An Overview of Image Retrieval System Using MPEG-7 Visual Descriptors

Mr. V.A.Bingi[1], Dr. S.R.Gengaje[2]
[1, 2]Dept of Computer Science & Engineering
[1, 2] Walchand Institute of Technology, Solapur

Abstract- *Every day huge amount of digital images are generated due to latest innovations in image storage and acquisition devices. It turns into complex and time consuming task to access the digital images from huge collection of images. There is a need to standardize content-based description to make image searching, retrieving process efficient. Moving Picture Experts Group (MPEG) is one the effort to standardize content-based description for multimedia data.*

This paper attempts to provide a comprehensive survey of various image retrieval by using MPEG-7 visual descriptors. Further, a few promising future directions are proposed based on existing system and challenges in image retrieval from real world applications.

Keywords- MPEG-7, CBIR, RBIR, DESCRIPTORS

I. INTRODUCTION

Image retrieval system is a computer system which searches and retrieves digital images from a set of image collection. The text annotated to image or image content descriptions are used for image retrieval. Different types of image retrieval techniques are discussed below

- Text Based Image Retrieval
- Content Based Image Retrieval
- Region Based Image Retrieval

Text Based Image Retrieval:

Text based image retrieval (TBIR) is one of the old image retrieval technique to search for images based on associated metadata such as text, keywords etc. The images are manually annotated with a textual description and their retrieval is based on matching of textual query of user to the annotation of the image. Unfortunately this technique barely describes the diversity and ambiguity of image contents. This technique becomes impractical for large image database due to manual annotation. Hence, Content based image retrieval (CBIR) was introduced to overcome the problems of text based image retrieval in the year 1990.

Content Based Image Retrieval:

CBIR systems gained significant attention by researcher in order to cope with enormous growth of image data for image retrieval. In CBIR, the features like color, texture and shape are extracted from query image and database images by using visual descriptors. The features which are extracted from images are stored in feature vector. Similar images are retrieved by using similarity measurement technique between feature vector of query image and database image. The performance of CBIR is degraded due to the semantic gap between low level features and high level features. The process is shown below in figure 1

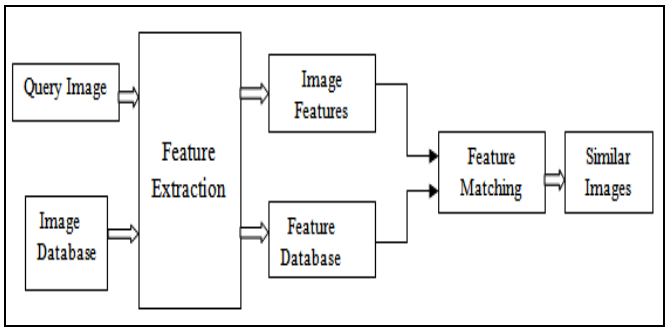


Figure 1: Content Based Image Retrieval

Region Based Image Retrieval:

Region based image retrieval (RBIR) is an extension to CBIR. It has been introduced to increase accuracy of CBIR by reducing the semantic gap. In region based image retrieval, the query image is segmented into various regions and features are extracted of the segmented regions. Similarity between query image and database images are compared at the fine-grain of regions. The RBIR technique works effectively on modular size of database. The accuracy of the RBIR system depends on the accuracy of the image segmentation algorithms.

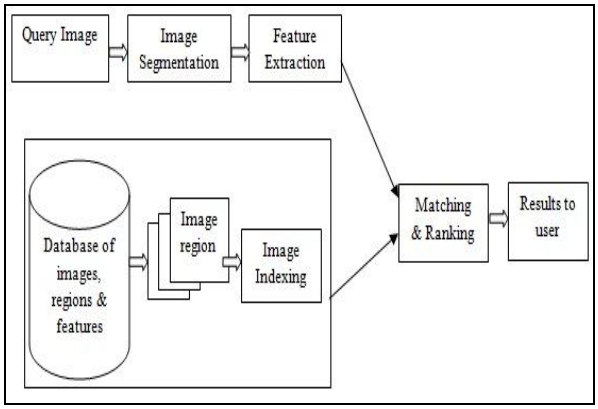
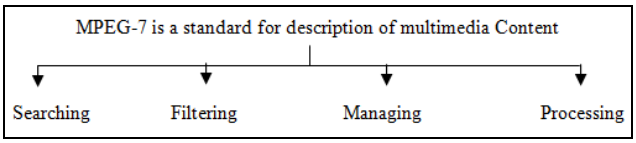


Figure 2: Region Based Image Retrieval

MPEG-7: Multimedia Content Description Interface

MEPG is multimedia standard with specifications for coding, compression and transmission of audio, video and data streams. The MPEG group created MPEG-1 standard with intention to standardize the coding and storage of video. MPEG-2 is next version of MPEG-1 with some improvements. MPEG-3 was created for compressing high definition television and MPEG-4 was created for encoding of multimedia content.

MPEG-7 is a standard for multimedia description and developed to describe multimedia content.



The MPEG-7 has eight general parts given below:

1. **System**: It refers to tools need to identify the descriptors.
2. **Visual**: MPEG-7 visual descriptors capture the visual description of multimedia data.
3. **Audio**: The MPEG-7 Audio standard contains description tools for audio describing content.
4. **Multimedia Description Schemes (MDS)**: MPEG-7 MDS specifies different tools that are generic and multimedia.
5. **Description Definition Language (DDL)**: It provides descriptors and description schemas by which user can develop their own schema descriptions.
6. **Reference Software**: It provides tools to generate content description which behaves in a conformant manner.
7. **Conformance Testing**: States guidelines for testing conformance to MPEG-7.
8. **Extraction and Use of MPEG-7 Descriptions**: It describes the process of extraction and description tool usage.

Visual Descriptors:

The MPEG-7 visual descriptors are categorized into 4 different types which are discussed below

1. Color Descriptor Tools:

Color is one of the most crucial and simply identifiable attribute for describing visual content of image. MPEG-7 group developed five color descriptors to cover different aspects of color features.

Dominant Color Descriptor (DCD): It represents a very compact description of Color content in an image. This compact description is sufficient to characterize an image by small number of representative colors.

Scalable Color Descriptor (SCD): It is a color histogram in the HSV color space model which is based on Haar transform. It is scalable in terms of bin numbers. It is useful in image similarity matching based on color characteristics.

Color Layout Descriptors (CLD): This is a very compact color descriptor which captures spatial color distribution on a grid superimposed on image. It is extremely effective in fast browsing and image retrieval systems.

Color Structure Descriptor (CSD): This descriptor is based on content of color as well as spatial arrangement of color content. It maintains the counts of number of times a color is in present by Using histogram. The images are matched on the basis of histograms.

2. Texture Descriptor Tools:

Texture is a fundamental low level feature of images for image browsing and matching. MPEG-7 have developed three texture based visual descriptors which are mentioned below.

Homogeneous Texture Descriptor: This descriptor is developed to characterize the properties of textures in image based on visual properties of the textures which are relatively constant over the region. It use Gabor filters homogeneous textures from image region.

Texture Browsing Descriptor: This descriptor is combined with homogeneous texture descriptor to provide scalable solution for representing uniform texture area in images. This type of descriptor is more suitable for browsing type of applications.

Edge Histogram Descriptor: This descriptor represents five types of edges or contours which are present in image.

3. Shape Descriptor Tools:

Shape is also one of the key low level features to distinguish images. User can easily describe query by using shape by using sketch or by example. Some of the widely used shape descriptors are discussed below.

Region Shape Descriptor: This descriptor use s a set of ART (Angular Radial Transform) coefficients to discover a particular shape from image. The shape object retrieved from image contains single region or multiple regions with holes. It can detect any type of complex shape from the image.

Contour Shape Descriptor: This descriptor is a 2D region of an image. It is compact descriptor which utilizes Curvature Scale Space (CSS) to represent contour in a image.

Shape 3D Descriptor: This descriptor is developed to cope up with advanced developments of multimedia technologies. It describes the details of shape in 3 dimensional structure.

II. RECENT ADVANCES IN IMAGE RETREIVAL

We have examined numerous image retrieval systems where the researcher proposed techniques to improve overall performance of the image retrieval system. The researchers have used multiples visual descriptors to improve accuracy of the system. Some researchers also tried to compact visual descriptor in order to improve performance. The researcher articles reviewed are described below.

Sung Min Kim, Soo Jun Park, and Chee Sun Won [1] developed a Query By Layout (QBL) system which is compliant utilizing the MPEG-7 texture and color visual descriptors. This system uses d 4x4 Edge Histogram of the EHD and Y, Cb, Cr which are inverse DCT values of CLD. The results demonstrate that theretrieved images are sufficiently compliant with the selected query layouts.

Dorairaj R & Namuduri K [2] introduced image retrieval system which uses compact combination of mpeg-7 color and Texture descriptors. They proved the fact of using multiple descriptors has a positive effect on image retrieval accuracy. The system retrieval rate is 0.24994 ANMRR (Averaged Normalized Modified Retrieval Rate) for the combination of CCD (Compact Color Descriptor) and CTD (Compact Texture Descriptor). The system retrieval rate is 0.30152 ANMRR for CCD and 0.3248 ANMRR for CTD.

[3] The authors developed an innovative content based image retrieval system which uses multiple MPEG-7 visual descriptors. The image features mean, variance, skewness, kurtosis, energy, entropy are used as texture description and spatial distribution of image is used as color description. Experiments are performed on Corel database. The results compared with high accuracy retrieval systems i.e. SIMPLIcity, Histogram based, FIRM. The experimental results accomplished significant performance in terms of accuracy.

M. Zamfir, A. Drimbarean, A. Zamfir,C.Vertan [4] have developed a generalized structure descriptor(GSD). The GSD descriptors is compact description of texture and color features which is used in content based image retrieval. The results which are obtained show that GSD can be effectively used for image retrieval and recognition.

E. Acar et.al [5] have presented a system which used Slim tree and BitMatrix as index structures for efficient retrieval of images based 3 dimensional low level features such as color, texture and shape. The features of images are extracted by using MPEG-7 descriptors and stored in native XML database. The similarity matching between two objected are evaluated based on Ordered Weighted Averaging (OWA). OWA is aggregate values of low level features Color Layout (CL), Dominant Color (DC), Edge Histogram (EH) and Region Shape (RS). The results show that using BitMatrix along with OWA method has better retrieval accuracy and performance.

Ka-Man Wong et.al. [6] have developed a visual color descriptors called Dominant Color Structure Descriptor (DCSD). This descriptor merges the color structure descriptor (CSD) and dominant color descriptors (DCD) values. It provides efficient way to characterize color and spatial information in a single descriptor. In the proposed system, DSCD uses a new similarity measurement algorithm based on matching similar color to produce a common palette. The experimental results show this method has excellent retrieval recall and accuracy ratio compared the original DCD.

Jian-hua li et.al. [7] main focus was to use HSV instead of Original Color Space YCbCr for content description. The work analyzes the characteristics of color space used by MPEG-7 color layout descriptor. In devising their technique of using HSV was main focus and experimental result shows that the modified technique enhanced retrieval efficiency.

[8]The researcher attempted a generic approach for representing image texture features by using Dominant Texture Descriptor (DTD). This approach is based on grouping the texture features and recognizing the dominant components and their spatial distribution. The researcher have

introduced enhanced version of DTD i.e. eDTD which predefine the spatial distribution of pixels within each dominant component. The experimental result shows that the performance of eDTD has positive results.

Wu Siqing[9] et.al .have focused on emphasizing more shape feature of an image. The researcher attempted on extracting shape feature, describing shape feature and matching the retrieved shape with database images. MPEG-7 visual shape descriptor is used to extract shapes from image. The system with shape descriptor has enhanced accuracy and efficiency of retrieval.

[10] The researcher developed algorithm which is based on nonlinear discrete random transform to extract texture description. They used texture browsing descriptor (TBD) of MPEG-7 to extract features. The experimental result shows that the proposed method is quick and extract texture features efficiently.

[11] The work attempted to implement MPEG-7 color and contour shape descriptors. The dominant color descriptor and contour shape descriptor are used to extract color and curvature scale of image respectively. Both descriptors are used collectively to improve the accuracy of the system. The researcher states positive experimental results without mentioning percentages of effectiveness.

[12] The author proposed an automatic process for searching similar images based on user input image. The proposed system uses MPEG-7 dominant color descriptor and a modified Quadratic Histogram Distance Measure descriptor. The experiment result shows an enhancement of 4.6% using DCD-QHDM combination.

[13] The work focused on retrieving images by region matching using multiple feature index based on color, shape and location index. It uses multiple MPEG-7 visual descriptors for feature extraction of image regions. The different combinations of image regions are indexed. The image retrieval process is non-cascading process. The experimental results obtained show that retrieval accuracy increases in non cascading region-based querying by merged index.

III. CONCLUSION

The MPEG group has played vital role to provide a standardized process for content description. This makes image retrieval system more efficient with tremendous amount of multimedia data. Image retrieval systems performance is getting affected due to semantic gap between visual features of images. So some researcher developed combination visual descriptors together to form a hybrid visual descriptor. The results obtained by using hybrid visual descriptors are more truthful as compared to single visual descriptor. However, there is a space to develop and improve new visual descriptor and algorithms for improving performance of image retrieval systems.

RBIR system is an extension to overcome the performance issues of CBIR. RBIR systems significantly reduce the semantic gap which eventually increased overall accuracy. But the performance of the RBIR systems is degraded due to inaccurate segmentations algorithms. There is a need to modify existing segmentation algorithms for better results.

IV. FUTURE DIRECTIONS

The following are major suggestions to improve the overall performance and accuracy of the image retrieval system.

1. The traditional Image retrieval systems are not efficient with huge image database. Hadoop based image retrieval must be developed in order to cope up the tremendous amount of multimedia data. Hadoop is an open source framework which supports the processing and storage of extremely large of multimedia data.
2. Developments of more robust and precise segmentation algorithms to improve the performance of RBIR systems.
3. Integration of different visual descriptor to form hybrid compact visual descriptors which can reduce the semantic gap between low level features and high level features.
4. Advancements in techniques and algorithms to classify images dynamically.

REFERENCE

[1] Sarthak Jain, Anant Vaibhav and Lovely Goyal “Raspberry pi based interactive home automation system through e-mail”, 2014 International Conference on Reliability, Optimization and Information Technology - ICROIT 2014, India, Feb 6-8 2014
[2] Shaiju Paul, Ashlin Antony and Aswathy.B “Android Based Home Automation Using Raspberry Pi”, International Journal of Computing and Technology, vol. 1, no. 1, February 2014.
[3] E. Upton & G. Halfacree. Raspberry Pi. User Guide, John Wiley, 2012
[4] Md. Nasimuzzaman Chowdhury, Md. Shiblee Nooman, Srijon Sarker, “Access Control of Door and Home Security by Raspberry Pi through Internet”, International

Journal of Scientific & Engineering Research, Volume4, Issue11, november2013,ISSN:2229-5518.

[5] Bruhathireddy, Dr. G. N. Kodandaramaiah, M. Lakshmipathy "Design and Implementation of Home Automation system using Raspberry Pi", International Journal of Science, Technology & Management, www.ijstm.com,Volume No. 03, Issue No. 12, December 2014, ISSN:2394-1537.

[6] Sundas Zafar, Aparicio Carranza, " Motion Detecting Camera Security System with Email Notifications and Live Streaming Using Raspberry Pi"

[7] Aamir Nizam Ansari, Mohamed Sedkyl, Neelam Sharma, Anurag Tyagil, An Internet of Things Approach for Motion Detection using Raspberry Pi, 2015 International Conference on Intelligent Computing and Internet of Things (IC1T),2015

[8] A. Bradbury and B. Everard, "Learning Python with Raspberry Pi", Wiley, 2014.

[9] K. Lambert, "Fundamentals of Python: Data Structures", Cengage Learning, 2013.

[10] G. Lindstrom, "Programming with Python", IEEE Computer Society, Oct. 2005, pp. 10–16.