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SURVEY ON HASHING TECHNIQUES FOR EFFICIENT IMAGE RETRIEVAL AND SEARCHING

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Abstract: **Hashing is a popular and efficient method for nearest neighbor search in large-scale data spaces by embedding high-dimensional feature descriptors into a similarity preserving Hamming space with a low dimension. For most hashing methods, the performance of retrieval heavily depends on the choice of the high-dimensional feature descriptor. By transforming data into binary representation, i.e., Hashing, we can perform high-speed search with low storage cost, and thus, Hashing has collected increasing research interest in the recent years. This paper presents a survey on the different techniques that were earlier proposed in the literature.**

Index Terms- Hashing Method, *Dimensional Features, Storage Cost,Survey*.

1 Introduction

The problem of similarity search, also known as nearest neighbor search, proximity search, or close item search, is to find an item that is the nearest to a query item, called nearest neighbor, under some distance measure from a search (reference) database. In the case that the reference database is very large or that the distance computation between the query item and the database item is costly, it is often computationally infeasible to find the exact nearest neighbor. Thus, a lot of research efforts have been devoted to approximate nearest neighbor search that is shown to be enough and useful for many practical problems.

Hashing is one of the popular solutions for approximate nearest neighbor search. Hashing-based similarity search is an important technique for large-scale query-by-example image retrieval system., since it provides fast search with computation and memory efficiency. However, it is a challenge work to design compact codes to represent original features with good performance In general, hashing is an approach of transforming the data item to a low dimensional representation, or equivalently a short code consisting of a sequence of bits.

The application of hashing to approximate nearest neighbor search includes two ways: indexing data items using hash tables that is formed by storing the items with the same code in a hash bucket, and approximating the distance using the one computed with short codes. The former way regards the items lying the buckets corresponding to the codes of the query as the nearest neighbor candidates, which exploits the locality sensitive property that similar items have larger probability to be mapped to the same code than dissimilar items.

The main research efforts along this direction consist of designing hash functions satisfying the locality sensitive property and designing efficient search schemes using hash tables. The latter way ranks the items according to the distances computed using the short codes, which exploits the property that the distance computation using the short codes is efficient. The main research effort along this direction is to design the effective ways to compute the short codes and design the distance measure using the short codes guaranteeing the computational efficiency and preserving the similarity.

2. EXISTING SYSTEM

LOCAL FEATURE HASHING:

Many hashing techniques mainly concentrate on the global features from the images for the search and retrieval process. But Li Liu, et.al., proposed a system which concentrates on the retrieval and search based on the local features extracted from the images[1]. By using these local features it is easy to improve our retrieval process. The study proposes a novel unsupervised hashing method called unsupervised bilinear local hashing (UBLH) for projecting local feature descriptors from a high dimensional feature space to a lower-dimensional Hamming space via compact bilinear projections rather than a single large projection matrix.

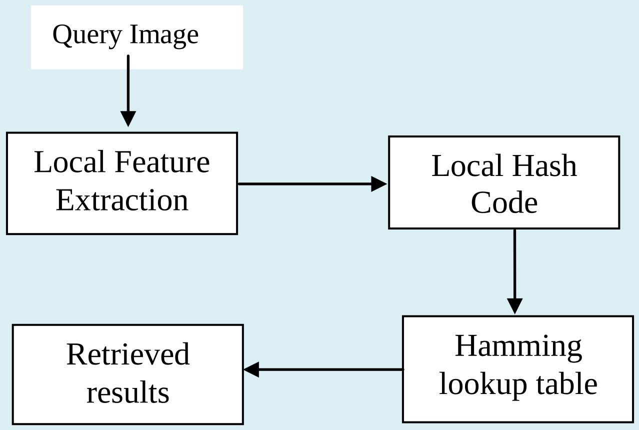

Fig 1: Block diagram of Unsupervised local feature Hashing

Missing of content in the retrieved image is greatly reduced. The above Fig. 1 illustrates the block diagram of Unsupervised local feature Hashing.

3. MULTIVIEW ALIGNMENT HASHING

For most hashing methods, the performance of retrieval heavily depends on the choice of the high-dimensional feature descriptor. Furthermore, a single type of feature cannot be descriptive enough for different images when it is used for hashing. Thus, it is necessary to combine multiple representations for learning effective hashing functions. The study proposes a novel unsupervised multiview hashing approach, termed Multiview Alignment Hashing (MAH), which can effectively fuse multiple information sources and exploit the discriminative low-dimensional embedding via Nonnegative Matrix Factorization (NMF).

The proposed work[2] is as follows:

- MAH can find a compact representation uncovering the hidden semantics from different view aspects and simultaneously respecting the joint probability distribution of data.
- To solve our non-convex objective function, a new alternate optimization has been proposed to get the final solution.
- The system utilizes multivariable logistic regression to generate the hashing function and achieve the out-of-sample extension.

4.CODE CONSISTENT HASHING

Learning based hashing techniques have attracted broad research interests in the Big Media research area. They aim to learn compact binary codes which can preserve semantic similarity in the Hamming embedding. However, the discrete constraints imposed on binary codes typically make hashing optimizations very challenging. The study[3] present a code consistent hashing(CCH) algorithm to learn discrete binary hash codes. To form a simple yet efficient hashing objective function, the system introduces a new code consistency constraint to leverage discriminative information and propose to utilize the Hadamard code which favors an information theoretic criterion as the class prototype. By keeping the discrete constraint and introducing an orthogonal constraint, the objective function can be minimized efficiently.

There are three major contributions of this work:

1. Based on the information-theoretic criterion (uncorrelated and balanced bits), a new code consistent term with Hadamard code is introduced for supervised hashing.
2. The system handles the discrete constraints (NP-hard in general) by introducing an orthogonal constraint to the transformation matrix in CCH.
3. Compared to several state-of-the-art hashing methods, CCH achieves better results on both retrieval and classification tasks.

5.ROBUST DISCRETE SPECTRAL HASHING

Yang yang, et.al., proposed a novel unsupervised discrete hashing approach[4], namely robust discrete spectral hashing (RDSH), which targets at jointly learning discrete binary codes as well as robust hash functions. Most of the traditional methods use relaxation on the discrete constraint to avoid the difficulty of the discrete optimization (NP-hard in general), which probably leads to severe information loss during the mapping process from original feature space to hamming space. In contrast, the system propose a unified hashing framework to directly output discrete binary codes, which guarantees the quality of binary codes to the greatest extent.

Moreover, it notice that the generated binary codes can hardly be perfect and inevitably contain some noise to disturb the subsequent semantic indexing task. Hence, in order to suppress the influence of unreliable binary codes and it learns robust hash functions. The system also integrate a flexible $l_{2,p}$ loss with nonlinear kernel embedding. The benefit of exploiting $l_{2,p}$ loss is two-fold: 1) strong ability of identifying noisy binary codes and 2) dynamic adaptability to different noise levels. Finally, we devise an alternating algorithm to efficiently optimize RDSH model.

6.INSTANCE-AWARE HASHING

The semantic hashing represents each image with the help of one hash code. This cannot be efficient in case of images with multiple labels. To solve this problem, the system proposes a deep architecture that learns instance aware image representations for multi-label image data, which are organized in multiple groups, with each group containing the features for one category. The instance-aware representations not only bring advantages to semantic hashing but also can be used in category-aware hashing, in which an image is represented by multiple pieces of hash codes and each piece of code corresponds to a category.

Hanjiang Lai, et.al., proposed a system for instance aware hashing[5]. It consists of four modules. The first module is to generate region proposals for an input image. The second module is to capture the features for the generated region proposals. The third module is a label probability calculation module, which outputs a probability matrix whose *i* -th row represents the probability scores of the *i* -th proposal belonging to each class. The fourth module is a hash coding module that firstly generates the instance-aware representation, and then converts this representation to hash codes for either category-aware hashing or semantic hashing.

7.QUERY-ADAPTIVE HASHING

The Study[6] proposes a novel and generic approach to building multiple hash tables with multiple views and generating fine-grained ranking results at bitwise and tablewise levels. For each hash table, a query-adaptive bitwise weighting is introduced to alleviate the quantization loss by simultaneously exploiting the quality of hash functions and their complement for nearest neighbor search. From the tablewise aspect, multiple hash tables are built for different data views as a joint index, over which a query-specific rank fusion is proposed to re-rank all results from the bitwise ranking by diffusing in a graph.

For each hash table learned from each view, we exploit the similarities between the query and database samples, and learn a set of query-adaptive bitwise weights that characterize both the discriminative power of each hash function and their complement for nearest neighbor search. Assigning different weights to individual hash bit will distinguish the results sharing the same hamming distance, and obtain a more fine grained and accurate ranking order. Compared to existing methods, our method is more general for different types of hashing algorithms, without strict assumptions on the data distribution.

8.COLLECTIVE MATRIX FACTORIZATION HASHING

The system proposes a novel framework for multimodal Hashing, termed as Collective Matrix Factorization Hashing (CMFH)[7]. The key idea of CMFH is to learn unified Hashcodes for different modalities of one multimodal instance in the shared latent semantic space in which different modalities can be effectively connected. Therefore, accurate cross-modality search is supported. Based on the general framework, the system can be extended to the unsupervised scenario where it tries to preserve the Euclidean structure, and in the supervised scenario where it fully exploits the label information of data.

The major contributions of the system are as follows:

1. The study proposes a novel framework CMFH for multimodal data which learns unified Hash codes for different modalities of one instance in the shared latent semantic space via collective matrix factorization.
2. With the general CMFH framework, we extend the unsupervised version (UCMFH) and the supervised version (SCMFH). When labels are unavailable, UCMFH integrates a linear embedding with CMFH.
3. For both UCMFH and SCMFH, we propose effective optimization algorithms respectively.

9.SEQUENTIAL DISCRETE HASHING

The system introduces a novel supervised cross-modality hashing framework, which can generate unified binary codes for instances represented in different modalities. Particularly, in the learning phase, each bit of a code can be sequentially learned with a discrete optimization scheme that jointly minimizes its empirical loss based on a boosting strategy. In a bitwise manner, hash functions are then learned for each modality, mapping the corresponding representations into unified hash codes. The system regard this approach as cross-modality sequential discrete hashing (CSDH)[8], which can effectively reduce the quantization errors arisen in the oversimplified rounding-off step and thus lead to high-quality binary codes. In the test phase, a simple fusion scheme is utilized to generate a unified hash code for final retrieval by merging the predicted hashing results of an unseen instance from different modalities.

It is worthwhile to highlight several contributions of this paper:

• The study proposes a novel supervised hashing algorithm for cross-modality similarity retrieval named CSDH, which can generate high-quality unified binary codes for instances represented in different modalities.
• In order to achieve better discrete optimization, an alternate scheme is adopted to transform the global NP-hard problem into several tractable sub-problems which can be directly solved with closed-form solutions.

10.LATENT SEMANTIC MINIMAL HASHING

The study proposes a novel joint binary codes learning method is proposed to combine image feature to latent semantic feature with minimum encoding loss, which is referred as *latent semantic minimal hashing* [9]. The latent semantic feature is learned based on matrix decomposition to refine original feature, thereby it makes the learned feature more discriminative. Moreover, a minimum encoding loss is combined with latent semantic feature learning process simultaneously, so as to guarantee the obtained binary codes are discriminative as well.

The following contributions made in the system:

1) The study proposes a latent semantic minimal hashing method to facilitate image retrieval. It exploits *semantic similarity* of image feature in an unsupervised way.
2) To better preserve the *semantic similarity* relationship, the feature in the original space is projected to a latent semantic space by matrix factorization, while the binary quantization loss is minimized by an orthogonal transformation simultaneously. In addition, the optimization is very efficient and converged fast.

11.CONCLUSION

This paper presents a survey on varied hashing techniques that was planned earlier by researchers for the higher development within the field of image mining. The aim of the mining is to provide all goodish patterns while not previous data of the patterns. Image mining handles with the hidden data extraction, image knowledge association and extra patterns that do not seem to be clearly accumulated within the pictures. Also, this paper provides a marginal summary for few analysis and enhancements. Bound potential future investigations that will be exhausted the world of image mining including the experimentations on different image components like textures, shape, etc using the hashing techniques.

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