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Image Retrieval Using Navigation Pattern for Relevance Feedback: A Survey

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***ABSTRCT*-This paper addresses survey of work done on relevance feedback in the past few years. Till date, various techniques have been proposed for relevance feedback. Some techniques used Bayesian classifier, while others are log based and Neuro-fuzzy based. Some of them use human computer interaction for providing feedback. However, existing methods require a large number of iterations and also it is difficult to converge the query towards user intention. Hence, in this paper we present some of the recent techniques that overcome the above disadvantagesand their comparative analysis.**

***Keyword*-Navigation Pattern, Relevance Feedback**

I. INTRODUCTION

Content-based retrieval is the ability of the system to retrieve relevant images based on the visual and semantic contents of images [1]. Content-based image retrieval uses the visual contents of an image such as color, shape, texture, and spatial layout to represent and index the image. CBIR is the application of computer vision techniques to the image retrieval problem, that is, the problem of extracting useful knowledge from digital images in large databases. The CBIR system works as follows:

- Conversion of an image into feature vector:
  The visual contents of the images in the database are extracted and described by multi-dimensional feature vectors. The feature vectors of the images in the database form a feature database.
- Providing query image:
  To retrieve images, users provide the retrieval system with example images or sketched figures. The system then changes these examples into its internal representation of feature vectors.
- Similarity search and indexing:
  The similarities /distances between the feature vectors of the query example or sketch and those of the images in the database are then calculated and retrieval is performed with the aid of an indexing scheme. The indexing scheme provides an efficient way to search for the image database [2].

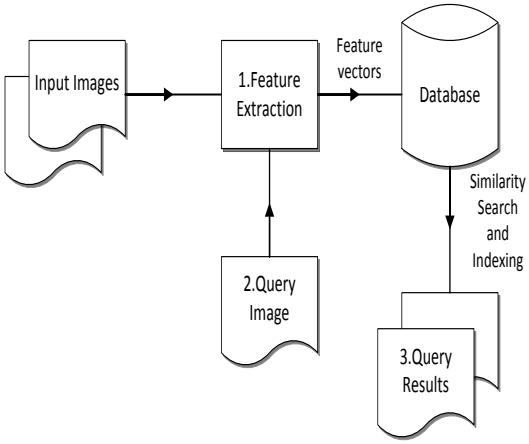

Figure 1.Workflow of CBIR.

Although number of algorithms have been proposed for CBIR, they suffer from numerous drawbacks. The problem is that the extracted visual features are too diverse to capture the concept of the user's query. To solve such problems, in the above system, the provision is given so that the users can pick up some selected images to refine the image explorations iteratively. The feedback procedure, called Relevance Feedback (RF), repeats until the user is satisfied with the retrieval results.

II. RELEVANCE FEEDBACK

Relevance Feedback (RF) is the process of automatically adjusting an existing query using the information fed back by the user about the relevance of previously retrieved objects [12]. The key issue in relevance feedback is how to effectively utilize the feedback information to improve the retrieval performance. After obtaining the retrieval results, user provides the feedback as to whether the results are relevant or non relevant. If the results are non-relevant the feedback loop is repeated many times until the user is satisfied [12]. It is a powerful technique in CBIR systems in order to improve the performance of CBIR effectively. It is an open research area to the researcher to reduce the semantic gap between low-level features and high level concepts [5]. In order to reduce the gap between the low level features and high level concepts, relevance feedback

was introduced into CBIR. That is a user providespositive and/or negative examples, and the systems learn fromsuch examples to separate all data into relevant and irrelevantgroups. Hence many machine learning schemes maybe applied to the RF such as, decision tree learning, Bayesian learning, support vector machines, boosting and so on [5].

III. LITERATURE SURVEY

A. *Different Approaches to Relevance Feedback:*

1) Bayesian Classifier:

Vasconcelos and Lippman (2000) [6] used a Bayesian learning algorithm that integrate relevance feedback provided by the user over a retrieval session. Su, Zhang, Li, and Ma (2003) [10] have given an approach to relevance feedback based CBIR using a Bayesian classifier. Positive examples in the feedback were used to estimate a gaussian distribution that represents the desired images for a given query.

2) User Computer Interaction:

Rui, Huang, And Mehrotra(1998) [4] have presented a relevance-feedback based approach to CBIR, in which a human and a computer interact to refine high-level queries to representations based on low-level features which addresses the gap between high level concepts and low level image features and, subjectivity in human perception of image content.

3) Online Leaning Algorithm:

Xiang Sean Zhou Thomas S. Huang (2001) [7] proposed the on-line learning algorithms for content based multimedia information retrieval which focused on the similarity metric issue named as Kernel based biased discriminate analysis (KBDA). Wei Bian and Dacheng Tao (2010)[18] have represented images by low-level visual features. They have designed a mapping to select the effective subspace for separating positive samples from negative samples based on a number of observations. They have proposed the Biased Discriminative Euclidean Embedding (BDEE) which parameterizes samples in the original high-dimensional ambient space to discover the intrinsic coordinate of image low-level visual features. AneliaGrigorova et al.(2007)[15] have suggested a new concept of semantically based feature space modification called feature adaptive relevance feedback (FA-RF). FA-RF is a RF-based approach that has used two iterative techniques to exploit the relevance information: query refinement and feature re-weighting.

4) Cluster Formation:

Sean D. MacArthur et al. (2002) [9] proposed a relevance feedback technique that have used decision trees to learn a common thread among instances marked relevant. Deok-Hwan Kim, Chin-Wan Chung, Kobus Barnard (2005) [14] have designed a method which constructs clusters and changes them without performing complete re-clustering. The computing time was short since same statistical measures were used at both the classification stage and cluster-merging stage.

5) Neuro-Fuzzy Based System:

Benitez, Beigi, and Chang (1998) [5] described MetaSeek, which is a Meta search engine to query distributed image collections on the Web. The Meta search engine interfaces with four image search engines: Visual Seek, Web Seek, QBIC, and Virage. User feedback was used to evaluate the quality of search results returned by each engine, and this history was preserved in a database. JormaLaaksonen et al. (2001) [8] implemented relevance feedback by using self organizing maps. The Self- Organizing Map (SOM) is an unsupervised, self-organizing neural algorithm widely used to visualize and interpret large high-dimensional data sets. Manish Chowdhury , Sudeb Das, and Malay Kumar Kundu (2012) [27] have presented content based image retrieval (CBIR) system based on a new Multiscale Analysis (MGA)-tool, called Ripplet Transform Type-I (RT).To improve the retrieval result, a fuzzy relevance feedback mechanism (F-RFM) was implemented. Fuzzy entropy based feature evaluation mechanism was used for automatic computation of revised feature's importance and similarity distance at the end of each iteration.

6) User Log Based:

Ja-Hwung Su et al. (2011) [25] have proposed a new method, Navigation-Pattern-Based Relevance Feedback (NPRF), to achieve the high efficiency and effectiveness of CBIR. The search algorithm, NPRF Search, makes use of the discovered navigation patterns and three kinds of query refinement strategies, Query Point Movement (QPM), Query Reweighting (QR), and Query Expansion (QEX).

7) Other Techniques:

Peter Auer et al. (2010) [19] have described Pinview, a content-based image retrieval system that works on implicit relevance feedback during a search session. Dorota G lowacka, John Shawe-Taylor (2010) [20] have presented a new approach to content-based image retrieval based on multinomial relevance feedback. They have modeled the knowledge of the system using a Dirichlet process.Chueh-Yu Li and Chiou-Ting Hsu (2008)[16] have used graphs to represent images, transform the region correspondence estimation problem into an exact graph matching problem, and proposed an optimization technique to derive the solution.

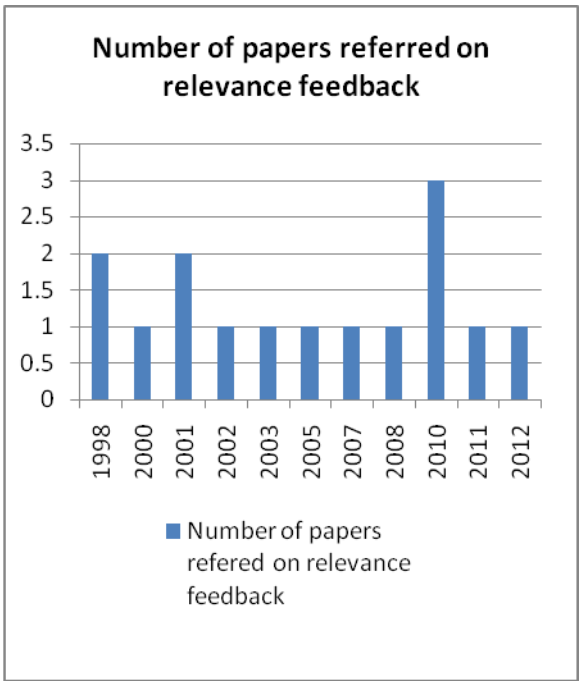

Figure 2. Chart showing number of papers referred on relevance feedback

B. *Recent Methodologies Of Relevance Feedback:*

1) Feature adaptive relevance feedback:

Feature adaptive relevance feedback is a learning approach to *adaptively* predict the optimal balance coefficient for each query and each collection [15]. This technique uses three heuristics to characterize the balance between query and feedback information. The three heuristics to characterize feed-back coefficients are: (1) Discrimination of query (2) Discrimination of feedback documents (3) Divergence between query and feedback documents. In this technique two query refinement strategies are used, query reweighting and feature refinement [15].

2) Biased discriminative Euclidean embedding

Bian and Tao proposed an RF approach, which can find the intrinsic coordinate of image low-level visual features [18]. They also showed that the unlabelled samples are essential in finding this intrinsic coordinate. But more samples are actually required to model the geometry structure in high dimensional space. Biased Discriminate Analysis (BDA) was introduced by Zhou and Huang as a way to solve the feedback samples imbalance problem, and select a subset of image features to construct a suitable dissimilarity measure [18]. The BDA algorithm provides a good solution to this biased learning problem, since there is unknown number of classes in CBIR but the user is interested in only one class. The BDA algorithm makes a strong assumption that all positive samples form a single Gaussian distribution [18], which is not true in real-world. These are the main hurdles impeding the performance of BDA for CBIR.

3) Relevance feedback with online feature selection:

The feature selection [26] basically narrows the semantic gap by selecting the feature subset that best represents the query and discards redundant features. The relevance feedback [26] narrows the semantic gap by making use of user provided judgments which are the labels (relevant or non-relevant) on the retrieved images for a query. The retrieval performance improves as the user provides more and more feedback information to the CBIR system. Query Vector Modification (QVM) and feature relevance learning are the two widely used methods to integrate user feedback information into the CBIR system. But here, the important classification or mutual information evaluation for feature selection isignored. Hence the new approach came up in which feature selection procedure is composed of two steps: searching the combination of feature subsets within a feature space using specified search strategy, and evaluating the performance of the selected subset by a criterion.

4) Navigation pattern based relevance feedback:

Ja-Hwung Su, Wei-Jyun Huang, Philip S. Yu [25] proposed a novel method named Navigation-Pattern-based Relevance Feedback (NPRF) to achieve the high retrieval quality of CBIR with RF by using the discovered navigation patterns. According to the discovered patterns, the users can obtain a set of relevant images in an online query refinement process. To deal with the problem of exploration convergence,the navigation-pattern-based search algorithm (NPRFSearch) merges three query refinement strategies, including Query Point Movement (QPM), Query Reweighting (QR), and Query Expansion (QEX) [25].

5) Ripplet transform and fuzzy relevance feedback mechanism:

Manish Chowdhury, Sudeb Das, and Malay Kumar Kunduhave [27] used the type-I Ripplet Transforms (RT) coefficients to represent the images at different scales and different directions. RT coefficients of intensity and chromaticity planes are used as the primitive features for computation of mean and standard deviation [27].

C. *Comparing Various RF Techniques:*

TABLE I. COMPARING VARIOUS RF TECHNIQUES

METHOD	ADVANTAG--ES	DISADVANT--AGES
Feature adaptive relevance feedback	• User centric. • Produces better results in less number of iterations	• Less efficient for large databases. • Efficient feature extraction algorithm is needed
Biased discriminative Euclidian embedding	• Represents image by low level features	• Number of observations are required to separate positive examples from negative ones
Relevance feedback with online feature selection	• Exploits implicit relevance feedback	• Less efficient for large databases
Navigation pattern based relevance feedback	• Most effective and efficient for large database • Minimiz es number of iterations	• Results depends on the navigation pattern of user
Ripplet transform and fuzzy relevance feedback mechanism	• Fuzzy entropy based evaluation method is used for obtaining better results	• Requires large number of iterations

IV. CONCLUSION

In this paper the current state of art in relevance feedback as seen from content based image retrieval perspective have been studied. The survey depicts that;by using navigation pattern mined from user query log for providing feedback may improve the retrieval performance. And also, this can reduce long iteration problem.

References

[1] RitendraDatta, Dhiraj Joshi, Jia Li, and James Z. Wang, "Image Retrieval: Ideas, Influences, and Trends of the New Age" , ACM Computing Surveys, Vol. 40, No. 2, Article 5, April 2008.

[2] Venkat N Gudivada "Relevance Feedback in Content-Based Image Retrieval"

[3] Dr. Fuhui Long, Dr. Hongjiang Zhang and Prof. David Dagan Feng "Fundamentals of Content-Based Image Retrieval"

[4] Yong Rui, Thomas S. Huang, Michael Ortega, and SharadMehrotra " Relevance Feedback: A Power Tool for Interactive Content-Based Image Retrieval" *IEEE Trans. on Circuits and Systems For Video Technology, Vol. 8, No. 5, pp. 644-655,Sept 1998*

[5] Ana B. Benitez, MandisBeigi, And Shih-Fu Chang "Using Relevance Feedback in Content Based Image Meta search*" Proc. IEEE, Int'l Conf. Internet Computing ,pp. 59-69 ,July- Aug.1998.*

[6] NunoVasconcelos, Andrew Lippman "Learning from user feedback in image retrieval systems" Appears in "*Advances in Neural Information Processing Systems 12" S.A. Solla, T.K. Leen and K.-R. M¨uller (eds.), MIT Press, 2000*

[7] Xiang Sean Zhou, Thomas S. Huang "Comparing Discriminating Transformations and SVM for Learning during Multimedia Retrieval"*ACM Multimedia 2001, Ottawa, Canada.*

[8] JormaLaaksonen, Markus Koskela, Sami Laakso and rkkiOja "Self-Organizing Maps as a Relevance Feedback Technique in Content-Based Image Retrieval" *Proc. Springer-Verlag on Pattern Analysis & Applications ,vol 4,pp. 140–152, Feb, 2001*

[9] Sean D. MacArthur, Carla E. Brodley, and Avinash C. Kak "Interactive Content-Based Image Retrieval Using Relevance Feedback" *Proc. Elsevier Science VOL. 3, NO. 6, July 2012 ISSN 2079-8407*

[10] Zhong Su, Hongjiang Zhang, Stan Li, and Shaoping Ma "Relevance Feedback in Content-Based Image Retrieval: Bayesian Framework, Feature Sub spaces, and Progressive Learning"*IEEETrans.on Image processing, Vol. 12, No. 8, pp. 924-937, Aug 2003.*

[11] Jing Xin and Jesse S. Jin "Relevance Feedback for Content-Based Image Retrieval Using Bayesian Network" *Workshop on Visual Information Processing (VIP), Sydney, 2003.*

[12] Xiang Sean Zhou, Thomas S. Huang "Relevance feedback in image retrieval: A comprehensive review" *Proc. Springer-Verlagon Multimedia Systems, vol 8, pp. 536–544, 2003*

[13] ZhongSua, Hongjiang Zhang, ShaopingMaa "Using Bayesian Classifier in Relevant Feedback of Image Retrieval"

[14] Deok-Hwan Kim, Chin-Wan Chung, Kobus Barnard "Relevance feedback using adaptive clustering for image similarity retrieval" *Elsevier Science (USA),The Journal of Systems and Software,Vol. 78,pp.9- 23,March 2005.*

[15] AneliaGrigorova, Francesco G. B. De Natale, Charlie Dagli, and Thomas S. Huang, "Content-Based Image Retrieval by Feature Adaptation and Relevance Feedback" *IEEE Trans. on Multimedia, Vol. 9, No. 6, pp. 1183-1192 ,Oct.2007.*

[16] Chueh-Yu Li and Chiou-Ting Hsu, "Image Retrieval with Relevance Feedback Based on Graph- Theoretic Region Correspondence Estimation" *IEEE Trans. Multimedia, Vol. 10, No. 2, pp. 447-456, April 2008*

[17] XiaoqianXu a, Dah-Jye Lee a,_, Sameer K. Antani b, L. Rodney Long b, James K. Archibald "Using relevance feedback with short-term memory for content-based spine X-ray image retrieval" *Elsevier Journal on Neuro computing, Vol. 72 ,pp. 2259–2269, 2009*

[18] Wei Bian and Dacheng Tao, " Biased Discriminate Euclidean Embedding for Content-Based Image Retrieval" *IEEE Trans.on Image Processing, Vol. 19, No. 2, pp.545-554, Feb 2010*

[19] Peter Auer,ZakriaHussain, Samuel Kaski ,ArtoKlami , JussiKujala,, JormaLaaksonen ,Alex P. Leung, KitsuchartPasupa, John Shawe-Taylor "Pinview: Implicit Feedback in Content-Based Image Retrieval" *JMLR: Workshop and Conference Proceedings , Workshop on Applications of Pattern Analysis ,pp. 51-57 ,2010*

[20] Dorota G lowacka, John Shawe-Taylor "Contentbased Image Retrieval with Multinomial Relevance Feedback" *JMLR: Workshop and Conference roceedings, 2nd Asian Conference on Machine Learning (ACML2010), Tokyo, Japan, pp.111-125, Nov. 8- 10, 2010.*

[21] J. Assfalg, A. D. Bimbo,J.A. Catalan, and J.S. Jin, "Dimension reduction of texture features for image retrieval using hybrid associative neural networks," *IEEE International Conference on Multimedia and Expo*, Vol.2, pp.1211 -1214, 2000.

[22] Pushpa B. Patil**,** Manesh B. Kokare, "Relevance Feedback in Content Based Image Retrieval: A Review," *Journal of Applied Computer Science & Mathematics, no. 10 (5) /2011, Suceava.*

[23] Yong Rui, Thomas S. Huang, "Relevance Feedback: A Power Tool for Interactive Content-Based Image Retrieval" *IEEE transactions on circuits and systems for video technology, vol. 8, no. 5, september 1998,* pp. 644-654.

[24] NidhiSinghai, Prof. Shishir K. Shandilya, "A Survey On: Content Based Image Retrieval Systems" *International Journal of Computer Applications (0975 – 8887) Volume 4 – No.2, July 2010.* Michel Crucianu, Marin Ferecatu, NozhaBoujemaa, "Relevance Feedback for Image Retrieval: a Short Survey".

[25] Ja-Hwung Su, Wei-Jyun Huang, Philip S. Yu, "Efficient Relevance Feedback for Content-Based Image Retrieval by Mining User Navigation Patterns" *IEEE Transactions On Knowledge And Data Engineering, Vol. 23, No. 3, March 2011. Pp.360-372.*

[26] Yu Sun, BirBhanu "Image Retrieval With Feature Selection and Relevance Feedback" Proceedings of IEEE 17th International Conference on Image Processing September 26-29, 2010, Hong Kong

[27] Manish Chowdhury, Sudeb Das and Malay Kumar Kundu "Novel CBIR System Based on Ripplet Transform Using Interactive Neuro-Fuzzy Technique" Electronic Letters on Computer Vision and Image Analysis 11(1) pp:1-13, 2012