Jan - March © 2016 Transactions; 3(9): 422-426

International Journal of Research and Applications

ISSN (online): 2349-0020 ISSN (print): 2394-4544 http://www.ijraonline.com/

Research Article

Improving Quality of Content Based Image Retrieval with Graph Based Ranking

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DOI:
http://dx.doi.org/
10.17812/IJRA.3.9(71)2016

Manuscript:
Received: 14th Jan, 2016
Accepted: 7th Mar, 2016
Published: 25th Mar, 2016

Publisher:
Global Science Publishing Group, USA
http://www.globalsciencepg.org/

ABSTRACT
Image retrieval has become very important aspect in the applications of real world. The rationale behind this is that image databases are growing rapidly and there are numerous applications that need to store and retrieve images. Content Based Image Retrieval (CBIR) has been around for many years. It is a method that supports query by example. However, this method has limitations when it is based on the features of input image. Retrieval of unrelated images is an important problem to be solved. Towards this end, many techniques came into existence. In this paper we provide an improved relevance feedback method that can help in improving quality of image retrieval. We proposed a methodology with underlying algorithm to achieve this. We built a prototype application to demonstrate the proof of concept. Our empirical results reveal that the proposed methodology is able to improve quality in image retrieval.

Key words: Content based image retrieval, ranking, query by example.

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IJRA - Year of 2016 Transactions:
Month: January - March
Volume – 3, Issue – 9, Page No's:422-426
Subject Stream: Computers

Paper Communication: Author Direct

Paper Reference Id: IJRA-2016: 3(9)422-426

DOI: 10.17812/IJRA.3.9(71)2016

International Journal of Research and Applications
Jan-Mar © 2016 Transactions 3(9): 422-426

eISSN : 2349 – 0020
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COMPUTERS RESEARCH ARTICLE

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ABSTRACT

Image retrieval has become very important aspect in the applications of real world. The rationale behind this is that image databases are growing rapidly and there are numerous applications that need to store and retrieve images. Content Based Image Retrieval (CBIR) has been around for many years. It is a method that supports query by example. However, this method has limitations when it is based on the features of input image. Retrieval of unrelated images is an important problem to be solved. Towards this end, many techniques came into existence. In this paper we provide an improved relevance feedback method that can help in improving quality of image retrieval. We proposed a methodology with underlying algorithm to achieve this. We built a prototype application to demonstrate the proof of concept. Our empirical results reveal that the proposed methodology is able to improve quality in image retrieval.

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1. INTRODUCTION

Image retrial can provide quality results with content based image retrieval. The query by example concept is followed. According to the query by example (QBE), an image is chosen as input. The CBIR system is supposed to take the input image and extract the features of the input image programmatically. Then the system will check with all images of image databases in order to find images that are relevant to the input image. A similarity measure is used to know the similarity between images. Based on the similarity threshold, the images are selected for presenting results. The CBIR system provides images as output. The general mechanism of CBIR is presented in Figure 1.

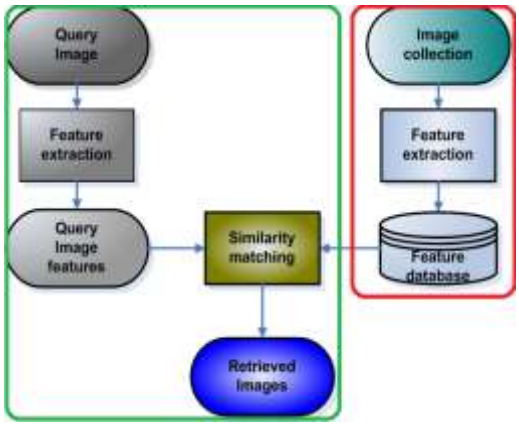

Figure 1: General Approach to CBIR

As shown in Figure 1, it is evident that the query is an image to the CBIR system. The given input image is subjected to feature selection. Afterwards the query image features are extracted. In the same fashion, features of image collection located in database are compared with that of query. The

similarity measure provides the similarity between 0.0 and 1.0. The higher in similarity the more relevant the image is. This is the general mechanism that is followed in order to have images retrieved from image database.

In this paper we proposed and implemented a framework that supports image retrieval in query by example fashion. This CBIR system has been improved in order to have relevance feedback and some sort of mining mechanism to retrieve best query images. The remainder of the paper is structured as follows. Section II provides review of literature. Section III presents the proposed system in detail. Section IV presents experimental results while section V concludes the paper.

2. RELATED WORKS

This section provides review of literature on CBIR systems. Especially it focuses on ranking for providing accurate results. The problem of ranking for image query results has been around. It has gained more attention recently in the areas of machine learning and information retrieval. There are conventional ranking models as explored in [1]. They include language modelling, BM25, Vector Space Model, which are content, based models. The linked structure based models include HITS as discussed in [3] and PageRank as explored in [2]. There are cross media models also [4]. Learning to rank model is another category for optimizing ranking function in order to have relevance features for having empirical study and tuning of parameters in the practical scenarios as explored in [5] and [6].

Many conventional models do not focus on efficiency which is very important in real time image retrieval systems that are web based. A unified framework was presented in [7] for joint optimization of efficiency and effectiveness. In this paper we focused on graph-based ranking model which is applied to other kind of analysis in the web such as link structure analysis as explored in [2], [3], [8] and [9]. There is another research in which ranking is explored. It is networks related research [10], [11], [12] and data analysis in multimedia applications as discussed in [13].

A graph in general is represented as G= (V, E, W) as presented in [14]. A set of vertices is represented by V. A data point is represented by e and VxV is a set of edges. W is considered as an adjacency matrix that holds weights among vertices. The importance of vertex is shown in graph-based ranking model with local and global information presented in the graph. As explored in [15] weighted graph model is used to have ranking function. Later by Guan et al. [11] a graph-based ranking algorithm is proposed for multiple resources with personalization and rag recommendations. Automatic tag ranking scheme is also found in [10] with random walk method. A music recommendation system was proposed in [12]. Hyper graph which is a graph based ranking model was focused in [16]. In [17] the data is divided into many partitions and ranking function was computed.

3. PROPOSED SYSTEM

We proposed a framework for content based image retrieval. The framework makes use of graph ranking and relevance feedback for retrieving images which are very much related to the query image. As all other CBIR systems, it takes an image as input and produces search results in the form of relevant images. Machine learning including graph ranking is used to have high quality images to be retrieved. The proposed CBIR system is meant for producing results based on the input image and its features. The input image features are extracted and they are used to have graph based ranking with respect to the features of the image database that are compatible with the input image features. Relevance feedback is given by user in order to find out the relevancy of images so as to refine search mechanism. Thus the search results contain more relevant images that can satisfy end users.

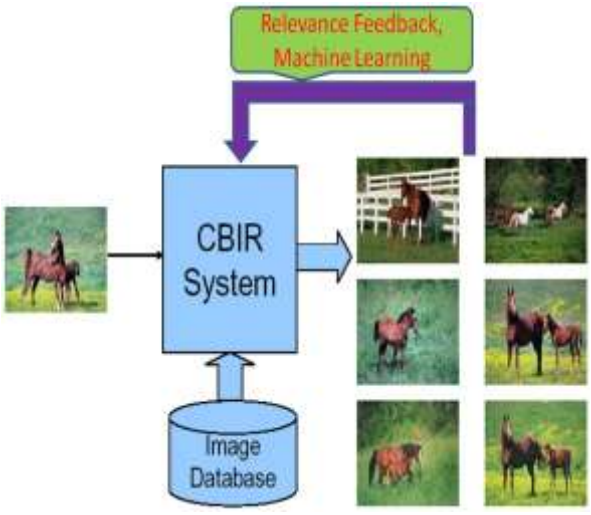

Figure 2: Conceptual Framework

As shown in Figure 2, the conceptual framework provides relevance feedback and machine learning in the form of graph ranking in order to have high quality search results. In the sample framework, the input image has a horse. This kind of image has its features. The features are obtained and they are compared with the features of image database. The matching results are retrieved after subjecting them to graph ranking. Thus it produces high quality results and eliminates unwanted results. It is evident the proposed framework.

4. EXPERIMENTAL RESULTS

Experiments are made with a prototype application. We built user friendly interface for performing CBIR activities. The application we built can demonstrate the proof of concept. It takes any input image for query by example and produces relevant images as output. After getting output also, the users can refine query by providing relevance feedback. Besides the system has mechanism for ranking relevancy of images. The ranking mechanism is known as graph based ranking. Thus the graph based ranking, relevance feedback and using features for similarity comparison makes the application very useful for image retrieval. The sample Corel images used for experiments are presented in Figure 3.

Figure 3: Core Image Samples

The experiments are made in terms of image retrieval and observations pertaining to efficient manifold ranking and manifold ranking. The set of anchors sharing same space is also presented in the results. The results for existing and proposed methods are presented in this section.

# OF ANCHORS	EMR	MR
1	0.23	0.32
2	0.26	0.32
3	0.28	0.32
4	0.3	0.32
5	0.3	0.32
6	0.311	0.32
7	0.322	0.32
8	0.32	0.32
9	0.32	0.32
10	0.31	0.32
11	0.32	0.32
12	0.31	0.32
13	0.325	0.32
14	0.32	0.32
15	0.325	0.32
16	0.323	0.32
17	0.33	0.32
18	0.329	0.32

Table 1: Number of Anchors vs. EMR and MR

As sown in Table 1, it is evident that the number of anchors, EMR and MR are presented. The value of EMR is higher than that of MR. This shows efficiency of EMR.

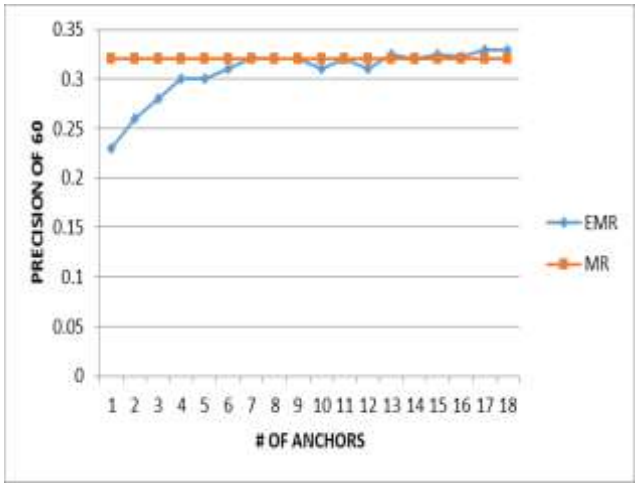

Figure 4: Precision vs. Number of Anchors

As shown in Figure 4, the number of anchors and precision are presented for both MR and EMR. The performance difference is shown for EMR and MR for anchors from 1 to 18.

# OF S	EMR	MR
1	0.057	0.32
2	0.31	0.32
3	0.32	0.32
4	0.32	0.32
5	0.31	0.32
6	0.3	0.32
7	0.298	0.32
8	0.294	0.32
9	0.29	0.32

Table 2: Number of S vs. EMR and MR

As shown in Table 2, it is evident that the number of S is considered from 1 to 9. For these values, the EMR and MR are observed and recorded. The results revealed that there is no much different in the values of MR and EMR.

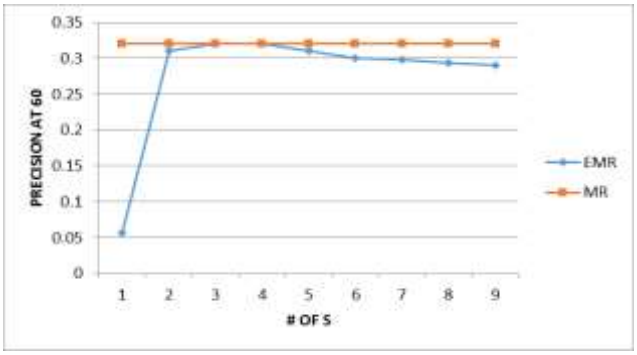

Figure 5: Number of S versus Precision for EMR and MR

As shown in Figure 5, it is evident that the horizontal axis represents number of S while the vertical axis represents precision. The precision performance when number of S is changed is presented for both MR and EMR.

# OF ANCHORS	LSH-256	LSH-128	EUD	EMR
1	0.812	0.859	0.91	0.885
2	0.812	0.859	0.91	0.919
3	0.812	0.859	0.91	0.929
4	0.812	0.859	0.91	0.93
5	0.812	0.859	0.91	0.935
6	0.812	0.859	0.91	0.935
7	0.812	0.859	0.91	0.94
8	0.812	0.859	0.91	0.945

Table 3: Number of Anchors and MAP value for Different Techniques

As shown in Table 3, the anchors are taken from 1 to 8. The MAP value for different techniques is recorded and presented. The EMR is compared with other techniques such as EUD, LSH-128, and LSH-256.

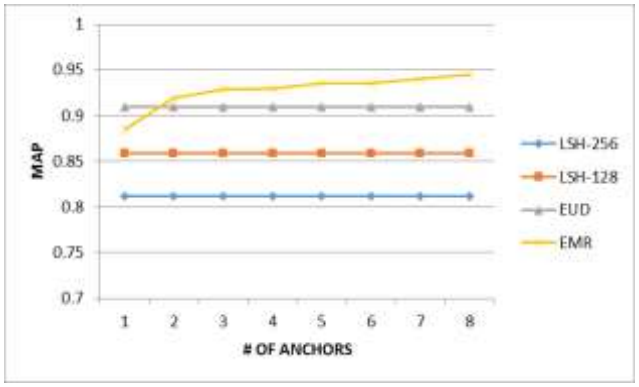

Figure 6: Number of Anchors versus MAP for Different Techniques

As shown in Figure 6, it is evident that there is performance comparison among different techniques in terms of number of anchors and MAP. The results reveal that the EMR has got more MAP while the LSH-256 has got least MAP.

5. CONCLUSIONS AND FUTURE WORK

In this paper we studied the process of Content Based Image Retrieval. CBIR has been around for many years. It is meant for obtaining images from image database based on query image. The query is an image itself and the database images that match with given input image are retrieved. The CBIR systems used to provide unrelated query results as well. To overcome this problem many techniques came into existence. In this paper we focused on feature extraction for both input image and database images for comparing similarity with a similarity measure. Besides the features of image database are constructed into a graph and graph based ranking is performed in order to have more relevant images from the query. The proposed system also supports relevance feedback to refine search results. We built a prototype application to demonstrate the proof of concept. The results reveal that the proposed system is very useful for image retrieval. This research can be extended further to have data mining approaches coupled with relevance feedback for improving customer satisfaction.

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