BLOCK TRUNCATION CODING BASED TECHNIQUES FOR CONTENT BASED IMAGE RETRIEVAL SYSTEM

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Abstract : Block Truncation Coding based techniques are playing crucial role in improving performance of content based Image Retrieval system due to which they are widely used in it. Content Based Image Retrieval System is a process of Retrieving exact matching and relevant images from large image database. Such a systems are required for many Commercial, Social and Business Purpose Application.Content Based Image Retrieval system are overcoming of the drawbacks of traditional Text Based Image Retrieval system is so widely used by many applications. various techniques based on Block Truncation Coding BTC,Multilevel BTC, Combination of even-odd BTC,BTC extended to color clumps are experimented on large image databases and it gives improved efficiency of system every time. Precision and recall are used to check the performance of Content Based Image Retrieval system.

Key Words: Content Base Image Retrieval (CBIR), Block Truncation Coding (BTC), Color BTC, Multilevel BTC, Even-odd BTC

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1. INTRODUCTION

In today's environment large number of digital data produced via. WWW digital communication infrastructure, satellite technology, digital cameras and television result into generation of gigantic image pool.[1] Large amount of digital data is generated by modern information and communication technologies. Tremendous amount of digital data is generated such as audio, video, images etc. so, capturing and storing of image is easier but accessing and retrieving is become more difficult.[2][3] Image retrieval is nothing but retrieving an image from large volume of digital database. The traditional image retrieval system i.e. Text Based Image Retrieve system (TBIR) in which retrieve an image using metadata. TBIR system is manual process it needs to give annotation to images .TBIR is not more efficient system it gives irrelevant result. CBIR system overcomes the drawback of traditional image retrieval system and many other limitations. Content-Based Image Retrieve system is automatic process in which user input query image then CBIR system generates feature vector of image by using comparison of similarity measurement then related images will be retrieve.[3][4][5] CBIR system is used in many real-time applications. Such as, Intellectual property, Architecture, medical field, engineering design, Trademark image registration fashion and Interior design, Journalism and advertising, Art galleries, Museums etc. [2] Also it can be used in social applications such as, Crime prevention. Mainly CBIR system work in two approach. First is feature extraction (FE) and second is similarity measurement (SM). Euclidean distance is used for similarity measurement in CBIR system. [8] CBIR system gives efficient and accurate result for image retrieve purpose.

2. Literature Survey

From ancient era large volume of image being produced due to advance in information and communication technology. Tremendous amount of digital data is generated from various sources daily bases. [1][2][6][8] TBIR system search query image using metadata of an image main drawback of image retrieval is more challenging and does not optimal result. [3][4][7] It doesn't meet to users demand it produces lots of garbage data as a result. Also it is manual process it consumes lots of time to give annotation to images. TBIR system is impossible, inefficient and expensive process. As compare to Text Based Image Retrieval system Content-Based Image Retrieval system is best. CBIR system is nothing but retrieve an image by using visual content of an actual image. It retrieves visual content in the basis of text, shape and texture. CBIR system gives appropriate result.

3. Applications

Crime Prevention - The Law enforcement agencies are maintain large archives of visual evidence, including past suspects facial photographs, whenever a serious crime is committed, they can compare evidence from the scene of the crime for its similarity to records in their archives. The basic techniques for automatic fingerprint matching.[6] [8]

The Military - Military applications of imaging technology are Recognition of enemy aircraft from radar screens, identification of targets from satellite photographs, and provision of guidance systems for cruise missiles. Many of the techniques used in crime prevention could also be relevant to the military field.[8]

Medical Application - The use of CBIR can result in powerful services that can benefit biomedical information systems. Most of the hospital uses modern diagnostic techniques such as radiology, histopathology and computerized tomography resulted in an explosion in the number and importance of medical images. [6] [8]

Digital Libraries - There are several digital libraries that support services based on image content. one example is the digital museum of butterflies aimed at building a digital collection of Taiwanese butterflies. This digital library includes a module responsible for content-based image retrieval based on color, texture, and patterns.[8]

Architecture and Engineering Design - Architecture and Engineering Design shares a number of common features. The ability to search design achieves for previous examples which are in way similar or meet specified suitability criteria, can be valuable[6] [8].

Fashion and Interior Design - The ability to search a collection of fabrics to find a particular combination of colour or texture is increasingly being recognized as useful to the design process[6] [8].

Intellectual property - CBIR is very useful at the time of trademark image registration, where new trademark image is compared with existing trademark images to avoid same trademark image for multiple products. It can be potentially used in Copyright protection system, to detect unauthorized copies of images if they have been altered in some way. Prototype systems specifically using CBIR techniques for identifying illicit copies of images on the Web are also at an advanced stage of development.

Journalism and advertising:-Newspaper agencies need to maintain archives of still photographs. As these archives are very large in size, they are very difficult to maintain and problem become more complex if we want to provide detailed keyword indexing. Even bigger problem is faced by broadcasting industry to deal with millions of hours of archive video footage. These are majority of problems in news and advertising industries where CBIR can be effectively useful to provide efficient and effective retrieval of photos and videos. It also reduces the need for manual keyword indexing.

4. Techniques of CBIR system

4.1Block Truncation Coding (BTC)

Block truncation coding is simple technique introduced by E.J. and O.R. Mitchell in 1979. It is comparatively a simple image coding technique. The working of CBIR system works simple and efficient on BTC technique. Lots of advanced CBIR systems are developed with BTC technique. In this approach the R,G and B (Red, Green and Blue) contents considered separately to calculate threshold values of each component[2]. This method acquires the statistical properties of the image blocks; these contents describes the features of an image and called as image features which are used for Content Based Image Retrieval[1]. In this technique the two means where generated from the pixels, the Upper mean is generated from the pixels, which are higher than or equal to the threshold value and the lower mean is generated from the pixels lower than the threshold value. Below equation we will see how to calculate the three mean thresholds as TR, TG, TB and then apply BTC to each individual R,G and B planes as shown in equations 1,2 and 3 for the image of size m*n[1].

$$TR = \frac{1}{m*n} \sum_{i=1}^{m} \sum_{j=1}^{n} R(i,j) \quad .... (1)$$

$$TG = \frac{1}{m*n}\sum_{i=1}^{m}\ \sum_{j=1}^{n} G(i,j) \quad ....(2)$$

$$TB = \frac{1}{m*n}\sum_{i=1}^{m}\ \sum_{j=1}^{n} B(i,j) \quad .....(3)$$

In this technique we will generate three bitmaps as BMr (Red), BMg (Green) and BMb (Blue). If a pixel in each individual component (R,G and B) is greater than or equal to the threshold values of each component, the corresponding pixel position of the bitmap will have a value 1 or else it will be 0. It can be represented in a mathematical forms as shown below in equations 4,5 and 6.

$$BMr(i,j) = \begin{cases} 1, & if\ R(i,j) \geq TR \\ 0, & if\ R(i,j) < TR \end{cases} \quad ....(4)$$

$$BMg(i,j) = \begin{cases} 1, & if\ G(i,j) \geq TG \\ 0, & if G(i,j) > TG \end{cases} \quad ....(5)$$

$$BMb(i,j) = \begin{cases} 1, & if\ B(i,j) \geq TB \\ 0, & if\ \ B(i,j) < TB \end{cases} \quad ....(6)$$

4.2 Multilevel BTC

Multilevel BTC uses BTC-Level-1, BTC-Level-2 and BTC-Level-3. In BTC Level-1 only one Threshold value is used to form the tow different clusters[2]. The threshold value can be generated by taking mean for every R,G and B contents. Feature vectors for BTC Level-1 consist of six mean values [Each R,G and B contents with two values].For every image stored in the database these feature vectors are generated and stored in the feature vector table[2].

BTC Level-2 uses Upper mean and Lower mean values of each contents from BTC Level-1. These values assigned as threshold values to generate BTC Level-2 feature vector. Two Bit maps are generated with the help of Upper and lower mean values of each component. Using these Bit maps Two means generated per bitmap one for the pixel greater than or equal to Upper means and one for Lower means generated from the smaller mean value than that of Upper means. As there are two threshold values per components, each R,G and B component generates four values resulting into size twelve feature vectors for BTC Level-2. For every image stored in the database these feature vectors are generated and stored in the feature vector table[2].

In the similar manner BTC Level-3 uses two Upper mean and two Lower mean as a threshold values to generate size eight feature vectors for each R,G and B component[1].

4.3 Even-Odd BTC

It is an technique of transforming original Image into Three categories as Flipped Image, Even Image and Odd Image. Flipped image can be generated by a mirror reversal of an actual image across a horizontal or vertical axis. Actually Flipping along X-axis means interchanging values along respective Rows where as Flipping along Y-axis means interchanging the values along respective Column. Even image can be obtained from adding pixel values of original as well as the flipped image and dividing it by 2 on the other side. Odd image can be obtained by subtracting all the pixel values of original as well as the flipped image and dividing it by 2[2].

4.4 Combination Types of Even and Odd

These combination types are used to obtain the feature vector from particular technique. Even BTC depends upon six sized feature vectors obtained from Even part only. Whereas Odd BTC depends upon six sized feature vectors obtained from Odd part only. By joining Even or Odd BTC with simple BTC, we are Easily able to obtain the Even and Simple BTC or Odd and Simple BTC. By this technique Even and Odd BTC's feature vector is combined with Simple BTC, which results into feature vector of size 12[1].

5. Color Spaces

5.1 RGB - RGB is device-dependent color model as Red-Green-Blue.[1] [3] [4] [5] [6]different devices detect or reproduce a given RGB value differently.RGB value does not define the same *color* across devices without some kind of color management.

5.2 LUV – L component denotes luminance, U & V components denotes color information. Negative values of U denote prominence of red component and negative values of V component denotes prominence of green. .[1] [3] [4] [5] [6] L, U, V components of color image for respective R, G, and B components.

5.3 YCgCb – Y component denote luminance and Cg,Cb contains chromaticity component. Negative values of Cg component denote prominence of green component over red and negative values of Cb component denote prominence of blue components over red.[1] [3] [4] [5] [6].

5.4 YCbCr - This color space gives better result compared to other color spaces.[1] [3] [4] [5] [6]

5.5 YUV - The YUV color model defines a color space in terms of one luminance (brightness) and two chrominance (color) components.[1] [3] [4] [5] [6] Inter conversion equations for YUV color space from R, G and B components.

6. Similarity Measurement Criteria

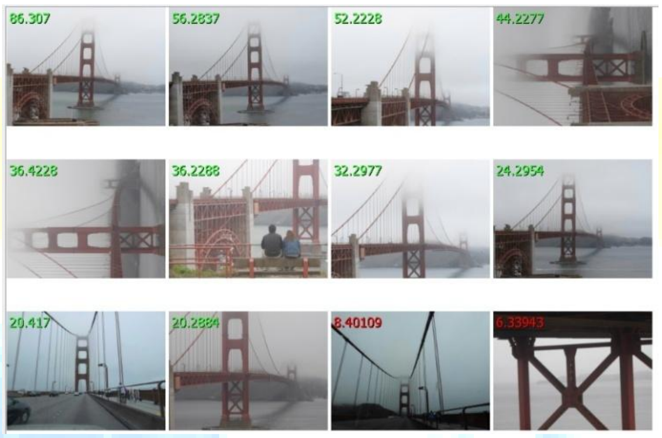
Finding good similarity measures between images based on some feature set is a challenging task. other hand, the ultimate goal is to define similarity functions that match with human perception, but how humans results to obtain the similarity between images is a topic of ongoing research. Many Current Retrieval systems take a simple approach by using typically norm-based distances (e.g., Minkowski distance [2]) on the extracted feature set as a similarity function. The main premise behind these CBIR systems is that given a “good set” of features extracted from the images in the database (the ones that significantly capture the content of images.) then for two images to be “similar” their extracted features have to be “close” to each other. The Direct Minkowski Distance of order two is known as Euclidian Distance. The Euclidian Distance between an image J and query image Q can be given as the equation below.

$$ED = \sqrt{\sum_{i=1}^{n}(V_{pi} - V_{qi})^2}$$

where, Vpi and Vqi be the feature vectors of image J and Query image Q respectively with size ‘n’.[6] [11]

8.Database

The Database used in this system is of 1000 images in10 different classes, each class contains 100 images. In the below image we see that the on class of bridge is there and the results obtained in that class is shown[1].



9.Performance Measurement Criteria

Precision and Recall are the two parameters used in this system for calculating the accuracy and correctness of the CBIR system. The average of the Precision and Recall will give the effectiveness of the system. Precision gives the result of Accuracy whereas the Recall gives the result of Completeness.

$$Precision = \frac{NO.of\ relevent\ \ images\ \ retrieved}{Total\ \ no.of\ images\ \ retrieved}$$

$$Recall = \frac{No.of\ relevent\ images\ retrieved}{Total\ no.of\ Images\ in\ the\ Database}$$

10.Conclusion

CBIR at present is still very much a research topic. CBIR system is useful for retrieving an images from large databases. Efficient and accurate retrieval techniques of images are desired because of the explosive growth of digital images. Content-based image retrieval is a promising approach because of its automatic indexing and retrieval based on their semantic features and visual appearance. CBIR is automatic process no need to give annotation to an images. Content based Image retrieval systems addresses the problem of efficiency improvement in image retrieval from large collection of image database. CBIR system is Efficient and return the accurate result. When user input the query image then CBIR system gives the accurate output which is related to query images. Our view is that CBIR is here to stay. It is not as effective as some of its more ardent enthusiasts claim – but it is a lot better than many of its critics allow, and its capabilities are improving all the time. most current keyword-based image retrieval systems leave a great deal to be desired.

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