flow and Description of the proposed methodology

Step 1: Read the input RGB image

Step2: Covert the RGB image into HSV

Step3: Implementation of XYZ algorithm: In this step we have to implement XYZ algorithm in which retrieval of images will be based on XYZ color spaces. For this we are using XYZ indexing for matching the resultant images. Moreover, we are using bins approach based feature extraction approach. For this, we have to first separate the image into three planes of respective color spaces. After that, we have to compute the histograms for each of the three planes of the image from each color space. Then each image has three histograms partitioned into two parts with map1 and map2. In this step three values of each pixel with respect to each plane (histogram) intensity is checked; that in which part of the respective histogram it falls. And finally, on the basis of Euclidean distance and XYZ indexes the associated images will be retrieved on the basis of colors, text and logos in the query image.

Step4: Implementation of proposed algorithm: In this step we have to implement HSV algorithm in which retrieval of images will be based on HSV color spaces. For this we are using indexing of Hue, Saturation and Intensity for matching the resultant images. Moreover, we are using bins approach based feature extraction approach. For this, first of all the image is separated into three planes of respective color spaces. After that, compute the histograms for each of the three planes of the image from each color space. Then each image has three histograms partitioned into two parts with map1 and map2. In this step three values of each pixel with respect to each plane (histogram) intensity is checked and combine in one; that in which part of the respective histogram it falls. And finally, the last phase called similarity measurement will be done on the basis of Euclidean distance and HSI indexes. The associated images will be retrieved on the basis of colors, text and logos in the query image.

Step5: Comparison and Evaluation of results: Finally the comparison of both algorithm will be done on the basis of Precision and Recall cross over point for parameters Mean, STD for the measurement of Euclidean distance.

- PRCP: Precision and Recall Cross over Point
- It has been derived from the two conventional parameters used for performance evaluation precision and recalls which are defined as follows:
- $\mathrm{PRECISION} = \frac{\text{Relevant Retrieved Images}}{\text{All Retrieved images}}$
- $\mathrm{RECALL} = \frac{\text{Relevant Retrieved Images}}{\text{All images in Database}}$
- Mean: It is the sum of all relevant values of precision or recall divided by total number of inputs taken.
- $\mathrm{MEAN} = \frac{\text{Sum of all relevant Values}}{\text{Total Number of inputs}}$

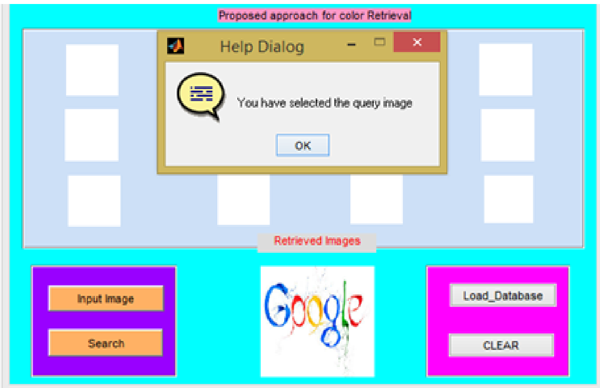

Figure 2 Snap shot of the successfully taken the input or query image

The above screenshot in Fig 2 indicates the function of Input image button. The figure clearly depicts that the input image is successfully selected and ready to perform their function. Here, input image is taken as 'Google' image which can be seen through the above screenshot.

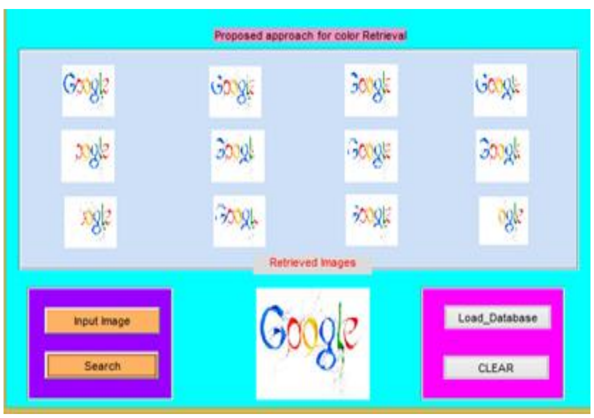

Figure 3 Snap shot of the image retrieval for proposed approach

The above Fig 3 clearly depicts the usage of search button. The search button is highly based over the implementation of proposed algorithm. In the above screenshot there is the retrieval of all associated images which are quiet similar in various manner to the input image and also on the basis of algorithm and the index applicable by HSI. There is twelve different images displayed in the screenshot which is highly applicable and the input image is appearing at first position.

Whenever the entire work is happened then there is need to clear all the data and associated database loaded in the main program. Furthermore, after that user can choose the next input image for examine the results and their performance. The above Figure 4 clearly depicts the deletion of database successfully.

Fig 4 Snap shot for clear all the data for the proposed GUI scenario

Fig 5 graph shows Precision on Y-axis and Input of Trademark images 1 to 85 on X-axis. It clearly depicts the comparison graph of XYZ algorithm and proposed HSV (HSI) method on the basis of precision value. The precision value of XYZ algorithm is constant and very low as compare to the proposed algorithm. For the proposed algorithm the precision value is quiet better and optimist which can be seen here from the above figure. Higher will be the precision value higher will be the accuracy of results. The precision value calculated on the basis on number of favorable retrieved image with respect to all retrieved images.

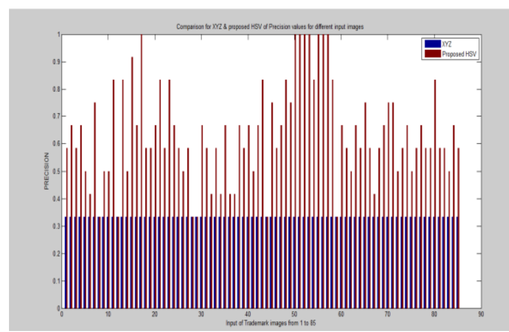

Figure 5 Comparison of PRECISION graph for XYZ and proposed HSI approach

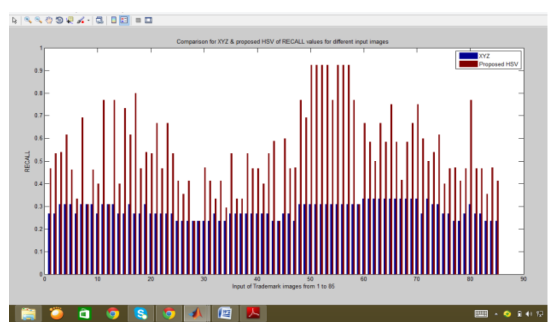

Figure6 Comparison of RECALL graph for XYZ and proposed HSI approach

Fig 6 shows Recall on Y-axis and Input of Trademark images on X-axis. Since, the precision value of XYZ algorithm is quiet low as compare to proposed approach. Then from the above Fig 6 Recall value of XYZ algorithm is also low as compare to propose HSI algorithm for all the relevant input images in the entire eighty five datasets. Here, Fig 6 clearly depicts that the comparison graph of XYZ and proposed algorithm on the basis of recall value and the results clearly indicates in high accuracy favor to the proposed algorithm. The recall value calculated on the basis on number of favorable retrieved image with respect to all associated and similar images in the datasets.

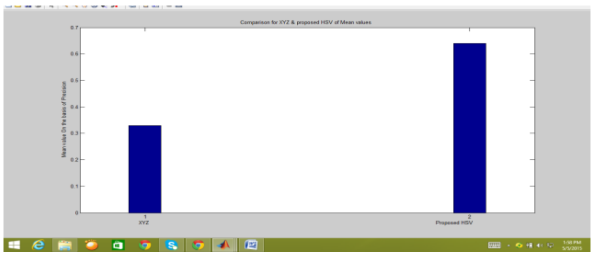

Figure 7 Comparison of MEAN graph on the basis of PRECISION for XYZ and proposed HSV approach

Fig 7 shows Mean value on the basis of Precision on Y-axis and comparison of XYZ proposed HSV of mean values on X-axis. Here, the another parameter mean taken for results analysis and the Fig 7 shows the comparison of mean graph on the basis of precision for XYZ and proposed HSV approach. The mean value of HSV approach is quiet better and higher as compare to XYZ approach which is quiet optimist and applicable in favor to the proposed approach. The result will be diagnose and calculated on the basis of all the precision value of XYZ and Proposed HSI algorithm which is divided by all the number of datasets taken.

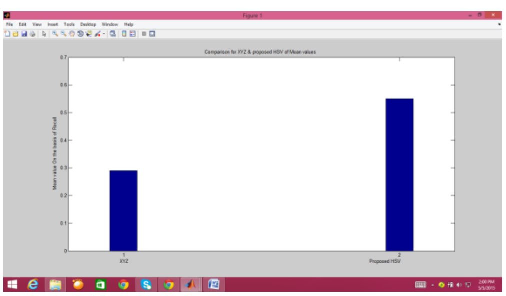

Figure 8 Comparison of MEAN graph on the basis of RECALL for XYZ and proposed HSV approach

Here, Fig 8 clearly depicts the comparison of MEAN graph on the basis of RECALL for XYZ and proposed HSV approach. The result of proposed approach for mean on the basis of Recall is better as compare to XYZ approach. The result will be diagnose and calculated on the basis of all the recall value of XYZ and Proposed HSI algorithm which is divided by all the number of datasets taken. That means, for XYZ there will be the sum of all recall values from one to eighty five images which is divided by total number of input images that is eighty five. Similarly, for HSI there will be the sum of all recall values from one to eighty five images which is divided by total number of input images that is eighty five.

5. CONCLUSION& FUTURE SCOPE

In this paper, stress has been laid towards the CBIR of Trademark Images on the basis of color, text and logo. The proposed work presented in this paper is exploring the bins approach for CBIR in different color spaces using XYZ and HSI. For this indexing of Hue, Saturation and Intensity for matching the resultant images has been used. Since, bins approach based feature extraction approach has been implemented. For this, first image has been separated into three planes of respective color spaces. After that, the histograms for each of the three planes of the image from each color space are computed. Then each image has three histograms partitioned into two parts with map1 and map2. In this step three values of each pixel with respect to each plane (histogram) intensity is checked and combine in one; that in which part of the respective histogram it falls and finally similarity matching and images retrieval was made using Euclidean distance. The performance and comparison was made over each images stored in the set of data set of various Trademark images. Here, two metrics have been taken namely PRECISION and RECALL. The results clearly depicts that the value of PRECISION and RECALL for all the images stored in the set of dataset is quiet higher for proposed HSV(HSI) as compare to XYZ approach. As it is experimented that for better results point of view there should be high PRECISION and RECALL values for analyzing the higher bit rate of accuracy and performance for CBIR. The results of proposed work is quiet full fill the above line and founds that the result of proposed HSV is quiet better as compare to XYZ algorithm for all different 85 images of datasets taken. Moreover, the paper also depicts the results for mean value on the basis of PRECISION and RECALL is quiet optimist and scalable for proposed HSV as compared to the XYZ approach. The result analysis and comparison is quiet scalable and optimistic one for set of datasets and founds that there is higher rate of accuracy for proposed HSV algorithm as compare to XYZ algorithm.

Furthermore, there is need to increase the work more for different techniques and also there should be need to use some more parameters for results evaluation. Again, there is also need to work over some different distance algorithm to find out and compare the results of these.

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