Visual Entity Identification using Content Based Image Retrieval Technique

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Abstract: **The enormous development in various types of images over internet, it becomes a challenging task to identify the visual entity from the large database. The method of retrieval of similar images on the basis of various contents of query images finds its application in various domains such as Digitally acquainted Libraries, Prevention of crimes, Identification of Fingerprints, Information Systems of Biodiversity, Medical, Research of Historical places & many others. Content based image retrieval gives solution to the problem of visual entity identification as it uses visual image contents or features such as color, shape, texture unlike only focusing on keywords deals with particular image. In this work the color features were computed using HSV histogram and color moments. The HSV histogram is computed as it gives strongest representation of actual color contents in the image whereas mean and standard deviation of red, green and blue channels were computed to represent color moments. The dataset consist wide range of objects has been used for testing and validation of proposed algorithm. The obtained results were found to be significant with respect to existing methods.**

Keywords— HSV Histogram, Color Moments, Content based image retrieval .

I. INTRODUCTION

Due to vast development in digital technology and explosion of inexpensive storage media, the digital data production has been tremendously increased. Over the years large amount of images and other data is increasing drastically. Such a huge amount of digital data creates difficulty in finding related data manually. Users upload thousands of images every day on Google. Although tremendous online and offline data is existing but precise image retrieval technique is still not there. Therefore to resolve these challenges intelligent method for searching, filtering and retrieving related data is strongly needed [1].

With a rapid growth and advances in data storage, it becomes very challenging task to handle a big image data. The stated problem can be resolved using image retrieval. Any image retrieval systems can be divided into two groups one is text-based and other is content based. Keyword is the base for retrieval of images in text-based methods. Design of these systems is easy and due to which they are well known. The major drawback of text based method is its quite difficult to have annotation for such a large number of images. In addition, text-based methods are unsuccessful to retrieve visually identical images. Another type of image retrieval falls under the category of content-based methods. Content based method retrieves the images as per the presence of features in the image. Without doing annotation manually CBIR retrieves images which are visually similar. A process of efficient image retrieval on the basis of similarity is termed as content base image retrieval. The accuracy of retrieval depends on appropriate extraction of such contents which exactly describes the image. Moreover, CBIR should be associated with query, match, index and search techniques.

The meaning of "Content-based" is that the search identifies the image contents than data. Data includes description, tags of a particular image. The content might refer to shapes, color or texture or combination of all that can be grasped from the image itself. Having human to manually annotate images might be very time consuming as it require manually entering keywords in a large dataset and might even not capture keywords desired to describe the image. Thus CBIR is need for today's trend as it is dependent on annotation quality and completeness [2].

The manuscript has been drafted in six major sections. The first section introduces the concept of content based image retrieval. In second section survey of various state of art methods has been carried out to identify the shortcomings and outperformance parameters in the domain. Third & fourth section provides details of proposed methodology and algorithms implemented. Results were discussed in fifth section whereas the conclusion of the work and its future scope has been noted in last section.

II. SURVEY OF LITERATURE

In this section a systematic review of existing methodologies has been presented. The review has been carried out to identify the inadequacy and outperforming element of past techniques.

In [3] the color feature has been extracted and stored in the form of feature vector. Author has used the naïve Bayesian classifier to classify the extracted features. Author claimed to have high classification accuracy even with highly complex nature of data. Author in [4] proposed use of DWT for extraction of color and texture features. The similarity metric used was Euclidian distance and testing has been done on Wang database. In [5] author has partitioned image into sub-blocks of equal size. Color features are extracted from each sub-block though quantification of HSV color space into non-equal intervals. The color features are represented using cumulative histogram. Gray level co-occurrence matrix was used to extract the texture feature of each sub-block. Point to point matching algorithm was used for comparative analysis of the query and target image.

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Author in [6] applied Gabor wavelet and Discrete Cosine Transform to extract the color and texture feature whereas Manhattan distance was used as similarity metric. [7] adopted color histogram and color moment for extraction of color features. Similar to [8] gabor wavelet has been used for texture feature while the extracted features were classified using support vector machine. Author has presented survey on various methodologies developed on the basis of types of features such as color, texture and shape. The methods based on Tamura Texture, Gabor Feature and Color Histogram has been implemented and their performance has been measured on the basis of Precision value, Accuracy and Recall value.

In [9] the concept of Fast Feature Extraction, Multi-codebook Approach and Multi-core Support vector machine. The major drawback of proposed method is it does not support large database. It includes design of an image database and retrieval of specific features using color histogram and the Euclidian distance as similarity measurement. In this method feature combination was not considered [10]. The semantic subspace learning (SSL) method has been proposed that exploit the RF log data with contextual information for retrieval of an image. Improvement in the low dimensional semantic concept subspace has been observed [11]. Image is divided uniformly into 8 coarse partitions; the centroid of each partition is selected dominant color. Texture features are obtained using gray level Co-Occurrence matrix (GLCM) and partial shape matching technique is used to derive the shape features. Gradient vector flow method was used to capture the shape information where invariant moments were computed to extract shape features. The texture and shape feature combination has given robust representation of image that helped to enhance the retrieval accuracy [12].

III. Proposed Methodology

This study proposes an improved method for visual similarity search in content-based image retrieval. In this method features such as color, shape and texture are extracted from query image and these features are compared with the feature vectors of database images using some similarity metrics. Color histogram is used to represent the color feature of image and color moment, under certain a color space like Hue Saturation Value (HSV). The Shape features like the outer edge and inner edge of an image would be analyzed through gabor wavelet method. Lastly the texture feature is also going to be used in retrieving the similar image. On applying HSV and color moment methods, ultimately we will get the edge gradient feature. Various proximity functions would be used that can effectively measure distance/similarity between images like Euclidean distance, Manhattan distance, standardized L2, Mahalanobis, Cityblock, Minkowski, Chebychev, Cosine, Correlation, Sperman, Normalized L2, Relative Deviation. The outcome would be a set of precision values. Performance of proposed system is calculated in terms of precision and recall. Recall is the system ability to retrieve all models whereas precision is nothing but the ability to retrieve relevant models only. The proposed method is implemented on MATLAB platform and tested on a standard database consisting of images. The search would be based on similarity rather than the exact match.

A. *Work Flow*

The standard architecture of content based image retrieval is shown in figure 3.1.

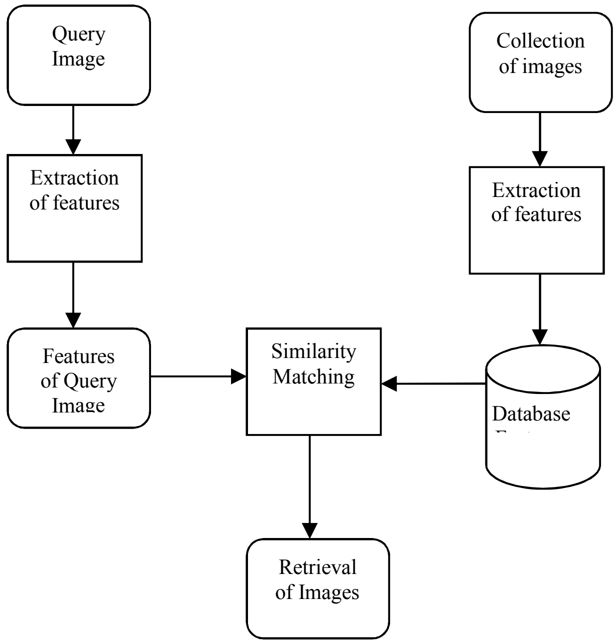

Figure 3.1: Standard Architecture of CBIR

First the data acquisition process comes into picture i.e. the collection of images in the database. Next the various features of images are extracted by using color, shape and texture features and saved in the feature vectors. The user input the query image and again the color, shape and texture features of the query images are extracted and saved. The matching of features is carried out between the feature database and query image feature. The image features that get matched are displayed in an ascending order and thus the similar images were retrieved.

B. *Algorithm:*

Following are the steps under proposed algorithm

1. Data Acquisition: Dataset has been collected from standard resources.
2. Features computation for image retrieval:
    i. Color features were computed from RGB image
    ii. L*a*b* color model has been obtained from RGB colorspace.
    iii. Compute the "average" L*a*b* color within 16-by-16 pixel blocks.
    iv. To obtain number of features, L*a*b* image is resized.
    v. Normalize color features
    vi. Color features are enhanced by padding the [x y].
    vii. To handle various image sizes, pixel coordinates are normalized.
    viii. Concatenate the spatial locations and color features.
    ix. Use color variance as feature metric.
    x. Return empty features for non-color images.
3. To form a Bag Of Features

4. Index the Images
5. Retrieve the similar Images.

IV. RESULTS

The proposed algorithm has been tested on wide range of dataset which consist of around 1360 images of various generic of flowers. The data has been collected from Visual geometry group, Department of engineering science, University of Oxford. The results have been represented in two categories:

A. Qualitative Analysis
B. Quantitative Analysis

5.1. Qualitative Analysis: The accuracy of content based image retrieval is depends on extraction of robust features. The color features are dominant features among many other features such as textures, shape and edge. In this work, color features have been extracted using HSV conversion of true color (RGB) images and computation of color moments. The hue, saturation and value contents of the images have been shown in figure 5.1.

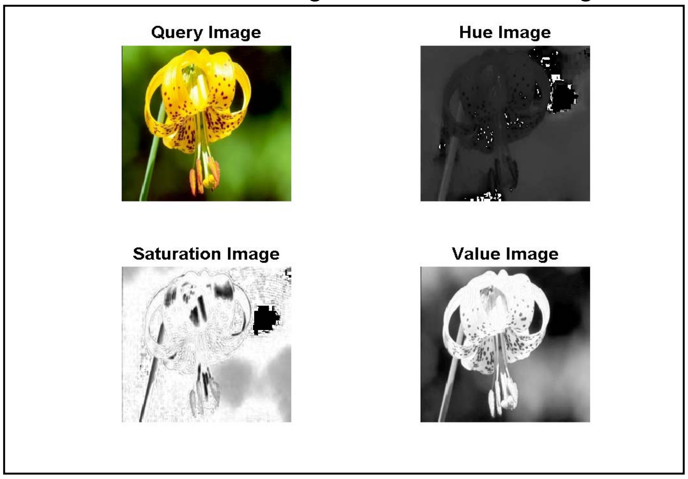

Figure 5.1: Hue, saturation and value contents of the images

After extraction of hue, saturation and value contents from true color images histograms of hue, saturation and value contents of the image were computed and plotted in figure 5.2.

5.2 Quantitative Analysis: The quantitative analysis mainly consists of computation of color moments which includes mean and standard deviation. The formulas to compute mean and standard deviation are given below:

Mean: In probability and statistics, population mean and expected value are used synonymously to refer to one measure of the central tendency either of a probability distribution or of the random variable characterized by that distribution[1]. In the case of a discrete probability distribution of a random variable *X*, the mean is equal to the sum over every possible value weighted by the probability of that value; that is, it is computed by taking the product of each possible value *x* of *X* and its probability P(*x*), and then adding all these products together. The mathematical formula for mean is shown in equation 5.1.

$$\mu = \frac{1}{N}\sum_{i=0}^{N-1} x_i$$

……….. 5.1

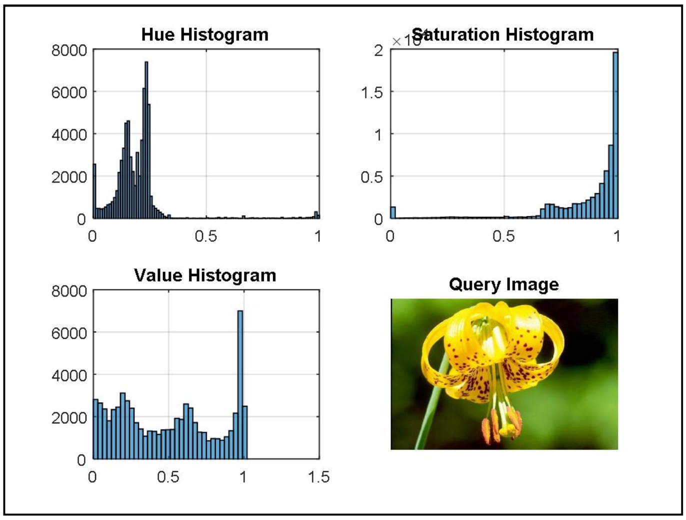

Figure 5.2: HSV histogram

Standard Deviation: The standard deviation (SD) is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A low standard deviation indicates that the data points tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

The standard deviation of a random variable, statistical population, data set, or probability distribution is the square root of its variance. It is algebraically simpler, though in practice less robust, than the average absolute deviation. A useful property of the standard deviation is that, unlike the variance, it is expressed in the same units as the data. There are also other measures of deviation from the norm, including average absolute deviation, which provide different mathematical properties from standard deviation. The formula for the sample standard deviation is shown in equation 5.2.

$$s = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \overline{x})^2}{N-1}}.$$

……….. 5.2

where {x1, x2, x3….xn} are the observed values of the sample items, $\overline{x}$ is the mean value of these observations, and *N* is the number of observations in the sample.

The color moments that is mean and standard deviation are computed for Red, Green and Blue channels separately. The color moment results for the one sample image are shown in table I:

Table I: Color Moments

Sr. No.	Color Channels	Mean	Standard Deviation

1	Red (R) of True color image	111.1	85.75
2	Green (G) of True color image	113.8	75.22
3	Blue (B) of True color image	19.35	35.25

V. CONCLUSION AND FUTURE SCOPE

In this work, a content based image retrieval technique has been proposed which finds several applications in the field of Biodiversity Information Systems, Digital Libraries, Crime Prevention, Fingerprint Identification, Medicine, Historical Research and many others. The proposed technique of content based image retrieval (CBIR) is based on extraction of color, texture and shape features where the similarity metric such as Euclidian, standard Euclidian, Manhattan, Mahalonobis, Chebyshev and Miniskowi distances were used to retrieve the similar images with reference to input query image.

To extract the color features, various color descriptors like color histogram, color correlogram and color moments were used in this work. The results of color histogram and color moments were represented in results and discussion section of this report, where obtained results are competitive with respect to state of arts method. For texture features, gabor wavelet and wavelet transform method has been proposed due to their strong time-frequency representation capabilities. For shape based features the sobel edge detection algorithm has been proposed because its performance is unaffected by the presence of noise in the image. Overall this work is an attempt towards designing and development of robust image retrieval algorithm which will provide high retrieval accuracy with low retrieval time.

The further work that needs to be extended is hybrid combination of color, texture and shape features and their testing on standard as well real time dataset to record the performance of developed algorithm. Region based retrieval systems are effective to some extent, but their performance is greatly affected by the segmentation process. Development of an improved image segmentation algorithm is one of the scopes for future work. The retrieval performance can be enhanced by development of automatic pre-classifier which classify the database into different semantic images.

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