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"A REVIEW ON IMAGE RETRIEVAL USING HYPERGRAPH"

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Abstract – Retrieving images similar to query image from a large image collection is a challenging task. Image consists of different regions. There are several methods in the literature which are useful to capture region level similarities between pair of images using graph. Each image can be represented by several visual concepts. Visual concept is the object or part of the image having some visual information. There are several images in the database which can be sharing the same visual concepts. Graphs are fails to capture the relationship between multiple vertices. Hypergraph is useful to represent group relationship between multiple vertices. Consider database images as a vertices and visual concept as a hyperedge of a hypergraph. All the images sharing same visual concept, form a hyperedge. Ranking methods on these hypergraph is design, to rank all the images in the database which are relevant to the query. Top k images are retrieved from these images which will handle query relevant image retrieval.

Keywords: - Hypergraph, Image Retrieval, Ranking, Visual Concept

I. INTRODUCTION

Retrieving images similar to query image plays most valuable role in the field of image processing. Image search engine is the best example of image retrieval. It is necessary to have image retrieval method which will give accurate query relevant images. Along with image search engine, image retrieval is useful in multiple domains like, medical field, digital libraries etc. In medical domain, images obtained from the digital devices are increasing rapidly. So to retrieve images related to particular medical image requires proper image retrieval system. Some of the digital libraries support services based on image contents. Let us consider example of butterflies digital museum which aim at constructing a digital collection of Indian butterflies. Such a digital library may include a module responsible for image retrieval, which is based on color information as well as texture [1].

Many image retrieval methods are available. Some of them use text information for query search, but text information found to be limited. So in the content based image retrieval (CBIR) method visual information is used instead of text information. Based on the visual information, there are some categories of

CBIR: Low level feature based search and region based search. Most of the low level feature based search techniques retrieves images based on the color layout or histogram from the pixel level. But there performance is limited because of the semantic gap between those features to the human perception system. Fig.1 shows the semantic gap [2].

Fig:-1 Semantic gap: Visual features are similar but semantic meaning is different.

Region based retrieval method extract features from region level of an image. Regions are the part of an image. Each image can be represented as a combination of several visual concepts. Visual concept is the object or part of an image having some visual information. In region based search graphs are useful to capture pair-wise similarities between images. There are several graph based methods explain in the literature. But in the image database more than two images are having similar visual concepts, which can be captured using hypergraph. Fig.2 gives the graph and corresponding hypergraph representation.

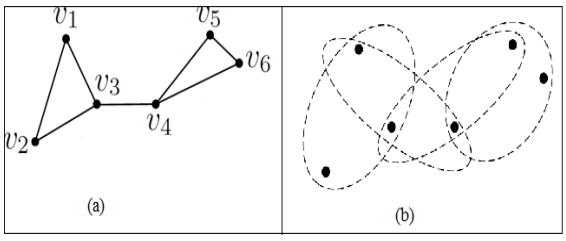

Fig.2- (a) Graph (b) Corresponding hypergraph

Hypergraph is defined over vertices and hyperedges. Each hyperedge can have more than two vertices [3]. In such a hypergraph consider images as a vertices and visual concepts as hyperedges. An images sharing same visual concept form a hyperedge. Design a ranking method on such hypergraph and retrieve top k images which will answer the query image.

Paper is organized as follows: section I introduces the image retrieval using hypergraph methods. Section II gives the literature review. Section III represents the problem formulation. Section IV describes the system architecture. Section V concludes the paper.

II. RELATED WORK

This section describes the work done in the graph based and hypergraph based image retrieval methods. Details of these methods are as follows:

A. Graph Based methods:

Jing and Baluja proposed a VisualRank [4], which is based on PageRank, for large scale web image search. This page rank is a ranking algorithm based on the graph for calculating the importance of webpages. VisualRank algorithm uses the computer vision techniques as well as locality sensitive hashing (LSH) techniques (existing search technique uses the image metadata as well as surrounding text information to retrieve an initial result candidates). Features are extracted from images and collected into a LSH hash table. Match is found when the features hash into the same bins.

Here image ranking problem is modeled as a task of finding authority nodes on a visual similarity graph and discover the VisualRank method to identify the visual link structures between images. The images(vertices) which found to be authorities are taken to answer the image query.

Ambai and Yoshida proposed a MultiClass VisualRank method[5]. This method extends the idea of VisualRank for multiple categories of the images. In the Multiclass VisualRank method, images gets from search engine are divided into multiple classes based on the distinct patterns of the visual features. Then ranking is applied in the classes. This method gives the images in sequence and each sequence contains the classified images which are sorted by their ranked scores. For the existing image search engine this method work as a post-filtering. Three steps of MultiClass VisualRank method are getting visual similarity, clustering and ranking. Visual similarity $w_{i,j}$ between images I_i, I_j is obtained by scale invariant feature transform(SIFT) keypoints. Main focus of this method is on clustering, used to obtained different image classes related to given keywords. Here similar images are connected with high visual similarity. If images having high visual similarity then considered that these are similar images. Several clusters in the graph correspond to the different image classes. Clusters from the graph are extracted from the normalized cuts, representative method of spectral clustering. Ranking is done by PageRank.

J. He et al. [6] proposed a image retrieval method which is based on manifold ranking called as Manifold Ranking Based Image Retrieval (MRBIR). In this method by considering each data point as a vertex, a weighted graph is formed. Assign a non-negative ranking score to each query and zero to remaining points. Scores of all the points are spread to the nearest points via weighted graph. Repeat these spreading process until global state reaches. All the points except query image have their own scores and using these scores they are ranked. Relationship of all data points are reflected by propagation of ranking scores. In a feature space, far away points can have different ranking scores except that they belong to the similar cluster. This is because, many points help to link the far away points. Many of nearest points can have similar rank score except that they having different clusters. Drawback of MRBIR method is that it can solve the problem only when query image is present in the database, because the query point is taken as a vertex in the weighted graph. However, as input image (query) is absent in the database, this method fails to spread the ranking score for images in the image database. In almost all of the retrieval method, input image is given by the user, and it is to be search in the database.

J. He et al. [7] proposed a method which is generalization of Manifold-Ranking Based Image Retrieval called generalized MRBIR. Generalized Manifold-Ranking Based Image Retrieval is the extension of MRBIR. This method works well even if query is absent in the image database. The basic concern of this method is efficiently initializing scores for ranking the nodes in the original graph. By giving a query image, this method performs the following two step procedure:-

1) Initialization: In this step ranking scores of the query is spread to its K nearest neighbors in the image database.

2) Propagation: This step spreads the ranking scores of the neighbors to all unlabeled images by using manifold based ranking.

If input query image is in the image database, MRBIR and generalize MRBIR gives the same ranking output when K=1. If the input query image is not present in the image database, the first step of gMRBIR gives the K seeds with different ranking scores. Then second step performs the manifold ranking which is based on

these seeds. Author included the relevance feedback and active learning into gMRBIR for refining the image retrieval results.

Xiaojun Qi and Ran Chang [8] propose a ranking system based on graph for image retrieval. Here performance of the system is improved using semantic feature-based long-term learning and the relevance feedback based transductive short-term learning. The dynamic feedback logs are built to extract semantic features of the images based on the active learning. Manifold graphs containing two layers and are build in both high level semantic and low level visual spaces. At the first layer graph is constructed using anchor images which are obtained from the feedback log. At the second layer several graphs are constructed using the images in their respective cluster formed around the anchor image. Asymmetric relevance vector is generated for each second layer graph by using initial scores taken from first layer. For propagating the relevance scores of unlabeled and labeled images, asymmetric relevance vectors are fuses. This system requires additional cost of creating a compressed dynamic feedback log for storing image retrieval patterns of each past image query session.

Michael K. Ng. et al.[9] presented MultiRank and Xutao Li. et al.[10] presented HAR(Hub, Authority and Relevance). These two methods are used to design a ranking scheme in a multi relational data for objects as well as relations. In MultiRank [9] importance of both objects as well as relations are simultaneously evaluated by probability distribution calculated from multi-relational data. HAR [10] uses relevance score of relations and, Hub and Authority score of objects in multi-relational data in order to search a query. The main idea behind this framework is to perform a random walk on a multi-relational data and study the limiting probabilities of the objects for hub scores and authority scores and of the relations for the relevance scores. These scores are use to obtain efficient searching results. But they have additional complexity in calculating hub, authority score of objects.

B. Hypergraph based methods:

Y. Huang et al. [11] presented a Hypergraph Rank framework for retrieving images. In the weighted hypergraph images are vertices and image searching problem is considered as a problem of hypergraph ranking. Compute the similarity matrix from different feature descriptors. Then consider each image as a centroid vertex and formed a hyperedge by centroid vertex and with its k-nearest neighbors. By assigning each vertex v_i to the hyperedge e_j, probabilistic hypergraph is constructed. Then hypergraph incidence matrix is used to describe the local grouping information. Here relevance feedback is provided and image labels are ranked after providing feedback to the retrieval system. This assign the equal label to vertices which share many incidental hyperedges and the constraints is that initial labels and predicted labels of the feedback images should be similar.

III. SYSTEM ARCHITECTURE

Fig.3 represents the proposed system architecture. Processing of the proposed work is as follows:

1. First extracts the features from images using ORB (Oriented FAST rotated BRIEF)[12].
2. Obtained regions from images using global contrast based salient region detection method.[13]

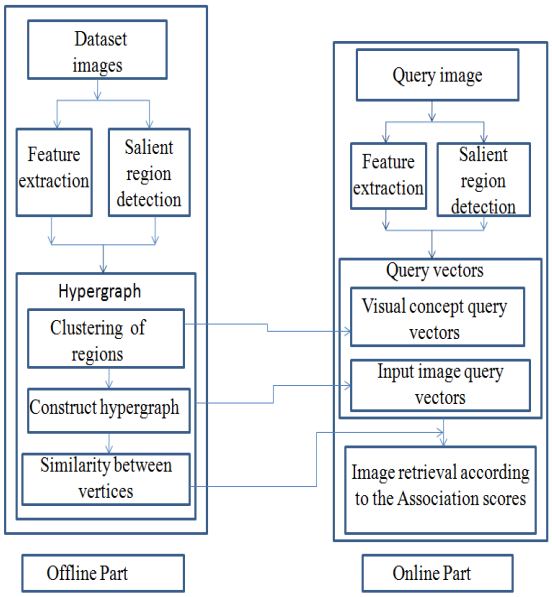

Fig. 3:- Architecture of the retrieval system

3. Hypergraph:

a. Consider all regions in the feature space and cluster them into visual concepts, so that one cluster represents one visual concept.

b. For hypergraph construction consider image as a vertex and visual concepts as a hyperedge.

c. Images sharing same visual concepts form a hyperedge. i.e. Images whose regions belongs to the same cluster form a hyperedge.

d. Similarity between vertices in a hyperedge is calculated. Weight between two vertices in a hyperedge is represented using tensor [14].

4. Similarly in the online process features of the query image are extracted and regions are detected.

5. Query vectors are constructed[15]:

These are prior probability distribution vectors

a. Input image query vectors are constructed from query features and images features.

b. Visual concept query vectors are constructed from query regions and average feature representation of the visual concept (cluster).

6. For calculation of association score, transition probabilities for visiting images are calculated.

From transition probabilities and query vectors association score is calculated which indicates importance of the images to the query.

Images with high association scores are retrieved to handle query specific image retrieval.

IV. CONCLUSION

Retrieving images similar to query is important in several applications. Query relevant images should be rank on the top of the retrieval result. Graph based methods are useful only for pairwise relationships, so to capture relationship between group of images hypergraph is most useful. Using hypergraph images sharing same visual concepts can be rank on the top of the retrieval result. So that most relevant images to the query can be obtained.

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